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A Multi-Site Survey Study of Patient Satisfaction with Teledermatology

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ABSTRACT

Introduction. Telemedicine has been of heightened focus due to spikes in usage during the COVID-19 pandemic. Disparities in health care may affect patient satisfaction with this resource depending on factors such as patient race, age, or socioeconomic background. The purpose of this study was to analyze patient satisfaction with teledermatology to identify any differences in satisfaction based on race, age, and income during the COVID-19 pandemic period.

Methods. A 21-question, IRB-approved survey was administered to patients at two academic dermatology clinics in Kansas City. Patient satisfaction was measured using a five-point Likert scale.

Results. A total of 64 completed surveys were analyzed (17.8% response rate). Most of the participants were female (n = 48, 75%), age 45 to 60 (n = 17, 26.6%), and reported White for race (n = 55, 85.9%). Overall, 73.4% (n = 47) of patients reported being satisfied with their visit. However, only 38.7% (n = 24) of participants were likely to choose a video over an in-person visit. Reasons for low patient satisfaction included concerns regarding ability to perform an accurate physical exam with a video visit (n = 9, 14.1%), receiving inadequate care (n = 4, 6.3%), protected privacy (n = 3, 4.7%), and provider understanding the patient (n = 2, 3.1%).

Conclusions. Our findings were similar to prior studies stating no difference in patient satisfaction with regards to age, income, or race and patients reporting high satisfaction with teledermatology appointments despite a preference for in-person dermatology visits. Future studies with a larger diverse cohort of participants are needed to elucidate and address possible disparities associated with teledermatology use.

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INTRODUCTION

Telemedicine has been of heightened focus due to spikes in usage during the COVID-19 pandemic.[1] Benefits of teledermatology for patients included increased access to care, lower costs, and decreased risk of viral transmission from direct physical contact. Disadvantages of this technology included issues with application connectivity, dependency on user technological capability, and barriers limiting accessibility to technological devices. Moreover, disparities in healthcare may affect patient satisfaction with this resource depending on factors such as patient race, age, or socioeconomic background. The purpose of this study was to analyze patient satisfaction with teledermatology to identify any differences in satisfaction based on race, age, and income during the COVID-19 pandemic period.

METHODS

A 21-question, IRB-approved survey (see Appendix) was administered to patients at two academic dermatology clinics in Kansas City. Both dermatology clinics used the synchronous (live interactive) method of teledermatology. The survey was distributed in person at one site due to technological limitations that prevented query for patients with teledermatology appointments in the specified time period and dissemination through email. The survey period was between March and July of 2021 with patients having a teledermatology appointment after March 2020. This was chosen as it was one year following the implementation of local city-wide closures to reduce viral transmission during the COVID-19 pandemic.

Patient satisfaction was measured using a five-point Likert scale ranging from highly dissatisfied (score = 1) to highly satisfied (score = 5) and condensed for analysis into a satisfied group (highly satisfied and satisfied), neutral group, and dissatisfied group (dissatisfied and highly dissatisfied). For statistical analysis, Mann Whitney U was performed, and patients were dichotomized into two groups for age, income, and race that would yield relatively equal comparison numbers.

RESULTS

A total of 64 completed surveys were analyzed (17.8% response rate). Most of the participants were female (n = 48, 75%), between the ages of 45 and 60 (n = 17, 26.6%), and reported White for race (n = 55, 85.9%). Both clinical sites had similar demographic characteristics (Table 1). Overall, 73.4% (n = 47) of patients reported being satisfied with their visit. However, only 38.7% (n = 24) of participants were likely to choose a video over an in-person visit (Table 2).

Nine (14.1%) participants reported concern regarding the ability to perform an accurate physical exam with a video visit in the comments section of the survey. Other reasons for low patient satisfaction with teledermatology visits included concerns regarding receiving inadequate care (n = 4, 6.3%), protected privacy (n = 3, 4.7%), and provider understanding the patient (n = 2, 3.1%). There were no statistical differences in patient satisfaction for age (p = 0.273), income (p = 0.431), or race (p = 0.071; Table 2).

DISCUSSION

Our findings were similar to prior studies stating no difference in patient satisfaction with regards to age, income, or race and patients reporting high satisfaction with teledermatology appointments despite a preference for in-person dermatology visits.[2,3] Limitations included the small sample size of relatively homogenous race and age. Additionally, there was possible selection bias due to patients with higher technological capabilities being more likely to have teledermatology appointments and able to complete the survey.[2] Future studies evaluating patient satisfaction with a larger group of participants of diverse races, socioeconomic statuses, and ages are needed to elucidate and address possible disparities associated with teledermatology use.

Table 1. Patient demographics.

	Site 1 (n = 34)		Site 2 (n = 30)		Overall	
Demographic Characteristic (64 respondents)	**N**	%	**N**	%	**N**	%
Gender						
Female	26	76.5	22	73.3	48	75
Male	8	23.5	8	26.7	16	25
Age						
18 - 29 years	5	14.7	2	6.7	7	10.9
30 - 45 years	5	14.7	8	26.7	13	20.3
45 - 60 years	11	32.4	6	20.0	17	26.6
61 - 75 years	10	29.4	12	40.0	22	34.4
76 years or above	3	8.8	2	6.7	5	7.8
Race*						
Black or African American	5	14.7	0	0	5	7.8
Native American	1	2.9	0	0	1	1.6
White	26	76.5	29	96.7	55	85.9
Other	1	2.9	1	3.3	2	3.1
Total Annual Household Income*						
Below $20,000	8	23.5	2	6.7	10	15.6
$20,000 to $39,999	4	11.8	1	3.3	5	7.8
$40,000 to $59,999	8	23.5	6	20.0	14	21.9
$60,000 to $79,999	5	14.7	2	6.7	7	10.9
$80,000 and above	7	20.6	15	50	22	34.4

*Not all participants answered.

Table 2. Factors associated with satisfaction of teledermatology.

	Overall Satisfaction	Quality of Video Visits	Choosing Video Visit Over In-person Visit	Understood What Provider Said	Provider Heard and Understood Patient	Had the Opportunity to Ask Questions	Felt Privacy Was Respected	Skin Condition Will Be Taken Care of
Satisfied/Agree/ Likely (n)	73.4% (47)	78.1% (50)	38.7% (24)	95.2% (60)	92.2% (59)	95.2% (60)	92.2% (59)	76.2% (48)
Dissatisfied/ Disagree/Unlikely (n)	9.4% (6)	3.1% (2)	46.8% (29)	0	3.1% (2)	0	4.7% (3)	6.3% (4)
Neutral (n)	17.2% (11)	18.8% (12)	12.9% (8)	4.8% (3)	4.7% (3)	4.8% (3)	3.1% (2)	17.5% (11)
p Value for Age Difference	0.273	0.286	0.801	0.786	0.773	0.332	0.417	0.377
p Value for Income Difference	0.431	0.276	0.966	0.72	0.188	0.246	0.273	0.349
p Value for Race Difference	0.071	0.236	0.074	0.316	0.787	0.884	0.274	0.706

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Keywords: telemedicine, community health, dermatology, patient satisfaction

APPENDIX

Survey Tool

1. Have you filled out this survey before?
2. Age
3. Sex
4. Race
5. What is your annual household income?
6. What is your zip code?
7. How many telederm (video visits) have you had since March 24, 2020?
8. Please rate your satisfaction with your video visits.
9. How likely are you to choose a video visit over an in-person visit?
10. How would you rate the quality of the video? Please answer the following statements according to your experience.
11. I understood what my provider told me on the video.
12. My provider heard and understood me.
13. I had the opportunity to ask questions.
14. I felt my privacy was respected.
15. My skin condition is or will be well taken care of.
16. How would you rate your ability to understand and use technology?
17. What device did you use for your appointment?
18. Is the device your own?
19. Did you have any issues with connectivity, screen lag, or interruption of signal?
20. Did you receive any instruction, educational handouts/material, or website links at the end of your visit?
21. Do you have any suggestions for how to improve the video visit experience?

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The Influence of the STORM Program and Other Elective Experiences During the Summer Between the First and Second Year on Medical Students' Career Interests

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ABSTRACT

Introduction. The purpose of this study was to investigate the influence of the Summer Training Option in Rural Medicine (STORM) program and other elective experiences during the summer between the first and second pre-clerkship years of medical school on medical students' career intentions.

Methods. A retrospective voluntary and anonymous cohort study was conducted by distributing an email survey to the 211 second-year medical students at the University of Kansas School of Medicine (KUSM). The survey consisted of a variety of questions regarding their recent summer break elective experiences.

Results. Eighty-nine students (42.2% response rate) completed the survey; 21 respondents participated in the STORM program. Important factors influencing the choice of an elective included, working one-on-one with an educator, hands-on experiences, and receiving academic credit. Sixty-seven respondents (75.3%) concluded that their experience met their expectations, 50 (56.2%) concluded that their experience helped solidify their career goals, while 20 (22.5%) concluded that their experience made them question their career goals. Eleven respondents (12.4%) wished they had participated in a different summer experience, and 16 respondents (18.0%) changed their career plans after their summer experience.

Conclusions. A break between first and second years of medical school allowed students to explore career options; such experiences may ignite a particular passion, solidify an already determined specialty choice, or dissuade a student from pursuing a particular career pathway. Medical school affirmation of the importance of significant, sustained, and student-chosen opportunities to work one-on-one with a mentor and engage in hands-on learning during the pre-clerkship years is crucial. The STORM program was one elective option that delivered on students' expectations. ***Kans J Med 2022;15:311-318***

INTRODUCTION

Clinical experiences during the early pre-clerkship years of medical school are important determinants of a medical student's professional learning and development.[1] These experiences may help a student focus on a particular career pathway or dissuade them from pursuing a particular medical specialty. Factors influencing students' decisions to consider certain medical specialties have been the subject of multiple previous reports.[2-7]

Mentorship has a major influence on career choice. Wright et al.[2] surveyed graduating students and found that a positive role model was associated strongly with a medical students' choice of a residency discipline. Jordan et al.[3] studied senior medical students at the University of Western Ontario in Canada who matched to a Canadian family medicine residency program. They found that family physician mentors were an important influence on the students' decisions to pursue a career in family medicine. Stagg et al.[4] reported that for students spending time shadowing in a specific specialty, whether they considered that specialty or not, the greatest influence on career choice was a high-quality teacher/mentor. The converse was also true; a poor teacher/mentor tended to dissuade medical students from pursuing a career in that field. They also found that preceptors in free-choice preceptorships had a stronger influence on career choice than those in required preceptorships.

Pre-clerkship research and clinical specialty experiences can influence a student's career intentions. Boyle et al.[5] found that early research exposure positively influenced students' decisions to include research as an integral part of their future medical career. In a systematic review of the literature, Marshall et al.[6] found that student experiences during the surgical rotation were associated with a higher interest in a career in surgery. A positive experience was determined by a variety of factors, including, positive role models, a welcoming atmosphere, and active participation in the operating room.

Scott et al.[7] surveyed students at eight Canadian medical schools at the beginning of medical school and again before the students entered clinical clerkships to determine why students may have switched career plans. Twenty percent of the students switched career plans. Seven factors influenced the switch: medical lifestyle, encouragement, positive clinical exposure, economics or politics, competence or skills, ease or residency entrance, and discouragement by a physician.

Pre-clerkship enrichment opportunities give students a break from the demands of their pre-clerkship studies. In a recent report from the University of Kansas School of Medicine, it was ascertained that enrichment activities in pre-clerkship years provided a welcome change of pace from the normal curriculum in addition to giving them opportunities to explore and discover.[8]

KUSM has three campuses, the main metropolitan campus in Kansas City, an urban regional campus in Wichita, and a rural regional campus in Salina. Medical students at all KUSM campuses have a 10 week break during the summer between their first and second year of medical school. During this time, students can participate in a variety of elective enrichment experiences: (1) the Summer Training Option in Rural Medicine (STORM) program, (2) a variety of basic science or clinical research experiences, (3) robust clinical preceptorships, (4) apply for a fellowship sponsored by the Department of History and Philosophy of Medicine, and (5) work as a medical preceptor at a summer youth camp. Students also can opt for a vacation, a respite from the demands of medical school. Most of the KUSM-approved summer enrichment experiences provide academic credit towards graduation and a small monetary stipend.

Approximately 30 first year KUSM students are selected for the STORM program. Students in this unique program spend four to eight

weeks in a rural Kansas community working with a family medicine physician. Each student receives medical school credit and a stipend for their participation. The aim of the STORM program is to expose medical students to family medicine in rural Kansas.[9] Kansas has a shortage of physicians in rural areas,[10] and the STORM program exposes medical students to the rewards and challenges of rural primary care, hoping that many will be attracted to rural family medicine.

This study focused on the influence of the STORM program and other summer experiences between the first and second year of pre-clerkship classes at KUSM on medical students' career intentions, what factors influenced a students' choice of an experience and what influence the experience had on the students' future career intent. The results may provide guidance to future medical students regarding the value of such experiences and how best to spend breaks in the formal pre-clerkship curriculum. Additionally, the results provided KUSM educators feedback regarding summer experiences and provide evidence of the importance of participating in similar enrichment activities during pre-clerkship years to other medical schools.

METHODS

An invitation to participate in an anonymous online 25-question REDCap®[11,12] survey was sent to the 211 members of the KUSM Class of 2024 during the first week of their second year of classes. The survey asked a variety of questions regarding student demographics, preliminary career plans, choice of summer experiences, satisfaction with their summer experiences, and changes in career plans after their summer experience (Appendix). Many questions required Likert-scale rankings. There were also several open-ended questions. Two additional emails (two and four weeks after the initial invitation) were sent to class members reminding them to complete the survey. The survey was closed approximately five weeks after it was opened. There were no incentives offered to the students for completing the survey. Participation was voluntary, and all responses were anonymous. The data collected from the survey were analyzed using univariate statistics. This study's protocol was approved by the University of Kansas Medical Center Institutional Review Board.

RESULTS

Of the 211 students invited to complete the survey, 89 responded (42.2%). The populations of the respondents' legal residences upon admission to medical school are noted in Table 1 and the distribution of respondent experiences is noted in Table 2.

Of the 21 respondents participating in the STORM program, 11 (52.3%) were previous residents of communities with populations less than 10,000. However, interest in the STORM program was not confined to students from rural communities; eight students from communities greater than 50,000 also participated in this rural preceptorship program.

Of these various experiences, 1 (1.1%) lasted two weeks, 1 (1.1%) lasted three weeks, 21 (23.6%) lasted four weeks, 1 (1.1%) lasted five weeks, 12 (13.5%) lasted six weeks, and 53 (59.6%) lasted eight weeks. Eighty-seven of the 89 respondents participated in their elective experience for four weeks or more, enough time to immerse themselves in the discipline chosen.

Table 1. Population of respondents' hometowns.

Population	Number (%) of Respondents
< 5,000	19 (21.4%)
5,000-10,000	7 (7.9%)
10,000-25,000	2 (2.3%)
25,000-50,000	7 (7.9%)
50,000-100,000	9 (10.1%)
> 100,000	45 (50.6%)

Table 2. Distribution of respondent experiences.

Summer Experience	Number (%)
Clinical research	32 (36.0%)
Summer Training Option in Rural Medicine (STORM)	21 (23.6%)
Clinical preceptorships other than STORM	12 (13.5%)
Basic science research	11 (12.4%)
Other (Dept of History and Philosophy of Medicine fellowships, graduate teaching assistant, required military service)	9 (10.1%)
Vacation	3 (3.4%)
Youth camp volunteer	1 (1.1%)

Eleven respondents (12.4%) wished they had participated in a different summer experience; interestingly, 5 of the 11 participated in a clinical research elective, while one participated in a public health elective, two engaged in basic science research, two took the summer off, and one participated in a clinical experience other than STORM. None of the students in the STORM program voiced dissatisfaction. Of the 21 respondents that participated in the STORM program, 10 voiced their intention to eventually practice in a rural community prior to their summer experience and did not change their mind afterwards. Eight students intending to practice in an urban setting prior to STORM still were interested in urban practice after STORM. One student changed from urban to rural practice. One student initially interested in rural practice was uncertain about future plans, and one student remained committed to a clinical practice combined with research career.

Sixteen respondents (18.0%) changed their career plans after their summer experience. There was no one specialty that respondents either disliked or gravitated to after their summer elective. Forty-five of all respondents (50.6%) and 19 of the 21 STORM participants (90.5%) received career counseling during their summer experience.

Likert scores were analyzed to determine the importance of the factors that influenced students' summer experience decisions (Table 3) and in rating their summer experience and its influence on career plans (Table 4). Four categories evolved: (1) Important or Agree (Likert scores of 4 or 5), (2) Neutral (Likert score 3), (3) Not important or Disagree (Likert scores of 1 or 2), and (4) Does not apply.

Table 3. Important characteristics of summer experiences.

Survey Question	Important/Very Important Number (%)	Neutral Number (%)	Low Importance/ Not Important Number (%)	Does Not Apply Number (%)
How important was receiving a stipend?	35 (39.3%)	11 (12.4%)	18 (20.2%)	25 (28.1%)
How important was it to work 1-on-1 with a clinician or researcher?	62 (69.7%)	7 (7.9%)	10 (11.2%)	10 (11.2%)
How important was it to receive school credit for the experience?	59 (66.3%)	13 (14.6%)	10 (11.2%)	7 (7.9%)
If a clinical experience, how important was it that the experience was rural?	13 (14.6%)	14 (15.7%)	25 (28.1%)	37 (41.6%)
How important was it that the experience was hands-on?	60 (68.2%)	10 (11.4%)	7 (8.0%)	11 (12.5%)
How important was it that you were able to choose the physician or researcher who supervised your summer experience?	39 (43.8%)	17 (19.1%)	20 (22.5%)	13 (14.6%)
How important was it that you were able to choose the location of your summer experience?	58 (65.2%)	11 (12.4%)	7 (7.9%)	13 (14.6%)
How important was the potential for patient interaction (ability to perform a history and physical exam)?	42 (47.2%)	9 (10.1%)	15 (16.9%)	23 (25.8%)

Table 4. Satisfaction with summer experience and influence on career plans.

Survey Question	Agree Number (%)	Neutral Number (%)	Disagree Number (%)
Summer experience met my expectations	67 (75.3%)	13 (14.6%)	9 (10.1%)
Summer experience helped solidify my career goal	50 (56.2%)	30 (33.7%)	9 (10.1%)
Summer experience made me question my career goal	20 (22.5%)	24 (27.0%)	45 (50.6%)

Students at KUSM chose their summer experiences for a variety of reasons. Major considerations for KUSM students (important to > 60% of respondents) included: working one-on-one with a physician or researcher, receiving school credit, having hands-on experience, and being able to choose the location of the experience. Twenty of 21 participants in the STORM program said hands-on experiences and the ability to perform history and physical exams were important or very important factors for choosing a summer experience. Less important factors for all respondents (important to < 40% of respondents) included receiving a stipend and location of the experience in a rural area.

Sixty-seven respondents (75.3%) concluded that their experiences met their expectations, 50 (56.2%) concluded that their experience helped solidify their career goals, while 20 (22.5%) concluded that their experience made them question their career goals. Nineteen of the 21 participants (90.5%) in the STORM program concluded that their experiences met their expectations, 14 (66.7%) concluded that their experience helped solidify their career goals, while 5 (23.8%) concluded that that the experience made them question their career goals.

Students were asked to expound on why they chose a particular summer experience (Table 5). Responses varied considerably, but some common themes became evident. Nearly 25% of the respondents chose their specific experience to explore career interests/options, and approximately one-third of respondents wanted a clinical experience. Twenty percent of respondents requested a research experience, believing that it was an important addition to their resume.

The final question in the survey asked the student to comment on how their experience helped solidify their career goals and to explain why or why not (Table 6). Two predominant sentiments emerged: (1) the summer experience helped the student achieve a better understanding of their proposed medical discipline choice, and (2) the impact of the experience on career planning, whether it solidified their choice or gave them reasons to doubt their original choice.

DISCUSSION

Working one-on-one with a mentor/teacher who provided hands-on experiences was a major determinant in the choice of summer experiences for the responding group of KUSM students who had finished their first year of medical school. The importance of mentorship noted in this study confirmed the findings of previous investigators.[2-4,7] KUSM students were able to choose among a variety of elective experiences and noted the importance of being able to choose the location of their elective, echoing the findings of Stagg et al.[4], who found that free-choice preceptorships had a stronger influence on career choice than required preceptorships.

A significant cohort of respondents (48.3%) chose to participate in clinical or basic science research. Given that the USMLE Step 1 exam was changed to pass/fail starting in 2022, students may have concluded that a high Step 1 score was no longer a requisite for a competitive residency slot and a research experience on their resume may improve their chances to secure a position of their choosing.

Thirty-six of the respondents (40.4%) elected a clinical experience (21 of the 36 participated in the STORM program). KUSM students

Table 5. Selected open-ended responses regarding students' choices of summer experiences.

"I picked the summer experience I did because I was uncertain about whether or not I wanted to do family medicine or rural medicine in general and I was hoping that STORM could give me the experience to make that decision."
"I chose to do an elective rotation in the emergency room at .... medical center. I choose this because I am on the KMS loan and emergency medicine is one of the options I can do for residency while still meeting loan terms. I'm primarily interested in pediatrics but had never been in an ER setting and wanted to see what it was like since it's an option under my loan."
"Need research to be competitive in specialties. I was also interested in what I was researching."
"During M1 year, I felt that I had a relative lack of clinical experience. I grew up in a smaller town, so I have always been interested in rural medicine. I always wanted to explore western KS because I had never been, and I felt that even if I end up specializing in a more urban area, I would want to be able to relate to patients from across the state."

Table 6. Selected open-ended responses regarding whether the summer experience helped students understand what career path they wanted to pursue.

"Yes, I am even more interested in rheumatology after my summer research experience."
"I think it did. It showed me that I might be more content in a career field that offers some sort of procedures, if it is not entirely procedure based. I enjoyed the patient interactions that I had during visits that didn't require a hands-on procedure, but I just felt a much different excitement when it was sutures or ingrown toenail removals."
"Yes, research is not for me, and I will not pursue it as a career."

in the class of 2024 completed their first year of medical school during the COVID-19 pandemic, which dramatically impacted already limited clinical experiences, as it has affected medical students globally.[13] The promise of a robust clinical experience, especially hands-on experiences and working one-on-one with a physician, during the summer break may have been attractive to many students, providing them with an opportunity to work with patients prior to their clerkship years. The STORM program offered students the desired clinical experiences.

A break between first and second years of medical school allowed students to explore career options, and half of the respondents noted that they received career counseling from a mentor/supervisor. A minority of students were dissatisfied with their summer experience; however, it was notable that students engaged in a clinical research elective comprised half of those who wished they had engaged in a different experience. The reason for dissatisfaction with clinical research was unknown but should be investigated. The majority of students concluded that their summer elective experience solidified their career choice, and a minority of students voiced a desire to change their career intentions following completion of their summer elective.

A response rate of 42% in this study was not unexpected given that there are more pressing demands placed on medical students than completing a voluntary survey and that there were no incentives provided to respondents. Another possible criticism of the study was the limitation of the survey to only the new second-year students; however, the investigators were interested in the career aspirations of pre-clerkship medical students. Nevertheless, the factors influencing decision making by a significant number of pre-clerkship students with regards to early enrichment experiences and the impact of those experiences on career choices were elucidated.

CONCLUSIONS

Determining what characteristics students find important in choosing an enrichment experience early in their educational program can guide medical schools in tailoring these experiences to match students' interests. For example, medical school affirmation of the importance of significant, sustained, and student-chosen opportunities to work one-on-one with a mentor and engage in hands-on learning by providing such experiences to pre-clerkship medical students may ignite a particular passion, solidify an already determined specialty choice, or dissuade a student from pursuing a particular career pathway. KUSM should be particularly proud of the success of the STORM program and continue to offer this or similar opportunities to pre-clerkship medical students. This program satisfied many students' need for a robust clinical experience, met their expectations, and helped solidify the career intentions of the majority of participants. Hopefully, this program will result in increased numbers of students eventually choosing to practice in rural Kansas. The KUSM educational leadership team also needs to investigate why a significant number of respondents were unhappy with their clinical research elective. Finally, the importance of offering ample research opportunities to students cannot be underestimated.

Current and future medical students are encouraged to take advantage of any class-free intervals in their early/pre-clerkship formal curriculum to participate in a clinical experience, such as the STORM program, or a research project. Such experiences can have a profound impact on their understanding of what they would like to do for a future career and can complement other KUSM career counseling services, such as those provided by Career and Specialty Advising in Learning Communities (CASA), a longitudinal mentoring and advisement program. Introduction to a mentor, someone who can provide wise counsel, in the pre-clerkship years is also another potential benefit of the summer elective program. Early clinical experiences can help students start the process of considering career options one to two years before a residency decision is necessary and may influence the students' choice of clinical electives during the clinical years. Even if the experience went differently than originally planned, the opportunity to learn and grow from that experience can be invaluable, redirecting focus towards a different career path.

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Keywords: career choice, undergraduate medical education, mentorship, curriculum

APPENDIX

KUSM MS2 Summer Experiences Questionnaire

1. Age:
   - ___ < 21
   - ___ 21 - 25
   - ___ 26 - 30
   - ___ 30 - 40
   - ___ 40+

2. Were you considered a Kansas Resident when you began your medical studies at KUSM?
   - ___ Yes
   - ___ No

3. What is the population of your hometown?
   - ___ < 5,000
   - ___ 5,000 - 10,000
   - ___ 10,000 - 25,000
   - ___ 25,000 - 50,000
   - ___ 50,000 -100,000
   - ___ > 100,000

4. What did you do this past summer (May-July 2021)? (Please select the one option that best fits the experience you had)?
   - ___ STORM
   - ___ Participation in bench/laboratory research at KUMC or another institution
   - ___ Participation in clinical research at KUMC or another institution
   - ___ Clinical experience in a specialty other than family medicine
   - ___ Volunteering at a youth camp
   - ___ Family medicine shadowing/clinical experience
   - ___ I did not participate in a summer elective medical/research experience
   - ___ Other (If so, please explain your experience in a few sentences)

     _____

5. How long was your summer experience?
   - ____ Weeks

6. Prior to your summer experience, what was your career goal in the medical field?
   - ____ Research-based medicine
   - ____ Rural clinical medicine
   - ____ Urban clinical medicine
   - ____ Combination of clinical medicine and research-based medicine
   - ____ Academic medicine (Teaching at least part time at a medical school or residency/fellowship program and engaging in clinical or basic science research)
   - ____ Other (if so, please explain below)

     _____

7. Prior to your summer experience, what medical specialty were you most interested in?
   - ____ Family medicine
   - ____ Pediatrics
   - ____ General Surgery or surgical subspecialty other than orthopedics
   - ____ General Internal Medicine/Hospitalist
   - ____ Cardiology
   - ____ Orthopedics

____ Anesthesiology
____ Neurology
____ Ophthalmology
____ Rheumatology
____ Hematology/Oncology
____ Urology
____ Radiology
____ Nephrology
____ Other (If so, please explain below)
_____

8. After your summer experience, what is your career goal in the medical field?
____ Research-based medicine
____ Rural clinical medicine
____ Urban clinical medicine
____ Combination of clinical medicine and research-based medicine
____ Academic medicine
____ Other (if so, please explain below)
_____

9. After your summer experience, what medical specialty are you interested in?
____ Family medicine
____ Pediatrics
____ General Surgery or surgical subspecialty other than orthopedics
____ Cardiology
____ Orthopedics
____ Anesthesiology
____ Neurology
____ Ophthalmology
____ Rheumatology
____ Hematology/Oncology
____ Urology
____ Radiology
____ Nephrology
____ Other (If so, please explain below
_____

10. Do you wish you would have participated in a different summer experience?
____ Yes
____ No

11. Did your summer experience mentor/supervisor counsel you as to career choices?
____ Yes
____ No

Please respond to the statements below (12-14) using the following scale: 1) Strongly disagree; 2) Disagree; 3) Neutral; 4) Agree; 5) Strongly Agree

12. My summer experience met my expectations
13. My summer experience helped solidify my career goals
14. My summer experience made me question my career goals

Please respond to questions 15 - 22 below using the following scale: 1) Not important at all; 2) Low importance; 3) Neutral; 4) Important; 5) Very important; 6) Does not apply

When choosing your summer experience:

15. How important was receiving a stipend?
16. How important was it to work 1-on-1 with a clinician or researcher?
17. How important was it to receive school credit for the experience?
18. If a clinical experience, how important was it that the experience was rural?
19. How important was it that the experience was hands-on?
20. How important was it that you were able to choose the physician or researcher who supervised your summer experience?
21. How important was it that you were able to choose the location of your experience?
22. How important was the potential for patient interaction (ability to perform a history and physical exam)?

Open-ended questions

23. Please tell us more about why you picked the summer experience that you did.

24. What was your major take-away from your summer experience?

25. Do you believe that this summer experience helped you develop a better understanding of what career path you would like to pursue? Explain?

KANSAS JOURNAL of MEDICINE

Birth Outcomes Related to Distance in Rural and Frontier Kansas

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ABSTRACT

Introduction. Women from rural communities must travel greater distances to secure obstetrical care. This study sought the extent to which distance traveled by mothers for obstetrical services affects birth outcomes in rural and frontier counties of Kansas.

Methods. Medical students invited women over the age of 18 to participate in a recall survey regarding their children under three years old. Participants were a sample of convenience, and the length of data collection was a month. A bivariate analysis was performed on the responses gathered regarding obstetrical measures as a function of self-reported distance traveled to the hospital of delivery.

Results. Eighty-five women completed the survey, but only 76 satisfied all eligibility requirements. No statistical difference in birth outcomes were found between women who travel more than or less than 20 miles. However, when correlating data to that of the Kansas Hospital Association and the Kansas Department of Health and Environment, counties without birth facilities had a higher percentage of very low birth weights (< 1,500 grams) and more babies born at full-term when compared to counties that offer birth facilities. Babies born to mothers who reside in counties with obstetrical services were born at an earlier gestational age than those without birth facilities. Lastly, babies born into a family with income less than $50,000 weighed less and had a shorter gestational age than those from a more affluent household.

Conclusions. The results revealed counterintuitive findings that deserve to be explored further by a study with greater statistical power.

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INTRODUCTION

Accessing obstetrical care in the U.S. has become a growing concern in rural settings due to a continual decline of obstetrician-gynecologists (OB-GYN) delivering babies and family medicine maternity (FM-Mat) physicians.[1,2] Although 75% of the land in the U.S. is rural, there is a disproportionate distribution of the physician workforce in nonmetropolitan regions. Central and mountain west states have the highest proportion of counties without an OB-GYN.[2] In 2008, it was estimated that only 6.4% of OB-GYN specialists practiced in rural settings, and of the family physicians who practiced in rural settings, only 19.2% performed routine deliveries.[3] Rayburn et al.[2] found approximately 49% of the 3,143 counties of the U.S. lack obstetrical services. The impact of this disparity can be appreciated further at an individual state level.

A recent study reported that 94 out of the 96 practicing physicians in Frontier counties of Kansas identified themselves as family medicine physicians, and only 19 of these were FM-Mat physicians.[4] There were no OB-GYN physicians present in these counties. Similarly, out of 212 practicing physicians in rural counties of Kansas, 115 identified themselves as family medicine doctors and from these only 43 offered maternity care services. Moreover, out of the 561 practicing physicians in densely settled rural counties, 164 identified themselves as family medicine physicians and 26 as OB-GYNs. However, only 36 from the 164 family medicine physicians and only 19 from the 26 OB-GYNS offered obstetrical care at the time of survey collection.[5] These statistics are concerning for rural communities, since FM-Mat physicians provide the majority of obstetrical care services to about one-third of all newborns.[3] Currently, it was projected that by 2030, only 24 counties of the 89 non-urban counties in Kansas will have at least one provider who offers obstetrical care.[5]

Due to the disparity of obstetrical services in rural communities, many women travel farther than 80 km to the nearest facility to secure prenatal and obstetrical care.[5] As a consequence of the barriers that patients experience when accessing these medical services, there was a concern that it may become less likely for these rural women to receive an equivalent level of care as those women who receive care locally.[6] In this study, we explored the extent to which distance traveled by mothers for obstetrical services affected birth outcomes in rural and frontier counties of Kansas.

METHODS

This study was approved by the University of Kansas Medical Center Institutional Review Board.

Study Population. The population used for this study was a convenience sample of women who delivered a child in rural or frontier Kansas and whose child was less than three years of age at the time of survey collection between June 22 and July 17, 2020. All participants were at least 18 years old at the time of survey collection. This survey was offered to women in clinics by medical students participating in the 2020 University of Kansas School of Medicine (KUSM) Summer Teaching Option for Rural Medicine (STORM) program. The women ultimately chose to participate or not. Table 1 shows the demographics (age and ethnicity) of study participants compared to the Kansas Department of Health and Environment (KDHE) data. The annual household income and educational level could not be compared with the KDHE data. Any discrepancies within the number for survey participants were due to participants not disclosing that information.

The Population Density Peer Groups (PDPG) from the study were defined based on the average number of persons per square mile (ppsm) in a county of Kansas.[7] The following definitions were used: frontier: less than 6.0 ppsm, rural: 6.0 - 19.9 ppsm, densely settled rural: 20.0 - 39.9 ppsm, semi-urban: 40.0 - 149.9 ppsm, urban: 150.0 or more ppsm.

Exclusion Criteria. Exclusion criteria consisted of women who had children equal to or greater than three years old, who delivered in semi-urban and urban counties, who delivered in another state that was not Kansas, or participants who were under the age of 18 at the time of survey collection.

Table 1. Respondent demographics.

Demographics	Category	Frequency (N = 76)	Percent	KDHE (N = 9,552)	Percent	p Value
Age	18-24	17	22.4	2,831	29.6	NS*
	25-34	53	69.7	5,473	57.3	
	35-44	6	7.9	1,109	11.6	
Ethnicity	White	63	82.9	7,052	73.8	NS
	Black	1	1.3	124	1.30	
	Latino	10	13.2	1,910	20	
	Native American	1	1.3			
	Asian	1	1.3			
Annual Household Income	Less than $50,000	26	35.1			
	More than $50,000	48	63.2			
Education Level	≤ High School	16	22.5	1,281	13.4	NS
	> High School	55	77.5	8,098	84.7	NS

*NS = non-significant

Method of Data Collection. The survey developed by the research team collected information regarding demographics (age, race, zip code, average annual household income, highest level of education); the child's age, weight, length, gestational age at delivery, prenatal genetic screening, family history of genetic disease, adverse birth outcomes; and delivery information (distance and time traveled for delivery, county of delivery, complications before, during and after delivery for child or mother, method of delivery, need for neonatal intensive care unit [NICU], and need for hospital transfer for either child or mother). The surveys were administered using REDCap®, and all survey data were stored on a secure server at the home institution. Most surveys were completed by entering data directly into REDCap®, however, a few paper surveys were completed, then entered into REDCap® by the STORM medical student and subsequently destroyed. These surveys and informed consent were made readily available in English and Spanish.

Statistical Analysis. Statistical analysis was performed on the respondents' quantitative and qualitative responses. The analysis team coded open text comments for positive, negative, and neutral replies. Additionally, a bivariate analysis of gestational age, birth weight, birth length, pregnancy complications, delivery complications, method of delivery, need for NICU, and need for hospital transfer for mother and/or neonate was performed. The responses to the survey were examined as a function of the self-reported distance (in miles) traveled by the mother from her residence to the hospital of delivery. Twenty miles was used as the distance cutoff for two reasons. First, 20 miles gave two cohorts that were of reasonable size for comparison. Secondly, a natural break point was observed by examining the data. Due to the small sample and clinical time restrictions because of COVID-19, a larger sample population that traveled a longer distance could not be captured.

The KDHE Department of Vital Statistics makes annual birth statistics available online. They report adverse birth outcomes as low birth weight, very low birth weight, gestational age < 37 weeks, and death rate. Since our study utilized maternal recall data, a reasonable estimation of birth outcome could be determined by using gestational age at birth, birth length, and birth weight as recalled by the mother.

An attempt was made to provide a weighted quantification to the survey data by assigning a numerical value to answers provided based on the relative severity of the birth complications. One point was assigned if the respondent marked the presence of an adverse birth outcome, pregnancy complication, and/or delivery complication. Zero points were assigned if the method of delivery was a vaginal delivery (either spontaneous or vaginal birth after cesarean section), one point if it was an instrumental-assisted delivery (either forceps delivery or vacuum-assisted delivery), and two points if it was a Cesarean delivery. Zero points were assigned if the newborn stayed in the room with the mother or if he or she was taken to the regular nursery after delivery. Three points were assigned if the newborn went to the NICU in their hospital of delivery or four points if the newborn was transferred to a NICU in another hospital. Two-tailed t-tests were performed to determine if there was a statistical significance between the self-reported distance traveled for delivery versus the aforementioned variables. A p value of less than 0.05 was used to infer statistical significance.

To compare our birth outcome findings as a function of distance traveled to the hospital-specific data counties reported to the state of Kansas, the publicly available 2017 American Hospital Association/Kansas Hospital Survey was retrieved.[8] These data initially were divided based on PDPG (i.e., densely settled rural, rural, and frontier), then subdivided by whether the county contained at least one hospital that offered obstetrical services. The KDHE birth statistics KIC (Kansas Information for Communities) database was used to retrieve birth weight and gestational age data for each of these counties.[9] Birth length information was not available through the KDHE database.

Two-tailed t-tests were used to evaluate the birth weight (very low birth weight [< 1,500 grams], low birth weight [< 2,500 grams], normal

weight, high birth weight [≥ 4,000 grams]) and gestational age (early pre-term less than 34 weeks, pre-term 34-36 weeks, early term 37-38 weeks, full-term 39-40 weeks, late term 41 weeks, post-term 42 weeks or longer) of newborns whose mothers' resided in counties that did not offer obstetrical services versus counties that did offer obstetrical services within the same PDPG.

RESULTS

Participants. Eighty-five women from rural and frontier regions of Kansas consented to be surveyed. Of these, 76 women satisfied all eligibility requirements. Nine participants were ineligible because they either delivered out-of-state, delivered in a hospital located in an urban region, their child(ren) was not less than three years old at the time of survey completion, and/or their survey was left incomplete. Tables 1 and 2 contain a discrepancy in the total number of responses (N) for each data comparison because some respondents chose not to answer specific questions. Table 1 compared the demographics (age, ethnicity, and education level) of our survey population to the rural population at large (rural, densely settled rural, and frontier counties) using the data from KDHE to determine the generalizability of our sample population. After performing a t-test on our data to KDHE's data, no statistical differences were found in all three comparisons.

Obstetrical Measures as a Function of Distance. Table 2 shows an analysis of the gestational age, birth length, and birth weight of the participating newborns. The data were compared between those who traveled a distance less than and greater than 20 miles and between annual household incomes of less than and greater than $50,000. As demonstrated by Table 2, no statistical significance was found when using a two-tailed t-test to analyze the gestational ages, lengths, and birth weights of infants born to mothers who traveled more than 20 miles to deliver compared to mothers who traveled less than 20 miles.

Data obtained from KDHE from 2019, which revealed that 2.3% of deliveries with very low birth weight were from mothers who resided in a densely settled county without birth facilities compared to the 1.1% of deliveries from counties that offered birth facilities ($p < 0.001$). Table 3 shows analysis of data from KDHE. The total birth weight and gestational age for each county within the same PDPG were obtained, then these counties were separated between those that offered obstetrical services and those that did not. The averages were compared to determine if there was a statistically significant difference in birth weight and gestational age in babies whose mothers had to travel to a nearby county for obstetrical care versus those babies whose mothers did not. As illustrated in Table 3, no statistical significances were found in the birth weight or gestational age of newborns whose mothers resided in a rural county that did not offer obstetrical services versus those rural counties that did offer obstetrical services.

Table 2. Analysis of distance versus different newborn parameters.

Parameter	Category	Mean	Frequency	p Value
Gestational Age (weeks)	Distance < 20 miles	38.9	48	NS*
	Distance > 20 miles	38.6	22	
	Income < $50,000	38.0	21	0.04
	Income > $50,000	39.1	48	
Length (cm)	Distance < 20 miles	50.3	44	NS
	Distance > 20 miles	50.6	20	
	Income < $50,000	49.2	18	NS
	Income > $50,000	50.8	44	
Birth weight (grams)	Distance < 20 miles	3359	48	NS
	Distance > 20 miles	3204	22	
	Income < $50,000	3054	21	0.007
	Income > $50,000	3401	48	

*NS = no statistical significance

Thirty-five percent of babies born to mothers who lived in frontier counties that offered obstetrical services were born at an early term gestational age of 37-38 weeks compared to the 22% of babies whose mothers resided in a county without birth facilities ($p = 0.005$). Moreover, 65% of newborns from frontier counties that do not offer obstetrical services were born full-term at 39-40 weeks versus 51% of babies from counties with birth facilities ($p < 0.001$). Additionally, no significant differences were found in the number of obstetrical complications/outcomes reported by mothers who traveled less than or more than 20 miles to deliver. In this analysis, the total number of birth complications, birth outcomes, method of delivery, and usage of intensive care unit by mother or newborn were taken into account.

Obstetrical Measures as a Function of Annual Household Income. Using a two-tailed t-test, babies born to mothers with a family annual income of less than $50,000 were found to weigh less at an average of 3054 grams compared to 3401 grams in babies born to mothers with an annual household income greater than $50,000. As shown in Table 2, this was statistically significant ($p < 0.007$). Moreover, infants born to mothers with an annual household income of less than $50,000 had an average gestational age of 38 weeks compared to babies from families with an annual household income of greater than $50,000 with an average gestational age of 39 weeks ($p = 0.04$).

Obstetrical Outcomes as a Function of Education Level. No statistical significances were observed in gestational age, length, and birth weight of babies whose mothers received an education equal to or less than high school versus those mothers who received an education greater than high school.

Table 3. Analysis of the 2019 data from the Kansas Department of Health and Environment (KDHE).

Region	Parameter	p Value	Total # of Counties Reporting Data without Obstetric Services	Total # of Counties Reporting Data with Obstetric Services
Densely Settled Rural (N = 19 Counties)			2 (10.5%)	17 (89.5%)
	Very Low Birth Weight (< 1,500 grams)	< 0.001	2.3%	1.1%
	Low Birth Weight (< 2,500 grams)	NS*	6.1%	6.0%
	Normal Weight	NS	82.4%	84.4%
	High Birth Weight (≥ 4,000)	NS	9.1%	8.4%
	Early Pre-Term < 34 weeks	NS	3.5%	2.6%
	Pre-Term 34-36 weeks	NS	7.9%	7.1%
	Early Term 37-38 weeks	NS	31.2%	27.8%
	Full Term 39-40 weeks	NS	54.4%	59.5%
	Late Term 41 weeks	NS	2.7%	2.5%
	Post Term ≥ 42 weeks	NS	0.23%	0.24%
Rural (N = 28 Counties)			13 (46.4%)	15 (53.6%)
	Very Low Birth Weight (< 1,500 grams)	NS	1.3%	2.0%
	Low Birth Weight (< 2,500 grams)	NS	5.6%	5.9%
	Normal Weight	NS	85.1%	85.0%
	High Birth Weight (≥ 4,000 grams)	NS	8.0%	7.1%
	Early Pre-Term < 34 weeks	NS	2.3%	2.7%
	Pre-Term 34-36 weeks	NS	6.4%	8.1%
	Early Term 37-38 weeks	NS	27.3%	24.4%
	Full Term 39-40 weeks	NS	61.0%	61.3%
	Late Term 41 weeks	NS	2.8%	3.5%
	Post Term ≥ 42 weeks	NS	0	0.06%
Frontier (N = 33 Counties)			25 (75.8%)	8 (24.2%)
	Very Low Birth Weight (< 1,500 grams)	NS	1.3%	1.2%
	Low Birth Weight (< 2,500 grams)	NS	5.6%	5.5%
	Normal Weight	NS	86.0%	87.7%
	High Birth Weight (≥ 4,000 grams)	NS	7.1%	5.6%
	Early Pre-Term < 34 weeks	NS	2.5%	2.7%
	Pre-Term 34-36 weeks	NS	7.8%	9.1%
	Early Term 37-38 weeks	0.005	22.0%	34.8%
	Full Term 39-40 weeks	< 0.001	64.6%	51.4%
	Late Term 41 weeks	NS	3.0%	1.8%
	Post Term ≥ 42 weeks	NS	0.065%	0.27%

*NS = no statistical significance

DISCUSSION

This study, similar to a study performed more than 30 years ago, explored the possible relationship between impaired access to local birth facilities and adverse birth outcomes.[10] In the prior study, they found that women who traveled longer distances for delivery experienced a greater number of birth-associated complications, and their newborns experienced a greater rate of premature births. Similarly, in a study published five years later, they found a negative correlation between the availability of maternal care services and infant mortality.[5] According to that study, the loss of an FM-Mat physician in rural Florida was predicted to be associated with an increase of infant mortality of 2.3%, and the loss of an OB-GYN was associated with a 9.6% increase in infant mortality. A more recent study also demonstrated an increase of perinatal mortality in newborns whose mothers traveled more than four hours to access obstetrical services, as well as an increase of NICU admissions in these newborns.[11] However, unlike the studies mentioned above, our study did not find a statistical difference in birth outcomes between women who travel more than or less than 20 miles, although intuitively we expected an association. Perhaps one of the reasons our study did not reveal a difference is because it did not have the power needed to be predictive. Another possibility is that due to sample bias from recall data there was some imprecision. To address this source of error, we could extract data from the birth certificates. However, this was beyond the means of this study group.

When the data were obtained from KHA and the KDHE and compared to our survey, counties without birth facilities had a higher percentage of very low birth weights when compared to counties that did have birth facilities available to their residents. This finding aligned with another study's finding which stated that women who traveled a greater distance to receive obstetrical facilities experienced fewer prenatal visits, and that these newborns experienced lower birth weights and gestational ages.[12] However, the KDHE did not report distance traveled nor the birth outcomes from one rurality to another. This was one of the reasons the influence that distance to access obstetric services can have on birth outcomes of newborns from rural and frontier Kansas was investigated. The distance traveled by mothers living in counties without birth facilities was significant and may have played a role in having babies with very low birth weight. Further study in this area is needed.

Additionally, the KDHE data suggested that women from densely settled counties without birth facilities may experience barriers that are contributing to the development of adverse birth outcomes and/or pregnancy complications among the women from these communities. These very low birth weights may be due to premature deliveries or intrauterine growth restrictions; however, the KDHE data did not find a significant difference between the number of premature babies from counties without birth facilities compared to those with birth facilities. Perhaps social risk factors such as malnutrition, low income, or inadequate prenatal care due to lack of transportation or medical insurance coverage, may have been contributing factors that led to newborns having very low birth weights. Furthermore, these nutritional deficiencies may have been due to having insufficient funds or living in a region where food deserts existed. This could be another area for further research.

Lastly, our study revealed that on average, babies born to families with a lower annual household income weighed less than those from a greater annual household income. A potential source for this association may be due to a myriad of complex issues in the social determinants of health compared to those from more affluent backgrounds. While this study was not designed to examine this issue, it aligned with a previous finding that demonstrated an association with preterm birth and intrauterine growth restrictions and lower socioeconomic status.[13] Some of the contributing factors that have been associated were chronic stressors, higher rates of maternal smoking, nutritional deficiencies, financial instability, and an increased risk of genitourinary tract infections among these women. A companion study to ours is examining adequacy of prenatal care related to distance traveled. That study may reveal a more specific association.

Surprisingly, during our analysis we found counterintuitive findings and represent an area for further research. Contrary to our previously mentioned findings, using the KDHE data, a greater number of babies in counties with birth facilities were delivered at an earlier gestational age of 37-38 weeks when compared to frontier counties without birth facilities. Additionally, more newborns were born at full-term at 39-40 weeks in counties that did not offer birth facilities. These findings were counterintuitive to existing research, especially with our initial presumption that mothers with impaired access to obstetrical services have babies with either more birth complications or premature deliveries. A possible explanation to the latter finding was that perhaps community health resources play an important role to compensate for the lack of obstetrical services within these communities. However, the reason for this finding was not clear. More research should be performed and more efforts need to be made to reach out to women from counties without birth facilities. This will help to understand the negative effects that a continual decline and/or absence of OB-GYN and FM-Mat physicians have on the development and delivery of newborns.

Due to how critical and life changing the lack of obstetrical services can be to the health of mothers and newborns, many states have established plans to increase the safety of births in rural areas by ensuring that pregnant mothers are transferred or referred to adequate facilities that can provide them with the appropriate care at the time of delivery. In Kansas, initiatives have been discussed to alleviate the shortage of physicians who provide obstetrical services by establishing loan repayment programs to recruit and retain physicians in rural Kansas.[6] There also has been recent discussion in Kansas about other methods for increasing access to obstetrical care in frontier and rural areas of the state. As of 2020, there were more than twice as many family medicine residencies; 685 compared to the 284 OB-GYN residencies.[14] Due to the increasing number of family medicine residencies, more family medicine residents are being trained in obstetrical care.

Limitations. This study had several limitations. First, COVID-19 (Coronavirus Disease 2019) reduced the data collection timeframe to half due to safety concerns. Consequently, the sample size did not allow

this study to gain enough statistical power to make strong associations. Second, there was limited published research with similar demographics, especially in the state of Kansas, that explored the relationship of adverse birth outcomes as a function of the distance mothers must travel to gain access to birth facilities in rural regions. Third, the statewide data recorded for vital statistics by the KDHE limited how their data could be manipulated to make associations with the data from our study. Lastly, our participants were not offered enticements for their participation, which could have encouraged more participation and increased our sample size.

Implications for Future Research. It is worthwhile for this study to be repeated at a larger scale and more in-depth analysis. As previously mentioned, the most recent studies on this topic, to the best of our knowledge, were conducted 10 and 30 years ago. The fact that there were no recent studies for such a critical topic as adverse birth outcomes due to limited access to obstetrical services calls for another look, as much has changed within the last 10 years. For example, it would be interesting to learn what kind of strategies or resources women use to compensate for the distance they have to travel to the nearest birth facilities, since our study did not observe a significant difference in adverse birth outcomes between those who travel more than or less than 20 miles. Perhaps a future study should subdivide those women who travel more than 20 miles by income to see if there is a significant difference in birth outcomes. Low-income women who must travel greater than 20 miles might be impacted more significantly, due to the financial burden the travel can place on them. Travel also may become a more considerable barrier in adverse weather conditions. Western Kansas can have significant winter weather events precluding travel, even with a well-maintained car.

Our study also found some counterintuitive findings, such as the greater number of full-term babies from counties with no birth facilities compared to those with birth facilities, which is also worth exploring further. This study serves as a pilot for future studies examining this critical health issue for rural residents.

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A Measure of Burnout in Current NCAA Student-Athletes

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ABSTRACT

Introduction. The prevalence of athletes who specialize in sports has increased in recent years. Substantial literature on youth sports has linked early sport specialization to negative consequences, such as burnout and injury. However, empirical evidence comparing rates of burnout and specialization in NCAA athletes is limited. The purpose of this study was to survey current NCAA Division I student-athletes to compare levels of burnout to sex, year of NCAA eligibility, and age at the beginning of sport specialization.

Methods. A self-reported survey was distributed to student-athletes at two NCAA Division I institutions, which included demographics, sport specialization history, injury history, and the Athlete Burnout Questionnaire. Results from the three measures of the Athlete Burnout Questionnaire (reduced sense of accomplishment, exhaustion, sport devaluation) were compared to sex, year of NCAA eligibility, age of beginning sport specialization, and injury history.

Results. A total of 267 athletes (95 males and 172 females) completed the survey. Of those, 156 (58.4%) were in their first or second year of NCAA eligibility, and 111 (41.6%) were in their third, fourth, or fifth year. Of the total, 121 (46.4%) reported specializing before the age of 15, and 140 (53.6%) specialized at age 16 or older. Females reported significantly higher levels of exhaustion than males (Difference of means (M) = 0.43, 95% confidence interval (CI) = [0.20, 0.66], $p < 0.01$). Athletes in their third, fourth, or fifth year of eligibility reported significantly higher levels of sport devaluation (M = 0.27, 95% CI = [0.05, 0.48], $p < 0.05$) than athletes in their first or second year. Athletes who specialized before age 15 did not report significantly higher levels of burnout than athletes who specialized at age 16 or later. In total, 203 athletes (77.2%) reported experiencing any injury. Athletes who reported a history of experiencing any injury demonstrated significantly higher feelings of reduced sense of accomplishment than athletes with no injury history (Difference of means (M) = 0.24, 95% confidence interval (CI) = [0.03, 0.45], $p < 0.05$).

Conclusions. Athletes were more likely to experience elevated levels of burnout if they reported female sex, older NCAA eligibility, or a past injury history. However, athletes were not more likely to experience increased burnout based on age of beginning specialization. The results demonstrated a need to address burnout in athletes following injury and to be aware that females and older athletes are more prone to burnout. ***Kans J Med 2022;15:325-330***

INTRODUCTION

Over the past 15 to 20 years, sport participation has increased,[1] as has sport specialization among high school athletes.[2] However, this shift to early sport specialization and high training volume may lead to increased risks of overuse/overload injuries or acute injuries requiring surgery,[3-5] as well as detrimental effects of the athletes psychological and social well-being.[1,6,7]

The topic of burnout and its effect on performance and psychological well-being has become a common theme within the literature. Burnout has been defined as "a syndrome of emotional exhaustion, depersonalization, and a sense of low personal accomplishment that leads to decreased effectiveness at work".[8] Athlete burnout has been defined as a syndrome of emotional and physical exhaustion (resulting from training and/or competition), a reduced sense of accomplishment (negatively evaluating one's abilities and achievements), and sport devaluation (a cynical attitude towards sports participation).[9] The Athlete Burnout Questionnaire (ABQ) was developed to study burnout in this specific population with questions specifically targeting athletics.[9,10] Using this survey tool, the prevalence of burnout previously has been reported as between 6-11% of athletes;[11] however, this has been thought to be underreported as burnout was considered if the athlete scored high on a single component.

The primary purpose of this study was to identify the prevalence of burnout in current NCAA Division I student-athletes. Secondary aims included comparing burnout to (1) demographic characteristics of sex and year of eligibility, (2) sport specialization, and (3) injury history. Our primary hypothesis was that athletes who specialized at a younger age and had a more extensive injury history would experience higher levels of burnout.

METHODS

A self-reported survey was distributed to athletes from two NCAA Division I programs with multiple sports between August 9, 2019 and April 27, 2020. Institutional Review Board approval was obtained from the primary institution prior to participant recruitment and data collection. Subjects were eligible to participate in this study if they were enrolled in an NCAA Division I institution and were participating in varsity athletics for their institutions athletic department. A standardized email explaining the purpose of the project and study procedures and requesting their athletes' voluntary participation was distributed to the head team physicians and athletic trainers of the two NCAA institutions. Participants were informed that their responses would remain confidential and would not be released to their coaches, trainers, physicians, or any other staff related to their institutions athletic department. After obtaining informed consent, participants were asked to complete a standardized survey, which included the ABQ, as well as information regarding demographics, sport specialization history, and injury history.

Athlete Burnout Questionnaire. The ABQ is the most popular measure of sport burnout, and previous work supports its reliability and construct validity.[9,10] The ABQ measures three dimensions of burnout (emotional/physical exhaustion, reduced sense of accomplishment, and sport devaluation) with five items each via a five-point Likert

scale. Athletes are presented with statements about their sport experiences and rate how often they feel that way from 1 (almost never) to 5 (almost always). Each athlete who takes the ABQ receives three scores. One score is the participant's mean response from the five statements measuring reduced sense of accomplishment, the second is their mean response from the five statements measuring exhaustion, and the third is their mean response from the five statements measuring sport devaluation. The three scores are means with ranges from 1-5, with lower scores representing low levels of burnout and higher scores representing higher levels of burnout. Mean scores and standard deviations were obtained for each subscale. A sample of the ABQ is shown in Figure 1.

		MOI	Almost Never	Rarely	Sometimes	Frequently	Almost Always
1	I am accomplishing many worthwhile things in my sport	RA	1	2	3	4	5
2	I feel so tired from my training that I have trouble finding energy to do other things	E	1	2	3	4	5
3	The effort I spend in my sport would be better spent doing other things	SD	1	2	3	4	5
4	I am not achieving much in my sport	RA	1	2	3	4	5
5	I feel overly tired from my sport participation	E	1	2	3	4	5
6	I don't care about my sport performance as much as I used to	SD	1	2	3	4	5
7	I am not performing up to my ability in my sport	RA	1	2	3	4	5
8	I feel "wiped out" from my sport	E	1	2	3	4	5
9	I am not into my sport like I used to be	SD	1	2	3	4	5
10	I feel physically worn out from my sport	E	1	2	3	4	5
11	I feel less concerned about being successful in my sport than I used to	SD	1	2	3	4	5
12	I am exhausted by the mental and physical demands on my sport	E	1	2	3	4	5
13	It seems that no matter what I do, I don't perform as well as I should	RA	1	2	3	4	5
14	I feel successful at my sport	RA	1	2	3	4	5
15	I have negative feelings toward my sport	SD	1	2	3	4	5

Note: Items 1 and 14 are reverse scored, MOI = measure of interest, RA = reduced accomplishment, SD = sport devaluation, E = exhaustion

Figure 1. Athlete Burnout Questionnaire administered to athletes. Items 1 and 14 are reverse scored. MOI = measure of interest, RA = reduced accomplishment, SD = sport devaluation, E = exhaustion

Data Extraction. Patient demographics included sex, age, sport of participation, year of NCAA eligibility, age of beginning specialization, and history of injury. Age of beginning sport specialization was determined by Jayanthi[12], which stated that an athlete is a sport specializer if he/she meets the following three criteria: (1) athletic participation is limited to one sport; (2) which is competed in over eight months in one year; (3) to the exclusion of all other sports.

The primary outcomes of interest for each group were scores from the ABQ. Injury history included history of experiencing any injury, history of experiencing an overuse injury (e.g., stress fracture, tennis elbow, shin splints, golfer's elbow, Achilles' tendonitis, swimmer's shoulder, little-league shoulder/elbow), or history of experiencing a significant injury. Significant injury was defined as an injury which resulted in the athlete missing competition and/or practice for over a two-week time period (anterior cruciate ligament tear, serious sprain, torn rotator cuff, concussion, broken bone, muscle strain). Reponses from these demographic data were compared to the results from the ABQ.

Statistical Analysis and Measures of Interest. Survey responses were separated based on reported sex, age of sport specialization, and injury history. These groups were compared using average burnout scores for reduced sense of accomplishment, exhaustion, and sport devaluation. Athletes with a history of any injury, overuse injury, and significant injury were compared to a control group consisting of athletes with no significant injury history. All groups were compared (males compared to females, underclassmen compared to upperclassmen, athletes with a history of injury were compared to athletes with no injury history) using average burnout scores for reduced sense of accomplishment, exhaustion, and sport devaluation. A difference of means report assessed for statistical significance in differences between the groups. Confidence intervals and p values were reported with a p value less than or equal to 0.05 being considered significant.

RESULTS

Participants. Between August 9, 2019 and April 27, 2020 data were collected from 306 participants from two Division I National Collegiate Athletic Association (NCAA) athletic programs. Incomplete responses were received from 41 participants, leaving 267 athletes for analysis. All 267 athletes competed solely in one sport for their respective school (Table 1). Participants ranged in age from 18 to 23 (M = 19.9 ± 1.43 years) with both males (n = 95) and females (n = 172). Year of NCAA eligibility consisted of 81 freshmen (30.3%), 75 sophomores (28.1%), 51 juniors (19.1%), 45 seniors (16.9%), and 15 graduate students (5.6%). The CONSORT 2010 Flow Diagram can be found in Figure 2 detailing the inclusion and specific grouping of participants.

Table 1. Sport of participation by athletes participating in survey.*

Sport of Participation (Sex)	n
Baseball (M)	17
Basketball (M)	2
Basketball (W)	3
Cross Country (M)	24
Cross Country (W)	43
Football (M)	38
Golf (W)	4
Gymnastics (W)	1
Rowing (W)	89
Soccer (W)	13
Softball	14
Swim and Dive (W)	10
Tennis (W)	2
Volleyball (W)	5
Not Reported	2

*(M) = Men's sport; (W) = Women's sport

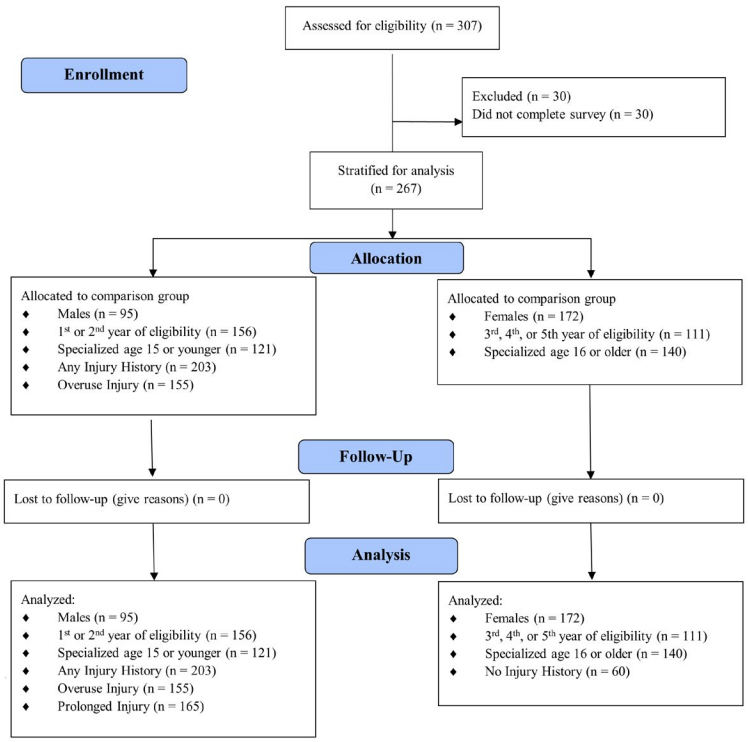

Figure 2. CONSORT 2010 Flow Diagram detailing the enrollment, allocation, follow-up, and analysis of athletes and separation of participants into statistical groups.

Burnout Profile by Sex. A total of 267 athletes filled out the ABQ to completion consisting of 95 males (35.6%) and 172 females (64.4%). Females reported significantly higher levels of exhaustion than males (Difference of means (M) = 0.43, 95% confidence interval (CI) = [0.20, 0.66], p < 0.01). However, females did not score significantly higher in regard to feeling a reduced sense of accomplishment (M = 0.17, 95% CI = [-0.03, 0.37], p = 0.09) or experiencing sport devaluation (M = 0.14, 95% CI = [-0.08, 0.36], p = 0.14). Results can be seen in Table 2.

Table 2. Statistical analysis of Athlete Burnout Questionnaire results compared to athlete sex.

Athlete Burnout Questionnaire Variable	Male (n = 95)	Female (n = 172)	Difference in Means (95% CI)	p
Reduced Sense of Accomplishment	2.23 ± 0.81	2.40 ± 0.76	0.17 (-0.03-0.37)	0.09
Exhaustion	2.52 ± 0.91	2.95 ± 0.91	0.43 (0.20-0.66)	< 0.01*
Sport Devaluation	1.98 ± 0.88	2.12 ± 0.90	0.14 (-0.08-0.36)	0.14

*Statistically significant difference between groups (p < 0.05).

Burnout Profile by Year of Eligibility. Of the 267 who completed the survey, 156 were in their first or second year of NCAA eligibility (58.4%), and 111 were in their third, fourth, or fifth year of eligibility (41.6%). Upperclassmen athletes in their third, fourth, or fifth year of NCAA eligibility reported significantly higher levels of sport devaluation (M = 0.27, 95% CI = [0.05, 0.48], p < 0.05) than underclassmen in their first or second year of eligibility. However, upperclassmen athletes in their third, fourth, or fifth year did not report significantly higher feelings of reduced sense of accomplishment (M = 0.16, 95% CI = [-0.03, 0.35], p = 0.11) or significantly increased levels of exhaustion (M = -0.07, 95% CI = [-0.29, 0.15], p = 0.54) than athletes in their first or second year. Results can be seen in Table 3.

Table 3. Statistical analysis of Athlete Burnout Questionnaire results compared to year of NCAA eligibility.

Athlete Burnout Questionnaire Variable	1st or 2nd Year (n = 156)	3rd, 4th, or 5th Year (n = 111)	Difference in Means (95% CI)	p
Reduced Sense of Accomplishment	2.27 ± 0.74	2.43 ± 0.83	0.16 (-0.03-0.35)	0.11
Exhaustion	2.27 ± 0.74	2.76 ± 0.92	-0.07 (-0.29-0.15)	0.54
Sport Devaluation	1.96 ± 0.90	2.23 ± 0.87	0.27 (0.05-0.48)	< 0.05*

*Statistically significant difference between groups (p < 0.05).

Burnout Profile by Age of Beginning Sport Specialization. From the 267 athletes who completed the ABQ, 121 reported beginning sport specialization before the age of 15 (45.3%), 140 sport specialized at age 16 or older (52.4%), and 6 did not report an age of beginning specialization (2.2%). Athletes who reported specializing before age 15 did not report significantly higher levels of burnout than athletes who specialized at age 16 or older in reduced sense of accomplishment (M = 0.14, 95% CI = [-0.04, 0.33], p = 0.14), exhaustion (M = 0.09, 95% CI = [-0.14, 0.32], p = 0.44), or sport devaluation (M = 0.09, 95% CI = [-0.13, 0.31], p = 0.43). Results can be seen in Table 4.

Table 4. Analysis of Athlete Burnout Questionnaire results compared to year of beginning sport specialization.

Athlete Burnout Questionnaire Variable	Age 15 or Younger (n = 121)	Age 16 or Older (n = 140)	Difference in Means (95% CI)	p
Reduced Sense of Accomplishment	2.43 ± 0.76	2.29 ± 0.78	0.14 (-0.04-0.33)	0.14
Exhaustion	2.86 ± 1.00	2.77 ± 0.88	0.09 (-0.14-0.32)	0.44
Sport Devaluation	2.14 ± 0.95	2.05 ± 0.86	0.09 (-0.13-0.31)	0.43

*Statistically significant difference between groups (p < 0.05).

Comparing Levels of Athlete Burnout by Injury History. There were 263 athlete responses to the injury survey. Of these, 203 (77.2%) reported experiencing any injury, 155 reported experiencing at least one overuse injury (58.9%), 165 reported at least one prolonged injury (62.7%), and 60 reported no significant injury history (22.8%).

Any Injury History Compared to No Injury History. Athletes who reported a history of experiencing any injury experienced significantly higher feelings of reduced sense of accomplishment than athletes with no injury history (M = 0.24, 95% CI = [0.03, 0.45], p < 0.05), but they did not score significantly higher in feelings of exhaustion (M = 0.10, 95% CI = [-0.15, 0.35], p = 0.45) or sport devaluation (M = 0.12, 95% CI = [-0.11, 0.35], p = 0.31). Results can be seen in Table 5.

Table 5. Analysis of Athlete Burnout Questionnaire results comparing history of any injury to no injury history.

Athlete Burnout Questionnaire Variable	Any Injury History (n = 203)	No Injury History (n = 60)	Difference in Means (95% CI)	p
Reduced Sense of Accomplishment	2.41 ± 0.79	2.17 ± 0.69	0.24 (0.03-0.45)	< 0.05*
Exhaustion	2.83 ± 0.95	2.73 ± 0.88	0.10 (-0.15-0.35)	0.45
Sport Devaluation	2.11 ± 0.93	1.99 ± 0.77	0.12 (-0.11-0.35)	0.31

*Statistically significant difference between groups ($p < 0.05$).

History of Overuse Injury Compared to No Injury History. Athletes who previously experienced an overuse injury scored significantly higher in feelings of reduced sense of accomplishment ($M = 0.34$, 95% CI = [0.12, 0.55], $p < 0.001$), but did not report significantly higher feelings of exhaustion ($M = 0.19$, 95% CI = [-0.07, 0.45], $p = 0.16$) or sport devaluation ($M = 0.20$, 95% CI = [-0.04, 0.45], $p = 0.11$) than athletes who had not experienced any injury. Results can be seen in Table 6.

Table 6. Analysis of Athlete Burnout Questionnaire results comparing history of overuse injury to no injury history.

Athlete Burnout Questionnaire Variable	Overuse Injury History (n = 155)	No Injury History (n = 60)	Difference in Means (95% CI)	p
Reduced Sense of Accomplishment	2.51 ± 0.79	2.17 ± 0.69	0.34 (0.12-0.55)	< 0.01*
Exhaustion	2.92 ± 0.93	2.73 ± 0.88	0.19 (-0.07-0.45)	0.16
Sport Devaluation	2.19 ± 0.94	1.99 ± 0.77	0.20 (-0.04-0.45)	0.11

*Statistically significant difference between groups ($p < 0.05$).

History of Prolonged Injury Compared to No Injury History. Finally, student-athletes who previously experienced a prolonged injury reported significantly higher levels of burnout in feelings of reduced sense of accomplishment ($M = 0.21$, 95% CI = [0.00, 0.42], $p = 0.05$) than athletes who had not experienced any injury. However, athletes with a history of prolonged injury did not experience significantly higher levels of exhaustion ($M = 0.05$, 95% CI = [-0.21, 0.32], $p = 0.71$) or sport devaluation ($M = 0.11$, 95% CI = [-0.13, 0.35], $p = 0.38$) than athletes who had no injury history. Results can be seen in Table 7.

Table 7. Analysis of Athlete Burnout Questionnaire results comparing history of prolonged injury to no injury history.

Athlete Burnout Questionnaire Variable	Prolonged Injury History (n = 165)	No Injury History (n = 60)	Difference in Means (95% CI)	p
Reduced Sense of Accomplishment	2.38 ± 0.80	2.17 ± 0.69	0.21 (0.00-0.42)	0.05*
Exhaustion	2.78 ± 0.94	2.73 ± 0.88	0.05 (-0.21-0.32)	0.71
Sport Devaluation	2.10± 0.95	1.99 ± 0.77	0.11 (-0.13-0.35)	0.38

*Statistically significant difference between groups ($p < 0.05$).

DISCUSSION

The results of this retrospective cohort did not support our primary hypothesis regarding age of specialization having an impact on symptoms of burnout. Instead, data showed that beginning sport specialization before 15 years old did not have a significant change in burnout symptoms compared to specializing at age 16 or older. However, significant findings from this cohort included evidence that current NCAA Division I female athletes were more likely to experience burnout symptoms of exhaustion compared to males. Furthermore, NCAA Division I athletes later in their collegiate careers were more likely to experience burnout in terms of sport devaluation than athletes early in their collegiate careers. Finally, any injury, including prior injury, overuse injury, or prolonged injury in NCAA Division I student-athletes, significantly increased burnout symptoms, specifically a reduced sense of accomplishment compared with athletes with no injury history.

Burnout vs. Sex. The current study demonstrated that female NCAA Division I athletes were more likely to experience the symptoms of burnout (exhaustion) compared to male athletes competing at the same level. Previous studies have found a similar correlation between burnout and adolescent female athletes.[13,14] In a study by Isoard et al.[13], the authors demonstrated that female athletes experienced significantly higher levels of reduced sense of accomplishment than male athletes, but not significantly higher in exhaustion or sport devaluation. Meanwhile, Moen et al.[14] found no significant difference in burnout scores between male and female athletes. These studies used adolescent athletes as their study subjects, which could cause differences in levels of burnout symptoms compared to the NCAA athletes used in this study. Our literature search did not find a study comparing burnout symptoms in NCAA athletes stratified by sex.

Confounding pathology within the female athlete could be an explanation for this difference in burnout between male and female athletes. Female athletes are more likely to experience a syndrome termed "Relative Energy Deficiency in Sport" (RED-S) than men and may be related to the previously described female athlete triad (eating disorder, low bone mineral density, and menstrual irregularities).[15] Future research is needed to investigate RED-S as a possible factor affecting burnout in female athletes.

Burnout vs. Age of Specialization. There were very few studies[13,16] which directly compared burnout levels in athletes who began specializing at different ages, and this is the first study which attempted to do so in high level collegiate athletes. A consensus statement by The American Orthopedic Society for Sports Medicine (AOSSM) was published in 2016 advising against early youth specialization due to increased levels of burnout and injury.[17] In this statement, it was demonstrated that youth specialization before the age of 12 was associated with increased levels of burnout, higher dropout rates, and decreased athletic development over time.[18] This was not consistent with our study which showed that athletes who specialized before the age of 15 were not significantly more or less likely to experience any symptoms of burnout, however, our sample size was relatively small and did not include enough athletes who specialized under age 12 for an analysis to be run.

Athletes who chose to specialize early did not necessarily increase their chances of becoming an NCAA Division I athlete and actually may have detrimental physical and psychosocial outcomes related to early sport specialization. In this study, 48 athletes (18.0%) reported specializing before the age of 12, and 122 athletes (45.7%) reported specializing at some point before college. These numbers were similar to a study performed by Bell et al.[19] which reported that 36% of all high-school athletes were specializing. Taking this and previous studies into account, it did not appear that specializing in high school increases chances of becoming an NCAA Division I athlete.[19,20] Additionally, because of the increased potential for injury, psychological burnout, and dropout among highly specialized athletes, those who chose to specialize early may increase their risk of a negative outcome without substantially increasing their chances of participating at the collegiate or professional levels.[18,20] A study by Myer et al.[6] reported that parents and coaches were large driving forces in an athlete's decision to specialize in hopes that their child or athlete will make it to the collegiate level or obtain a scholarship. This study found that 43.5% of athletes reported their parents being a major influence and 38.5% reported their coach being an influence on their decision to sport specialize. However, 64.9% of athletes reported that their decision to sport specialize was largely self-motivated, suggesting that there is a combination of factors that plays a part in an athlete's decision to sport specialize.

Multiple statements advising against specialization have been published[15,21]; however, burnout levels in NCAA athletes have not been widely evaluated. Although our study did not show a significant difference in burnout levels based on age of specialization, future studies should continue to assess burnout levels in NCAA athletes to understand the causes and outcomes of this condition.

Burnout vs. Year of NCAA Eligibility. This study was the first to describe levels of burnout based on year of NCAA eligibility. Athletes in the second half of their eligibility (third, fourth, and fifth years) were found to have significantly higher scores in the sport devaluation subcategory of the ABQ compared to athletes in their first and second years of eligibility. Previous studies have shown that burnout occurs over a long period of time,[16,22] so athletes in their later years of eligibility may fit this profile. As discussed above, age at beginning sport specialization can play a role in an athlete's levels of burnout. We found that 33.2% of athletes did not begin specializing until they started training at the NCAA level. Therefore, it was possible that these athletes in their third year of eligibility and beyond were beginning to experience the burnout symptoms associated with their transition to collegiate sport specialization.

Athlete burnout has been suggested to occur on a continuum.[22] Exhaustion was thought to occur at the start of the burnout process and followed by a reduced sense of accomplishment and finally by sport devaluation.[22] While no research has proven this "burnout continuum" phenomenon, it was interesting that athletes near the end of their NCAA careers reported burnout symptoms in the subcategory of sport devaluation, which occurred at the end of the proposed "burnout continuum". Future research should be conducted at NCAA Division I institutions to assess burnout profiles for athletes based on year of eligibility. Furthermore, it would be interesting to compare these results based on sport of participation to find if certain sports increase likelihood of burnout throughout an athlete's collegiate career.

Burnout vs. Injury History. NCAA Division I athletes surveyed in this study demonstrated higher levels of burnout in the subcategory of a reduced sense of accomplishment if they had a history of injury, whether it be prolonged injury or overuse injury. Studies have reported that a history of multiple injuries has a correlation with increased levels of burnout.[3,23] However, this was the first study to demonstrate that levels of burnout were consistent among types of injury, whether traumatic, prolonged, or overuse injuries. In a study by Grylls et al.[24], the authors demonstrated that athletes with current injury experienced lower levels of burnout compared to athletes with no injury. On the other hand, athletes with a past history of repeated injury experienced higher levels of burnout compared to athletes with no history. A possible explanation for this result may be due to the temporary break from intense sporting involvement that an injury provides, which may decrease levels of burnout. Multiple injuries, though, could have a cumulative effect, creating a lack of enjoyment leading ultimately to burnout. Furthermore, even though our study did not show that specialization leads to burnout, the results revealed that injury can lead to burnout. It could be inferred that early specialization leads to increased risk of injury, and injury leads to increased risk of burnout. Other studies could be conducted which compare injury rates from this cohort to other early sport specializers to see if they are similar.

Future studies should attempt to assess larger sample sizes to identify burnout patterns in athletes with injury history. Studies also could attempt to measure burnout levels before injury, immediately after injury, then at regular intervals during recovery and return to sport to assess an athlete's burnout patterns post-injury.

Limitations. As with most retrospective cohorts, a major limitation of this study was recall bias. Current collegiate athletes were asked to recall their sport participation history, specialization history, and injury history as far back as the age of 8 years old and in some cases as far back as they can remember participating in sports. Athletes from all years of NCAA eligibility were surveyed, including graduate students and athletes competing in a fifth year, which potentially could worsen recall among the oldest athletes in the sample. Another limitation was the unequal distribution of subjects between sports. This was largely the result of the inclusion of rowing, track and field, and football which have a much larger roster than other college sports. With a higher proportion of athletes in this study participating in rowing (n = 89), an attempt should be made to conduct a study among sports with higher levels of youth specialization. Furthermore, a sample size of 267 athletes may not be generalizable to the entirety of Division I NCAA athletics. Considering variability of institutions, coaches, sports, and time of year, there are many factors that can play a role in an athlete's current levels of burnout; however, this variability also can contribute to improved generalizability of the data found in this study. Future research should attempt to sample larger numbers of athletes from multiple institutions in an attempt to include more sports and athletes.

CONCLUSIONS

Overall, these results showed that females, athletes later in their careers, and athletes with injury history (specifically overuse injury) are most at risk for burnout. With these data, a population of athletes within athletic departments have been identified which should receive further counseling and attention in regard to mental health and burnout. Future studies should attempt to assess burnout in a large population of athletes, such as the NCAA, to understand predisposing factors to burnout better. Most importantly, future studies should attempt to find ways to prevent burnout as well as treat burnout once it begins to occur.

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Keywords: sports, psychological burnout, overuse injury, gender differences, sports medicine

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Clinical Rotation Handbook Promotes Orthopaedic Resident Wellness: A Quality Improvement Study

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ABSTRACT

Introduction. Transitioning from one clinical rotation to the next may be particularly stressful for orthopaedic residents attempting to navigate new work environments with new faculty mentors and new patients. The purpose of this quality improvement (QI) project was to determine if resident stress could be improved by using a handbook to disseminate key rotation-specific data during quarterly rotation transition periods.

Methods. A comprehensive electronic handbook was created by residents to describe each rotation in our orthopaedic training program in terms of: (1) faculty and staff contact data, (2) daily clinic and surgery schedules, (3) resident responsibilities and faculty expectations, and (4) key resources and documents. At rotation transition, a session in the academic schedule was dedicated for outgoing residents to update the handbook and to sign-out to incoming residents. Pre- and post-handbook questionnaires were administered to assess resident perceptions of stress or anxiety, preparedness, and confidence before commencing the new rotation. Nonparametric data derived from the surveys were analyzed using the sign test choosing $p < 0.05$ for a two-tailed test as the level of statistical significance.

Results. Most residents perceived improvements in stress/anxiety, preparedness, and confidence understanding rotation expectations after the handbook was implemented. Changes in these three outcome parameters were statistically significant.

Conclusions. This rotation transition QI initiative consisting of a resident-authored, rotation-specific electronic handbook and dedicated verbal sign-out session enhanced resident wellness by decreasing stress, increasing preparedness, and improving confidence among residents starting a new rotation. Similar online resources may be useful for trainees in other specialties. ***Kans J Med 2022;15:331-335***

INTRODUCTION

In 2017, the Accreditation Council for Graduate Medical Education (ACGME) mandated physician wellness education for all residency programs regardless of specialty.[1] Since wellness is crucial to the delivery of optimal healthcare, residents and faculty members must be committed to maintaining a learning and work environment where respect for physician well-being is paramount.[2] In the recently revised Common Program Requirements, the ACGME emphasized that all physician mentors and trainees not only bear responsibility for their own physical and mental health and for managing their own life stressors, but also share responsibility for the well-being of their physician colleagues.

Failure to cope with the stresses and demands of training during orthopaedic surgery residency has been associated with burnout, a work-related distress syndrome of emotional exhaustion, depersonalization, and a reduced sense of accomplishment.[3] In a survey study of orthopaedic residents from a large university training program by Sargent et al.[3], respondents exhibiting greater levels of burnout also reported increased levels of anxiety about their own clinical competence. Such feelings of inadequacy are common among residents in training.

In this context, our residents identified the start of a new rotation as a particularly stressful time owning to the overwhelming amount of new information they are expected to assimilate. This data compendium included fundamental knowledge about the orthopaedic subspecialty, faculty preferences on various patient issues ranging from in-office injections to surgical indications to preoperative patient positioning, faculty expectations regarding resident performance, and relatively mundane matters such as personnel contact information, clinic assignments, and operating room schedules. Typically, this information was passed from one resident rotator to the next by verbal communication on an informal and sometimes inconsistent basis. This oral sign-out often was lacking in detail and/or clarity, which may amplify resident anxiety and compromise the quality of patient care.

The resident staff chose to focus on this shortcoming in transition of patient care by creating a handbook to transmit key information from outgoing to incoming resident rotators. This resident handbook, organized by post-graduate year, clinical rotation, and faculty mentor, was designed to minimize stress and to maintain resident well-being during the transition to a new rotation. In addition, time was allocated in the academic calendar at the beginning of each rotation for outgoing residents to update the handbook and sign-out to their incoming colleagues.

The purpose of this QI project was to assess the impact of handbook utilization on resident wellness. It was hypothesized that use of the handbook would decrease stress/anxiety, increase preparedness, and improve confidence for orthopaedic residents starting a new rotation.

METHODS

Setting and Participants. This QI study was conducted at the University of Kansas School of Medicine-Wichita in the Department of Orthopaedic Surgery. Our five-year training program has four residents in each post-graduate year (PGY) for a total of 20 residents. After PGY-1, all clinical rotations are three months in duration except for the PGY-4 six-month rotation in pediatric orthopaedics (Table 1). For PGY-1 residents, the duration of rotations varies from one month to three months. The five-member QI team managing this project was comprised of one resident from each PGY level.

Table 1. Orthopaedic resident rotations, academic year 2021-22.

PGY-1	Faculty
Orthopaedic Trauma, Service 1	2
VA, Adult Orthopaedics	2
Orthopaedic Research	2
Orthopaedic Basic Science	2*
Off-service rotations (6 months)	
PGY-2	
Orthopaedic Trauma, Service 2	2
Hand & Wrist, Foot & Ankle, Service 1	4
Sports Medicine, Service 1	3
Hip & Knee Arthroplasty	3
PGY-3	
VA, Adult Orthopaedics	2*
Shoulder & Elbow (including arthroplasty)	3
Sports Medicine, Service 2	2
Spine	1
PGY-4	
Hand & Wrist, Service 2	2
Hip & Knee Arthroplasty	3*
Shriners Children's Hospital, Saint Louis (6 months)	
PGY-5	
Orthopaedic Trauma, Service 1	2*
Orthopaedic Trauma, Service 2	2*
Foot & Ankle, Service 2	2
Elective rotation, Academic Chief Resident	

*Some faculty members overlap on services; 28 orthopaedic faculty serve as resident mentors.

As a preliminary step to assess the potential value of an orthopaedic resident handbook, the QI team administered a resident questionnaire by email in January 2021. The survey consisted of six multiple choice items requiring a Likert scale response and three yes/no items (Figure 1). Since the questionnaire also measured resident perceptions of stress, preparedness, and confidence prior to starting a new rotation, the responses also served as a baseline against which later survey results could be compared. Because the survey documented favorable resident sentiment regarding handbook utility, the department authorized the resident team to move forward with the project as a QI study.

Quality Improvement Intervention. From January to June 2021, using the initial survey results and input from residency leadership, faculty, and residents, a comprehensive handbook was created for our five-year residency program. Contributions to the handbook for each rotation were made by residents who already had completed the rotation. All entries were edited by the QI team to assure handbook accuracy.

1. Upon starting your new rotation, how stressed do you feel during the first two weeks getting to know the new rotation and schedule?
   Very Stressed, Somewhat Stressed, Almost Never Stressed, Never Stressed

2. Upon starting your new rotation, how prepared do you feel to fully meet the expectations of the rotation?
   Very Unprepared, Somewhat Unprepared, Somewhat Prepared, Very Prepared

3. Prior to your new rotation, how confidently did you know the expectations of the rotation?
   Very Unconfident, Somewhat Unconfident, Somewhat Confident, Very Confident

4. Prior to your new rotation, did you have any contact with the previous resident about the rotation schedule and expectations?
   Yes, No

5. Prior to your new rotation, how much time did you spend with the previous resident discussing your rotation?
   No Time, Very Little Time, Adequate Time, Extensive Time

6. In your opinion, would a transition guide including general overview of schedule, important numbers, and attending expectations be helpful in transitioning to a new rotation?
   Yes, No

7. How much would a transition guide be helpful?
   Very Helpful, Somewhat Helpful, Somewhat Unhelpful, Very Unhelpful

8. In your opinion, would a standardized face-to-face transition with the previous resident on service help better prepare you for your new rotation?
   Yes, No

9. How much would a standardized face-to-face transition be helpful?
   Very Helpful, Somewhat Helpful, Somewhat Unhelpful, Very Unhelpful

Figure 1. Resident questionnaire (condensed) administered before creating the handbook.

For each rotation, the handbook was organized into four major categories: (1) primary contact information, (2) general rotation schedule, (3) resident responsibilities and faculty expectations, and (4) useful resources and documents (Table 2). Primary contact information included names and telephone numbers for each staff member, such as attending surgeons, physician assistants, nurse practitioners, medical assistants, and secretaries. The handbook also included the preferred method of contact for these personnel. The general schedule outlined the clinic schedule (location and start time) and the operating room schedule (location and start time) for each day of the week. Information on parking, codes for restricted access doors, how to obtain scrubs, location of cafeteria/lounge also were included in this section. Faculty expectations and the responsibilities of resident rotators in both the clinic and operating room were specified in the third section of the handbook entry for each rotation. Lastly, valuable resources and documents, such as surgeon instrument preference lists, were included.

Table 2. Handbook organization.*

Contact Information
All faculty members, clinical assistants, and key staff members
Telephone numbers, pager numbers
Preferred method of contact for each
Rotation Schedule
Clinic assignments (days of the week, times)
Operating room venues (days of the week, times)
Where to park, where to enter various locations
Access to locker rooms, scrub attire
Responsibilities and Expectations
Interview and examine all new patients in clinic, formulate diagnosis
Assist with preoperative positioning of patients
Dictation of clinic notes, operative reports, discharge summaries
Special communication requirements, sign-out of on-call patients
Resident clinical competency expectations at completion of rotation
Resources and Documents
Protocols for administering in-office injections
Preferences for preoperative imaging
Surgical instrument preferences for specific cases

*By resident year level, clinical rotation, and faculty member.

As part of this QI initiative, time in the academic schedule was designated to facilitate resident transition to a new rotation. During the week before the start of a new rotation, 15- to 30-minute periods were dedicated for incoming residents to discuss rotation expectations with outgoing residents. This formal transition period allocated time for residents to review the handbook, to familiarize themselves with the requirements of the new rotation, and to ask questions of outgoing residents.

After the electronic resident handbook was completed, the document was uploaded to a secure, cloud-based, data storage platform (Google Drive). On June 30, 2021, one day before the start of the new academic year and new rotations, all residents were given access to the handbook, which was available on computer platforms or mobile devices. At the end of each rotation, the handbook was updated by the resident completing the rotation to assure the most current information was documented and available for resident consumption.

Evaluating the Intervention. In January 2022, six months after implementing the resident handbook, a new survey was administered by email to assess the efficacy of the QI initiative. The inquiry consisted of seven multiple choice items requiring a Likert scale response, one yes/no item, and one simple multiple-choice item (Figure 2). Importantly, the questionnaire evaluated resident perception of stress/anxiety, preparedness, and confidence prior to starting a new rotation after using the handbook. These follow-up responses permitted comparison to the resident responses obtained during the initial survey administered one year earlier.

Data Analysis and Reporting. Standard statistics were used to describe the data collected in this study. Changes in the three key parameters of perceived resident stress, preparedness, and confidence were analyzed using the sign test for nonparametric data. The level of statistical significance was set at $p < 0.05$ for a two-tailed test. This manuscript was prepared in accordance with the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines for quality improvement reporting.[4]

1. Did you have access to the handbook prior to the start of the rotation?
   Yes, No

2. After reading and having access to the handbook, how stressed did you feel during your first two weeks of your new rotation?
   Very Stressed, Somewhat Stressed, Almost No Stress, No Stress At All

3. After reading and having access to the handbook, how prepared did you feel to fully meet the expectations of the rotation?
   Very Unprepared, Somewhat Unprepared, Somewhat Prepared, Very Prepared

4. After reading and having access to the handbook, how confident did you know the expectations of the rotation?
   Very Unconfident, Somewhat Unconfident, Somewhat Confident, Very Confident

5. In your honest opinion, how helpful was the rotation handbook in helping you prepare for your new rotation?
   Very Helpful, Somewhat Helpful, Somewhat Unhelpful, Very Unhelpful

6. In your honest opinion, how helpful was the rotation handbook in helping alleviate any stress at the beginning of the rotation?
   Very Helpful, Somewhat Helpful, Somewhat Unhelpful, Very Unhelpful

7. In your honest opinion, how helpful was having dedicated face-to-face transition in preparing you for your new rotation?
   Very Helpful, Somewhat Helpful, Somewhat Unhelpful, Very Unhelpful

8. How helpful would it be to update the rotation handbook after each quarter with new pertinent information for the incoming resident?
   Very Helpful, Somewhat Helpful, Somewhat Unhelpful, Very Unhelpful

9. How often did you use the guidebook during the first month?
   1 to 2, 3 to 4, 5 to 6, > 6

Figure 2. Resident questionnaire (condensed) administered 6 months after using the handbook.

RESULTS

Pre-Handbook Survey. Seventeen of 20 residents had contact with the outgoing resident to discuss specifics of the rotation, but only four believed that sufficient time was devoted to that discussion. Nineteen of 20 residents experienced stress or anxiety during the first two weeks of a new rotation, while 12 believed they were somewhat unprepared and 14 expressed limited confidence regarding expectations. All 20 residents responded that a rotation-specific handbook would be helpful, with 14 stating that such a resource would be very helpful. Fourteen of 20 residents favored a standard face-to-face debriefing by the outgoing resident on service.

Post-Handbook Survey. For the 2021-22 academic year, all 20 residents had access to the handbook. Nineteen residents stated this source of information was either very helpful (n = 13) or somewhat

helpful (n = 6) in preparing them for the new rotation. One resident opined that the handbook was very unhelpful. As a resource to help alleviate stress, 18 responded that the handbook was very helpful (n = 12) or somewhat helpful (n = 6), whereas two responded that it was very unhelpful. Nineteen residents stated the face-to-face session with the outgoing resident was very helpful (n = 17) or somewhat helpful (n = 2). Only one resident stated the face-to-face debriefing was very unhelpful. Ten residents used the handbook one to two times, eight used it three to four times, one used it five to six times, and one used it more than six times during the first month of a new rotation.

Change in Wellness Perception. Matched pair responses of 16 residents who had completed both pre- and post-handbook questionnaires were available for review and analysis (Table 3). Most residents perceived improvements in stress, preparedness, and confidence understanding expectations after the handbook was implemented compared to before this resource was available. Using the sign test with $p < 0.05$, the changes in all three outcome parameters were statistically significant.

Table 3. Change in resident perception of wellness after handbook implementation.

Resident Perception	Better	Worse	Unchanged	p Value*
Stress during first two weeks of rotation	12	1	3	0.002
Preparedness to meet expectations	13	1	2	0.001
Confidence knowing expectations	12	0	4	< 0.001

*Sign test used to determine p value with statistical significance at $p < 0.05$ for two-tailed test. Matched paired responses before and after handbook use were available for 16 residents.

DISCUSSION

This QI project demonstrated that the intervention of a rotation-specific handbook combined with a designated sign-out period was well received by the residents in our orthopaedic program, facilitating resident transition to a new rotation. By comparing pre- and post-handbook questionnaire responses, statistically significant improvements were found in resident stress/anxiety, preparedness, and confidence understanding their responsibilities and mentor expectations prior to the start of a new rotation. Insofar as the measured parameters served as surrogates for overall well-being, this intervention promoted resident wellness.

The findings were consistent with similar resident handbook QI projects published in the literature. At the Aintree University Hospital in Liverpool, UK, Davies et al.[5] found that 70% of junior doctors endorsed using the trainee-created handbook to ease their transition from one rotation to the next. After implementing a junior doctors' handbook at the National Health Service in Tayside, Scotland, Ross et al.[6] reported that 22 of 23 survey respondents believed the resource was beneficial to have starting their new jobs and 16 of 23 (70%) stated it improved their efficiency. However, neither report indicated the specialties of these doctors in training.

Over a decade ago, a comprehensive analysis of stress among orthopaedic residents, faculty, and spouses in the United States was conducted using data from a nationwide survey of 64 ACGME-accredited residency training programs. This study found high levels of burnout in 56% of the 384 orthopaedic residents surveyed.[7] Burnout risk was greatest among PGY-2 level residents, female residents, and those in larger training programs with six or more residents per year level. The recent pandemic has imposed additional stress on trainees, falling disproportionally on the shoulders of junior orthopaedic residents, some of whom were temporarily reassigned to provide direct care of patients with COVID-19.[8] In this high-stress environment, program directors and faculty members, who themselves were subject to the negative effects of chronic stress,[3,7,9] must be cognizant of their obligation to train residents not only to be competent clinicians and surgeons, but also to maintain a healthy work-life balance.

Recent interventions to enhance well-being have focused on empowering residents with control over certain aspects of their work environment,[10] such as establishing call schedules and delineating duties and responsibilities according to their level of experience. Consistent with this concept, the present QI initiative permitted trainees to create, edit, and maintain their own resident handbook specifying daily schedules and clinical duties. In so doing, the project improved resident sense of control over their workplace, thereby enhancing wellness. The pre-handbook survey indicated that most residents were stressed somewhat about their upcoming rotation, whereas a small minority reported being stressed post-handbook. Similarly, most residents perceived that they were prepared better for their new assignments and more confident understanding rotation expectations after the handbook was made available. Consequently, trainees transitioning to a new service immediately were able to focus more on patient care and adapting to their new clinical environment, rather than on learning routine details about the rotation now specified in the resident handbook.

The biggest challenge encountered during this initiative was having residents update handbook entries at the end of each rotation. This problem was addressed by designating specific sign-out periods during our academic calendar for residents to update the handbook. This time also was used to answer questions of incoming residents prior to starting their new rotation. Overall, residents were very satisfied with these changes to our program, but about half accessed the handbook only once or twice during the first month of their new rotation. To improve handbook utility throughout the rotation, some suggested inclusion of additional information about surgeon preferences such as treatment methods for specific diagnoses, surgical approaches or techniques, and key literature citations.

This study had several limitations. First, the questionnaire used to assess wellness parameters has not been validated. Second, internal validity of the study may have been influenced adversely by resident confirmation bias in responding to the survey. Third, since the study evaluated only orthopaedic surgery residents, the results may not be generalized to other specialties, thereby negatively impacting the study's external validity. Fourth, because the resident handbook and mandatory sign-out session were implemented simultaneously, it

cannot be determined which intervention was more beneficial to residents.

This QI intervention was a low-cost endeavor requiring the initial investment of resident time and effort and the nominal expense of having web-based access to the electronic data. The handbook should be updated continually and ideally should be modified as described above to assure its ongoing utility as a resident resource. Maintaining the documented wellness gains may be difficult without residents continuing to champion this QI initiative in the future.

CONCLUSIONS

The rotation transition QI initiative consisting of resident-authored, rotation-specific handbook and dedicated verbal sign-out session was well received and well supported in our orthopaedic surgery training program. Overall, well-being was enhanced as evidenced by decreased stress/anxiety, increased preparedness, and improved confidence among residents during the first month of a new rotation. Trainees are now more familiar with their clinical duties and expectations, allowing them to focus on patient care rather than routine details regarding the new rotation. Similar online resources may be useful for residents in other surgical or medical specialties depending on the number of subspecialties, clinical rotations, and faculty mentors associated with the specific training program.

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Lessons Learned from Implementing Unconscious Bias Training at an Academic Medical Center

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ABSTRACT

Introduction. In 2018, our Midwestern university medical center began offering unconscious bias training. Each session concluded with a standard evaluation. We analyzed two years of data that focused on three areas: 1) whether demographic differences or amount of prior knowledge on the topic influenced the training experience; 2) what participants liked best about the training; and 3) whether participants' stated intentions to apply their learning at the end of the training aligned with institutional goals of the training.

Methods. Participants attended sessions open to the campus community pre-scheduled by the Office for Diversity, Equity, and Inclusion and posted on its website. Chi-square tests were utilized to test associations between outcomes and questionnaire responses. Outcome measures included race/ethnicity, prior knowledge level, and overall rating of the training. Thematic analysis was used to code comments and establish themes from two open-ended survey questions.

Results. Significant differences were found by race and ethnicity for all questionnaire responses; each were $p < 0.001$. Those who reported they had advanced/expert knowledge on the topic were less likely to report the training increased their knowledge, and those who reported their race as White/Caucasian tended to give the training the highest overall rating, as did heterosexuals. Through thematic analysis, participants valued the interactive nature of the training sessions, the use of storytelling, and the safety of the learning environment. Participants' intention to apply their learning indicated they had gained general awareness of bias and settings where it might influence their work.

Conclusions. In an effort to foster a better working and learning environment for those who are underrepresented in the health professions, training was provide that may not have met the expectations of all participants. At the same time, participants who identified as White clearly increased their awareness of bias. Therefore, it is recommended to move away from one-size-fits-all unconscious bias training and develop a robust training continuum to provide ongoing advancement for diverse audiences. ***Kans J Med 2022;15:336-346***

INTRODUCTION

Unconscious bias (UB) refers to mental shortcuts we take in making decisions.[1] These shortcuts typically are unexamined and outside our awareness. Without meaning to, some individuals might perpetuate discriminatory behavior.[2] Some aspects of discrimination are so deeply ingrained in society that certain groups, such as people who have disabilities or people of color, collectively often have interactions involving automatic and often harmful associations.[3]

Impacts of UB have been documented extensively in academic medicine and patient care. Areas such as the recruitment, hiring, promotion, and retention of Black, Indigenous, and People of Color (BIPOC), LGBTQIA+, and female faculty of color,[4-7] along with admission, retention, and graduation rates of underrepresented students,[8-10] all have been linked to UB. Increasingly, UB is used as a concept to explain, and at times justify, lack of diversity in faculty hiring, student admissions, and curricular content.[11] Like the general population, healthcare providers have been shown to hold bias and stereotypes against patients from marginalized and minoritized groups already burdened by health disparities. UB research documents treatment differences in pain management, chronic disease management, and psychiatric care among others.[12,13] Health care providers who hold negative unconscious biases against Black/African American and Hispanic patients are more likely to identify these patients as non-compliant or uncooperative.[12-14] Conversely, providers tended to favor patients specified as White in their clinical judgment and behavior.[15,16]

UB trainings have emerged as a reactive and ubiquitous strategy in many organizations to address bias and promote diversity, equity, and inclusion (DEI). Although previous research has indicated that similar training effectively influences participants' awareness of different biases,[17,18] critics argue that UB training is an insufficient response to institutional inequities,[2,19] and little evidence exists on the ability of UB training to effect institutional change.[20] A recent meta-analysis of 492 studies and 87,418 participants found the effects of such training to be relatively weak and rarely translates into change of explicit measures in behavior.[21] Moreover, some UB training interventions may lead to further entrenchment of biases.[20,21]

Despite these flaws, it remains imperative to educate people in academic medicine about the automatic cognitive processes that impact important decisions and judgments in their work. While UB training may be a contested educational method, these cognitive processes are well documented and extensively researched in the work of Daniel Kahneman and others.[22,23] Thus, in 2018, amidst rising concern of the impact of UB on internal policies and practices, our Midwestern medical center began offering UB training to the campus community. Since then, more than 2,500 students, staff, faculty, residents, and others from our schools of medicine, nursing, pharmacy, and health professions have participated in this training.

As our university medical center and other institutions consider ways to address flaws in diversity programming, it is of paramount importance to identify effective teaching strategies for delivering these difficult topics. Developing a deeper understanding of what works to bring about behavioral change (and what does not) is also critical. Two

years of evaluation data from our UB training were evaluated with three questions in mind: Did a one-size-fits-all training meet the needs and expectations of participants; did participants' intentions to apply learning align with the goals of the training; and did participant feedback indicate key instructional strategies to emphasize as we consider next steps in DEI training?

METHODS

Training Materials. The university medical center sent 16 faculty and staff to a four-day train-the-trainer course endorsed by the American Association of Medical Colleges. Trainees became certified to facilitate a two-hour training on unconscious bias using materials provided (slides and a participant guide). The training emphasized bias as an unconscious process of the mind and included activities to help people become more aware of these mental shortcuts. It also emphasized documented impacts of bias in healthcare and provided some strategies to encourage individual growth.

Participants. Trainings were offered as general sessions open to any interested employee and advertised via broadcast emails and announcements. Supervisors also were encouraged to request training for their teams or department. From 2018-2020, 1,408 employees, including supervisors, registered for general sessions. Training was provided 54 times to teams, departments, and committees by trained facilitators reaching an estimated 2,500 individuals across the medical center. At the end of each training, participants were asked to complete anonymously a standard questionnaire involving demographic information, participants' experience during training, need for additional resources, and intentions to apply the content learned. Surveys included both multiple-choice and open-response fields. A total of 923 participants completed these end-of-training questionnaires.

Questionnaire. A 23-item questionnaire was developed to evaluate participant perception of the Unconscious Bias training. We used questionnaire responses to: 1) evaluate demographic differences of respondents; 2) assess differences in perception by race and ethnicity; 3) measure the impact of prior knowledge on training satisfaction; 4) identify training areas that were most likely to have lower verses higher ratings; and 5) qualitatively determine trends in satisfaction and plans to utilize what was learned.

Data Analysis Plan. This project was deemed and approved as a quality improvement study by the university's institutional review board. Descriptive statistics were used to summarize responses to the UB training questionnaire. Frequencies and percentages were used for categorical items. Chi-square tests were utilized to test associations between each outcome and questionnaire responses. Where data were sparse, Fisher's exact test of association was used. In each case, two-sided tests were conducted using an alpha value adjusted for multiple tests, which resulted in $p = 0.001$ as level of significance. Analyses were conducted in IBM SPSS Statistics, version 26.

Open item responses were analyzed by two team members with backgrounds in education, sociology, and communications. Thematic analysis, a method often employed for analyzing qualitative data by identifying, analyzing, and reporting repeated patterns, was used to examine the response to two questions: 1) What did you like best about this training? and 2) In which ways are you planning to use what you learned today? Braun and Clarke's six-stage analysis process was used to identify patterns or themes within the narrative data.[24] Open item responses were inductively coded by two coders. The researchers engaged in an independent first reading, becoming familiar with the data by reading and re-reading the responses and noting initial impressions. Coders then discussed initial emergent topics and themes. Inconsistencies were resolved before proceeding with the coding process. The analysis process was iterative and emergent themes were cross questioned and critiqued by coders, clarified, defined, and reviewed until saturation was reached.[25] Results were summarized, which included compelling extracted examples.

RESULTS

Respondents. Of the 2,500 attendees, 923 completed the questionnaire for a response rate of about 37%. Table 1 summarizes the responses to the demographic questions. Most respondents were female (n = 554; 74%), described their sexual orientation as heterosexual (n = 677; 82%), had not served in the military (n = 805; 94%), did not have a disability (n = 789; 92%), and were self-described as university medical center staff (n = 445; 53%). Over half of respondents reported they had intermediate prior knowledge of UB prior to the training event (n = 447; 54%).

Response to Training by Race/Ethnicity. Bivariate associations for race/ethnicity for 861 respondents are shown in Table 2. Most respondents were White/Caucasian (n = 650; 76%), followed by Black/African American (n = 55; 6%) and Hispanic/Latino (n = 43; 5%). Overall perceptions of the training were collapsed into two categories, Yes vs. Neutral/NA or No. Respondents tended to report "Yes" the training met expectations, was relevant, engaging, and increased knowledge; responses ranged from 61% to 98%. However, responses differed significantly by race/ethnicity, each were $p < 0.001$; those who preferred not to answer the race/ethnicity question rated these items lowest compared to all others. Similar results were shown on ratings for the overall event: 33% of undeclared race/ethnicity respondents rated the event as excellent, whereas almost 66% of Hispanic/Latino respondents rated the event as excellent.

Responses by Prior Knowledge. Prior knowledge was categorized as none/beginner (n = 250; 30%), intermediate (n = 447; 54%), or advanced/expert (n = 131; 16%; Table 3). Bivariate analysis showed only one significant association between prior knowledge and the question "Did the training increase your knowledge?". Those who reported they had an advanced/expert knowledge on the topic were less likely to report the training increased their knowledge 71% vs. 94% for none/beginner and 91% for intermediate. However, because all percentages were high, the training appeared to have value regardless of prior knowledge.

Table 1. Summary of participant responses to demographics.

Description	Missing	Frequency (n)	%
Total participants		923	100.0
What is your age?	57		
18 - 24 years		86	9.9
25 - 34 years		257	29.7
35 - 44 years		194	22.4
45 - 54 years		154	17.8
55 years +		145	16.7
Prefer not to answer		30	3.5
What is your racial or ethnic identification?	62		
White/Caucasian		650	70.4
Black/African American		55	6.0
Hispanic/Latino		43	4.7
Asian, American Indian/Alaskan Native, Pacific Islander		38	4.1
Other, Multi-racial		36	3.9
Prefer not to answer		39	4.2
What is your gender identity?	171		
Male		176	23.4
Female		554	73.7
Other		22	2.9
Which of the following best describes your sexual orientation?	97		
Asexual		41	5.0
Bisexual		19	2.3
Gay		11	1.3
Heterosexual		677	82.0
Lesbian		8	1.0
Other*		13	1.4
Prefer not to answer		57	6.9
Have you ever served in any branch of the Unites States military?	64		
Yes		34	4.0
No		805	93.7
Prefer not to answer		20	2.3
Do you currently have a diagnosed disability?	69		
Yes		29	3.4
No		789	92.4
Prefer not to answer		36	4.2
Which of the following best describes your PRIMARY affiliation?	79		
Faculty		144	17.1
Resident/Fellow		55	6.5
Student		118	14.0
Hospital Staff		41	4.9
University Medical Center Staff		445	52.7
Community Member		5	0.6
Other		36	4.3

Table 1. Summary of participant responses to demographics. *continued.*

Description	Missing	Frequency (n)	%
If you are a student, what is your academic program?	769		
School of Nursing		6	3.9
School of Medicine		36	23.4
School of Health Professions		97	63.0
Graduate Studies		15	9.7
If you are a student, are you an international student?	740		
Yes		11	6.0
No		172	94.0
What was your knowledge of the topic prior to the event?	95		
None		35	4.2
Beginner		215	26.0
Intermediate		447	54.0
Advanced/Expert		131	15.8

*Other: Pansexual, Queer, Questioning or unsure, Same gender loving, Other.

Table 2. Bivariate associations by race/ethnicity.

Description	n	% Prefer not to answer (n = 39)	% White/ Caucasian (n = 650)	% Black/ African American (n = 55)	% Hispanic/ Latino (n = 43)	% Asian[1] (n = 38)	% Other, Multi-Racial (n = 36)	p
Yes, the training...								
Met my expectations	860	69.2	92.2	87.3	90.7	94.6	88.9	< 0.001
Seemed relevant to me	859	76.9	96.8	90.9	97.7	97.4	94.4	< 0.001
Engaged me	858	71.8	93.8	85.5	95.3	94.7	94.4	< 0.001
Increased my knowledge	856	61.5	91.2	83.6	86.0	94.6	83.3	< 0.001
Please rate the following aspects of the event:								
Overall	836							< 0.001
Excellent		33.3	59.1	64.2	65.9	48.6	42.9	
Good		38.5	34.2	28.3	19.5	45.9	42.9	
Poor, Fair, or N/A		28.2	6.7	7.5	14.6	5.4	14.3	
Which types of resources would you find helpful; all that apply	859							
Faculty/staff development for teaching cultural awareness		18.3	21.5	23.2	23.7	24.3	25.5	0.062
Patient-case related resources		15.1	15.5	12.3	19.1	19.6	16.0	0.042
Electronic/Online learning modules		22.6	19.4	20.3	18.3	19.6	21.3	0.962
Links to resources from other		18.3	19.7	16.7	18.3	16.8	13.8	0.268
On-campus workshops		11.8	19.3	22.5	16.0	18.7	17.0	0.096
No additional resources		33.3	12.3	12.7	14.0	2.7	16.7	0.006
Demographics								
What is your age?	828							0.004
18 - 34 years		42.1	41.3	22.2	45.2	64.9	37.1	
35 years +		57.9	58.7	77.8	54.8	35.1	62.9	
What is your gender identity?	745							0.024
Male		11.1	23.5	21.4	19.4	23.5	36.4	

Table 2. Bivariate associations by race/ethnicity. *continued.*

Description	n	% Prefer not to answer (n = 39)	% White/ Caucasian (n = 650)	% Black/ African American (n = 55)	% Hispanic/ Latino (n = 43)	% Asian[1] (n = 38)	% Other, multi-racial (n = 36)	p
Female		77.8	73.6	78.6	80.6	76.5	51.5	
Other		11.1	2.9	0.0	0.0	0.0	12.1	
Best describes your sexual orientation	818							< 0.001
Heterosexual		15.4	86.5	81.6	78.9	75.8	82.9	
All other		2.6	10.6	10.2	13.2	24.2	17.1	
Prefer not to answer		82.1	2.9	8.2	7.9	0.0	0.0	
Served in any branch of the United States military	850							< 0.001
Yes		7.7	3.9	1.8	7.0	0.0	5.6	
No		51.3	95.6	98.2	90.7	100.0	94.4	
Prefer not to answer		41.0	0.5	0.0	2.3	0.0	0.0	
Do you currently have a diagnosed disability	845							< 0.001
Yes		0.0	3.6	3.6	4.7	2.8	2.8	
No		48.7	94.0	94.5	95.3	97.2	97.2	
Prefer not to answer		51.3	2.4	1.8	0.0	0.0	0.0	
Best describes your PRIMARY affiliation	834							0.217
University Medical Center employee		70.6	70.4	75.5	60.5	59.5	69.4	
Student		8.8	14.9	3.8	20.9	16.2	8.3	
Hospital employee or other		20.6	14.7	20.8	18.6	24.3	22.2	
If you are a student								
What is your academic program?	153							0.030
School of Nursing		0.0	3.3	20.0	11.1	0.0	0.0	
School of Medicine		50.0	21.7	20.0	11.1	20.0	80.0	
School of Health Professions		25.0	67.5	40.0	66.7	50.0	20.0	
Graduate Studies		25.0	7.5	20.0	11.1	30.0	0.0	
Other		11.1	2.9	0.0	0.0	0.0	12.1	
International student	182	0.0	2.8	0.0	50.0	33.3	0.0	< 0.001

[1]Asian, American Indian/Alaskan Native, and Native Hawaiian/other Pacific Islander

Table 3. Bivariate associations by prior knowledge.

Description	What was your knowledge of the topic prior to the event?				
	n	% None/Beginner (n = 250)	% Intermediate (n = 447)	% Advanced/Expert (n = 131)	p
Yes, the training...					
Met my expectations	827	90.4	91.7	86.3	0.176
Seemed relevant	826	96.0	96.6	90.8	0.016
Engaged me	825	93.5	92.8	87.8	0.109
Increased my knowledge	823	94.4	90.6	71.3	< 0.001
Please rate the following aspects of the event:					
Overall	803				0.110
Excellent		59.7	56.3	56.3	
Good		34.0	35.7	29.7	
Poor, Fair, or N/A		6.3	8.0	14.1	

Table 3. Bivariate associations by prior knowledge. *continued.*

Description	What was your knowledge of the topic prior to the event?				
	n	% None/Beginner (n = 250)	% Intermediate (n = 447)	% Advanced/Expert (n = 131)	p
Which types of resources would you find helpful; all that apply	826				
Faculty/staff development for teaching cultural awareness		54.4	61.0	56.9	0.224
Patient-case related resources		37.2	42.2	52.3	0.018
Electronic/Online learning modules		54.8	53.4	50.0	0.672
Links to resources from other		52.8	50.0	53.8	0.652
On-campus workshops		51.6	51.5	44.6	0.353
No additional resources		13.6	11.9	14.6	0.638
Demographics					
What is your age?	796				0.988
18 - 34 years		41.9	41.6	42.4	
35 years +		58.1	58.4	57.6	
What is your racial or ethnic identification	818				0.031
Prefer not to answer		3.2	4.3	6.9	
White/Caucasian		83.9	72.0	68.5	
Black/African American		2.4	8.2	8.5	
Hispanic/Latino		3.6	5.9	5.4	
Asian, American Indian/Alaskan Native, and Native Hawaiian/ other Pacific Islander		4.0	4.8	4.6	
Other, multi-racial		2.8	4.8	6.2	
What is your gender identity?	725				0.221
Male		21.5	23.6	25.0	
Female		76.3	74.1	69.0	
Other		2.3	2.3	6.0	
Which of the following best describes your sexual orientation?	792				0.481
Heterosexual		85.7	81.5	79.4	
All other		8.0	11.7	13.5	
Prefer not to answer		6.3	6.8	7.1	
Have you ever served in any branch of the Unites States military?	823				0.693
Yes		4.4	2.9	5.3	
No		92.8	94.8	92.4	
Prefer not to answer		2.8	2.3	2.3	
Do you currently have a diagnosed disability	820				0.807
Yes		2.4	3.9	4.6	
No		93.6	92.1	90.8	
Prefer not to answer		4.0	4.1	4.6	
Which of the following best describes your PRIMARY affiliation?	815				0.578
University Medical Center employee		67.3	68.8	75.0	
Student		16.3	14.5	10.9	
Hospital employee or other		16.3	16.7	14.1	
If you are a student					
What is your academic program?	152				0.178
School of Nursing		3.9	2.5	9.5	

Table 3. Bivariate associations by prior knowledge. *continued.*

Description	What was your knowledge of the topic prior to the event?				
	n	% None/Beginner (n = 250)	% Intermediate (n = 447)	% Advanced/Expert (n = 131)	p
School of Medicine		17.6	23.8	28.6	
School of Health Professions		74.5	58.8	57.1	
Graduate Studies		3.9	15.0	4.8	
International student	182	8.5	6.0	0.0	0.351

Table 4. Bivariate associations by overall rating of the training.

Description	n	% Poor, Fair, N/A (n = 74)	% Good (n = 310)	% Excellent (n = 507)	p
Yes, the training...					
Met my expectations	890	54.1	86.8	98.2	< 0.001
Seemed relevant to me	889	64.9	94.8	99.4	< 0.001
Engaged me	888	55.4	89.0	99.0	< 0.001
Increased my knowledge	886	37.8	87.7	96.4	< 0.001
Which types of resources would you find helpful; all that apply	887				
Faculty/staff development for teaching cultural awareness		45.8	50.5	64.2	< 0.001
Patient-case related resources		43.1	35.0	43.5	0.050
Electronic/Online learning modules		48.6	45.0	55.9	0.009
Links to resources from other		45.8	44.0	53.8	0.021
On-campus workshops		43.1	43.7	54.7	0.005
No additional resources		23.6	17.5	9.5	< 0.001
Demographics					
What is your age?	811				0.044
18-34 years		55.6	40.8	39.1	
35 years +		44.4	59.2	60.9	
What is your racial or ethnic identification	836				< 0.001
White/Caucasian		60.0	75.5	77.7	
Hispanic/Latino		8.6	2.8	5.6	
Other, multi-racial		7.1	5.2	3.1	
Black/ African American		5.7	5.2	7.1	
Asian, American Indian/Alaskan Native, and Native Hawaiian/other Pacific Islander		2.9	5.9	3.8	
Prefer not to answer		15.7	5.2	2.7	
What is your gender identity?	727				0.822
Male		28.3	21.5	23.9	
Female		67.9	75.7	73.3	
Other		3.8	2.8	2.8	
Which of the following best describes your sexual orientation?	800				< 0.001
Heterosexual		63.8	81.0	84.8	
All other		17.4	10.4	10.8	
Prefer not to answer		18.8	8.6	4.3	
Have you ever served in any branch of the Unites States military?	832				< 0.001
Yes		1.4	5.2	3.6	
No		87.0	92.7	95.2	
Prefer not to answer		11.6	2.1	1.3	

Table 4. Bivariate associations by overall rating of the training. *continued.*

Description	n	% Poor, Fair, N/A (n = 74)	% Good (n = 310)	% Excellent (n = 507)	p
Do you currently have a diagnosed disability	827				< 0.001
Yes		4.3	2.5	4.0	
No		81.2	92.9	93.3	
Prefer not to answer		14.5	4.6	2.7	
Which of the following best describes your PRIMARY affiliation?	818				0.613
University Medical Center employee		67.7	68.6	70.9	
Student		10.8	14.5	14.5	
Hospital employee or other		21.5	17.0	14.7	
If you are a student					
What is your academic program?	151				0.151
School of Nursing		12.5	0.0	5.4	
School of Medicine		37.5	32.0	17.2	
School of Health Professions		50.0	60.0	65.6	
Graduate Studies		0.0	8.0	11.8	
International student	179	0.0	4.8	4.7	0.801

Responses by Overall Rating for the Training Event. Overall rating for the training was categorized as Poor, Fair, N/A (n = 74; 8%), Good (n = 310; 35%), or Excellent (n = 507, 57%; Table 4). Compared to those who rated the event as excellent, the poor raters were least likely to report the training increased knowledge (96% vs. 38%, respectively; $p < 0.001$). Several demographic factors differed significantly by overall rating: race/ethnicity, sexual orientation, military service, and disability. Those who identified as White/Caucasian tended to give the training the highest overall rating, as did heterosexuals. Additionally, those who did not serve in the military and who did not have a disability were more likely to rate the training as excellent. Throughout the analysis, one pattern seemed clear: those respondents who self-identified as White/Caucasian heterosexuals with intermediate knowledge of the topic tended to rate the trainings more favorably than any other group.

Thematic Analysis. Responses to the open-ended questions yielded insights into elements of the training that our campus community enjoyed as well as potential areas for improvement. Two questions were analyzed and formed five total themes from responses. Answers to the question, "What did you like best about the training?", were categorized into three main themes: 1) appreciation for interactivity and multi-modal communication, 2) the power of storytelling, and 3) the learning environment. Answers to the question, "In which ways are you planning to use what you learned today?", were categorized into two themes: 1) improve general awareness and 2) settings knowledge could be applied.

Question 1: What Did You Like Best about the Training?

Interactivity and Multiple Modes of Communication. An overwhelming majority of the participants valued the interactivity of the trainings. Words such as, "interactive", "engaging", and "practical" were used often to describe the training. Participants highlighted the "discussion-based" teaching and the multiple modes of delivery such as videos, pictures, hands-on activities, and the use of personal and institutional examples as having a positive impact on their understanding of a complex topic and satisfaction with the training. One participant shared:

> *"I enjoyed how the facilitators asked open-ended questions and allowed silence to let participants think through answers. I liked that they had guiding PowerPoints and visuals, but did not simply read off the screen. There was a lot of discussion."*

The Power of Storytelling. Several participants specifically warned against making unconscious bias trainings didactic with comments such as, "I don't think you should make this a PowerPoint training that people speed through". Participants consistently commended the use of small and large group discussion during the trainings and the "interaction of everyone at the table and willingness to share". Participants seemed to value sharing personal stories over the presentation of behavioral and neurophysiological research studies, calling attention to the crucial role that storytelling had on their positive experience of the session. They commented on how, "stories shared painted vivid pictures", and "storytelling made the whole session very relatable". The team approach to training allowed facilitators to bring in multiple personal and institutional experiences. Participants noted, "the honesty the presenters had in sharing their biases". They "liked that there was more than one person giving the presentation. It helped give a few different perspectives", and said, "the real sharing of the presenters encouraged me to be more vocal".

Importance of the Learning Environment. Another theme generated from the response analysis was the importance of the learning environment, including the "perceived safety" of the space and

avoidance of "shaming". In their accounts, participants spoke about the "warmth" and "balanced" nature of the environment and how it facilitated meaningful reflections. One participant commented: "The staff created an environment where discussion could take place with everyone's opinion being equally respected". Another shared that facilitators were "very personable and engaging, creating a friendly atmosphere", while a third said "It felt like a safe space, so I felt comfortable participating".

Comments around "not-shaming" and "normalization of bias" were common, with participants noting that the environment was a "non-threatening environment" that "didn't call out any particular group or blame anyone". Participants felt they were "not being put on the spot" and had the "freedom to respond to questions". They also appreciated that facilitators, instead of shaming, explicitly highlighted "the understanding that it's okay and natural to have biases, but we need to recognize them and understand their impacts".

Question 2: In Which Ways Are You Planning to Use What You Learned Today?

Improve General Awareness. Despite positive reviews of the training, participants' plans to utilize their learning were vague. Some participants answered with general statements such as, "treat everyone the way I want to be treated" or "during interaction with everyone I meet". Most respondents reflected on the knowledge and skills learned and indicated a commitment to "making myself aware of my bias" and to improving relationships and interpersonal communication, particularly with those belonging to a minoritized group. Some discussed how the training was "very applicable as I work with multiple ethnicities" or how they would use the knowledge when "engaging with others from different backgrounds".

Settings Knowledge Could Be Applied. Some participants connected the content of the training to their role at the institution, identifying a general intention to use the knowledge acquired to improve recruitment, teaching, and/or patient care. One participant shared they could "use the information obtained from the course with my Doctor of Nursing Practice proposal, interaction with colleagues, and patients I care for". Others added they would be "thinking about what biases I have when interacting and thinking about students" or "in aspects of teaching/grading and in applicant admissions". A handful of respondents provided more concrete examples or a plan of action as they shared their plans to apply learning. One specifically indicated a commitment to watching for "biased language in what I write", while others intended to pay more attention to certain indicators that could signal a need for intervention. For example, during interviews, if an applicant is described as a bad fit, it "means I should take an inward look and explore why I feel that way toward having a person on my team. First quick assumptions aren't necessarily true." Similarly, a faculty member noted the training would be "very helpful when interviewing/recruiting residents. If I'm feeling bias or uncomfortable with a candidate, I can stop and ask myself why, plus try to filter out the bias."

DISCUSSION

This study described the results of a satisfaction survey administered after UB training at a Midwestern medical center. These insights will be used to craft our next steps in terms of UB awareness and education efforts. Results indicated that participants were overwhelmingly positive in their evaluation of the training, with over half rating the sessions as excellent. A large majority of participants rated the sessions as meeting their expectations, indicating it was relevant, engaging, and increased their knowledge. Participants who identified as White, heterosexual, and without a disability tended to give the highest ratings. Participants who identified as belonging to a minoritized group reported finding the content relevant and engaging, however, they had lower satisfaction in terms of the training meeting their expectations and increasing their knowledge. These differences are unsurprising given that White and/or heterosexual participants may be sheltered from experiences of bias while minoritized participants often experience bias in their daily lives in the form of microaggressions.[26]

Echoing criticisms of UB training,[20] the thematic analysis revealed a lack of alignment between the outcomes of the UB trainings (i.e., awareness and improvement of interpersonal communications) and the hopes that our institution had for this effort (i.e., addressing systemic bias and racism). As evidenced by the rapid proliferation of UB trainings, the intensified political unrest of the last three years led many academic institutions like ours to embrace such programs as the silver bullet to achieve equity. As institutions continue to invest time and resources on DEI efforts, their design, the evidence behind their effectiveness, and their limitations must be considered.

Limitations. This study had limitations worth noting. First, the low response rate to the questionnaire, uneven distribution between male and female responders, and an amount of missing data per each question were noted. These might indicate a responder bias. Second, it was unknown how much of the knowledge gained during training will be retained. Conducting a follow-up survey six months after training may help determine knowledge retention. Finally, a small proportion of respondents appeared to be uncomfortable reporting on some key aspects of the questionnaire, selecting the option "prefer not to answer" on such things as age, race/ethnicity, sexual orientation, military service, and diagnosed disability. These are all factors that may be impacted by UB, and most are listed as protected classes from discrimination. Perhaps future training could do more to make all persons more comfortable, such as developing stronger methods for completely anonymous surveys.

There were significant strengths of the project. First, all trainers were certified to facilitate a two-hour UB training event. The certifying organization also provided standardized training material (slides and a participant guide). This ensured that all participants received similar information by trained specialists; thus, events were consistent across all sessions. Second, we had a diverse group of trainers regarding age, race, ethnicity, role, gender, and sex. This may have helped the audience better relate to facilitators and experience safety as evidenced by their positive comments.

Implications for Practice. The results of this study provided several areas of consideration for those who are engaged in DEI education efforts. We propose the following recommendations:

1. Multipronged, interdisciplinary initiatives that are sustained over a long period of time are more likely to render results than annual compliance trainings or one-time trainings. The term "training" seems to suggest a focus on competency development,[27] which in the case of UB training might have led adopters to believe that it was indeed a pragmatic solution to elimination of bias. If the institution's goal is to address systemic racism/isms, then UB training must be situated as part of a larger conversation about systemic oppression, its origins, and how it continues to permeate our society. Academic medical centers may benefit from interdisciplinary partnerships with history, sociology, anthropology, and education experts who are positioned better to provide such offerings.
2. Contextualized programming. While an overall approach to programming may benefit from interdisciplinary partnerships, the need for institutions to develop internal DEI experts was also apparent. Although participants in our UB trainings appreciated the facilitators' sharing of specific institutional examples of bias, ultimately the analysis also indicated that the training failed to empower participants to develop clear plans of action. Institutions should engage internal experts to develop programming that creates space for attendees to reflect on inequities within context-specific problems, policies, and procedures, as well as potential solutions.
3. Scaffolded professional learning opportunities. The analysis revealed that a one-size-fits all training failed to meet the expectations of underrepresented participants and of those with advanced knowledge on the subject. Some participants self-reported preparedness for a deeper dive into these topics; indeed, they may have come to the training with higher expectations for the depth of content. Providing a continuum of educational experiences could alleviate this satisfaction gap and address the needs of a variety of learners.
4. Adopt a multi-modal, interactive approach with emphasis on storytelling. A strong conclusion from our analysis was that participants appreciated variety in facilitation including use of audiovisual materials, small/large group discussion, and individual reflection. Particularly noteworthy was the value conferred to storytelling by both facilitators and participants over, for instance, presentation of behavioral and neurophysiological research studies. As noted in previous literature,[28] storytelling assisted in building rapport, credibility, and trust. It provided a space for those in our audience who identified as White and cisgender to listen and practice perspective-taking, and for folks from minoritized backgrounds to share and feel heard.

CONCLUSIONS

Systemic racism/isms and bias are complex problems to solve. UB training might be a piece of the solution; however, it will not end institutional racism/isms. DEI initiatives should be planned, designed, and evaluated with the same level of rigor and expertise that we demand in patient care, research, and teaching. The results presented in this paper could challenge institutions to evaluate existing DEI offerings critically, to determine what their campus needs are, and to develop their own educational goals and talent as they strive to become more equitable and inclusive.

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Millennials Seeking Healthcare: Examining the Degree to Which Patients Utilize Online Resources

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ABSTRACT

Introduction. According to the 2020 U.S. Census, a Silver Tsunami is looming, with more than 75.4 million persons aged 57 to 75 expected to need more costly medical care. However, a larger wave of 83.1 million Millennials nearing adulthood is approaching rapidly. Therefore, it is important to understand how this population finds their physician and what may influence this decision.

Methods. Paper-based surveys were administered to adult patients at primary care and geriatric clinics located at the University of Kansas Medical Center in Kansas City, Kansas. Questions included demographic information, utilization and influence of online reviews, and the effects negative and positive reviews have on a patient's choice of physician. Descriptive statistics were calculated for respondent characteristics and survey responses. Chi-square and McNemar's tests were performed to evaluate differences between age and gender groups, and to determine how influential review ratings are in choosing a physician for medical care. Statistical significance was determined at the 0.05 level.

Results. A sample of 284 patients completed the survey (44.35 ± 17.54 years old [range = 18-90], 60.6% female, 57.4% white). Of Millennials, 67.2% read online reviews before choosing a physician. Millennials were significantly more likely to read online reviews before choosing a physician ($p = 0.004$) and utilize online resources to search for a new physician ($p < 0.001$) than older patients.

Conclusions. Millennials were more likely to research online reviews before choosing a physician. Therefore, an online review presence will be beneficial to one's practice to acquire this new wave of patients.

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INTRODUCTION

Many are concerned about the "Silver Tsunami", an expected increase in healthcare spending due to a large portion of the population living longer and, as such, expected to cost more to treat.[1] According to the U.S. Census, there is an estimated 73 million individuals aged 57 to 75 years old who are likely to require this higher acuity of care.[2] However, a much larger wave of patients is fast approaching with 83.1 million individuals, Millennials, the largest living generation, accounting for nearly 10 million more individuals than the Baby Boomer generation. At the age of 26, Millennials will be required to purchase their own health insurance as current health policy permits dependents of family insurance plans up to this age.[3] As many Millennials are approaching this age limit, they are beginning to interact with the medical field independently for the first time in their lives. Patients are reliant and overall trusting of internet resources, so one might expect the next generation to turn first to their smartphone when navigating their healthcare.[4] Further, patients may place more confidence in online health information than friends and family.[5]

Varying rates of patients using online physician reviews have been reported, with investigators indicating between 16% and 63% of patients utilize online reviews.[6,7] According to a recent survey, almost three quarters (71%) of surveyed patients used online reviews as the first step to finding a new doctor.[8] The wide discrepancy in utilization rates and relatively few studies conducted on use of online reviews to find a physician indicated a need for further research. Likewise, internet trends are changing constantly and adapting to users' needs. Therefore, up-to-date research on these trends is necessary to understand and respond to the needs of patients. Online reviews in other consumer markets matter to Millennials. According to a recent study conducted on consumer behavior, 96% of consumers aged 18 to 34 read local business reviews online.[9] Moreover, 89% of consumers aged 18 to 34 trust online reviews. Although medicine is a fundamentally different industry than those measured in the preceding survey, utilization of a search engine for reviews on something as personal as healthcare may bleed into medicine.

Millennials contributed about 21% of total healthcare spending in 2018, with this portion of healthcare spending expected to grow as Millennials age and require additional care.[10] Moreover, this generation of patients are changing expectations across the industry with greater demands for improved healthcare access, value, and consumer experience. In contrast to older generations, Millennials are much less brand loyal, and anyone seeking their business must adapt to acquire these patients.[11] This generation is comfortable and reliant on technology in daily life. To attain and further retain this patient population will require physicians to provide easy access to and availability of information about them online.[5]

It is feared that online reviews may have a negative impact on a provider's reputation. Previous publications have expressed that fears of negative reviews are what prevents providers from having an online review platform.[12,13] According to findings published almost a decade ago, physicians were likely to have positive website ratings, with most patients likely to leave a positive review of their physician.[5,14] Based on these findings, the likelihood of a provider's reputation being tarnished by poor patient reviews is relatively low. It is not known how the next generation of patients, however, will interpret online reviews of physicians.

Understanding how this next generation of patients finds and interacts with healthcare will better prepare the industry to receive the next wave of patients. The goal of this study was to explore the extent to which online resources and online reviews influence a patient's choice of physician.

METHODS

Patients visiting primary care and geriatrics clinics at an academic medical center located in the Midwest between May and July 2020 were invited to participate in a brief anonymized survey. Paper survey forms were distributed to patients and subsequently returned to clinic staff at the end of their appointment. Data collected included general demographic information, if participants read online reviews before choosing a physician, other resources they might utilize, and where they most commonly receive medical care. In addition, a five-point Likert-type scale, from extremely unlikely to extremely likely, was used to determine the influence of negative and positive online reviews on a participant's decision when selecting a physician for care and the likelihood participants will utilize online resources when looking for a physician. Incomplete surveys, and participants whose stated age was less than 18 were not included in the study. The project was approved by the University of Kansas Medical Center Human Research Protection Program. Consent for the study was obtained through a written preface at the beginning of the survey.

Data Analysis. Descriptive statistics were calculated for respondent characteristics and responses to survey questions (i.e., frequencies and percentages for categorical variables, and means and standard deviations for continuous variables). The chi-square test of independence and McNemar's test were performed to evaluate differences between age and gender groups and within the groups in terms of using online resources and how influential review ratings are in choosing a particular physician for medical care. Statistical significance was determined at the 0.05 level and effect sizes (Cramer's V, Cohen's κ, and odds ratio and their 95% confidence interval if applicable) were calculated for each comparison. REDCap®, a HIPAA-compliant web-based application, was used to collect and manage study data.[15] All analyses were conducted using SAS 9.4.[16]

RESULTS

A total of 284 patients completed the survey (Table 1), consisting of 172 women, 110 men, and 2 respondents who self-identified as "Other". The patients' ages ranged from 18 to 90 years (M ± SD = 44.35 ± 17.54 years), and their race/ethnic distribution was representative of the geographic location. Survey results are presented with the study sample as well as subgroups based on age (Table 2 and Table 4) and gender (Table 3). Age subgroups were defined as those aged 18 to 38 years (n = 122) and those older than 38 years of age (n = 162); such grouping could maintain an adequate number of responses in each subgroup while differentiating the two by distinct generations. Gender subgroups were defined as females (n = 172) and males (n = 110), excluding "Other".

Reading Online Reviews. Overall, more than half of the patients (57%) reported they read online reviews of their physician. As seen in Table 2, the results of chi-square test further indicated that those aged between 18 to 38 years were two times more likely to read online reviews when choosing a physician compared to those who were older ($\chi^2(1) = 8.43$, $p = 0.004$, $V = 0.17$, OR = 2.05 [1.27; 3.33]). Women read online reviews more than men (59.9% vs. 52.7%), but this difference was not significant ($\chi^2(1) = 1.40$, $p = 0.24$, $V = 0.07$, OR = 1.34 [0.83; 2.17]).

Table 1. Sample demographics.

Variable	n/M	%/SD	Range
Age (years)	44.35	17.54	18-90
Gender			
Female	172	60.6%	
Male	110	38.7%	
Prefer not to say	2	0.7%	
Race/Ethnicity			
White	163	57.4%	
Black or African American	74	26.1%	
Hispanic or Latino	23	8.1%	
Asian or Pacific Islander	17	6.0%	
Native American/American Indian	4	1.4%	
Other	3	1.1%	
What other resources do/would you utilize when looking for a new doctor? (Choose all that apply)			
Friends/Family	222	78.2%	
Google Search	100	35.2%	
Doctors Clinic Website	114	40.1%	
Online Reviews (Google, Yelp, etc.)	86	30.3%	
Other	58	20.4%	
Where do you most commonly receive medical care?			
Primary care physician	231	81.3%	
Urgent care center	16	5.6%	
Emergency Room	9	3.2%	
Work/School clinic	7	2.5%	
Other	21	7.4%	

Utilize Online Resources. The majority of patients (n = 163, 57.4%) indicated they were likely to utilize online resources when looking for a physician. Those aged between 18 to 38 years were significantly more likely to do so compared to older patients ($\chi^2(4) = 28.64$, $p < 0.001$, $V = 0.32$). Also, women were more likely to utilize online resources than men, but this difference was not significant ($\chi^2(4) = 9.23$, $p = 0.056$, $V = 0.18$).

Influence of Online Reviews. On the survey, patients indicated how negative and positive reviews would influence their decision when looking for a physician. About half reported they were likely to be influenced by negative reviews (n = 141, 49.6%: either "extremely likely" or "likely"), while 23.6% (n = 67) reported they did not. Those aged between 18 to 38 years were more likely to be affected by negative reviews than older patients (59% vs. 42.6%); however, this difference was not significant ($\chi^2(4) = 9.01$, $p = 0.061$, $V = 0.18$). Also, women were more likely to be affected than men, but the gender difference (54.7% vs. 41.8%) was not significant ($\chi^2(4) = 8.69$, $p = 0.069$, $V = 0.18$).

Table 2. Survey responses by age group.

Variable	All (N = 284)		Aged 18-38 Years (n = 122)		Aged > 38 Years (n = 162)		Group Difference				
	n	%	n	%	N	%	χ^2	p	V	OR	95% CI
Do you read online reviews before choosing a doctor?							8.43	0.004	0.17	2.05	1.27; 3.33
Yes	163	57.4%	82	67.2%	81	50.0%					
No	121	42.6%	40	32.8%	81	50.0%					
How likely are you to utilize online resources?							28.64	< 0.001	0.32	-	-
Extremely Unlikely	35	12.3%	12	9.8%	23	14.2%					
Unlikely	30	10.6%	2	1.6%	28	17.3%					
Neutral	56	19.7%	23	18.9%	33	20.4%					
Likely	93	32.7%	41	33.6%	52	32.1%					
Extremely Likely	70	24.6%	44	36.1%	26	16.0%					

Table 3. Survey responses by gender.

Variable	All (N = 284)		Female (n = 172)		Male (n = 162)		Group Difference				
	n	%	n	%	n	%	χ^2	p	V	OR	95% CI
Do you read online reviews before choosing a doctor?							1.40	0.240	0.07	1.34	0.83; 2.17
Yes	163	57.4%	103	59.9%	58	52.7%					
No	121	42.6%	69	40.1%	52	47.3%					
How likely are you to utilize online resources?							9.23	0.056	0.18	-	-
Extremely Unlikely	35	12.3%	14	8.1%	21	19.1%					
Unlikely	30	10.6%	17	9.9%	13	11.8%					
Neutral	56	19.7%	34	19.8%	22	20.0%					
Likely	93	32.7%	59	34.3%	33	30.0%					
Extremely Likely	70	24.6%	48	27.9%	21	19.1%					

Table 4. Influence of online reviews.

Variable	McNemar's Test			
	S	p	κ	95% Confidence Interval
Influence of reviews on those aged 18-38				
General vs. Negative	15.44	0.120	0.43	0.30; 0.55
General vs. Positive	19.51	0.034	0.65	0.54; 0.76
Negative vs. Positive	15.95	0.101	0.46	0.34; 0.59
Influence of reviews on those aged >38				
General vs. Negative	15.92	0.102	0.63	0.54; 0.72
General vs. Positive	23.17	0.010	0.65	0.56; 0.74
Negative vs. Positive	34.75	< 0.001	0.67	0.58; 0.75

Almost two-thirds of the patients (n = 184, 64.8%) reported they were likely to be influenced by positive reviews, a greater percentage than the case of negative reviews (49.6%). Similar to negative reviews, those aged between 18 to 38 years and women were more likely to be affected by positive reviews than their counterparts, but the differences were not statistically significant (for age, 71.3% vs. 59.9%, $\chi^2(4) = 9.11$, $p = 0.058$, $V = 0.18$; for gender, 69.8% vs. 57.3%, $\chi^2(4) = 6.76$, $p = 0.15$, $V = 0.15$). Those aged between 18 to 38 years were more likely to be affected by positive reviews than by general reviews ($S = 19.51$, $p = 0.034$, $\kappa = 0.65$ [0.54; 0.76]). Similarly, for those aged older than 38 years, positive reviews were more influential compared to general reviews ($S = 23.17$, $p = 0.010$, $\kappa = 0.65$ [0.56; 0.74]) and negative reviews ($S = 34.75$, $p < 0.001$, $\kappa = 0.67$ [0.58; 0.75]).

Other Resource Options. To ascertain what other resources patients used to find a physician, respondents were asked to select all resource options that apply. The most common responses were "Friends/Family" (n = 222, 78.2%), followed by "Doctor's clinic website" (n = 114, 35.2%) and "Google Search" (n = 100, 40.1%). One specific item that was not included in the list of response options, but was specified by several patients, was their insurer's website (n = 19, 6.7%). Patients being seen at a primary care clinic indicated they most commonly received medical care at a primary care clinic (n = 231, 81.3%); the next most utilized was Urgent Care (n = 16, 5.6%) followed by the Emergency Room (n = 9, 3.2%).

DISCUSSION

This single-site survey of patients seen at an academic medical center located in the Midwest found patients were likely to read online reviews and utilize online resources when searching for a physician. Those aged between 18 to 38 years were more likely to conduct their own research by utilizing online resources and reading online reviews before choosing a physician. Likewise, those aged > 39 years were found to utilize online resources and read reviews, but not to the same degree as those within the 18 to 38 year age group.

We found that more than half of patients read online reviews of their physician. Other studies have found similar rates ranging from 42% to 61% compared to the 57% found in this study.[5,7] Participants aged 18 to 38 years were two times more likely to read online reviews than older generations, indicating the online shift occurring generationally and the importance of online reviews to this patient population. The influence of online reviews has been extended past patients themselves. Online reviews have been linked to better Hospital Consumer Assessment of Healthcare Providers and Systems scores (HCAHPS) and, given the impact these scores have on hospitals and physicians, it can be conceived that online reviews may find themselves in a similar type of scoring system.[7] In fact, in 2009 the United Kingdom's National Health Service (NHS) encouraged patients to rate their general practice physicians through the NHS webservice.[17] Whether a similar approach will be implemented by government subsidized healthcare in the U.S. remains unclear. Furthermore, it has been reported that patients are more likely to leave a positive review than a negative one.[14] To better serve this population, it may be within a medical practice's best interest to be more available on online review platforms and encourage patients to leave online reviews.

Online resources were found to be useful to patients when looking for a physician. By age group, those aged 18 to 38 years were much more likely to utilize online resources compared to older generations. This may signify a shift in the way patients find their physician and directly impacts primary care as online resources, such as reviews or a clinic website, will be the first impression many patients gain about a practice. It would be within a practice's best interests to put time and resources into their online presence to be better perceived by prospective patients.

Another finding suggested that online reviews influence a patient's choice of physician. Providers have become concerned about the impact negative reviews may have on their reputation within the community.[12,13] We found negative reviews, compared to positive ones, were not likely to influence a patient's decision. Furthermore, positive reviews had a much larger degree of influence compared to negative reviews. Similarly, other investigations have shown positive reviews have a greater influence than negative ones, providing further evidence that negative reviews have little influence on patients' decisions.[5,14]

The most recent research on the effects of online resources on patients' decisions were outdated, as these studies were published several years ago.[7,14] Further, these studies did not compare internet usage on a generational basis. Importantly, internet habits and practices change rapidly and must be measured on a consistent basis to capture and understand current trends.[18] This constant adaptation may explain the wide range of online review usage reported previously. Although our research suggested there may be a relationship between the tone of the review and patients recruited to a practice, it would be advantageous for providers seeking to expand their practice to encourage online patient reviews.

We also gathered data on what other resources patients use to find their physician. Many respondents utilize word of mouth communication via friends and family while also indicating they utilize "Google search" as resources to find their physician. Interestingly, very few respondents used Facebook as a resource while the "Doctors clinic website" was the second most common response. This suggested that both word of mouth and Google can be effective forms of obtaining patients, while Facebook may have limited benefit.

Limitations. This study should be interpreted considering the limitations of a cross-sectional study. Using self-reported data to study internet use may have resulted in over- or under-reporting of use, although studies of internet use for health purposes similarly have relied on self-reported data.[19] No information was collected on education, household income, or internet availability, all factors that have been reported to influence internet use.[20] The survey was conducted at a single institution with adults who were waiting to receive medical care and female respondents represented most survey responses, limiting the generalizability of the results. Further, the survey instrument did not specific whether an individual had been an established patient at the practice. New patients were likely younger and more trusting of internet resources while older, more established patients, may have

been seen by the same provider for several years. As the utilization of online resources by patients accessing health care was extensive and varied greatly by age, gender, and background, further study is warranted.

CONCLUSIONS

Despite looming concerns about our aging population, Millennials are the largest living generation, with many approaching an age where they will need to find new insurance and, in many cases, a new physician. When confronted with this issue, they will look online for reviews of practicing physicians. Negative reviews have little impact on a patient's choice of physician, therefore demonstrating the necessity to be available online. Further research is necessary to determine whether reviews have an impact on the number of new patients recruited to a practice. However, our research suggests an online presence can make a physician's practice more accessible to younger generations and can be instrumental in capturing the new wave of young patients.

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Healthcare Access Among Individuals of Asian Descent in the U.S.

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ABSTRACT

Introduction. Some groups of Asian Americans, especially Asian Indians, experience higher rates of atherosclerotic cardiovascular disease (ASCVD) compared with other groups in the U.S. Barriers in accessing medical care partly may explain this higher risk as a result of delayed screening for cardiovascular risk factors and timely initiation of preventive treatment.

Methods. Cross-sectional data were utilized from the 2006 to 2015 National Health Interview Survey (NHIS). Barriers to accessing medical care included no place to seek medical care when needed, no healthcare coverage, no care due to cost, delayed care due to cost, inability to afford medication, or not seeing a doctor in the past 12 months.

Results. The study sample consisted of 18,150 Asian individuals, of whom 20.5% were Asian Indian, 20.5% were Chinese, 23.4% were Filipino, and 35.6% were classified as "Other Asians". The mean (standard error) age was 43.8 (0.21) years and 53% were women. Among participants with history of hypertension, diabetes mellitus, or ASCVD (prevalence = 25%), Asian Indians were more likely to report delayed care due to cost (2.58 (1.14,5.85)), while Other Asians were more likely to report no care due to cost (2.43 (1.09,5.44)) or delayed care due to cost (2.35 (1.14,4.86)), compared with Chinese. Results among Filipinos were not statistically significant.

Conclusions. Among Asians living in the U.S. with cardiovascular risk factors or ASCVD, Asian Indians and Other Asians are more likely to report delayed care or no care due to cost compared with Chinese.

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INTRODUCTION

There is a high burden of ASCVD among Asian Americans. A prior study has shown that cardiovascular mortality rates in Asian Americans remained the same or, in the case of Asian Indian women, increased from 2003-2010, whereas the corresponding rates in non-Hispanic Whites decreased in that time period.[1] Studies also have shown heterogeneity in the prevalence of cardiovascular risk factors among various groups of Asian Americans residing in the U.S.[2,3] It is, therefore, important to understand why Asian Americans, especially Asian Indians, have a higher risk of ASCVD.

Asian American is defined by the U.S. Federal Government as persons having origins in the original Far East, Southeast Asia, or the Indian subcontinent. Asians are the fastest-growing racial group in the U.S. and are projected to reach 40 million by the year 2050.[4] Race-specific research among Asians living in the U.S. has been limited partly due to a lack of specificity of the term "Asian".[5,6] The U.S. Census Bureau defines Asian race if an individual traces their origins to the Far East, Southeast Asia, or the Indian subcontinent.

The higher risk of ASCVD among Asian Americans is multifactorial including a higher burden of cardiovascular risk factors as a result of changes in lifestyle habits due to acculturation to North American lifestyle, discrimination, delayed detection of risk factors or screening for subclinical disease, or underutilization of preventive therapy and treatment of risk factors due to lack of access to healthcare. Adequate access to healthcare is necessary to ensure screening for risk factors and initiation of appropriate preventive medical therapy. This is especially important among high-risk individuals such as those with existing ASCVD or a high burden of traditional cardiovascular risk factors such as hypertension or diabetes mellitus.[7] As these individuals require longitudinal access to healthcare,[8] it is important to identify barriers to receiving timely medical attention.[9]

While prior studies have examined measures related to healthcare access in the overall U.S. population[10,11] and those with cardiovascular risk factors,[12] few have focused specifically on individuals of Asian descent.[13,14] To address these knowledge gaps, the barriers to accessing healthcare among Asians living in the U.S. were examined, specifically among those with hypertension, diabetes mellitus, or ASCVD.

METHODS

Study Design and Population. The NHIS is a nationally representative health survey that has been conducted continuously since 1957 by the National Center for Health Statistics of the Centers for Disease Control and Prevention.[15] It is the principal source of information on the health of the civilian, non-institutionalized population of the U.S. Our analysis included data from the 2006 to 2015 NHIS datasets. Detailed information on the cross-sectional survey design and methods

can be found at http://www.cdc.gov/nchs/nhis.htm. Individuals who self-identified as Asian were included and those with missing information on race were excluded. The study was exempt from Institutional Review Board approval since it utilized deidentified data from a publicly available dataset.

Dependent Variables. Barriers to healthcare access included the following items:

1) *No place to seek medical care when needed* was assessed using, "Is there a place that you usually go to when you are sick or need advice about your health?"

2) *No healthcare coverage* was assessed using, "Are you covered by any kind of health insurance or some other kind of health care plan (include health insurance obtained through employment or purchased directly, as well as government programs like Medicare and Medicaid that provide Medical care or help pay medical bills)?"

3) *No care due to cost* was assessed using, "During the past 12 months, was there any time when you needed medical care, but did not get it because you couldn't afford it?"

4) *Delayed care due to cost* was assessed using, "During the past 12 months, have you delayed seeking medical care because of worry about the cost?"

5) *Inability to afford medication* was assessed using, "During the past 12 months, was there any time when you needed prescription medicines, but didn't get it because you couldn't afford it?"

6) *Did not see doctor in past 12 months* was assessed using, "During the past 12 months, have you seen or talked to any general doctor about your own health?"

Independent Variable. Asian race in NHIS was self-reported and was defined if participants identified themselves as Chinese, Filipinos, or Asian Indians. "Other Asians" included Japanese, Vietnamese, Korean, and other Asian subgroups.

Covariates. Demographic characteristics included age, gender, level of education (less than high school graduate, high school graduate, some college, and college graduate or above), country of birth, number of years lived in the U.S., and annual income (< $25k, $25-45k, $45-75k, and > $75k). Coronary heart disease (CHD) was defined if participants reported ever having angina pectoris, or being told they had CHD or a heart attack. Stroke was identified if participants reported ever being told they had a stroke. ASCVD was defined as a composite of CHD or stroke. Hypertension was defined if participants answered yes to the question: "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" Diabetes mellitus was defined by affirmative answer to the question: "Have you ever been told by a doctor or other health professional that you had diabetes?". Smoking status was categorized as never versus ever depending on whether participants reported having smoked 100 cigarettes in a lifetime. Participants who answered yes were then asked if they now smoke every day, on some days, or not at all. Current smoking was defined as those who smoke every day or on some days, while former smoking was defined if they reported not smoking at all.

Statistical Analysis. Baseline characteristics were summarized using mean (standard error) and numbers (weighted percentages) and compared by Asian race group for both the overall study population and among those with ASCVD, hypertension, or diabetes mellitus. Multivariable-adjusted logistic regression models were used to evaluate the association of Asian race categories (Chinese as reference given that they have a lower cardiovascular risk factor profile compared with other Asian groups[16]) and inability to access healthcare. Results were adjusted for age, gender, place of birth, education, and income and presented for the overall study population, then by restricting to individuals with self-reported ASCVD, diabetes mellitus, or hypertension. Sensitivity analyses further adjusted for comorbidity burden.

Sampling weights were used to produce national estimates that are representative of the civilian, noninstitutionalized U.S. population. These weights included design, ratio, non-response and post-stratification adjustments. Analyses were conducted using Stata version 16.1 (StataCorp, College Station, TX). A p value of < 0.05 was considered statistically significant.

RESULTS

The study sample was comprised of 18,150 Asian individuals, of whom 20.5% were Asian Indian, 20.5% were Chinese, 23.4% were Filipino, and 35.6% were classified as "Other Asians". The mean (standard error) age was 43.8 (0.21) years, and 53% were women. Asian Indian individuals were younger, less likely to be women (46.8%), born in the U.S. (8.3%) or lived there for over 10 years (58%), have less than college education (28.6%), or an annual income < $25k (28.6%). They also were less likely to smoke cigarettes currently (5.7%) or have hypertension (16.3%). The prevalence of current cigarette smoking, diabetes, hypertension, CHD, stroke, and ASCVD was highest among Filipinos (Table 1).

In the overall cohort, Asian Indians were more likely to report not having a place to seek medical care when needed and no healthcare coverage, but less likely to report no care or delayed care due to cost. Filipinos had highest prevalence of no healthcare coverage, no or delayed care due to cost, and inability to afford medications, while Chinese were most likely to not have seen a doctor in the past 12 months (all $p < 0.05$). Among individuals with ASCVD, diabetes, or hypertension, Asian Indians were more likely to report no place to seek medical care, absence of healthcare coverage, no care due to cost, and inability to afford medications, while Filipinos were more likely to report not seeing a doctor in the past 12 months (all $p < 0.05$; Table 2).

In adjusted analyses, Asian Indians were significantly more likely to report inability to afford medications compared with Chinese: odds ratio 2.11 (95% CI: 1.26,3.54). Filipinos were more likely to report inability to afford medications: 1.81 (1.12,2.91). Other Asians also were more likely to report no place to seek medical care: 1.35 (1.13,1.62), no healthcare coverage: 1.57 (1.28,1.94), no care due to cost: 1.61 (1.10,2.35), and inability to afford medications: 1.76 (1.14,2.74). Among individuals with self-reported ASCVD, diabetes, or hypertension, Asian Indians were more likely to report delayed care due to cost: 2.58 (1.14,5.85). Other Asians were more likely to report no care due to cost: 2.43 (1.09,5.44) or delayed care due to cost: 2.35 (1.14,4.86). Results for Filipinos were not statistically significant (Table 3). Further adjustment for comorbidity burden yielded similar results (not shown).

Table 1. Baseline characteristics of the study population in Asian individuals.

	Asian Indian (N = 3,392)	Chinese (N = 3,865)	Filipino (N = 4,170)	Other Asians (N = 6,723)	p Value
Current age, years (SE)	40.0 (0.4)	44.4 (0.5)	45.9 (0.3)	44.3 (0.3)	< 0.001
Women (%)	1,516 (46.8)	2,099 (54.7)	2,394 (55.0)	3,685 (53.3)	< 0.001
U.S. Birth (%)	307 (8.3)	831 (21.9)	1,496 (35.9)	1,965 (26.0)	< 0.001
Lived in U.S. >10 years (%)	1,624 (58.0)	2,002 (72.0)	2,085 (78.7)	3,526 (77.4)	< 0.001
Education less than college (%)	478 (15.9)	976 (25.5)	1,246 (27.7)	2,338 (34.0)	< 0.001
Income < $25K (%)	574 (28.6)	706 (34.2)	800 (32.6)	1,225 (38.3)	< 0.001
Current cigarette smoking (%)	224 (5.7)	250 (9.2)	560 (17.1)	903 (14.1)	< 0.001
Diabetes mellitus (%)	255 (8.8)	193 (4.3)	448 (10.3)	530 (7.5)	< 0.001
Hypertension (%)	514 (16.3)	761 (18.5)	1,341 (31.0)	1,583 (20.7)	< 0.001
CHD (%)	96 (2.8)	127 (2.8)	220 (4.6)	242 (2.9)	< 0.001
Stroke (%)	30 (1.0)	55 (1.1)	84 (1.9)	133 (1.8)	0.01
ASCVD (%)	114 (3.4)	148 (3.1)	263 (5.5)	329 (4.1)	< 0.001

Abbreviations: CAD (coronary heart disease); ASCVD (atherosclerotic cardiovascular disease).
Continuous variables are summarized using mean (standard error) and categorical variables as count (weighted percentage).

Table 2. Healthcare access measures in the overall study population restricting to individuals with atherosclerotic cardiovascular disease, diabetes mellitus, or hypertension.*

	Overall (n = 18,150)					Individuals with Atherosclerotic Cardiovascular Disease, Diabetes Mellitus, or Hypertension (n = 4,829)				
	Asian Indian	Chinese	Filipino	Other Asians	p Value	Asian Indian	Chinese	Filipino	Other Asians	p Value
No place to seek medical care when needed (%)	712 (18.6)	651 (15.0)	584 (13.0)	1,328 (19.8)	< 0.001	73 (10.2)	49 (5.2)	101 (5.8)	139 (9.2)	< 0.001
No healthcare coverage (%)	383 (12.6)	435 (11.9)	577 (12.3)	1,123 (17.2)	< 0.001	74 (11.3)	63 (8.6)	127 (7.7)	165 (10.3)	0.15
No care due to cost (%)	131 (3.2)	138 (3.4)	230 (4.1)	386 (5.1)	< 0.001	44 (5.3)	33 (3.9)	95 (4.7)	110 (5.7)	0.45
Delayed care due to cost (%)	194 (4.4)	220 (5.1)	304 (6.1)	502 (6.4)	0.008	55 (6.8)	47 (4.9)	120 (6.8)	139 (7.6)	0.27
Inability to afford medication (%)	138 (4.3)	94 (2.6)	233 (5.1)	317 (4.6)	< 0.001	52 (7.1)	29 (3.6)	113 (7.0)	122 (7.1)	0.09
Did not see doctor in past 12 months	1,279 (36.6)	1,488 (37.4)	1,433 (33.6)	2,617 (40.5)	< 0.001	117 (16.9)	149 (17.8)	302 (18.1)	337 (20.0)	0.54

*Categorical variables are presented as count (weighted percentage).

Table 3. Odds ratios (95% confidence interval) for the association of Asian race and healthcare access overall and restricting to individuals with atherosclerotic cardiovascular disease, diabetes mellitus, or hypertension.

	Chinese	Asian Indian	Filipino	Other Asians	Asian Indian	Filipino	Other Asians
	Unadjusted				Adjusted		
Overall							
No place to seek medical care when needed (%)	1.00 (ref)	**1.29 (1.10,1.52)**	0.85 (0.71,1.00)	**1.39 (1.22,1.59)**	1.18 (0.96,1.46)	0.84 (0.67,1.07)	**1.35 (1.13,1.62)**
No healthcare coverage (%)	1.00 (ref)	1.07 (0.88,1.29)	1.03 (0.84,1.27)	**1.54 (1.30,1.82)**	1.25 (0.96,1,61)	1.11 (0.86,1.44)	**1.57 (1.28,1.94)**
No care due to cost	1.00 (ref)	0.92 (0.67,1.26)	1.21 (0.89,1.66)	**1.51 (1.16,1.97)**	1.13 (0.72,1.75)	1.12 (0.76,1.65)	**1.61 (1.10,2.35)**
Delayed care due to cost	1.00 (ref)	0.87 (0.68,1.13)	1.21 (0.94,1.56)	**1.27 (1.01,1.58)**	0.96 (0.67,1.37)	1.02 (0.75,1.39)	1.11 (0.85,1.46)
Inability to afford medication	1.00 (ref)	**1.73 (1.24,2.42)**	**2.03 (1.47,2.81)**	**1.84 (1.34,2.54)**	**2.11 (1.26,3.54)**	**1.81 (1.12,2.91)**	**1.76 (1.14,2.74)**
Did not see doctor in past 12 months	1.00 (ref)	1.04 (0.92,1.17)	**1.18 (1.06,1.31)**	**0.88 (0.79,0.98)**	1.13 (0.96,1.33)	1.10 (0.93,1.30)	0.84 (0.71,1.00)
Individuals with Atherosclerotic Cardiovascular Disease, Diabetes Mellitus, or Hypertension							
No place to seek medical care when needed (%)	1.00 (ref)	**2.06 (1.31,3.23)**	1.11 (0.72,1.74)	**1.84 (1.17,2.88)**	1.76 (0.90,3.45)	0.97 (0.49,1.91)	1.50 (0.79,2.81)
No healthcare coverage (%)	1.00 (ref)	1.35 (0.87,2.10)	0.89 (0.56,1.41)	1.22 (0.78,1.90)	0.99 (0.51,1.91)	0.83 (0.46,1.49)	1.18 (0.65,2.17)
No care due to cost	1.00 (ref)	1.36 (0.75,2.48)	1.22 (0.70,2.15)	1.48 (0.91,2.43)	4.15 (0.74,4.09)	1.74 (0.74,4.09)	**2.43 (1.09,5.44)**
Delayed care due to cost	1.00 (ref)	1.43 (0.84,2.41)	1.41 (0.88,2.27)	1.59 (1.04,2.45)	**2.58 (1.14,5.85)**	1.52 (0.73,3.18)	**2.35 (1.14,4.86)**
Inability to afford medication	1.00 (ref)	**2.05 (1.21,3.32)**	**2.00 (1.21,3.32)**	**2.05 (1.26,3.32)**	2.16 (0.85,5.50)	1.83 (0.84,4.01)	1.79 (0.83,3.84)
Did not see doctor in past 12 months	1.00 (ref)	1.06 (0.76,1.49)	0.98 (0.72,1.32)	0.87 (0.66,1.14)	1.14 (0.70,1.86)	1.15 (0.72,1.84)	0.97 (0.65,1.43)

Results are adjusted for age, gender, place of birth, education, and income.
Bolded items are statistically significant.

DISCUSSION

In a contemporary and representative sample of individuals of Asian descent living in the U.S., Asian Indians and Other Asians with a high burden of cardiovascular disease were more likely to suffer more from cost-related healthcare access measures compared with Chinese.

A prior study using data from the Kaiser Family Foundation found that nearly 18% of Asian Americans were uninsured.[17] However, there is heterogeneity in health insurance among Asian Americans. According to data from the Commonwealth Fund 2001 Health Care Quality Survey, Korean Americans were the most likely to be uninsured (55%) followed by 37% of Vietnamese, 18% of Asian Indians, 16% of Chinese, 15% of Filipinos, and 4% of Japanese.[18] However, factors beyond insurance also may compromise access to healthcare. Lee et al.[19] performed an in-depth analysis of healthcare access in among Asian Americans and identified several challenges. The major barriers to healthcare access included financial (lack of insurance or gaps in coverage, expensive out of pocket payments), physical (lack of transportation or scheduling conflicts), communication (language barriers and health literacy), and cultural attitudes towards health and healthcare (medical care not being a cultural norm, barriers unique to women, and strong preference for Asian physicians). Furthermore, a majority of Asian Americans tended to utilize complementary and alternative medicine as opposed to Western medicine. These barriers also represented opportunities for improving access to healthcare among Asian Americans.

Healthcare delivery is a multistep process that involves obtaining healthcare coverage, finding a place where medical services are provided, and subsequently, being able to afford medical bills and, if necessary, pharmacotherapy. It is important to evaluate these different facets of healthcare access each of which may constitute a barrier to receiving adequate and timely medical care especially among high-risk individuals. As Asian Americans represent a heterogeneous group of individuals, culturally tailored interventions will be needed to address healthcare disparities. Effort especially must be expended to find providers who are able to speak their patient's language.[20] Increasing Asian multicultural and multilinguistic competency training and awareness of unique health needs among non-Asian clinicians also may improve healthcare access.[20-22] Improving health literacy and emphasizing the importance of preventive care also may increase the likelihood of Asian Americans seeking medical care. It is also important to help patients navigate the healthcare system, finding an adequate provider, and being able to pay medical bills.[23] This multipronged approach may mitigate some health disparities among Asian Americans, especially those who are high-risk.

In the present analysis of individuals with history of ASCVD, diabetes mellitus or hypertension, Asian Indians were more likely to report

delayed care due to cost even after adjusting for sociodemographic factors. However, it is unclear why cost remains a barrier among Asian Indians despite having comparable rates of healthcare coverage and higher educational attainment and income compared with other Asian groups. Although our analyses adjusted for age, there may be residual confounding from factors that our study did not account for. Asian Indians represented the youngest age group in this study. The authors surmised that younger people may be more likely to face financial pressures leading to actual or perceived lack of disposable funds to afford healthcare such as: 1) investing in education for their children or contributing towards their parents' retirement; or 2) sending remittances via formal channels back to their home country. Second, larger nuclear families (multi-generation home including children, parents, and grandparents may lead to higher net family expenses despite higher income leading to a perception of an inability to afford healthcare. Third, there may be cultural issues related to how Asian Indians perceive cost as a barrier to accessing healthcare. Although some of these reasons were posited, elucidating causes underlying this disparity among Asian Indians compared with other Asian groups will require further qualitative work.[24] "Other Asians" also had a higher risk of no care or delayed care due to cost. As Other Asians in our study represented a heterogenous group of individuals from Japan, Vietnam, or Korea, it is important for future studies to include these groups specifically to identify which group is disproportionately susceptible to lack of healthcare access.

Our results should be interpreted in the context of important limitations. All of our variables were self-reported and may be prone to measurement error and recall bias. NHIS may not have captured all reasons for difficulty accessing medical care, which may have underestimated its true prevalence among Asians living in the U.S. Small sample size likely underpowered our analyses to detect significant differences among Asian groups, especially in those with ASCVD or cardiovascular risk factors. We did not assess when participants immigrated to the U.S. The Naturalization Act of 1965 essentially allowed only the educated to enter the U.S. initially. Hence, early wave immigrants were able to accumulate wealth and become well accultured into American society. Thereafter, laws were relaxed, allowing families to reunite (parents and spouses and perhaps not given the advantage of higher education). We also did not assess birth country among Asian Indians which may be important given that ASCVD risk varies by country of origin. Lastly, there is the possibility of residual confounding in this epidemiologic cohort study.

In conclusion, among Asians living in the U.S. with cardiovascular risk factors or ASCVD, Asian Indians and Other Asians were more likely to report delayed care or no care due to cost compared with Chinese.

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Keywords: Asian Americans, health services accessibility, atherosclerosis, cardiovascular diseases

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Angioedema with Three Possible Etiologies

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INTRODUCTION

Angioedema (AE) is the localized extravasation of fluid into skin or mucosa resulting from increased vascular endothelial permeability. It is self-limited, often asymmetrical, and can be life threatening if associated with airway compromise and/or anaphylaxis. While hereditary AE has been examined thoroughly in the literature,[1-3] there is much to be discovered of the acquired and idiopathic forms. This case reports a new onset unspecified postoperative angioedema, possible etiologies, and best treatment practices. Written, informed consent was obtained from the patient for publication of this case report.

CASE REPORT

A 72-year-old female patient presented for an elective venous port placement for recently diagnosed metastatic colon adenocarcinoma. She had undergone a video-assisted thoracic surgery for pulmonary wedge biopsy one month prior with no complications. She had allergies to lisinopril and atenolol, but had not been taking either for months.

Preoperative exam revealed an obese 80 kg female with Mallampati II and otherwise negative physical exam, with an American Society of Anesthesiologists (ASA) grade of III. The case proceeded uneventfully under monitored anesthesia care with standard ASA monitors. Perioperatively, she received Pepcid®, ondansetron, cefazolin, lidocaine, propofol, and hydromorphone. The patient recovered well in the post-anesthesia care unit, but several hours post-operative she developed tongue swelling which progressed rapidly to her entire oropharynx, necessitating emergent transfer back to the operating room for airway management. Glidescope insertion, as well as oral fiberoptic intubation, were unsuccessful. After applying lidocaine jelly and a topical 5% lidocaine spray, an awake nasal fiberoptic intubation yielded successful placement of a 7.0 mm endotracheal tube through the left nare. No signs of anaphylaxis were noted. She was transported to the intensive care unit, received fresh frozen plasma, dexamethasone, and Benadryl® with gradual resolution of edema. Ultimately, she was extubated and discharged four days later.

Lab work revealed normal complement (C4, C1q, total complement and functional C1-INH), borderline low thyroid levels, and elevated thyroglobulin antibodies (77 nml < 5 IU/mL). It was discovered later that the patient had an episode of hand/lip/mouth swelling three weeks prior to the procedure associated with strawberry consumption that was treated with steroids and Benadryl®, along with discontinuation of losartan. At the time of discharge, the patient was referred to immunology for additional diagnostic testing and management to reduce the risk of recurrence. On follow-up four weeks after discharge, no additional testing had been done, and the patient continued to have minor episodes of swelling (without strawberries) despite initiation of chemotherapy.

DISCUSSION

Angioedema is localized extravasation of fluid into skin or mucosa resulting from increased vascular endothelial permeability caused by vasoactive substances including histamine, bradykinin, proteases, tryptase, complement, and prostaglandin.[4] AE is pertinent to anesthesia providers as acute airway compromise may occur any time throughout the perioperative period, as was demonstrated by our case. In fact, the lifetime risk for experiencing AE is estimated between 10-15%.[5] Our case demonstrated the need for rapid decisive action in cases of AE involving the airway to avoid excessive surgical procedures, asphyxiation, or death. There are several possible causes of AE, along with typical empiric treatment which covers the broad etiologies of AE.

Angioedema can be categorized into three broad etiologies: mast cell mediated, bradykinin pathway mediated, and idiopathic.[6] AE from mast cell degranulation can occur as an acute allergic reaction from the activation of sensitized immunoglobulin E receptors, or as direct stimulation, and presents with urticaria and/or pruritis.[5] Direct stimulation of mast cells has been observed with narcotics (codeine and meperidine), neuromuscular blocking agents, and radiocontrast.[6] Our patient received cefazolin and hydromorphone, but had no reaction on previous administrations, making either of these an unlikely cause of her AE. Her prior reaction attributed to strawberries was a reasonable consideration, although she still showed recurrence without strawberry consumption up to four weeks later. Treatment of mast cell mediated AE cases includes antihistamines, glucocorticoids and, if anaphylaxis is present, epinephrine.

Bradykinin is a potent natural vasodilator and alterations in its production and metabolism have the potential to cause AE.[6] Most notably, it is well known that angiotensin converting enzyme inhibitors (ACE-I) downregulate the renin-angiotensin-aldosterone system and inactivate the degradation of bradykinin into its metabolites. While the mechanism has not been elucidated, angiotensin receptor blockers have been associated with AE.[7] Dipeptidyl peptidase-4 inhibitors also may increase vasoactive substances, including bradykinin and substance P.[8]

Our patient did not receive an ACE-I due to her documented allergies and, while she previously was prescribed losartan (an angiotensin receptor blocker), it was unprescribed three weeks prior to surgery. However, AE can develop several years from the onset of ACE-I therapy[9] with up to 46% of patients reporting AE recurrences long after the discontinuation of the ACE-I therapy.[10]

Another facet of the bradykinin pathway involves the enzyme C1 esterase inhibitor (C1-INH), which is responsible for inhibiting activation of the complement system. Deficiency or dysfunction of C1-INH allow inappropriate activity of bradykinin and is the mechanism for hereditary AE which affects approximately 1 in 50,000 people.[2] Treatment options for bradykinin mediated AE are centered around ceasing ACE-I or angiotensin receptor blocking medications and replacing C1-INH or ACE through fresh frozen plasma. Medications that specifically target the bradykinin pathway include Berinert®, Ruconest®, and Lanadelumab®.[2,6,11,12]

Acquired angioedema (AAE) is a rare form of AE that presents in the fourth or later decade and can be associated with lymphoproliferative and autoimmune disorders or gastrointestinal adenocarcinomas.[6,13] There are two proposed mechanisms for AAE: Type 1 includes the consumption of C1-INH by immune complexes; and Type 2 have autoantibodies directed towards C1-INH.[12] Autoimmune disorders such as lupus or thyroiditis have long been associated with AE,[4,14] as well as the relationship between AAE and lymphomas.

Data on the relation between AE and gastrointestinal tract cancers were limited, but there was a report of adenocarcinoma-associated AE.[15] Our patient had a confirmed colon adenocarcinoma, and it was possible her AE may be explained by progression of the malignant process. However, AAE usually presents with altered complement levels, such as decreased C1-INH, C4 levels, or C1q assay, which was not seen in our patient.[5,16] She did have elevated thyroglobulin levels despite having no thyroid disease diagnosis, which may have resulted in her acute case of AE.

A thorough understanding of the possible etiologies of AE aids in the successful prevention and treatment of this phenomenon. Our patient showed three possible explanations for her new onset nonhistaminergic AE including an atypical reaction to strawberries, a new onset AAE associated with her colon cancer, or an undiagnosed thyroid autoimmunity. Ultimately, the etiology of our patient was still unspecified. Upon discharge, we referred her to the immunology service for additional testing to seek a definitive diagnosis and treatment to optimize management and reduce the risk of AE recurrence.

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Keywords: angioedema, etiology, case report, anesthesiology

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Emergency Action Planning in Kasas High Schools

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ABSTRACT

Introduction. Current evidence showed a variable rate of emergency action plan (EAP) implementation and a low rate of compliance to EAP guidelines in United States secondary schools. Compliance to EAP recommendations in Kansas high schools is not known. The purpose of this study was to identify the emergency preparedness of high school athletics in the state of Kansas and identify prevailing characteristics of schools that correlate with decreased compliance of an EAP.

Methods. Athletic directors for high schools in the state of Kansas were asked to participate in a web-based questionnaire that was emailed to each athletic director. The questionnaire identified demographics of the study population, EAP implementation rates, compliance to national EAP guidelines, access to certified medical personnel, and training received by athletics personnel. Descriptive statistics were then compiled and reported.

Results. The response rate for the survey was 96% (341/355). A total of 94.1% (320/340) of schools have an EAP, 81.4% (276/339) of schools have an automated external defibrillator (AED) at all athletic venues, and 51.8% (176/340) of schools had an athletic trainer (AT) on staff. Urban schools were significantly more likely than rural schools to have an AT on staff (OR = 11.10, 95% CI = [6.42, 19.18], $p < 0.0001$), have an EAP (OR = 3.69, 95% CI = [1.05, 13.02], $p = 0.0303$), require additional training for coaches (OR = 2.69, 95% CI = [1.42, 5.08], $p = 0.0017$), and have an AED on-site for some events (OR = 2.18, 95% CI = [1.24, 3.81], $p = 0.0057$).

Conclusions. Most Kansas high schools have an EAP in place and have at least one AED. Emergency planning should be improved through venue specific EAPs, access to early defibrillation, and additional training. Rural and lower division schools had less AT staffing and consequently were impacted more significantly than urban and higher division schools by these factors. These factors should be taken into account in future improvement strategies.

Kans J Med 2022;15:360-364

INTRODUCTION

In 2019, nearly 8 million adolescents participated in school-related sporting activities according to the 2018-19 High School Athletics Participation Survey conducted by the National Federation of State High School Associations.[1] From 2011 to 2014, the U.S. Centers for Disease Control and Prevention reported nearly 5.6 million injuries related to sport or recreation among persons aged 5-24.[2] Although the majority of injuries were not life threatening, there were a significant amount of catastrophic and fatal injuries.

During the 2017-2018 academic year, 99 catastrophic injuries occurred in U.S. high school and college athletics.[3] Catastrophic injuries were defined as fatalities, permanent disability injuries, serious injuries (fractured neck or serious head injury) even though the athlete had a full recovery, temporary or transient paralysis, heat stroke due to exercise, sudden cardiac arrest or severe cardiac disruption, and they occurred in high school and college athletes. Of these, 85 events occurred during or due to sport-related activities, and 66 of 85 sport-related catastrophic injuries were at the high school level.

Implementing an EAP is an essential part of ensuring an efficient response to any catastrophic event in high school athletics.[4] An EAP is a written guideline of emergency planning designed to help individuals respond to a catastrophic injury within sports. The National Athletic Trainers' Association (NATA) has published guidelines on emergency preparedness in organized athletics through their position statements.[4-6] NATA's guidelines identify the components of emergency response preparation, which includes formation and implementation of an EAP, proper education and training for personnel, acquisition and maintenance of emergency equipment and supplies, and appropriate use of personnel.[5] In addition, the Sideline Preparedness Collaboration (comprised of six major professional organizations: American Academy of Family Physicians, American Academy of Orthopaedic Surgeons, American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, American Osteopathic Academy of Sports Medicine), American Academy of Pediatrics, and American Heart Association all endorse the formation and implementation of emergency plans in schools.[7-9]

EAP adoption has been studied in many other states and cities, but, to our knowledge, no literature has studied EAP adoption in Kansas.[10-22] The purpose of this study was to identify the emergency preparedness of high school athletics in the state of Kansas and identify prevailing characteristics of schools that correlate with decreased compliance of an EAP.

METHODS

A web-based questionnaire (see Appendix) was developed to perform a cross-sectional analysis of the emergency preparedness of Kansas high schools. The questionnaire included 16 questions focused on demographics of the study population, EAP adoption, compliance to national EAP guidelines, access to certified medical personnel, and training received by athletics personnel.

The questionnaire was delivered by email to athletic directors for each high school in March, April, and May 2020. All recipients were contacted through the Kansas State High School Athletic Association (KSHSAA) in December 2020 asking all non-responders to complete

the questionnaire. Questionnaire distribution and data organization was done using REDCap® (Research Electronic Data Capture) software.

For statistical analysis, responses were stratified by high school division, or between rural and urban status. For the analysis of responses by division, Cochran-Armitage tests for trend were used to test for increasing or decreasing trends in the proportions of school district with respect to their division. For the analysis of responses stratified between rural and urban, a chi-square test was used to analyze dichotomous responses. Continuous responses were analyzed by t-tests. A p value of < 0.05 was considered statistically significant.

RESULTS

Of the 355 recipients, 341 (96%) returned the survey in some capacity. KSHSAA assigns schools to each division by the size of their student population in grades 9-12. The assignment is updated in September of each year. The largest 36 schools are classified as 6A, the next 36 are 5A, the next 36 are 4A, the next 64 are 3A, the next 64 are 2A, and the remaining schools are classified as 1A.[23] From this, it could be determined that 59% (196/341) of schools had a student population greater than or equal to 1,000 students, and 41% (136/341) had a student population less than 1,000 students. In 50.1% (170/339) of schools, athletic trainers (AT) were the primary medical providers during school athletic events (Figure 1), and 51.8% (340/355) of schools had an AT on staff. Figure 1 represents the proportion of schools in Kansas that were the primary medical provider for athletic events. The proportion of schools using each medical provider as their primary provider for athletic events is shown in Figure 1. AED access and EAP adoption rates are shown in Table 1.

Urban/Rural. Urban schools were significantly more likely than rural schools to have an AT on staff (OR = 11.10, 95% CI = [6.42, 19.18], $p < 0.0001$), have an EAP (OR = 3.69, 95% CI = [1.05, 13.02], $p = 0.0303$), require additional training for coaches (OR = 2.69, 95% CI = [1.42, 5.08], $p = 0.0017$), and have an AED on-site for some events (OR = 2.18, 95% CI = [1.24, 3.81], $p = 0.0057$; Table 2). Urban schools were significantly less likely than rural schools to have an ambulance at football games (OR = 0.119, 95% CI = [0.063, .227], $p < 0.0001$). Among schools that have an EAP, there was no significant difference between urban and rural schools with regards to having a site specific EAP (OR = 1.51, 95% CI = [0.812, 2.81], $p = 0.1914$) or reviewing the EAP with opponents prior to events (OR = 0.954, 95% CI = [0.602, 1.51], $p = 0.8422$). Among schools that did not have an ambulance at their football games, urban schools were significantly closer to an ambulance than rural schools (6.36 vs. 11.58 minutes; $\Delta = 5.21$, 95% CI = [0.641, 9.78], $p = 0.0284$). Among schools that had an AT on staff, urban schools had ATs that worked significantly more hours (28.60 vs. 9.43 hours; $\Delta = 19.17$, 95% CI = [15.51, 22.85], $p < 0.0001$).

Athletic Trainers. Schools that had an AT on staff were more likely to have an EAP (OR = 3.38, 95% CI = [1.89, 9.60], $p = 0.0161$), have an AED on site for some events (OR = 1.85, 95% CI = [1.05, 3.27], $p = 0.0326$), require additional training for coaches (OR = 3.55, CI = [1.75, 7.24], $p = 0.0003$), and, if they had an EAP, have site-specific EAPs (OR = 2.23, CI = [1.23, 4.05], $p = 0.0076$; Table 3).

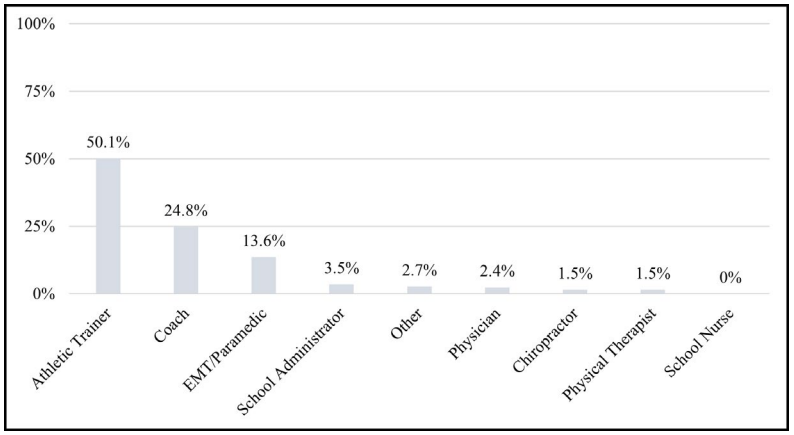

Figure 1. Providers of medical care during high school athletic events (n = 339).

Table 1. Automated external defibrillator (AED) access and emergency action plan (EAP) adoption.

AED access within 4 minutes	
AED available for all athletic venues	276 (81.4%)
AED available for some venues	63 (18.6%)
AED not available	0 (0%)
Presence of EAP	
EAP adopted	320 (94.1%)
No EAP	20 (5.9%)
EAP is venue specific	
Yes	259 (82.5%)
No	55 (17.5%)
EAP is reviewed with the opposing team before an event	
Yes	201 (59.5%)
No	137 (40.5%)
Open to assistance in creating or improving EAP	
Yes	228 (67.7%)
No	109 (32.3%)

Division. For having an AT on staff, a higher division was associated with a higher proportion of schools with an AT on staff ($p < 0.0001$). Lower divisions were associated significantly with higher proportions of having an ambulance at football games ($p < 0.0001$). Additionally, higher divisions were associated significantly with greater proportions of having an EAP ($p = 0.0005$), requiring additional training for coaches ($p = 0.0049$), and having an AED on-site for some events ($p = 0.0229$). Among schools that had an EAP, there was no significant trend in the proportions of having a site-specific EAP ($p = 0.1142$) or reviewing the EAP with opponents prior to an event ($p = 0.6429$).

Table 2. Urban/rural results and differences.

	Urban (n = 136)	Rural (n = 196)	Urban-Rural	
			Odds Ratio (95% CI)	p Value
Athletic Trainer on staff	112 (82%)	59 (30%)	11.10 (6.42 - 19.18)	< 0.0001
Having EAP	133 (98%)	179 (91%)	3.69 (1.05 - 13.02)	0.0303
Require additional training for coaches	29 (21%)	18 (9%)	2.69 (1.42 - 5.08)	0.0017
AED on site for some events	35 (26%)	27 (14%)	2.18 (1.24 - 3.81)	0.0057
Ambulance at football games	82 (60%)	178 (91%)	0.119 (0.063 - 0.227)	< 0.0001
Site-specific EAP	111 (82%)	142 (72%)	1.51 (0.812 - 2.81)	0.1914
Review EAP with opponents before event	78 (57%)	113 (58%)	0.954 (0.602 - 1.51)	0.8422
Athletic Trainer hours	28.60 hours	9.43 hours	Δ = 19.17 95% CI = (15.51 - 22.85)	< 0.0001
Ambulance distance	6.36 minutes	11.58 minutes	Δ = 5.21 95% CI = (0.641 - 9.78)	0.0284

Note: EAP = emergency action plan; AED = automated external defibrillator.

Table 3. Athletic trainer (AT) services results and differences.

	AT on staff (n = 176)	No AT on staff (n = 164)	AT-No AT	
			Odds Ratio (95% CI)	p Value
Having EAP	171 (97%)	148 (90%)	3.38 (1.89-9.60)	0.0161
Having site-specific EAP	147 (84%)	113 (69%)	2.23 (1.23-4.05)	0.0076
Having AED for some events	39 (22%)	24 (15%)	1.85 (1.05-3.27)	0.0326
Require additional training for coaches	37 (21%)	11 (7%)	3.55 (1.75-7.24)	0.0003

Note: EAP = emergency action plan; AED = automated external defibrillator.

DISCUSSION

Rural and lower division schools are less likely to have EAP implementation, AED access, and additional athletics staff training, which are three vital components of emergency preparedness in athletics. Schools with an AT on staff were more likely to have site-specific EAPs, access to AEDs, and require additional training for coaches. Both access to an AT and access to an AED have shown a positive correlation with other markers of emergency preparedness.[10,13,15,21] Poor access to ATs in rural Kansas schools likely plays a role in other aspects of emergency preparation. This is important because it emphasizes the fact that many schools rely on athletic directors and other staff to implement health and safety policies without the help of an AT. Additional training may allow schools with and without an AT on staff to more efficiently implement the standard of care as outlined by the NATA's recommended health and safety guidelines.

All schools reported having access to at least one AED on campus, but only 81.4% (276/339) have an AED available within four minutes of all athletic venues. It is well known that early defibrillation and early activation of an emergency response are crucial for cardiac arrest survival, thus improving AED access in Kansas schools should be of utmost importance.[6] Pike et al.[24] identified education and cost as barriers to health and safety policy implementation for state high school athletic associations. This was relevant for rural and lower division schools who were less likely to have an AT on staff, as shown by our survey results. Rural schools could have limited funding and AT availability compared to urban areas, further compounding the difficulty in successful implementation of state health and safety policies. In addition, more than 25% of schools utilize coaches, school administrators, and other staff for medical coverage. These individuals would benefit from training beyond cardiopulmonary resuscitation and AED, like concussion management, heat illness, and emergency action planning. Trained healthcare providers are vitally important to high school athletics. The majority (67.7%) of Kansas schools were open to assistance in creating or improving their current EAP. This showed that future improvement strategies will be received positively and are likely to be successful.

Limitations. This study was limited by potential bias since only 96% (341/355) of responses were received and some of the schools may have been underrepresented because some responses may be duplicates if the same school submitted the survey more than once. Survey responses were received anonymously through REDCap®, therefore we were unable to determine if there were any duplicate entries. Finally, a lack of AT staffing may be the result of lower funding, which could impact how many schools have EAPs.

CONCLUSIONS

The results of this study showed that the majority of Kansas high schools have an EAP in place and have at least one AED. While these are important factors, there is improvement to be made through venue specific EAPs, access to early defibrillation, and additional training. While having an AT on staff seemed to improve the emergency preparedness of schools, it can be challenging due to financial cost. Funding and other barriers to emergency preparedness in school-based athletics should be discussed with relevant stakeholders like athletic directors, state legislative officials, and ATs to determine a viable improvement strategy. Education regarding the importance of EAPs, AEDs, and ATs could be an important improvement strategy, especially in schools with low compliance to current recommendations. Rural and lower division schools were impacted more significantly than urban and higher division schools and this should be taken into account in future improvement strategies.

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Keywords: sports medicine, athletic injuries, youth sports, team sports

APPENDIX

Questionnaire

	Question	Available Responses
1	What division of high school do you participate in?	1A, 2A, 3A, 4A, 5A, 6A
2	Where are you located in the state of Kansas?	Northwest, Southwest, North Central, South Central, Northeast, Southeast
3	Would you consider your school rural? (fewer than 1,000 population)	Yes, No
4	Which of the following provide care for athletic injuries or illnesses during school athletic events?	Athletic trainer (ATC), Coach, School administrator, School nurse, Emergency medical technician or paramedic, Physician (MD or DO), Chiropractor (DC), Physical therapist (PT), Other, None of the above
5	Do you have an athletic trainer on staff?	Yes, No
6	If so how many hours per week?	Open numerical value
7	Do you have an ambulance at your football games?	Yes, No
8	If not how far away is the nearest ambulance (minutes)?	Open numerical value
9	Does your school require coaches to obtain CPR and AED training?	Yes, No
10	Does your school require coaches to undergo additional training on athlete healthcare beyond what is required by KSHSAA? Currently KSHSAA requires all coaches to be trained in CPR and AED use.	Yes, No
11	If your school requires additional training, please specify:	Open
12	Does your school have an automated external defibrillator (AED) that is available and can be used within 4 minutes of any athletic venue?	Yes, for all athletic venues; No; Yes, but only for some athletic venues
13	Does your school have an emergency action plan for medical emergencies during athletic events?	Yes, No
14	If your school does have an emergency action plan, is the emergency action plan specific to all athletic venues? (e.g. specific for football field, basketball court, weight room, etc.)	Yes, No
15	Do you review the EAP with the opposing team before an event?	Yes, No
16	Would you be open to assistance to help create or improve your EAP?	Yes, No

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Comparing Outcomes of Robotic-Assisted versus Conventional Laparoscopic Hiatal Hernia Repair

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ABSTRACT

Introduction. Robotic-assisted laparoscopic surgery for anti-reflux and hiatal hernia surgery is becoming increasingly prevalent. The purpose of this study was to compare hospital length of stay and outcomes of robotic-assisted versus conventional laparoscopic hiatal hernia repair.

Methods. A retrospective review was conducted of 58 patients who underwent robotic-assisted laparoscopic (n = 16, 27.6%) or conventional laparoscopic (n = 42, 72.4%) hiatal hernia repair.

Results. Patient characteristics and comorbidities were similar between groups. The robotic-assisted group had a significantly higher use of fundoplication (81.3% vs. 38.1%; p = 0.007). Complications observed between the robotic-assisted and conventional laparoscopic groups were pneumothorax (6.3% vs. 11.9%; p = 1.000), infection (0% vs. 4.8%; p = 1.000), perforation (0% vs. 2.4%; p = 1.000), bleeding (6.3% vs. 2.4%; p = 0.479), ICU admission (31.3% vs. 11.9%; p = 0.119), and mechanical ventilation (18.8% vs. 2.4%; p = 0.60). There were no reported complications of dysphagia, deep vein thrombosis/pulmonary embolus, myocardial infarction, or death in either group. Hospital length of stay was similar for robotic versus conventional patients (3.0 vs. 2.5 days; p = 0.301).

Conclusions. Robotic-assisted versus conventional laparoscopic hiatal hernia were compared, which demonstrated similar post-operative complication rates and hospital length of stay. The results showed robotic-assisted or conventional laparoscopic hiatal hernia repair can be performed with similar outcomes. ***Kans J Med 2022;15:365-368***

INTRODUCTION

Patients with medically refractory gastroesophageal reflux disease (GERD) or hiatal hernia may undergo surgical repair to treat their symptoms. Anti-reflux surgery has a satisfactory outcome in 85-96% of patients with these conditions.[1] Prior to minimally invasive techniques, a traditional open approach was used for hiatal hernia repair. This approach eventually was replaced by conventional laparoscopic repair, with reduced rates of perioperative morbidity and shorter hospital stays.[2,3] However, there were some pitfalls to conventional laparoscopic surgery, including unstable video-camera, limited motion of straight laparoscopic instruments, and 2-D imaging.[3,4] More recently, robotic-assisted laparoscopic surgery has become increasingly prevalent.

Robotic surgery overcomes many of the pitfalls of conventional laparoscopic surgery, including steady state, 3-D cameras, improved dexterity of robotic instruments, and superior ergonomics for the surgeon.[3-5] After a thorough search of the surgical literature, there were very few studies that directly compared the outcomes of robotic-assisted versus conventional laparoscopic hiatal hernia repair. Soliman et al.[5] performed a retrospective review of data collected from The Society of Thoracic Surgery database comparing outcomes of conventional laparoscopic versus robotic surgery for hiatal hernia repairs, whereas Tolboom et al.[1] used a single institute cohort to compare laparoscopic versus robotic redo hiatal hernia repairs. Those studies demonstrated statistically significant decreases in hospital length of stay (LOS) from 1.8 to 1.3 days[5] and from 4 to 3 days.[1] Soliman et al.[5] also found a statistically significant decrease in post-operative events (i.e., intensive care unit [ICU] admission, pneumonia, respiratory failure, deep vein thrombosis [DVT], urinary tract infection [UTI], surgical site infection, and need for ventilatory support), from 29 to 9 with robotic-assisted hiatal hernia repair. However, in a retrospective population-based analysis by Ward et al.,[3] robotic-assisted hiatal hernia repair had a significantly increased risk of complications, such as respiratory failure and esophageal perforation (2.4% vs. 1.6%; p = 0.003 and 0.6% vs. 0.3%; p = 0.01, respectively). This study also demonstrated a longer hospital LOS for the robotic-assisted group, although this was not statistically significant. The purpose of this study was to add to the existing literature of outcomes of robotic-assisted versus conventional laparoscopic hiatal hernia repair.

METHODS

This study was approved for implementation by the Ascension Via Christi Hospitals Wichita, Inc Institutional Review Board. A three year retrospective review was conducted of all patients, ≥ 18 years of age, who underwent robotic-assisted or conventional laparoscopic hiatal hernia repair at a single tertiary-care hospital. The medical records utilized covered the time period from January 1, 2014 through December 31, 2016. All patients were followed for three years, with the follow-up period ending December 31, 2019.

Data collected included patient demographics (age, sex, height, weight, body mass index [BMI]), American Society of Anesthesiologist (ASA) physical status class, and the presence of co-morbidities (GERD, hypertension, diabetes, coronary artery disease, and chronic obstructive pulmonary disease [COPD]). Medical records also were reviewed for procedure performed (conventional laparoscopic versus robotic-assisted laparoscopic), use of fundoplication and type, use of mesh, conversion to open procedure, post-operative complications (i.e., pneumothorax, infection, bleeding, perforation, dysphagia, DVT/pulmonary embolus [PE], myocardial infarction [MI], and other), ICU admission and LOS, need for mechanical ventilation and ventilator days, hospital LOS, 30-day readmission rate, mortality, and discharge to hospice.

The primary outcome variables were hospital LOS and post-operative complications between the two groups. In addition, patient age, BMI, ASA class, as well as specific co-morbidities that may have affected the primary outcomes were evaluated.

Data Analysis. A total of 58 cases met inclusion criteria. Data were summarized and presented as frequency and counts for categorical data, mean ± standard deviation for parametric continuous data, or median and interquartile range for nonparametric continuous data.

Pearson's Chi-Square was used to compare all categorical variables, though Fisher's Exact Test was used when the cell count was less than 5. The t-test and Mann-Whitney U test were used to compare continuous parametric and nonparametric data, respectively. Analyses were considered significant when the p value was ≤ 0.05. All analyses were conducted using IBM SPSS release 19.0 (IBM Corp., Armonk, NY).

RESULTS

Patient Demographics and Comorbidities. A total of 58 patients were included in the final analyses after exclusions were applied. Patient demographics (age, sex, height, weight, BMI) and ASA class were similar between study groups (Table 1). The average patient age was 63.9 years and average BMI was 30.9. Female sex was most common (70.7%). ASA class 2/3 was most common (91.4%). Patient comorbidities also were similar between the two groups with GERD being the most common comorbidity observed (82.8%). Hypertension was observed more commonly in patients undergoing conventional laparoscopic repair (71.4% vs. 43.8%; p = 0.050).

Procedure Comparisons. Conventional laparoscopic hiatal hernia repair was performed more commonly than robotic-assisted repair (72.4% vs. 27.6%; Table 2). Fundoplication was used twice as often in the robotic-assisted group than in the conventional group (81.3% vs. 38.1%; p = 0.007). In those patients that underwent a fundoplication, the Nissen was the most common type of fundoplication performed in both the robotic-assisted (84.6%) and conventional laparoscopic groups (68.8%). Use of mesh was not different between the robotic-assisted and conventional laparoscopic groups (37.5% vs. 28.6%; p = 0.511) nor was conversion to open procedure (0% vs. 16.7%; p = 0.173).

Post-operative Complications. No patients in either group had a reported complication of dysphagia, DVT/PE or MI (Table 3). The robotic-assisted group had no reported complications of infection or perforation, and only one reported complication of pneumothorax (6.3%) and bleeding (6.3%). The conventional laparoscopic group had five reported cases of pneumothorax (11.9%), two reports of infection (4.8%), one for bleeding, and one for perforation (2.4% each). Other complications included acute hypoxia that required new home oxygen, acute kidney injury, atrial fibrillation, supraventricular tachycardia, urinary retention, ileus, immediate hiatal hernia recurrence, and retained surgical foreign body. There were no differences between the two groups for these complications.

Hospital Outcomes. There were no statistically significant differences between study groups for ICU admission or LOS, mechanical ventilator requirements, hospital LOS, 30-day readmission, mortality, or discharge disposition (Table 3). There was a trend for the conventional laparoscopic group to have a longer median ICU LOS (five vs. two days; p = 0.095). However, the robotic-assisted group tended to have more patients require mechanical ventilation (18.8% vs. 2.4%; p = 0.060). There were no mortalities in either group.

Table 1. Comparison of characteristics of patients undergoing hiatal hernia repair by a conventional laparoscopic or robot-assisted laparoscopic approach.*

Parameter	Composite	Study Group		p Value
		Conventional Laparoscopic	Robotic Assisted Laparoscopic	
Number of observations	58 (100%)	42 (72.4%)	16 (27.6%)	---
Age (years)	63.9 ± 14.2	64.9 ± 13.1	61.4 ± 16.9	0.406
Female sex	41 (70.7%)	28 (66.7%)	13 (81.3%)	0.347
Height (cm)	166.3 ± 9.9	166.1 ± 10.5	166.7 ± 8.4	0.824
Weight (Kg)	85.2 ± 19.2	83.4 ± 18.4	89.9 ± 20.9	0.251
Body mass index	30.9 ± 5.5	30.3 ± 5.4	32.3 ± 5.5	0.218
ASA class				0.929
1	4 (6.9%)	3 (7.1%)	1 (6.3%)	
2	33 (56.9%)	24 (57.1%)	9 (56.3%)	
3	20 (34.5%)	14 (33.3%)	6 (37.5%)	
4	1 (1.7%)	1 (2.4%)	0 (0.0%)	
Comorbidities				
GERD	48 (82.8%)	35 (83.3%)	13 (81.3%)	1.000
Hypertension	37 (63.8%)	30 (71.4%)	7 (43.8%)	0.050
Diabetes	8 (13.6%)	8 (19.0%)	0 (0.0%)	0.092
Coronary artery disease	4 (6.9%)	2 (4.8%)	2 (12.5%)	0.303
COPD	1 (1.7%)	1 (2.4%)	0 (0.0%)	1.000

*Presented as number (%) or mean ± standard deviation.
ASA = American Association of Anesthesiologists, GERD = gastroesophageal reflux disease, COPD = chronic obstructive pulmonary disease.

Table 2. Comparison of operative procedures of patients undergoing hiatal hernia repair by a conventional laparoscopic or robot-assisted laparoscopic approach.*

Parameter	Composite	Study Group		p Value
		Conventional Laparoscopic	Robotic Assisted Laparoscopic	
Number of observations	58 (100%)	42 (72.4%)	16 (27.6%)	---
Use of fundoplication	29 (50.0%)	16 (38.1%)	13 (81.3%)	0.007
Nissen fundoplication				0.410
Yes	22 (75.9%)	11 (68.8%)	11 (84.6%)	
No	7 (24.1%)	5 (31.3%)	2 (15.4%)	
Use of mesh	18 (31.0%)	12 (28.6%)	6 (37.5%)	0.511
Conversion to open	7 (12.1%)	7 (16.7%)	0 (0.0%)	0.173

*Presented as number (%).

Table 3. Comparison of complications and hospital outcomes of patients undergoing hiatal hernia repair by a conventional laparoscopic or robot-assisted laparoscopic approach.*

Parameter	Composite	Study Group		p Value
		Conventional Laparoscopic	Robotic Assisted Laparoscopic	
Number of observations	58 (100%)	42 (72.4%)	16 (27.6%)	---
Patients with 1 or more complications	20 (34.5%)	15 (35.7%)	5 (31.3%)	0.749
Pneumothorax	6 (10.3%)	5 (11.9%)	1 (6.3%)	1.000
Infection	2 (3.4%)	2 (4.8%)	0 (0.0%)	1.000
Bleeding	2 (3.4%)	1 (2.4%)	1 (6.3%)	0.479
Perforation	1 (1.7%)	1 (2.4%)	0 (0.0%)	1.000
Dysphagia	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
DVT/PE	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
Myocardial infarction	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
Other complications	16 (27.6%)	11 (26.2%)	5 (31.3%)	0.700
ICU admission	10 (17.2%)	5 (11.9%)	5 (31.3%)	0.119
ICU days	3.5 (1.75-5.5)	5.0 (2.5-8.5)	2.0 (1-2)	0.095
Mechanical ventilation	4 (6.9%)	1 (2.4%)	3 (18.8%)	0.060
Ventilator days	2.5 (1.0-4.0)	4.0	1.0	0.423
Hospital LOS	3 (2-4)	2.5 (1-4)	3 (2-5.75)	0.301
30-day readmission	7 (12.1%)	6 (14.3%)	1 (6.3%)	0.660
Mortality	0 (0.0%)	0 (0.0%)	0 (0.0%)	---
Discharged to hospice	1.7% (1)	1 (2.4%)	0 (0.0%)	1.000

*Presented as number (%) or median (IQR).
DVT = deep vein thrombosis, PE = pulmonary embolus, ICU = intensive care unit, LOS = length of stay.

DISCUSSION

GERD and hiatal hernias are a common complaint among many patients, and anti-reflux surgery has been reported to have a satisfactory outcome in 85-96% of patients with these conditions.[1] While a conventional laparoscopic approach is more common, robotic surgery is becoming common place in many general surgeons' practices. There were several studies that have compared robotic-assisted and conventional laparoscopic hiatal hernia repairs, with three studies demonstrating decreased hospital LOS and a decrease in the number of post-operative events,[1,5,6] whereas one study demonstrated increased hospital LOS and the number of post-operative complications in the robotic-assisted group.[3] This study aimed to add to the existing literature on comparing the outcomes of robotic-assisted and conventional laparoscopic hiatal hernia repair.

Hospital Length of Stay. The median hospital LOS for conventional laparoscopic hiatal hernia repair was 2.5 days and for robotic-assisted was 3.0 days (p = 0.301). Our data suggested that there was no statistically significant difference or trend in hospital LOS between the two groups. The study by Soliman et al.[5] showed a statistically significant reduction in hospital LOS when comparing conventional laparoscopic and robotic-assisted hiatal hernia repair (1.8 vs. 1.3 days; p = 0.003). Their study had a larger sample size (laparoscopic, n = 151; robotic-assisted, n = 142) compared to the study presented in this paper. The increased power of their study likely explained the statistically significant results. The single-center study by Vasudevan et al.[4] demonstrated a mean hospital LOS of 2.8 days (n = 29) for robotic-assisted hiatal hernia repair. Our study demonstrated similar median LOS of 3.0 days for the robotic-assisted group. The study by Tolboom et al.[1] demonstrated a significant reduction in hospital LOS for robotic-assisted redo hiatal hernia repair compared to laparoscopic redo hiatal hernia repair (three vs. four days; p = 0.042). Also, the retrospective observational cohort study performed by O'Connor et al.[6] showed a statistically significant decrease in hospital LOS favoring the robotic-assisted approach (3.3 vs. 2.3 days; p = 0.003). Ward et al.[3] demonstrated a longer hospital LOS in the robotic-assisted group, although this was not statistically significant.

While our study did not specifically divide first-time and redo hiatal hernia repairs, the results showed similar robotic-assisted hospital LOS of three days as the Vasudevan et al.[4] and Tolboom et al.[1] studies. Overall, the literature on robotic-assisted compared to conventional laparoscopic hiatal hernia repair was limited, with most studies showing statistically significant decreases in hospital LOS, favoring robotic-assisted over laparoscopic hiatal hernia repair. Our study did not demonstrate a statistically significant difference in hospital LOS between the two groups, however, the median hospital LOS for our robotic-assisted group was three days, which is very similar to other studies in the literature.

Complications. Post-operative complications were the other main outcome of interest in this study. Pneumothorax was the most common complication observed in our study. In our study, five patients in the conventional laparoscopic group and one patient in the robotic group had a pneumothorax (11.9% and 6.3%, respectively). Tolboom et al.[1] had two patients (4.4%) in the robotic group who had a pleural defect during surgery, one of which required a chest tube, while the conventional laparoscopic group had no patients with a pleural defect.

Our study had one patient (2.4%) in the conventional laparoscopic group with a perforation while the robotic group had no patients with a perforation. Tolboom et al.[1] had three patients (6.7%) in the robotic group and four patients (13.3%) in the conventional laparoscopic group having either an esophageal or gastric perforation; these were noted to be repaired and managed laparoscopically. Ward et al.[3] demonstrated a statistically significant difference in the number of esophageal perforations, favoring the conventional laparoscopic group over robotic-assisted (457 [0.3%] vs. 64 [0.6%]; p = 0.01).

Our rates of bleeding as a complication compared favorably to that reported in the literature with one patient in both the conventional laparoscopic and robotic groups (2.4% and 6.3%, respectively; p = 0.479). Soliman et al.[5] had three patients (2.0%) in the laparoscopic

group and two patients (1.4%) in the robotic group that had a need for post-operative transfusion of packed red blood cells. Tolboom et al.[1] had two patients (4.4%) in the robotic group that had bleeding as a minor complication that was able to be controlled during surgery; they had no patients in the laparoscopic group with a bleeding complication. As with our study, Ward et al.[3] demonstrated no difference in rates of post-operative bleeding between the two groups (2.5% conventional laparoscopic vs. 2.8% robotic-assisted; p = 0.39).

Two patients (4.8%) in the laparoscopic group and no patients in the robotic group had an infection as a complication in our study. In Soliman et al.[5], five patients (3.3%) in the laparoscopic group and two patients (1.4%) in the robotic group had an infection, either a urinary tract infection, surgical site infection, or other infection requiring intravenous antibiotics, as a post-operative complication. Ward et al.[3] showed a trend for the robotic-assisted group to have a higher rate of post-operative infections (1.5% vs. 1.1%; p = 0.08).

In our study, no patients in either the laparoscopic or robotic-assisted groups had dysphagia as a post-operative complication. In the literature, the rate of dysphagia as a complication was also low. Vasudevan et al.[4] found 1 patient out of 28 redo robotic-assisted hiatal hernia repairs (3.6%) had post-operative dysphagia. Tolboom et al.[1] found 2 patients out of 30 (6.7%) in the conventional laparoscopic group and 5 patients out of 45 (11.1%) in the robotic-assisted group had dysphagia as a post-operative complication.

Intensive Care Unit Utilization. This study demonstrated a trend for conventional laparoscopic hiatal hernia repair to have a higher number of ICU days (five vs. two days; p = 0.095); although the proportion of ICU admissions trended to be higher for the robotic-assisted group (31.3% vs. 11.9%; p = 0.119). In contrast, Soliman et al.[5] showed a trend for laparoscopic hiatal hernia repair patients to have higher initial ICU admissions compared to robotic-assisted repair patients (7/151 = 4.6% vs. 2/142 = 1.4%; p = 0.17). However, both our findings and that of Soliman et al.[5] were nonsignificant trends. Ward et al.[3] demonstrated a statistically significant difference in the number of post-operative respiratory failure events, favoring the conventional laparoscopic group (1.6% vs. 2.4%; p = 0.003). However, this study did not define what the post-operative complication of respiratory failure included (e.g., home oxygen, ICU admission, mechanical ventilation).

Mortality. Similar to the studies by Tolboom et al.[1] and Soliman et al.[5], there were no deaths in hiatal hernia repair patients in either the laparoscopic or robotic groups. Vasudevan et al.[4] had one reported death in the immediate post-operative period out of 28 patients undergoing robotic-assisted hiatal hernia repair. The retrospective study by Ward et al.[3] demonstrated a trend for the robotic-assisted group to have a higher rate of mortality (0.4% vs. 0.3%; p = 0.08). Overall, the complication rates for both conventional laparoscopic and robotic-assisted hiatal hernia repair in the literature are very low, which was similar to the findings in our study.

Limitations. There were several limitations to this study. This study was performed at a single tertiary-care, Midwestern hospital over a three year time period, from January 2014 to December 2016, with a limited sample size. While robotic surgery was becoming more popular during this time, the application of robotic surgery has increased drastically since this time. Increasing the time frame for data collection to include more recent years would increase the sample size and power of this study. Also, adding additional institutions to the study would increase sample size and power. Another limitation encountered during data collection was that the single institution reviewed in this study had switched electronic medical records during the year 2014. This caused some of the patient data in the early parts of 2014 to be lost/missing during the conversion, and these patients had to be excluded from the study as details surrounding the operations and post-operative courses were unable to be located.

Another limitation of this study was that it did not differentiate elective, urgent, or emergent hiatal hernia repairs. During data collection, there was a trend for more of the urgent/emergent procedures to undergo open repair from the start of the operation, which excluded these from this study. There also seemed to be a trend that laparoscopic hiatal hernia repair was more common in urgent repairs for gastric volvulus, which likely contributed to the trend for the conventional laparoscopic group to have a higher number of ICU days (5.4 vs. 2.4 days; p = 0.095). Limiting the data collection to elective hiatal hernia repairs for GERD (done on day of admission and excluding repairs done for gastric volvulus) likely would make the two groups more equal and standardized.

CONCLUSIONS

Robotic-assisted versus conventional laparoscopic hiatal hernia were compared, which demonstrated comparable post-operative complication rates and hospital LOS. The results showed robotic-assisted or conventional laparoscopic hiatal hernia repair can be performed safely with similar outcomes. Further study is needed to illicit any statistically significant differences between the two groups.

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Debridement Versus Simple Scrubbing of External Fixator Pin Sites

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ABSTRACT

Introduction. Irrigation and debridement of external fixator pin sites are methods utilized by some orthopedic surgeons to minimize the risk of surgical site infections in patients undergoing definitive internal fixation after temporization in an external fixation device. This study aimed to determine if irrigation and debridement of external fixator pin sites leads to fewer deep surgical site infections, compared to simply scrubbing the external fixator pin sites with a chlorhexidine scrub-brush.

Methods. This single center retrospective cohort study was performed at a university level I trauma center. All cases in which a single surgeon removed an external fixator and followed this with definitive open reduction and internal fixation (ORIF) in the same operative setting between October 2007 and October 2018 were reviewed. A total of 313 patients were temporized in 334 external fixators prior to ORIF and were included in the study.

Results. Eighteen of the 179 Irrigation and Debridement cohort (10.0%) and 8 of the 155 Simple Scrubbing cohort (5.2%) had infections that required a return to the operating room. No statistical difference ($p = 0.10$) or meaningful effect size (Cohen's $d = 0.18$) were found between irrigation and debridement and simple scrubbing of external fixator pin sites.

Conclusions. Given no significant differences were found in deep infection rates between debridement of pin sites versus simply scrubbing, it is reasonable to ask whether the time and resources required for debriding external fixator pin sites is worthwhile.

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INTRODUCTION

Infection following open reduction and internal fixation of a fracture can be a devastating complication, resulting in significant morbidity.[1] Furthermore, such infections often are associated with a significant socio-economic burden.[2,3]

One potential source of deep post-operative infection following open reduction and internal fixation of a fracture that has been temporized in an external fixator is inoculation of the surgical site with bacteria from the external fixator pin site. Some studies have demonstrated findings suggestive of this. For instance, Bhandari et al.[4] demonstrated that intramedullary nailing of tibial shaft fractures temporized in an external fixator for 28 days or fewer resulted in an 83% reduced risk of deep infection. This finding suggested that the likely connection between increased risk of infection with increased time in an external fixator was a greater incidence of clinically signicant pin site colonization/infection with greater time in an external fixator.

In another study, an increased rate of deep infection was observed in tibial pilon and plateau fractures, where overlap of plates with external fixator pin sites occurred.[5] From this study, it seemed reasonable to conclude that this increased rate of infection was secondary to colonized/infected external fixator pin sites inoculating the fracture implants, thereby leading to deep infection. However, this spatial relationship was not observed in a similar study that only included tibial plateau fractures.[6] Notable differences between the two studies included time in an external fixator, which was only 10 days in the Laible et al.[6] study, versus 20 days in the Shah et al.[5] study that demonstrated an increased risk of infection with plate overlap. Other substantial differences included the primary surgeons being residents versus attending traumatologists, the manner in which external fixator pins were placed into the bone (i.e., predrilling versus simply driving the pin in on power), and prepping the external fixator pins into the field at the time of definitive internal fixation versus prior removal. Furthermore, neither study made mention of whether the pin sites were debrided at the time of definitive internal fixation. These study differences suggested that there were more factors involved in producing post-operative infection when fractures temporized in an external fixator undergo internal fixation, other than only overlapping pin sites with the fracture implants.[6]

Finally, in an animal model of infected external fixator pin sites in which intramedullary nailing was performed after pin sites were inoculated with staphylococcus, infection was observed in all cases unless debridement of the pin sites occurred prior to internal fixation.[7] Although this was an animal study, it demonstrated a very clear link between infected external fixator pin sites with overlap of fracture implants by the development of subsequent deep infection, with the same bacteria used to inoculate the pin site. In addition, this study also demonstrated a method to prevent clinically significant deep infection when internal fixation is placed in the face of a pin site infection. In this study, pin sites were debrided mechanically and irrigated prior to performing the surgical procedure in addition to the administration of antibiotics. This regimen was found to prevent the development of clinically significant infection following the placement of internal fixation.

Currently, some surgeons will debride external fixator pin sites mechanically when removal of the external fixator is followed by internal fixation of the fracture in the same operative setting. The rationale for performing this mechanical debridement of the external fixator pin-sites is to decrease the risk of post-operative infection. However, to our knowledge, this procedure has never been substantiated in a clinical study. In this study, it was hypothesized that sharply debriding (DB) external fixator pin sites compared to simply scrubbing (SS) external fixator pin sites prior to performing definitive internal fixation will result in no significant difference in surgical site infection.

METHODS

This was a retrospective chart review of all patients who underwent external fixator removal by an individual fellowship-trained traumatologist at an academic level I trauma center. Definitive fracture fixation was performed with plates, screws, intramedullary nails, or a

combination of devices. After approval from the associated University Institutional Review Board, all surgical cases for which the CPT® billing code for the removal of external fixation system under anesthesia was billed for were reviewed to ensure they met the inclusion criteria. A manual chart review was performed to collect patient information including age, sex, body mass index (BMI), fracture status, duration in external fixator device, management of external fixator pin sites, and presence of a deep infection requiring return to the operating room for surgical debridement. The HERON data query tool was utilized to cross reference patient medical records of included study participants to collect patient status with regards to diabetes mellitus diagnosis and current smoking status.[8]

The period for this study spanned 11 years, including all cases from October 2007 to October 2018. This period was chosen as it would include all cases performed by one surgeon at this center after he completed his orthopedic trauma fellowship training. The October 2018 stop date was chosen as it allowed for appropriate patient follow-up prior to data collection and analysis. The following pin site care regimen was utilized in the respective time frame to determine whether debridement or scrubbing affected infection:

- Pin site debridement was the mainstay of practice from October 2007 to January 2013.
- From February 2013 to December 2014, there was a similar number of cases of both debridement and simple scrubbing.
- From January 2015 to October 2018, when the study was concluded scrubbing had become the treatment of choice.

Inclusion criteria included all patients over the age 12 where an external fixator was removed immediately prior to definitive internal fixation of a fracture in the same operative setting. Patients with the following fractures were included in this study: radius, ulna, humerus, pelvis, femur, tibia, fibula. For a patient to be included in this study, the infection required a return to the operating room for treatment.

Exclusion criteria included known bone or deep tissue infection prior to external fixator placement, age under 12 years old, those not receiving definitive internal fixation at the time of external fixator removal, the treatment of non-unions and mal-unions, and inadequate follow-up. Reasons for not receiving definitive internal fixation at time of external fixator removal included risk to patient, patient refusal of definitive surgery, a fracture that had healed satisfactorily in the external fixator, amputation, death, and external fixator use in the treatment of vascular, soft tissue, and other ligamentous injury not requiring reconstruction of a fracture. All patients that were included in the study were followed for at least 12 months after the removal of their external fixator and performance of definitive internal fixation.

Surgical Technique. For both sharp debridement and simple scrubbing of external fixator pin sites protocols were developed as described below.

The removal of the external fixator was performed the same for each technique. The patient's limb was marked prior to entering the operating room. Once in the operating room, anesthesia was induced and patients were administered perioperative antibiotics within 30 minutes of incision. The external fixator was removed by cutting the pins with a bolt cutter or deconstructing the external fixator with wrenches. The external fixator pins within the bone were removed with a t-handle chuck. From this point, the external fixator pin sites were managed in one of two ways: sharp debridement or scrubbing.

Sharp Debridement. The patient's limb was scrubbed with chlorhexidine and rinsed with sterile normal saline. Next, a sterile curette was used to sharply debride the pin tracts. The skin, subcutaneous tissue, muscle, and bone were debrided until only healthy bleeding tissue remained. The tracts were irrigated using a 60 cc syringe of sterile normal saline with an 18 guage angiocatheter attached to the end that was inserted into the depth of the external fixator pin sites. After at least 1 L of normal saline had been placed through the external fixator pin sites, the limb was prepped and draped in sterile fashion for definitive internal fixation.

Scrubbing. The limb and skin over the pin sites were scrubbed with a chlorhexidine scrub-brush and rinsed with sterile saline. Then, the limb was prepped and draped in sterile fashion, followed by open reduction and internal fixation of the fracture.

Statistical Analysis. All statistical analyses were calculated and/or confirmed by a consulting statistician. Patient demographics between the two pin site management techniques were described with means and standard deviation. Student t-tests were used to compare contiguous variables including age, BMI, and duration in an external fixator. Categorical variables including patient sex, smoking status, diabetes mellitus, and whether a fracture was open or closed were compared with a chi-square test. Sex, age, open versus closed nature of fracture, BMI, smoking status, diabetes mellitus, and duration of time in external fixation were considered as possible confounders between the techniques. To isolate the impact of pin site management on the outcome of interest, which was deep post-operative surgical site infections that required surgical debridement, the previously stated demographics were compared using a chi-squared test to determine if there was a statistically significant difference between the interventions, and a Cohen's d effect size was calculated to determine if the magnitude of the difference was meaningful for analysis purposes. A statistical difference was a p value < 0.05. The Cohen's d effect size was interpreted using the traditional stratification of Small 0.2, Medium 0.5, and Large 0.8.

RESULTS

There were 472 external fixators removed from 444 patients during the date range of our chart review. A total of 335 external fixators on 316 patients met the inclusion criteria of our review and are presented in the results. Polytrauma patients with more than one injury requiring external fixation were included in this study. Furthermore, all infections recorded in this study were deep tissue infections. To account for them accurately, all external fixation devices were considered independent cases, as they were managed as separate injuries. Sharp debridement of pin sites to the bone was performed for 179 external fixators on 171 patients. Scrubbing of the surgical site with chlorhexidine was performed for 156 external fixators on 145 patients. Table 1 compares general demographics of the populations, including some comorbid

conditions between the two groups that are known to increase the risk of infection.[9]

Table 1. Demographics of all included patients.

Variable	DB (n = 179)	SS (n = 155)	p Value
Age, Years, Mean (Range, SD)	45.2 (16-87, 14.3)	45.0 (14-84, 16.0)	0.93
BMI, kg/m^2, Mean (Range, SD)	30.2 (19-55, 7.5)	29.9 (16.7-66.7, 8.9)	0.71
Diabetes Mellitus, %	16.2%	14.2%	0.61
Duration in external fixator, days, Mean (Range, SD)	17.6 (1-74, 11.5)	18.8 (1-64, 11.9)	0.34
Open fracture, %	32.4%	25.8%	0.19
Sex, Female, %	38.5%	38.1%	0.93
Smoking history, %	55.9%	45.8%	0.22

When comparing the demographics of the two groups of patients, no statistical differences were detected in the age of participants, sex of participant, BMI, open versus closed, or duration in external fixator. This lack of statistical difference supported the assumption that the two groups were composed of comparable populations and eliminated some sources of confounding. Table 2 displays the frequency of deep infections that required return to the operating room. Table 3 shows infection information.

Table 2. Outcome of interest and timeline.

	DB (n = 179)	SS (n = 155)	p Value[a]	Cohen's d[b]
Deep surgical site infection requiring re-operation, n (%)	18 (10.0%)	8 (5.2%)	0.10	0.18
Total patients with external fixator for 0 - 10 days	53	40		
Patients with external fixator for 0 - 10 days with deep surgical site infection requiring re-operation, n (%)	5 (9.4%)	1 (2.5%)		
Total patients with external fixator for 11 - 20 days	57	32		
Patients with external fixator for 11 - 20 days with deep surgical site infection requiring re-operation, n (%)	6 (10.5%)	3 (9.3%)		
Total patients with external fixator for > 20 days	69	83		
Patients with external fixator for > 20 days with deep surgical site infection requiring re-operation, n (%)	7 (10.1%)	4 (4.8%)		

Abbreviations: DB, Irrigation and Debridement; SS, Simple Scrubbing
[a]p value < 0.05 considered statistically significant.
[b]Cohen's d effect size traditional stratification of Small 0.2, Medium 0.5, and Large 0.8.

A statistical difference was not detected in post-operative infections requiring return to the operating room between the two groups (p = 0.10). With a p value of 0.1, the data suggested there might be a difference in rates of deep post-operative infection requiring re-operation, but that the rate was higher in the debridement group. A Cohen's d effect size of 0.18 for deep post-operative infection between the two groups correlated to a very small effect size.

Table 3. Infection information.

	DB (n = 18)	SS (n = 8)
Sex at birth, Males/Females	11/9	6/2
Age of patients in years, Mean (SD)	42.4 (14.1)	47.1 (13.4)
Duration of external fixator prior to infection in days, Mean (SD)	21.1 (16.8)	21.5 (11.8)
Status of fracture, Open/Closed	7/11	3/5
Body Mass Index in kg/m^2, Mean (SD)	30.3 (7.9)	27.7 (2.5)
Methicillin Sensitive *Staphylococcus Aureus* (MSSA), n (%)	1 (5.6%)	1 (12.5%)
Methicillin Resistant *Staphylococcus Aureus* (MRSA), n (%)	0	2 (25%)
Coagulase Negative *Stapylococcus species*, n (%)	7 (38.8%)	2 (25%)
Multiple bacteria grew on culture, n (%)	5 (27.8%)	1 (12.5%)
No growth appreciated on culture, n (%)	5 (27.8%)	2 (25%)

Abbreviations: DB, Irrigation and Debridement; SS, Simple Scrubbing; SD, Standard Deviation

DISCUSSION

In this retrospective cohort study, cases performed by an individual, fellowship trained, orthopedic traumatologist over more than a decade were reviewed. After data analysis, no significant difference in the rate of deep surgical site infection requiring return to the operating room was found between the two groups.

Research surrounding the management of external fixators and the care of patients temporized in an external fixator for the purpose of eventually performing internal fixation was incomplete. Ideal pin site dressings, pin care, management of pin crusts, types of pins implanted, and location of pins in relation to likely locations where definitive internal fixation will be placed have been studied.[10,11] The information yielded was beneficial to the decision making process in managing patients with external fixators.

To our knowledge, there are no studies in humans examining the best method to prepare external fixator pin sites when internal fixation is performed in the same operative setting as removal of the external fixator. This conclusion was reached after a thorough review of the literature.

As mentioned, an animal study by Clasper et al.[7] demonstrated a decreased rate of infection when debridement was performed on infected external fixator pin sites prior to intramedullary nailing. In this study, *Staphylococcus aureus* was used to infect the external fixator pin sites two weeks prior to intramedullary nailing of a tibia in an ovine model. This resulted in widespread infection in the control group, while the treatment group with debrided pin sites and administered antibiotics, for the most part, healed without clinical infection. It was difficult to

conclude from this study how much debridement of the external fixator pin sites contributed to the lack of clinical infection because local and systemic antibiotics also were administered to the treatment group but not in the control group.

In this current study, we attempted to determine if the debridement technique used to decrease surgical site infection in the Clasper et al.[7] ovine model could be repeated in humans. Debridement of external fixator pin sites prior to definitive internal fixation is practiced by a number of orthopedic surgeons, with some of the rationale for doing so based upon extrapolations from the ovine model. Indeed, when the senior surgeon (AH) inquired in his trauma fellowship why external fixator pin sites were debrided prior to placement of internal fixation, he was referred to the Clasper study. There were some major differences between the Clasper et al.[7] model and our study. However, it was reasonable to conduct this study, because the manner in which external fixator pin sites were debrided, prior to internal fixation, in our study, was the manner in which the Clasper study has been translated into clinical practice by a number of surgeons.

In this study, the null hypothesis that there would be no difference in deep infection rates between patients that had debrided pin sites versus simple scrubbing was upheld. However, because this was a retrospective study that evaluated a limited number of parameters, there are a number of factors which could have resulted in a type 2 statistical error, which needs to be discussed.

The lack of statistically significant infection rates between the two groups may be explained by the relatively small sample size of this study. Therefore, caution must be applied when interpreting these study results. In addition, the patients were all treated by an independent surgeon spanning the course of his career from immediately after graduating trauma fellowship to 11 years into his career. Surgeon experience has been demonstrated to effect a number of parameters in orthopedic surgery.[12-14] It was possible the effect of gained experience by this surgeon could have resulted in a decrease in surgical site infection rate over time. This possible decrease in infection rate due to experience could have negated any small increased risk of infection that may have been present with simply scrubbing the external fixator pin sites, as this was the method of pin site preparation during the surgeons most experienced years of this study.

In light of this, a more appropriate conclusion to this study would be that simple scrubbing of external fixator pin sites, prior to performing definitive internal fixation, performed by an experienced traumatologist (i.e., greater than six years of experience) demonstrated no difference in deep post-operative infection rates when compared to patients treated by sharp debridement of their external fixator pin sites, prior to definitive internal fixation, performed by a less experienced traumatologist (i.e., less than six years). One might conclude from this study that if the difference of post-operative deep infection between simple scrubbing versus debridement was so small that it can be overcome by experience, it would be better to invest time and resources in training that more quickly brings junior surgeons up to an experienced level.

Other issues that could have affected the outcome of this study that were not analyzed included the socioeconomic status of the patient, education level, race, workers compensation status, discharge home versus to a rehabilitation or skilled nursing facility, presence of active psychiatric issues, and whether the initial external fixator was placed by the surgeon performing definitive internal fixation.

CONCLUSIONS

Based on these results, irrigation and debridement of external fixator pin sites prior to definitive internal fixation in the same operative setting did not result in a decreased rate of deep surgical site infection requiring re-operation compared to simply scrubbing with a chlorhexidine scrub brush. Surgeons should decide based upon this information, if it is worth the extra time, expense, and effort to perform debridement of external fixator pin sites prior to definitive internal fixation.

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Variations in Postpartum Opioid Prescribing Practices among Obstetrician-Gynecologists

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ABSTRACT

Introduction. There have been many efforts to combat the United States opioid crisis that has been occurring for the past two decades, specifically with postpartum patients that often were prescribed opioids. Prior studies described how accounting for usage of inpatient opioids on the day prior to discharge had an impact on how much discharge opioids were prescribed on the day of discharge. These studies provided a guideline to use the inpatient opioid amount from the day before discharge to determine discharge opioid quantity and minimize how much was being prescribed. In July 2018, the American College of Obstetrics and Gynecologists (ACOG) published Committee Opinion 742, guidelines for obstetricians-gynecologists about postpartum pain management. Prescription pain medications (including opioids, if necessary) require a shared decision-making approach between the physician and patient to determine the medication type and quantity. This study aimed to determine if there were differences in prescribing practices based on the specific post-operative day that opioid prescriptions were written, and if there were differences in the prescribing practices for cesarean deliveries following the publication of ACOG Committee Opinion 742.

Methods. This retrospective chart review included patients who had a live cesarean birth at one rural Midwest facility anytime between July 1, 2017 and February 28, 2021. This study excluded those with chorioamnionitis and those discharged after more than four days. Opioid amounts were converted to oral morphine milligram equivalents (MME) for comparison, and total MME was calculated for each prescription. Patients were stratified into two groups based on the day that their discharge opioid medication prescriptions were written (i.e., a day prior to discharge or the day of discharge). Patients were also stratified based on date of delivery, before or after the publication of ACOG Committee Opinion 742.

Results. Of 411 cesarean patients, 93.9% (n = 386) had opioids prescribed at discharge, 86% (n = 330) of whom received a prescription written on the day of discharge. There was no difference in the quantity of MMEs, doses per day, or dosage from discharge prescriptions between those written on the day of discharge and those written on a prior day. Patients whose deliveries occurred after the publication of ACOG Committee Opinion 742 (63.9%, n = 263) received discharge prescriptions with fewer average MMEs (159.53 ± 61.64) than those whose deliveries occurred before the publication (36%, n = 148; 187.35 ± 53.42; χ^2 (1, N = 411) = 17.71; p < 0.001), and they were prescribed fewer doses per day.

Conclusions. After cesarean sections, the specific post-operative day did not seem to impact the prescribing trends as there were no differences in MMEs, doses per day, or dosage between prescriptions that were written on the day of discharge and before the day of discharge. Patients whose deliveries occurred after the publication of ACOG Committee Opinion 742 received discharge prescriptions with fewer MMEs, fewer doses per day, and the same dosage than those whose deliveries occurred before the publication, reflecting the overall national trend of decreasing prescription opioids over these years.

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INTRODUCTION

From 1999 to 2019, there was a four-fold increase in the number of drug overdose deaths in the U.S., with prescription opioid overdose accounting for 247,000 deaths.[1] The quantity of opioids prescribed per patient (determined through morphine milligram equivalents (MMEs)) was approximately three times higher in 2015 than the MMEs prescribed in 1999.[2] The overall rate of opioid prescriptions peaked at 81.3 prescriptions per 100 patients in 2012, stabilized at 70.6 prescriptions per 100 patients from 2015 through 2017[2], and has decreased more since then, at 43.3 prescription per 100 patients in 2020.[1]

Although postpartum caesarean and vaginal delivery patients often were prescribed opioids, patients with caesarean deliveries more commonly were prescribed discharge opioid prescriptions.[3] However, there was a lack of standardization regarding the quantity of opioids prescribed for caesarean or vaginal deliveries;[3,4] the quantities did not always correlate with postpartum patient's measures of pain,[4] and patients often were prescribed more opioids than what was consumed.[5,6]

Prior studies have described the quantity of discharge opioid prescriptions written on the day of discharge and evaluated if accounting for the usage of inpatient opioids on the day prior to discharge had an impact on how much was prescribed.[7,8] Hill and colleagues suggested that home post-discharge opioid use was best predicted by usage of inpatient opioids the day before discharge, and suggested a guideline to use the inpatient opioid amount from the day before discharge to determine discharge opioid quantity and minimize how much is being prescribed.[7] Schwab and colleagues implemented a protocol that eliminated patient-controlled analgesia on the days prior to discharge and found that patients continued to be prescribed excess opioids at discharge compared to inpatient opioid use the day prior to discharge.[8] However, it was unknown if the day that the discharge prescriptions were written, which can be on the day of discharge or an earlier post-operative day, led to a difference in prescribing practices for discharge opioid medications after caesarean deliveries.

In an effort to combat the opioid crisis, the American College of Obstetrics and Gynecologists (ACOG) published a Committee Opinion in July 2018 with guidelines for obstetricians-gynecologists about postpartum pain management.[9] While there is varying information on what

might reduce overprescribing opioids, ACOG Committee Opinion 742 described that prescription pain medications (including opioids, if necessary) required a shared decision-making approach between the physician and patient to determine which type of medication and the appropriate quantity to prescribe.[9]

Therefore, this study sought to determine if patients with caesarean deliveries received different prescribing practices based on the day that discharge opioid medications were written, relative to the day of discharge. This study also sought to determine if patients with caesarean deliveries that occurred before the publication of ACOG Committee Opinion 742 experienced a change in opioid prescriptions compared to those whose deliveries occurred after the publication. Specifically, this study sought to determine if the publication contributed to a change in the type and quantity of MMEs.

METHODS

Participants. Eligible patients had a live birth via cesarean anytime between July 1, 2017 and February 28, 2021 and received care in a specific rural community hospital. Patients were identified through the medical records at Newton Medical Center in Newton, KS through DRG codes (783, 784, 786, 787, 785, or 788) for all types of caesarean deliveries. Patients eligible for this study delivered newborns at Newton Medical Center with APGAR (Appearance, Pulse, Grimace, Activity, and Respiration) scores that were greater than zero at one minute. Patients were excluded from this study if they were diagnosed with chorioamnionitis or discharged post-operatively after more than four days.

Instrument. The primary outcome for this study was the discharge prescription's morphine milligram equivalents (MMEs). The independent variables included the date of the written postpartum opioid prescription (day of discharge or prior to day of discharge) and date of delivery (if it occurred before or after the publication of ACOG Committee Opinion 742). Possible confounding variables included previous narcotic use, type of cesarean, and type of anesthesia.[10]

The data abstracted from each patient's medical records included demographics (e.g., name, race, ethnicity, date of birth), maternal history (e.g., smoking status, diabetes, past opioid use), delivery information (e.g., first or repeat cesarean, anesthesia type, date, time), and infant information (e.g., gestational age, APGAR score). Discharge information (e.g., date, time) and opioid medication information (e.g., prescription type, dose, date prescription written) also were abstracted from patient charts.

Opioids were converted to oral MMEs to compare the different types of opioids.[11] The total MME of each prescription was calculated by using an opioid conversion factor, based on the strength of each opioid, and multiplying it by the dose and the number of tablets in the prescription. For example, oxycodone is a stronger opioid than hydromorphone, so it had a 1.5 conversion factor when converting to MME, whereas hydromorphone had a conversion factor of 1.

Procedures. This project was approved by the Institutional Review Boards at the University of Kansas Medical Center and Newton Medical Center. Patient charts that met study criteria were abstracted into a Research Electronic Data Capture (REDCap®) database hosted at the University of Kansas School of Medicine.[12]

Patients were stratified into two groups based on if physicians wrote their discharge opioid medication on the day of discharge or if it was written on a day prior to discharge. Patients also were stratified into two additional groups based on their date of delivery, with reference to the publication of ACOG Committee Opinion 742. Patients who had their caesarean delivery from July 1, 2017 through July 1, 2018 were categorized as having delivered "before the ACOG publication", and patients who had their caesarean delivery from July 2, 2018 through February 28, 2021 were categorized as having delivered "after the ACOG publication".

Statistical Analysis. Data were analyzed using SAS version 9.4 (SAS Int. Inc., Cary, NC). Means and standard deviations (or medians and interquartile ranges) were reported for continuous variables; counts and percentages were reported for categorical variables. Likelihood ratio chi-square and Fisher's exact tests were for 2*2 and r*c contingency tables to test the association and agreement for the categorical and nominal variables. Based on the distribution of the quantity of opioid meditation, a robust regression approach was used to test the relationship between the quantity of MME prescribed and if it was prescribed on the day of discharge or prior to the day of discharge, as well as if it was before or after the publication of ACOG Committee Opinion 742. For modeling the relationship between number of pills and the predictor variable, negative binomial regression model was utilized. Goodness of fit criteria such as Akaike and Bayesian Information criteria were used to identify the approach that better fits for the model between outcome and predictor variables. All statistical tests at $p \leq 0.05$ were considered significant.

RESULTS

In total, 411 patient charts were reviewed for this study, and all met inclusion and exclusion criteria. The ages of the patients ranged from 15 to 43 years, with a mean patient age of 28 years (SD = 5.0). Most of the population was White (95.1%, n = 391; Table 1). Sixty-nine percent (n = 286/411) of patients had a history of past pregnancies prior to the current caesarean delivery. For approximately half of the patients (52.8%, n = 217/411), this was a repeat caesarean delivery. Nearly two-thirds of the patients had a history of past opioid use (64.2%, n = 264/411). Most patients (65.5%, n = 269/411) had a spinal block anesthesia, 67.3% of whom (n = 181/269) had Duramorph® (morphine sulfate injection) as part of their anesthesia plan. The average body mass index for patients was 35.21 and the average gestational age was 38.66 weeks. There were no significant differences in demographic or clinical characteristics before or after the publication of ACOG Committee Opinion 742.

Table 1. Demographic and clinical characteristics of patients, n (%) or mean ± SD.

	All Patients	Before ACOG Publication	After ACOG Publication	p Value
Total	411 (100.0%)	148 (36.0%)	263 (64.0%)	
Ethnicity				0.562
Hispanic or Latino	43 (10.5%)	16 (10.8%)	27 (10.3%)	
Not Hispanic or Latino	358 (87.1%)	130 (87.9%)	228 (86.7%)	
Unknown/not reported	10 (2.4%)	2 (1.4%)	8 (3.0%)	
Race				0.537
Asian American	3 (0.7%)	2 (1.4%)	1 (0.4%)	
Native Hawaiian or Other Pacific Islander	1 (0.2%)	1 (0.7%)	0 (0.0%)	
Black or African American	10 (2.4%)	4 (2.7%)	6 (2.3%)	
White or Caucasian	391 (95.1%)	139 (93.9%)	252 (95.8%)	
Unknown/not reported	6 (1.5%)	2 (1.4%)	4 (1.5%)	
Smoking status				0.364
Never smoker	275 (66.9%)	95 (64.2%)	180 (68.4%)	
Current smoker	83 (20.2%)	29 (19.6%)	54 (20.5%)	
Former smoker	52 (12.7%)	24 (16.22%)	28 (10.65%)	
Unknown/not recorded	1 (0.24%)	0 (0.0%)	1 (0.4%)	
Diabetes status				0.281
Type 1 diabetes	6 (1.5%)	4 (2.7%)	2 (0.8%)	
Type 2 diabetes	3 (0.7%)	2 (1.4%)	1 (0.4%)	
Gestational diabetes	39 (9.5%)	13 (8.8%)	26 (9.9%)	
No diabetes diagnosis	363 (88.3%)	129 (87.2%)	234 (89.0%)	
Hypertension				0.563
No	382 (92.9%)	139 (93.9%)	243 (92.4%)	
Yes	29 (7.1%)	9 (6.1%)	20 (7.6%)	
Chronic pain				0.790
No	401 (97.6%)	144 (97.3%)	257 (97.7%)	
Yes	10 (2.4%)	4 (2.7%)	6 (2.3%)	
Past opioid use				< 0.001
No	147 (35.8%)	72 (48.7%)	75 (28.5%)	
Yes	264 (64.2%)	76 (51.4%)	188 (71.5%)	
Alcohol consumption during pregnancy				0.477
No	347 (84.4%)	121 (81.8%)	226 (85.9%)	
Yes	43 (10.5%)	19 (12.8%)	24 (9.1%)	
Unknown	21 (5.1%)	8 (5.4%)	13 (4.9%)	
History of past pregnancy				0.373
No	125 (30.4%)	49 (33.1%)	76 (28.9%)	
Yes	286 (69.6%)	99 (66.9%)	187 (71.1%)	
First or repeat cesarean				0.518
First	194 (47.2%)	73 (49.3%)	121 (46.0%)	
Repeat	217 (52.8%)	75 (50.7%)	142 (54.0%)	
Anesthesia type				0.293
Epidural	142 (34.6%)	56 (37.9%)	86 (32.7%)	
Spinal	269 (65.5%)	92 (62.2%)	177 (67.3%)	

Table 1. Demographic and clinical characteristics of patients, n (%) or mean ± SD. *continued.*

	All Patients	Before ACOG Publication	After ACOG Publication	p Value
Duramorph®				0.979
No	88 (32.7%)	30 (32.6%)	58 (32.8%)	
Yes	181 (67.3%)	62 (67.4%)	119 (67.2%)	

Table 2. Opioid discharge prescription characteristics, n (%) or mean ± SD.

	All Patients with Opioid Prescription	Before ACOG Publication	After ACOG Publication	p Value
Total	386 (100%)	145 (37.6%)	241 (62.4%)	
Opioid type				0.412
Hydrocodone	272 (70.5%)	108 (74.5%)	164 (68.1%)	
Oxycodone	111 (28.8%)	36 (24.8%)	75 (31.1%)	
Hydromorphone	2 (0.5%)	1 (0.7%)	1 (0.4%)	
Tramadol	1 (0.3%)	0 (0.0%)	1 (0.4%)	
MME prescribed	169.98 ± 60.15	187.35 ± 53.42	159.53 ± 61.64	< 0.001
Doses per day				< 0.001
Four	69 (17.9%)	1 (0.7%)	68 (28.2%)	
Six	317 (82.1%)	144 (99.3%)	173 (71.8%)	
Prescription dose				0.547
2 mg	2 (0.5%)	1 (0.7%)	1 (0.4%)	
5 mg	364 (94.6%)	137 (94.5%)	228 (94.6%)	
7.5 mg	17 (4.4%)	6 (4.1%)	11 (4.6%)	
10 mg	1 (0.3%)	1 (0.7%)	0 (0.0%)	
50 mg	1 (0.3%)	0 (0.0%)	1 (0.4%)	
Number of days between prescription date and discharge date				0.048
Zero	330 (85.5%)	120 (82.8%)	210 (87.1%)	
One	52 (13.5%)	23 (15.9%)	29 (12.0%)	
Two	4 (1.0%)	2 (1.4%)	2 (0.8%)	

Of the 411 patients included in this study, 93.9% (n = 386) had opioids prescribed to them at discharge, 85.5% of whom (n = 330) received a prescription that was written on the day of discharge (Table 2). The other 14.5% (n = 56) received a prescription that was written one or two days prior to discharge. The most common prescription type was hydrocodone (70.5%, n = 272), and the most common prescription dosage was 5 mg (94.6%, n = 360; Table 2). Most patients (82.1%, n = 317) received a prescription with instructions to take a dose up to six times per day (every four hours). The total MME ranged from 25 to 450, with a mean of 169.9 MME (SD = 60.15).

Differences in Outcomes in Reference Day that Discharge Prescription was Written. There was no significant difference in the discharge opioid prescriptions' MME between those written on the day of discharge (163.65 ± 63.45 MME) and those written one- or two-days prior (171.19 ± 43.46 MME). There was also no difference in average doses per day instructions on the discharge opioid prescriptions between those written on the day of discharge and those written one- or two-days prior. The proportions of prescriptions written with instruction to take four doses or six doses per day were the same for prescriptions written on day of discharge and a day that was prior to discharge. Additionally, the dosage between prescriptions written on day of discharge versus written on a day prior to discharge was not different, but the ranges were not identical. All prescriptions written on day of discharge had a dosage of 5 mg, while the dosage for prescriptions written on a day prior to discharge ranged from 2 mg to 50 mg.

Differences in Outcomes in Reference to Publication of ACOG Committee Opinion 742. Patients whose caesarean deliveries occurred after the publication of the ACOG document (62.4%, n = 241) received prescriptions at discharge with fewer quantities of MMEs than for those who delivered before the publication (37.6%, n = 145; $\chi^2(1, N = 411) = 17.71$; $p < 0.001$; Figure 1). The average quantity of MME for the deliveries that occurred prior to the publication was 187.35 ± 53.42 MME, whereas the average quantity of MME for the deliveries that occurred after the publication was 159.53 ± 61.64 MME. However,

there was no difference in the type of opioid prescribed before compared to after the publication of ACOG Committee Opinion 742.

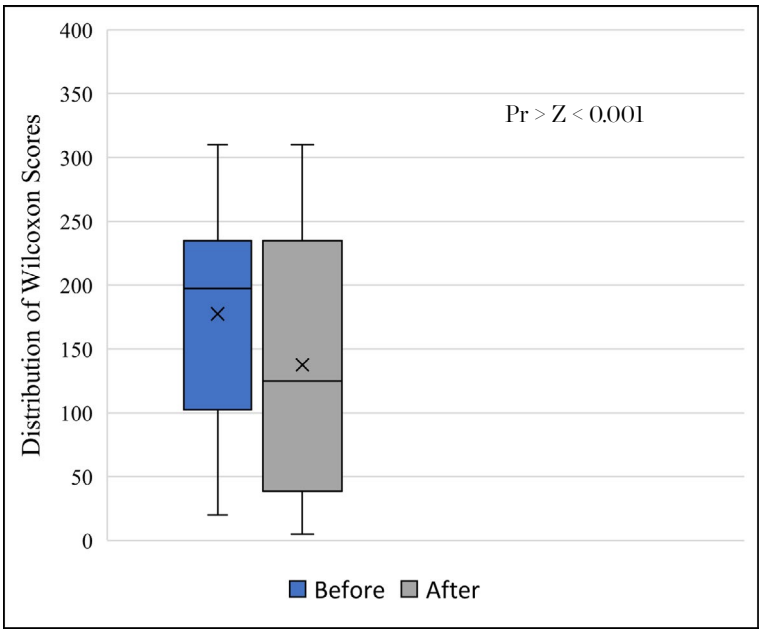

Figure 1. Differences in MME based on date of delivery: Before or After ACOG guidelines.

On average, patients whose deliveries occurred after ACOG Committee Opinion 742 was published received prescriptions at discharge with fewer doses per day than patients whose deliveries occurred before the publication ($\chi^2(1, N = 411) = 46.60$; $p < 0.001$). Nearly all (99.3%, n = 144) caesarean delivery patients who delivered before the publication received a prescription for opioid medication to be administered up to six times a day, whereas 71.8% of their post-publication counterparts (n = 173) received the same number of doses per day.

There was no difference in prescription dosage. The dosage was 5 mg for 94.5% of patients (n = 137) who delivered before the ACOG Committee Opinion 742 was published and 94.6% of patients (n = 228) who delivered after the publication. However, fewer discharge opioid prescriptions were written on the day of discharge (82.8%, n = 120) before the publication of ACOG Committee Opinion 742 than after the publication (87.1%, n = 210; $\chi^2(2, N = 386) = 5.65$; $p < 0.05$).

Outcomes of Patients with History of Opioid Use. Two incidental findings were found in this study in relation to patients with past opioid use. A significant difference was found in the proportion of patients who had a history of opioid use between those who delivered before (51.4%, n = 76) and after the publication of ACOG Committee Opinion 742 (71.8%, n = 188). Additionally, patients who previously used opioids (64.2%, n = 264) had a lower quantity of MMEs in their discharge prescription (165.45 ± 61.36 MME) than those who did not have a history of opioid use (35.8%, n=147; 177.95 ± 59.06 MME; p = 0.05; Figure 2).

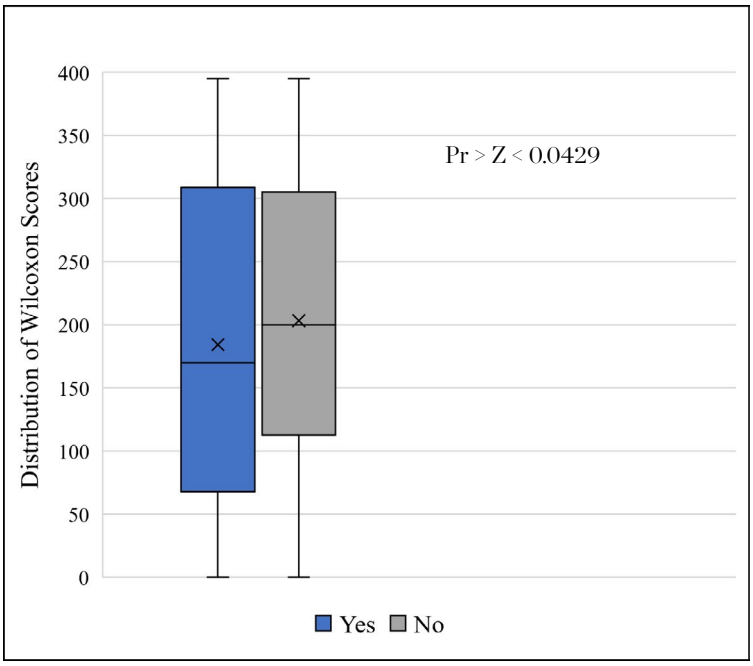

Figure 2. Difference in MMEs based on history of past opioid use: Yes or No.

DISCUSSION

This study indicated that 94% of patients who underwent caesarean deliveries were given a discharge opioid prescription. This was consistent with other studies, where 94% to 97% were prescribed discharge opioids after caesarean deliveries.[3,4] However, the current study contributes to the literature due to its rural setting and population, whereas previous studies have been conducted in large medical centers with more patients and more diverse samples that may not reflect rural communities. The current study was unique in that it explored the discharge opioid prescribing patterns for patients with caesarean deliveries in relation to the day of hospital stay that the discharge prescription was written, as well as if the surgery occurred before or after the publication of ACOG Committee Opinion 742.

The current study suggested that the quantity of discharge prescription MMEs, dosage, and doses per day did not differ between those that were written on the day of discharge and those that were written on a day prior to discharge. This result aligned with other studies that suggested post-operative discharge medications may be planned ahead of time, based on a preoperative evaluation rather than being determined on the day of discharge.[13-15] However, an interesting difference between the groups was the minimum and maximum values of prescription dosage. For those written prior to day of discharge, 100% of the prescriptions had a dosage of 5 mg, while the dosage for prescriptions written on the day of discharge ranged from 2 mg to 50 mg. Although the average dosages between the two groups did not have a significant difference, there may be some implication to this result based on the dosages. When writing prescriptions prior to day of discharge, pain evaluation was not factored, so physicians more likely used a standard order, and in this case, the 5 mg dosage, leading to less variability in prescribing practices. This was consistent with another study that

suggested that when utilizing a standard order set, there was less variability in the prescribing patterns of discharge opioid medications.[16]

This study suggested that greater MME quantities and doses per day were prescribed for patients with caesarean deliveries that occurred prior to the publication of ACOG Committee Opinion 742 than those that occurred after the publication. This difference may be due to the increased awareness of the national problem leading to more initiatives overall. ACOG Committee Opinion 742 highlighted the significance of the issue for physicians and provided suggestions for postpartum discharge opioid medications to aid in minimizing opioid quantity.

The differences in MME quantity can be attributed to consistent efforts to decrease opioid prescriptions from July 1, 2017 through February 28, 2021. The peak of opioid prescriptions occurred in 2012, but there has been a consistent annual decline, with fewer opioids prescribed each year.[1] Due to the stratification in the current study having one group of patients from July 2017 through July 2018 and the other group from August 2018 through February 2021, the significant decrease in MME quantity was likely reflective of the national trend.

Additionally, around the time that the ACOG document was published, there were increased initiatives involving physician awareness, national guidance, and a push on how to minimize opioid quantity given the decades-long opioid epidemic. These included quality improvement projects by Baruch and colleagues[17], Osmudson and colleagues[18], Prabhu and colleagues[19], and Lavand'homme[20], which were all published in 2018. These studies described strategies to reduce opioid quantity post-caesarean deliveries to continue the decline of opioid prescriptions in the U.S.

Prior studies have examined physician adherence to ACOG recommendations, but there was a lack of consensus on the extent to which physicians adhere to guidelines. One study suggested that physicians strongly adhered to ACOG guidelines regarding prenatal practices[21], whereas another study suggested that physicians were highly nonadherent to guidelines.[22] Conflicting reports of physician adherence to past ACOG guidelines challenged the assumption that the dissemination of ACOG Committee Opinion 742 was the single reason for the significant change in opioid quantity.

Not only was past opioid use significantly associated with a decreased MME in discharge opioid prescriptions, but there was also a significantly greater number of patients with past opioid use among those that delivered after the publication of the ACOG document. This might provide evidence that more people were exposed to opioids than in the past and reflects the opioid crisis. Additionally, this suggested that more people were exposed to opioids over time and revealed the importance of having measures to minimize future opioid quantity within prescriptions.

Finally, this study suggested that there were more discharge opioid prescriptions being written prior to day of discharge (17%, n = 25) before the publication of ACOG Committee Opinion 742 than after the publication (13%, n = 31). This was important because it is another aspect of prescribing practices that significantly changed over time. Suggested guidelines from prior studies[7,8], as well as suggestions from ACOG Committee Opinion 742, stated the need for accounting inpatient opioid use the day prior to discharge and shared decision making as a way to minimize discharge opioid quantity. Simply writing discharge prescriptions on the day of discharge rather than on an earlier day allowed for the opportunity to utilize those suggestions. Because this aspect of prescribing practices significantly changed over time, before and after the publication of the ACOG document, it could indicate an avenue to make further strides in combating the opioid crisis.

As of September 2021, ACOG withdrew the Committee Opinion 742 on Postpartum Pain Management and replaced it with ACOG Clinical Consensus No. 1 Pharmacologic Stepwise Multimodal Approach for Postpartum Pain Management.[23] The information regarding recommendations for discharge opioid medications remained the same in the updated document. However, when reaching out to ACOG, the authors of the current study were not given the specifics as to why the ACOG Committee Opinion 742 was replaced.

Future Studies. Future studies can examine obstetrician-gynecologists from other clinics that look to ACOG for guidelines to determine if a similar change in MMEs occurred following the publication of the ACOG guidelines regarding opioid prescribing. This process could reinforce the idea that increased awareness, initiatives, and overall public eye on the opioid crisis around that time made a significant difference in prescribing practices. More specifically, future research needs to be conducted to explore if similar relationships are found with different patient populations, as the current study had a majority population of White patients in a rural setting.

Additionally, while the current study did not find a difference in opioid quantity for prescriptions written on the day of discharge compared to those written on a day prior to discharge, this could have been due simply to not having enough patients that had their prescriptions written prior to discharge. It could be valuable to have a future study with a longer timeframe to include more patients that had their discharge opioid prescriptions written on a day prior to discharge and observe if the results are different.

Limitations. One weakness in the current study was the lack of patient diversity. Although this may make the results less generalizable, having all patients from one clinic allowed the investigators to control for fewer differences in how caesarean procedures were performed, prenatal care, and overall hospital stay. Another limitation was the cutoff for the two groups of patients who had their caesarean deliveries before and after July 1, 2018, the day that ACOG Committee Opinion 742 was published. Distribution and practice changes might have taken some time, but the current study assumed that it could have all occurred on July 1, 2018. Finally, as this study was a retrospective chart review, this study was limited by missing data; however, most of the missing data came from demographic or patient characteristic information. All variables of interest were included in the medical records.

CONCLUSIONS

Cesarean patients who had their discharge prescriptions written on the day of discharge versus a day that was prior to discharge had no differences in MMEs, doses per day, or dosage in their prescriptions.

Patients whose deliveries occurred after the publication of ACOG Committee Opinion 742 received discharge prescriptions with fewer MMEs and fewer doses per day than those whose deliveries occurred before the publication. However, the opioid dosage remained the same in the two groups.

In our study group, there was not a significant difference in how much postpartum opioid prescriptions patients were receiving based on what point of their stay the prescription was written. However, there has a been a trend in decreasing amount of postpartum opioids being prescribed overall, as evidenced by the decline before and after the ACOG Committee Opioid 742 published in July 2018.

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Keywords: caesarean section, opioids, postpartum

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Idiopathic Orbital Inflammation Underlying Drug-Associated Thyroid Eye Disease

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INTRODUCTION

Alemtuzumab has been reported to cause thyroid eye disease in approximately 30% of patients being treated for multiple sclerosis (MS).[1] Treatment of alemtuzumab-induced thyroid ophthalmopathy mimics Graves' ophthalmoplegia regimen, whereas systemic symptoms frequently require thyroidectomy. While Graves' ophthalmoplegia is clinically common, ophthalmoplegia has a wide differential diagnosis, which often can be narrowed via imaging and, of potentially more importance, tissue analysis.[2] We present an unusual case where thyroid eye disease and idiopathic orbital inflammation co-occurred, resulting in a hazy clinical picture. The unique findings in the combined disease processes are underscored and outcomes of the patient's management are presented.

CASE REPORT

A 41-year-old female presented for evaluation and treatment of thyroid eye disease. Three years prior to presentation, she was treated for relapsing, remitting multiple sclerosis with alemtuzumab. Three months prior to presentation, she developed eye pain, pressure, and binocular diplopia. Review of systems was otherwise negative and family history was unremarkable. Her prior lab work was consistent with Graves' disease and an outside provider began treating her with selenium.

The exam showed 20/25 vision in both eyes, mildly elevated intraocular pressure (25 mmHg in the right eye, 21 mmHg in the left eye) and a 2+ afferent pupillary defect in the left eye. Motility showed -1 deficit with left abduction. Hertel measurements were 19 mm in the right eye and 23 mm in the left eye. Slit lamp exam showed 1+ edema and erythema of both upper eyelids. There was 1+ injection of the conjunctiva and caruncle with 1+ chemosis in both eyes. The remainder of her exam was unremarkable.

Thyroid labs showed a thyroid stimulating hormone of 0.6 mIU/L, low free T4 0.02 ng/dL, elevated thyroid stimulating immunoglobulin 4.9 IU/L, and elevated thyroid receptor antibody 4.78 IU/L. Complete blood count, angiotensin converting enzyme, lysozyme, anti-nuclear antibodies, erythrocyte sedimentation rate, c-reactive protein, myeloperoxidase, and proteinase-3 antibody were within normal limits. IgG subclass 4 was low < 0.3 mg/dL. Computed tomography (CT) of the orbits without contrast showed moderate left greater than right infiltrative soft tissue thickening in the superior and lateral intraconal and extraconal orbits with less involvement in the inferior orbit. These findings were non-specific, but were not suggestive of thyroid eye disease. The patient underwent left orbitotomy with biopsy of the abnormal tissue. The biopsy showed focal lymphoplasmacytic infiltrate, chronic inflammatory infiltrate. The findings were suggestive of a reactive process. Immunoglobulin gene rearrangement was negative, excluding lymphoma.

Oncology and endocrine services were consulted for a lymphoplasmacytic mass, with a concern for lymphoma versus inflammatory mass with concurrent thyroid eye disease. At three-month follow-up, monitoring of Graves' clinical activity scores showed no changes from baseline. Humphrey visual field results were borderline with normal right eye results and non-specific left eye changes. Positron emission tomography (PET) scan showed hypermetabolic activity in the posterior orbits bilaterally corresponding to the region of soft tissue thickening. The PET scan was not concerning for systemic lymphoma. Response to high dose steroids was minimal.

The medical oncology service started a three-week course of rituximab, after which the patient developed worsening proptosis. Prednisone 60 mg resulted in moderate improvement of the proptosis. Follow-up CT two months later showed mild improvement of left muscle thickening. The patient's condition was complicated by active COVID-19 infection during rituximab infusions and severe headaches from vision changes. The oncology service pursued radiation treatment of bilateral extraocular muscles, which resulted in gradual, moderate improvement in double vision, ability to close the eyelids, and proptosis without full resolution.

The patient received 4 Gray in 2 fractions to the bilateral orbits. With the endocrine service suggesting that Graves' disease played a major role in her symptoms, the patient underwent a near-total thyroidectomy one-month later. One-month post-operation, she was clinically euthyroid and the thyroidectomy was unremarkable. She was awaiting retroorbital surgery for continued ocular symptoms, unresolved by thyroidectomy.

DISCUSSION

This case highlighted the similarities between idiopathic orbital inflammation and thyroid eye disease. The patient was presumed to have thyroid eye disease given the associations in the literature with alemtuzumab and lab work was consistent with Graves' disease.[1] However, imaging showed foci consistent with orbital inflammation rather than muscle enlargement seen with Graves' ophthalmopathy.[3] Inflammatory workup was negative, as was gene rearrangement. Biopsy demonstrating chronic inflammation confirmed the diagnosis of idiopathic orbital inflammation.

This case emphasized the importance of maintaining a broad differential when evaluating patients with symptoms suggestive of thyroid eye disease. Orbital imaging and histopathological analysis remain important diagnostic steps in distinguishing thyroid eye disease from other inflammatory processes and determining treatment course. This was demonstrated by the decision to administer a lower radiation dose than what would be used typically to treat clear-cut Graves' exophthalmos,[4] due to reduced suspicion of Graves' disease based on her imaging and tissue analysis.

Case reports describing eye diseases masquerading as Graves'

ophthalmopathy can be found in the literature;[5,6] however, only a few cases demonstrated idiopathic orbital inflammation and thyroid eye disease occurring concurrently. While clinicians frequently order imaging in these cases, imaging is often inconclusive.[2] The risk of unnecessarily initiating thyroid disease treatment versus obtaining minimally invasive biopsies under local anesthesia must be considered in each case. Imaging combined with histopathologic analysis tends to efficiently narrow the differential and orient toward a more specific treatment.[2] Relying on purely non-invasive analysis risks neglecting a secondary inflammatory condition, such as in this patient.

This report described an interesting case where the clinical picture of alemtuzumab-induced thyroid eye disease was disconcerted by an underlying idiopathic orbital inflammation. The two conditions frequently were compared throughout the literature with plentiful discussion of how to distinguish the two diseases.[5,6] While labs were consistent with thyroid eye disease, imaging suggested idiopathic orbital inflammation, which was proven by biopsy. This resulted in a more reserved style of management, relative to standard thyroid eye disease management, by all consulted providers. This case serves as a reminder of the importance of histopathologic analysis in cases of complicated thyroid eye disease.

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Keywords: alemtuzumab, thyroid, lymphoma, eye abnormalities, Graves' disease

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Symptomatic Colonic Metastasis in a Patient with Non-Small Cell Lung Carcinoma

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INTRODUCTION

Lung cancer is the leading cause of death related to cancer in the United States.[1] Of the various types of lung cancer, the majority are non-small cell lung cancer (NSCLC). A significant number of patients that present with NSCLC have distant metastases at the time of diagnosis, however, only a small percentage have abdominal metastasis.[1,2]

Abdominal metastases are most often squamous cell carcinoma and can be found in the liver, adrenal glands, pancreas, spleen, kidneys, gastrointestinal (GI) tract, peritoneum, or abdominal lymph nodes.[1-3] Metastases to the GI tract are rare with a prevalence rate of 0.5 - 14% and are often asymptomatic but can present with abdominal pain, intestinal obstruction, bloody stool, diarrhea, or intestinal perforation.[4,5] Colonic metastasis often is not diagnosed during life, with up to one-third diagnosed during an autopsy.[2] We present a female with a history of Stage IV NSCLC diagnosed with sigmoid colon metastases after complaints of bright red blood per rectum.

CASE REPORT

A 63-year-old female with a past medical history of bilateral deep vein thrombosis, ischemic stroke with patent foramen ovale, and stage IV non-small cell lung carcinoma, presented with melena and bright red blood per rectum. She was diagnosed with NSCLC of the adenocarcinomatous type with metastasis to the brain and abdominal wall two years prior and had completed treatment of carboplatin, pemetrexed, and pembrolizumab, along with radiation to the brain, abdomen, and lung.

Upon admission, computed tomography (CT) showed an infiltrative lesion obstructing the right upper lobe bronchus consistent with the patient's NSCLC history, as well as increased mesenteric and retroperitoneal lymphadenopathy. A previous pancreatic head mass also was increased. A new enhancing 1.9 cm lesion in segment 5 of the right hepatic lobe was found along with a peripherally enhancing mass in the mid-sigmoid colon extending into the mesocolon (Figure 1). Colonoscopy revealed a 50% circumferential bleeding sigmoid mass 30 cm from the anal verge. The patient underwent sigmoid resection with palliative intent showing a 4.5 cm ulcerated mass with carcinoma extending the entire thickness of the bowel with extensive tumor necrosis and lymphovascular space involvement. Pathology revealed moderately to poorly differentiated adenocarcinoma with 30 of 32 lymph nodes positive for metastasis. Immunohistochemical staining showed positive for TTF-1, Napsin-a, and CK7, but negative for CK20 and CDX2 consistent with lung adenocarcinoma. Her post-operative course was uneventful, and the patient opted for hospice on discharge.

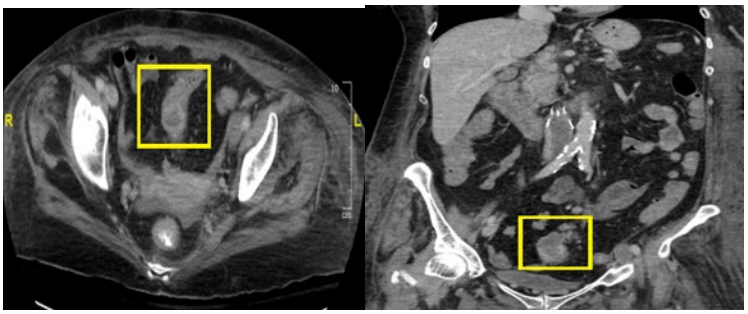

Figure 1. The highlighted image shows peripherally enhancing mass in the mid sigmoid colon extending into the mesocolon.

DISCUSSION

Lung cancer is the leading cause of death worldwide with most patients presenting with distant metastasis at the time of diagnosis. The common site of metastasis are the lymph nodes, liver, bones, adrenal glands, and the brain.[1] While metastasis to the GI tract is rare, with majority of them being in the small bowel, only a few cases of colonic metastasis have been reported.

Most GI tract metastases are asymptomatic, thus diagnosed post-mortem.[2] Symptoms when present may include weight loss, abdominal pain, constipation, diarrhea, and bloody stool. In our case, the patient was diagnosed with colonic metastasis after she presented with melena. GI endoscopy with the histopathologic diagnosis is the golden standard for confirming GI tract metastasis from the lungs.[6] Symptomatic GI metastasis should be treated by surgical intervention or medical treatment. With appropriate treatment, these patients may have longer survival with improved quality of life.[5] Therefore, although there may not be high suspicion of colonic metastasis in NSCLC patients, it is important to screen for them, especially if symptomatic.

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Keywords: non-small-cell lung carcinoma, colon, metastasis, cancer screening

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Acute Chest Pain in an Acute Complicated Pancreatitis with Severe Hypophosphatemia

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INTRODUCTION

Acute chest pain is the second most common cause of admission to the emergency department after trauma. Causes of chest pain vary and can be cardiac or noncardiac.[1] Angina triggered by cardiac ischemia can indicate an acute coronary syndrome.[2] Upon suspicion of acute coronary syndrome, risk stratification for cardiac ischemia dictates management.[1] In this case, an episode of angina in a patient is presented in the setting of intravenous phosphate supplementation in acute severe complicated pancreatitis. This was a case of acute chest pain associated with sodium phosphate intravenous infusion in complicated acute pancreatitis associated with severe hypophosphatemia.

CASE REPORT

A 46-year-old male patient with no past cardiac history presented for severe abdominal pain. He had a past medical history of cholecystitis treated with laparoscopic cholecystectomy 12 days prior to presentation. One day prior to his presentation, he underwent an endoscopic retrograde cholangiopancreatography (ERCP). He developed epigastric pain one hour after ERCP. The pain was radiating to the back, progressively worsening, and associated with subjective shortness of breath, decreased oral intake, and nausea.

On physical examination, the patient was in distress. His abdomen was diffusely tender to palpation, with guarding but no rebound pain. Chest exam showed tachypnea with no abnormal breath sounds on auscultation. Otherwise, vital signs were normal. His lipase level was > 7500 U/L, and his abdominal computed tomography (CT) scan showed fat stranding around the pancreas suggesting pancreatitis (Figure 1). Blood urea nitrogen and hematocrit levels were normal with values of 18 mg/dl and 43.9%, respectively. Accordingly, the patient was diagnosed with ERCP-induced pancreatitis.

The patient received medical management for pain, was given intravenous fluids, and kept from food or drink intake for bowel rest until he could tolerate oral intake. He began to develop severe hypocalcemia, mild hypomagnesemia, and severe hypophosphatemia with levels reaching 5.6 mg/dl, 1.5 mg/dl, and 0.9 mg/dl, respectively. Thus, oral and intravenous supplementation were initiated. An abdominal CT scan performed on day two showed acute pancreatitis with development of peripancreatic collection measuring approximately 8 cm anteroposterior, 11.7 cm transverse, and 4.5 cm craniocaudal interposed between the pancreas and stomach (Figure 2).

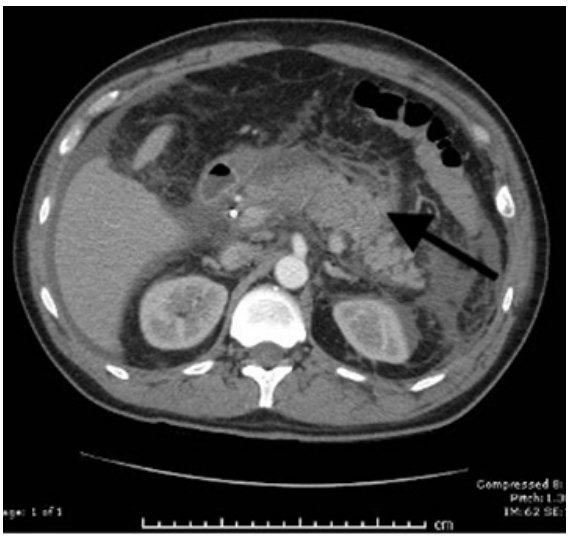

Figure 1. Abdominal CT scan shows peripancreatic fat stranding suggestive of pancreatitis.

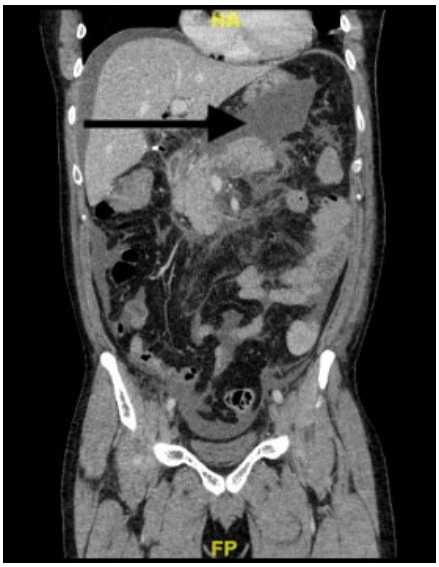

Figure 2. Abdominal CT scan shows pancreatitis and newly forming peripancreatic fluid.

When 40 mmol of intravenous sodium phosphate was initiated at a rate of 250 ml/hour, the patient experienced pressure-like substernal chest pain and worsened tachycardia reaching 127 bpm, which did not resolve until intravenous infusion was stopped. An electrocardiogram showed sinus tachycardia and nonspecific ST and T wave changes (Figure 3). Troponin I levels were elevated, reaching 0.71 ng/ml. Chest x-ray showed moderate left and mild right pleural effusion. Calcium level was 6.9 mg/dl.

The patient's angina in the presence of elevated cardiac enzymes prompted treatment with aspirin, 324 mg, and intravenous heparin drip. Troponin trended down afterwards, reaching 0.09 ng/mL. A repeat abdominal CT scan (Figure 4) showed increased peripancreatic and mesenteric inflammatory changes concerning for worsening pancreatitis, no evidence of pancreatic necrosis, and a peripancreatic fluid collection superior to the pancreas extending from the head/proximal body into the left upper quadrant measuring 16.7 x 6.9 x 11.3 cm.

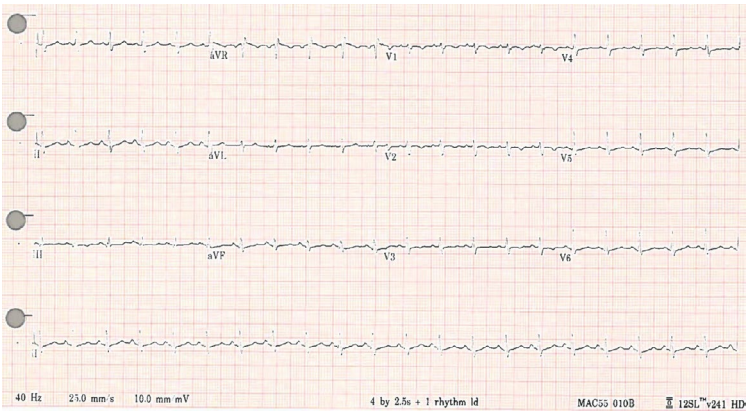

Figure 3. Electrocardiogram shows sinus tachycardia and ST and T wave changes.

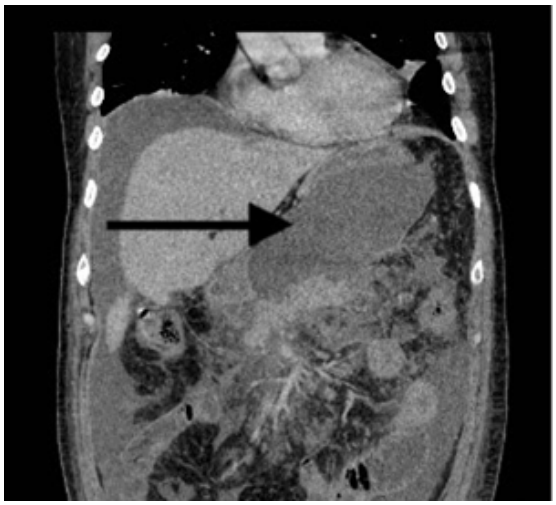

Figure 4. Abdominal CT scan shows pancreatitis and expanding peripancreatic fluid collection.

The hospital course continued without cardiac disease manifestation and electrolytes were replenished. Intravenous potassium phosphate was infused at a slower rate of 187.5 ml/hour to supplement phosphate without causing side effects, which may have been attributed to the phosphate infusion. Chest pain resolved soon after the initiation of treatment and was discharged home safely. The patient remained asymptomatic afterwards, but required further follow-up on complications secondary to his pancreatitis.

Echocardiogram performed one month later showed no myocardial wall abnormality, ejection fraction of 60-65%, and no pericardial effusion.

DISCUSSION

Acute pancreatitis is a very common gastrointestinal disease and can present with varying severity spanning from a mild disease requiring conservative management to severe disease associated with a worse prognosis.[3] Management of acute pancreatitis includes early aggressive fluid resuscitation and pain management.[4]

The pathophysiology of acute pancreatitis includes activation of trypsinogen into trypsin within the acinar cells upon increased ductal pressures and adenosine triphosphate depletion resulting in increased intra-acinar calcium concentration which activates zymogens.[5,6] This leads to the destruction of pancreatic parenchyma and the release of Damage Associated Molecular Patterns (DAMPs) that activate neutrophils and trigger the inflammatory cascade responsible for the systemic manifestation of acute pancreatitis. As a result, increased capillary permeability and damage of the endothelium results along with microvascular thrombosis that leads to multiorgan dysfunction syndrome (MODS).

Electrolyte abnormalities associated with pancreatitis include hypocalcemia and hypomagnesemia. The pathophysiology is not clear but suggested to be secondary to pancreatic enzymes digesting peripancreatic fat, and thus releasing fatty acids that bind free calcium.[7,8] However, severe hypophosphatemia (< 1 mg/dl) in acute pancreatitis rarely was mentioned in the literature, and when it was, it often was attributed to alcohol in alcohol-induced pancreatitis.[9] Intravenous supplementation of phosphate in critically ill patients has been documented to be safe and efficacious.[10] In general, causes of hypophosphatemia were inadequate phosphate intake, extracellular to intracellular space phosphate shift, and increased phosphate excretion.[11] Severe hypophosphatemia rarely was mentioned in acute pancreatitis, and its management is not explained in this context.

Side effects of intravenous phosphate supplementation are limited to confusion, weakness, lightheadedness, nausea, chest pain, irregular cardiac rhythm, numbness or tingling in extremities, weakness, decreased heart rate, weak pulse, or decreased respiratory rate.[12] It can result in hypocalcemia as the infused phosphate binds the free calcium.[10] This can precipitate vasospasms or arrhythmias leading to decreased blood supply to the cardiac muscle and precipitate anginal symptoms.[13]

We speculate that the angina that our patient experienced might have been precipitated by decreased cardiac blood and oxygen supply secondary to phosphate supplementation directly or due to iatrogenic transient hypocalcemia and resulting in hypotension or transient arrhythmia. Guidelines for the assessment of acute chest pain recently were published to guide management of similar episodes.[1] Another study suggested several biomarkers to differentiate between type I myocardial infarction, type II myocardial infarction, and myocardial injury.[14] This can lead to more accurate diagnoses and understanding of the underlying pathophysiology of cardiac chest pain in the future. Further studies also are needed to assess the mechanism and guide treatment of severe hypophosphatemia in patients with acute severe pancreatitis.

Limitations of our case report included the absence of a troponin level prior to the chest pain incident, which did not provide an accurate temporal relationship between enzyme elevation and the chest pain.

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Keywords: acute chest pain, pancreatitis, hypophosphatemia, case report

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Dacryocystitis Involving *Parvimonas micra* and *Bacteroides thetaiotaomicron* Infection

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INTRODUCTION

Dacryocystitis is an inflammation of the nasolacrimal canals. The disease is most prevalent in pediatrics and individuals above 40 years of age, following a bimodal age distribution, with predilection for white or female populations.[1] Dacryocystitis commonly is caused by acute infection of a ductal obstruction and appears as an erythematous, tender, inflamed medial orbit. Treatment of infectious dacryocystitis involves warm compress and oral antibiotics.

Common infectious organisms involved in dacryocystitis include *Staphylococcus* spp., *Streptococcus* spp., *Haemophiles influenza*, and *Pseudomonas aeruginosa*.[1] No known cases were reported in the medical literature of lacrimal duct infection by *Parvimonas micra*, a gram-positive organism native to the human gastrointestinal flora and associated with blood and oropharyngeal infections after dental procedures,[2] or *Bacteroides thetaiotaomicron*, a component of gastrointestinal flora and fecal matter.[3]

This case of dacryocystitis presented with cultures positive for *P. micra* and *B. thetaiotaomicron*. Whereas common infectious organisms implicated in dacryocystitis are aerobic, *P. micra* and *B. thetaiotaomicron* are anaerobes with unique pharmaceutical resistances. Currently, empiric treatment consists of oral antibiotics with gram positive and negative coverage, such as amoxicillin/clavulanate or clindamycin.[1] Awareness of these novel causative agents of dacryocystitis can help tailor empiric antibiotic therapies.

CASE REPORT

A 50-year-old Hispanic female presented to the emergency department with two days of severe eye pain, increased tearing, decreased vision, and foreign body sensation involving only the right eye. Past medical history was significant for diabetes mellitus type 2 with hyperglycemia, hyperlipidemia, obesity, and one month of diagnosed hypertension. She reported two previous episodes of similar symptoms in 1994 and 2001, for which there was no available documentation. In 2001, she required incision and drainage, followed by amoxicillin.

Physical exam revealed an injected right conjunctiva with purulent discharge and a right eye pressure of 35 mmHg, bilateral middle ear effusions, and swollen right and left turbinates. The left eye was unremarkable. The patient reported pain with right head turn and physical exam revealed palpable right cervical lymphadenopathy; her history was otherwise unremarkable. The patient denied tobacco, alcohol, or illicit substance use. Vancomycin 20 mg/kg IV was started. The ophthalmology service was consulted.

Slit lamp exam revealed periorbital edema and ecchymosis as well as induration inferior to the right medial canthus. Conjunctiva showed 1+ injection; otherwise, anterior segment exam was normal. Dilated fundus exam revealed symmetric cup to disc ratios of 0.8. Computed tomography of the head and neck with contrast revealed right dacryocystitis with surrounding pre-septal cellulitis with subtle stranding in the medial extraconal fat along the posterior aspect of the fluid collection.

The patient was diagnosed with dacryocystitis with subsequent spread to the orbit based on induration inferior to the right medial canthus, in addition to orbital cellulitis. Piperacillin/tazobactam was started when the patient was admitted to inpatient services. On inpatient day one, the infectious disease service recommended switching from vancomycin to linezolid 600 mg/D5W 300 mL IV due to worsening infection. Rigid endoscopy was negative for sinus disease or bony erosion, but revealed a superficial pre-septal abscess. On inpatient day two, the patient was brought to the operating room and swabs from the medial canthus were sent for culture. The patient underwent dacryocystorhinostomy with tube placement, during which the abscess was drained and sent for culture.

On post-operative day two following dacryocystorhinostomy, the patient's pain improved, and the infection began showing signs of clearing. On post-operative day four, the cultures and susceptibilities returned. Anaerobic culture showed moderate growth of *B. thetaiotaomicron* and heavy growth of *P. micra* alongside heavy growth of additional mixed flora. Aerobic culture showed moderate growth of *Staphylococcus lugdunensis* and three colonies of *Staphylococcus epidermidis*. Piperacillin/tazobactam was switched to ampicillin/sulbactam 3 g in 100 mL IV piggyback. The patient was discharged post-operative day six on amoxicillin/clavulanate 875 mg twice daily.

DISCUSSION

No known cases in the literature depicted dacryocystitis caused by *P. micra* or *B. thetaiotaomicron*. However, Barnet et al.[4] reported several panophthalmitis cases involving *P. micra* infection, demonstrating *P. micra* can infect tissue with anatomic proximity to the tear ducts. *P. micra* has been reported as an infective cause of chronic periodontitis, endocarditis, renal abscesses, and psoas abscesses.[5-7] These reported findings were expected, given the organism is a normal part of gastrointestinal, oral, genital, and potentially skin flora.[2,8] *Staphylococcus lugdunensis* and *Staphylococcus epidermidis*, the aerobic infecting agents present in our patient's tear duct culture, are also components of normal skin flora and commonly implicated in nasolacrimal duct infections.[9,10] Because *S. lugdunensis*, *S. epidermidis*, and *P. micra* are components of skin flora, it would be logical to assume skin flora may have entered the tear ducts. Furthermore, the patient owned a dog and allowed the dog to lick her face; hence oral flora could have entered the tear ducts through direct contact of the adnexa oculi to canine saliva, resulting in *P. micra* infection.[11]

B. thetaiotaomicron, the other anaerobic infective agent, is part of gastrointestinal tract flora.[3] No evidence suggested *B. Thetaiotaomicron* is a normal component of skin flora, reducing the likelihood of

our findings being due to contamination of cultures by skin microbes. Gastrointestinal and skin flora may have entered the tear ducts via poor hand hygiene after toilet use, followed by touching of the inner eye. The patient's anaerobic infection played a large role in her dacryocystitis as suggested by the heavier growth in the anaerobic cultures relative to the aerobic cultures.

Both organisms display drug-resistances that should be considered during treatment. *P. micra* commonly exhibits resistance to doxycycline (11.3% resistant) and clindamycin (47.3% resistant).[12] A study examining isolates of *B. thetaiotaomicron* showed resistance to moxifloxacin (44.9% resistant), clindamycin (51.0% resistant), and cefoxitin (14.3% resistant).[13] Clindamycin is a common empiric dacryocystitis treatment.[14]

This case reported that *P. micra* and *B. thetaiotaomicron*, which commonly exhibit clindamycin resistance, can be implicated in dacryocystitis. This report should allow clinicians to reassess whether clindamycin is a suitable empiric treatment choice for dacryocystitis, especially in patients with risk factors for *P. micra* and *B. Thetaiotaomicron* infection. Additionally, this case informed clinicians that, if dacryocystitis is refractory to the listed antibiotics, these organisms should be considered. Lastly, consideration of infection by these agents may be warranted in patients with frequent facial exposure to canine oral flora.

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Keywords: bacteroides, dacryocystitis, ophthalmology

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Letter to the Editor: Before Blaming SARS-CoV-2 Infection or Vaccination for Takotsubo, Differentials Should be Ruled out

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Dear Editor,

We read with interest the article by Rahimi et al.[1] about a 67-year-old female with symptomatic SARS-CoV-2 infection beginning 10 days prior to admission, administration of the second dose of the Moderna anti-SARS-CoV-2 vaccine four days prior to admission, and admission for respiratory insufficiency (tachycardia, tachypnoea, and hypoxigenation) without fever or cough. Examination for sudden chest pain on hospital day two revealed Takotsubo syndrome (TTS). Myocardial infarction was ruled out by coronary angiography. Decreased systolic function improved within three weeks of hospitalization, but the overall outcome was not provided. The study was appealing but raised concerns.

Whether TTS was due to the SARS-CoV-2 infection or due to SARS-CoV-2 vaccination was not discussed. Since both occurred before the suspected onset of TTS and both have been reported as causes of TTS,[2,3] it is crucial to delineate whether one or both were causative. It also should be considered whether TTS was triggered by respiratory insufficiency (there was severe hypoxigenation), which can cause severe anxiety, and whether TTS occurred prior to hospitalization or prior to SARS-CoV-2 vaccination.

Since SARS-CoV-2 infections or vaccinations can be complicated by myocarditis,[3,4] the exclusion of myocarditis by cardiac magnetic resonance imaging with contrast medium or endo-myocardial biopsy is crucial. We should be informed of the results of creatine-kinase (CK), CK-MB, and pro-brain natriuretic peptide (proBNP) serum levels. Since the patient had an "irregular tachycardia", we should be informed whether this was classified as sinus-arrhythmia, supraventricular arrhythmia (particularly atrial fibrillation), or ventricular arrhythmia. Knowing the type of arrhythmias is essential as treatment varies between them. We should know whether TTS also was seen on transthoracic echocardiography or only on ventriculography. According to the description, echocardiography revealed apical hypokinesia, but no apical ballooning.[1] After how many days did apical ballooning resolve?

Since the onset of TTS remains unclear, we should know the results of the electrocardiogram (ECG) at admission, specifically whether upslanting ST elevation already was present on hospital day one.

We should know if pulmonary embolism has been ruled out by spiral CT with contrast medium or if the patient just received a plain CT scan of the lungs. Was there any evidence of acute right ventricular strain on echocardiography?

A limitation of the study was that no reference limits for blood tests were specified.[1] Another limitation was that the cardiovascular risk profile was not reported in addition to arterial hypertension. We should know if the patient had diabetes, hyperlipidemia, a history of stroke or myocardial infarction, or if she was smoking. There was no information about the treatment that the patient received for TTS.

Overall, the interesting study had limitations that call the results and their interpretation into question. Clarifying these weaknesses would strengthen the conclusions and could improve the study. The diagnosis of TTS requires the exclusion of various differential diagnoses, including myocarditis.

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Keywords: SARS-CoV-2, COVID-19, Takotsubo cardiomyopathy, heart failure, complications

Author Response: Before Blaming SARS-CoV-2 Infection or Vaccination for Takotsubo, Differentials Should be Ruled out

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In response to the Letter to the Editor by Dr. Finsterer and Dr. Stollberger, we submit the following information.

1. Whether Takotsubo syndrome (TTS) was due to the SARS-CoV-2 infection or due to SARS-CoV-2 vaccination was not discussed.

Response: Based on the information provided, TTS was suspected to both the acute COVID-19 infection and possibly the vaccine. As documented in our case, IL-6 induced inflammation from the acute viral infection likely caused TTS,[1] but as also cited by Fearon et al.[2], there are cases of vaccine induced TTS, which based on our patient's timeline makes this differential possible.

2. It also should be considered whether TTS was triggered by respiratory insufficiency (there was severe hypoxigenation), which can cause severe anxiety, and whether TTS occurred prior to hospitalization or prior to SARS-CoV-2 vaccination.

Response: Although this is a possibility, the underlying cause of the hypoxigenation and anxiety would be the COVID-19 infection and/or the COVID-19 vaccine.

3. Since SARS-CoV-2 infections or vaccinations can be complicated by myocarditis,[3,4] the exclusion of myocarditis by cardiac magnetic resonance imaging with contrast medium or endo-myocardial biopsy is crucial. We should be informed of the results of creatine-kinase (CK), CK-MB, and pro-brain natriuretic peptide (proBNP) serum levels.

Response: No cardiac MRI was available to assist with diagnosis, but given the severe troponin elevation with no signs of coronary ischemia, the likely cause of a hs-troponin > 3,000 ng/L is myocarditis. No CK-mb or CK levels were collected as hs-troponin is a better barometer for myocardial tissue damage.

4. Since the patient had an "irregular tachycardia", we should be informed whether this was classified as sinus-arrhythmia, supraventricular arrhythmia (particularly atrial fibrillation), or ventricular arrhythmia. Knowing the type of arrhythmias is essential as treatment varies between them.

Response: It was atrial fibrillation that was paroxysmal and resolved by discharge. Given the elevated CHADVASC score, the patient was discharged on anticoagulation. This was not placed in the report as it was not in relation to the TTS and given it had resolved with treatment for the inflammatory response was likely stress induced as well. This could be another area to consider for a future separate report.

5. We should know whether TTS also was seen on transthoracic echocardiography or only on ventriculography. According to the description, echocardiography revealed apical hypokinesia, but no apical ballooning.[1] After how many days did apical ballooning resolve?

Response: Apical hypokinesis is synonymous with ballooning in the setting of basal wall hyperkinesis and it was noted in the report[1] that the findings were collected by a transthoracic echocardiogram. The resolution was after 16 days, which was omitted as it was not relevant for the outcome of the report.

6. Since the onset of TTS remains unclear, we should know the results of the electrocardiogram (ECG) at admission, specifically whether upslanting ST elevation already was present on hospital day one.

Response: Although not noted in the original manuscript, there were no ST elevations on admission as could have been inferred, as the patient was admitted on BiPAP without being sent for cardiac angiography, which is standard of care if the patient was found to have ST elevations with signs of cardiopulmonary distress.

7. We should know if pulmonary embolism has been ruled out by spiral CT with contrast medium or if the patient just received a plain CT scan of the lungs.

Response: The report stated CT chest with contrast was negative for pulmonary embolism.[1] This was a spiral CT as that was the indication for getting the CT.

8. Was there any evidence of acute right ventricular strain on echocardiography?

Response: No strain was noted.

9. A limitation of the study was that no reference limits for blood tests were specified.

Response: Standard normal values are used at our laboratory. The findings reported were significantly elevated such that any laboratory normal value could be inferred.

10. Another limitation was that the cardiovascular risk profile was not reported in addition to arterial hypertension.

Response: Risk profile was to be inferred by the reader given the patient's past medical history noted by the report.[1] Arterial hypertension was noted by stating the patient had a history of hypertension.

11. We should know if the patient had diabetes, hyperlipidemia, a history of stroke or myocardial infarction, or if she was smoking.

Response: None was reported as she did not have any of these conditions. Given the report was on cardiac disease, these would be reported if positive.

12. There was no information about the treatment that the patient received for TTS.

Response: Given the TTS was suspected to be secondary to either acute COVID-19 infection or post-vaccination, then treatment would be COVID-19 infection driven. As noted, she received steroids, remdesivir, and evaluated for tociluzimab.[1]

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Pediatric COVID-19 Vaccination: A Description of Adverse Events or Reactions Reported in Kansans Aged 6 to 17

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ABSTRACT

Introduction. There have been widespread concerns about the safety of the COVID-19 vaccines, particularly when it comes to pediatric populations, and it is important to provide information for parents and guardians to make informed decisions. This study sought to identify the adverse events or reactions (AERs) associated with the COVID-19 vaccines in Kansans aged 6 to 17.

Methods. The U.S. Department of Health and Human Services' "Vaccine Adverse Event Reporting System" (VAERS) database was searched from May 11, 2021, to April 30, 2022, for AERs related to COVID-19 vaccines in adolescents ages 6 to 17. Results were grouped by vaccine manufacturer and patient gender.

Results. A total of 159 individuals reported 409 AERS, with an average of 2.6 per person (± 1.7; median = 2; range 1 to 10). Females (n = 95) reported 237 AERs, with an average of 2.5 each (±1.7; median = 2; range 1 to 8), while males (n = 64) reported 172 AERs, with an average of 2.7 each (±1.8; median = 2; range 1 to 8). The most common adverse event associated with Pfizer® vaccination was syncope/fainting.

Conclusions. COVID-19 vaccines have undergone intensive monitoring and safety regulations since the onset of the coronavirus. With over 591 million doses administered, there was compelling evidence that the COVID-19 vaccines are safe and effective. Informing the public about the potential AERs of the COVID-19 vaccines in children can help to alleviate vaccine hesitancy and strengthen vaccination confidence.

Kans J Med 2022;15:390-393

INTRODUCTION

In December 2019, the first case of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection, colloquially known as "coronavirus 19" or "COVID-19", was seen in China.[1] The virus rapidly spread throughout the first few months of 2020, becoming a worldwide pandemic, with the first case in the United States reported on January 20, 2020. Due to the rapid spread and virulent nature of the SARS-COV-2 virus, a national campaign to develop a vaccine in the U.S. ensued. The United States Food and Drug Administration (FDA) declared an emergency use authorization (EUA) for the first COVID-19 vaccine on December 11, 2020. This vaccine was manufactured by Pfizer-BioNTech (Pfizer®) and had an efficacy rate of up to 95%.[2] This vaccine was first given an EUA for those persons aged 16 and older and subsequently given emergency approval for children ages 5 to 15 by October 29, 2021.[3]

The Pfizer® vaccine requires two doses given three weeks apart for all age groups. For children who are moderately or severely immunocompromised, the U.S. Centers for Disease Control and Prevention (CDC) recommended that they receive a total of four doses of the Pfizer® vaccine.[4] This would include a primary series of three doses and an additional booster shot.[5] On December 18, 2020, the FDA granted an EUA for a second COVID-19 vaccine developed by Moderna® Therapeutics, the National Institute of Allergy and Infectious Diseases (NIAID), and Biomedical Advanced Research and Development Authority (BARDA).[6] The Moderna/NIAID/BARDA (Moderna®) vaccine was authorized for persons aged 18 and older and requires two doses to achieve an efficacy rate of 94.1%.[7] The FDA granted one more EUA for Johnson & Johnson's Janssen® (J&J) single dose COVID-19 vaccine on February 27, 2021, for persons 16 and older.[8] The J&J vaccine has a slightly lower efficacy rate at 66.3%.[9]

These three vaccines continue to be monitored and serious adverse events or reactions (AERs) that occur after administration are reported by health care providers through the U.S. Department of Health and Human Services' "Vaccine Adverse Event Reporting System" (VAERS). VAERS is co-managed by the FDA and CDC, and accessible through the public resource WONDER (Wide-ranging ONline Data for Epidemiologic Research). The VAERS defines serious AERs as:

> *Death; a life-threatening adverse event; inpatient hospitalization or prolongation of existing hospitalization; a persistent or significant incapacity or substantial disruption of the ability to conduct normal life functions; a congenital anomaly/birth defect; an important medical event that based on appropriate medical judgement may jeopardize the individual and may require medical or surgical intervention to prevent one of the outcomes listed above; cases of multisystem inflammatory syndrome; cases of COVID-19 that result in hospitalization or death.*[10]

Individuals can submit their AERs directly to VAERS online or report to their health care provider or vaccination manufacturer, who are mandated to report the AERs to VAERs.[10] These reports cannot be used accurately to determine if a vaccine directly caused the reported AERs, however, the VAERS system can be utilized to detect unusual patterns ("safety signals") that are monitored regularly by VAERS staff.

From December 11, 2020 to May 13, 2021, the AERs reported in persons aged 18 and older in Kansas revealed that only 0.00068% of all COVID-19 vaccine doses given were associated with an AER.[11] The most common AERs associated with the three vaccines included fatigue/tiredness, tingling/itching, fever, hives, and muscle/joint pain. Furthermore, no report extrapolated from the VAERS system in Kansas provided a sufficient causal link between a COVID-19 vaccine and death. In contrast, there have been over 841,000 cases of COVID-19 and 8,970 deaths logged in Kansas due to COVID-19.[12] Nationally, there have been 1,257 deaths reported due to COVID-19 in individuals between the ages of 6 to 18.[13] Moreover, instances of long COVID-19 in children who suffer from morbidity post COVID-19 infection have been reported significantly in the U.S., however, exact numbers of incidence or prevalence were unknown.

Given the potential risks associated with COVID-19 infection in children and the sensitive nature associated with vaccine uptake in the

country, it was important to give individuals and parents the knowledge they need to make informed decisions about COVID-19 vaccines. There have been widespread concerns about the safety of the COVID-19 vaccines, particularly when it comes to pediatric vaccine administration. This study sought to shed light on the current state of adverse events associated with the COVID-19 vaccines approved for use in ages 6 to 17 in Kansas with the hope that parents may use this as a guiding resource when it comes to COVID-19 vaccine safety.

METHODS

The VAERS database was searched from May 11, 2021 to April 30, 2022, for AERs related to the three COVID-19 vaccines in adolescents ages 6 to 17. The study team chose this time period as it was the time period when this age group was given FDA approval up until the date children five and under were given approval. Results were grouped by vaccine manufacturer, whether the impacted patient resided in Kansas, patient age and gender, and included information on AER description, as well as any relevant or available data regarding labs, current illnesses, AERs after prior vaccinations, medications at time of vaccination, and medical history and/or allergies. The full description of the search strategy is available from the authors upon request. This study was approved by the University of Kansas School of Medicine Institutional Review Board as non-human subject research.

Data Screening. The search identified 292 separate patient entries in VAERS. The initial data file was screened by two of the authors (AT and KN) for entries that needed to be removed. One hundred and twenty-seven entries were removed for seven reasons: a COVID-19 diagnosis (four removed), an appendicitis diagnosis (one removed), report of improper vaccine storage (six reported), incorrect dosage given (40 removed), report of unapproved underage administration (70 removed), entries that were not COVID-19 vaccine related (six removed), and duplicate entries (two removed). The breakdown of the screening criteria by vaccine manufacturer is shown in Table 1. Of the initial 292 entries, 129 were removed for a total of 163 VAERS entries to be coded by the research team.

Table 1. VAERS COVID-19 vaccine entry data screening procedure.

	Pfizer®	Moderna®	J&J	Total
Initial Cases	**246**	**37**	**9**	**292**
Cases Removed				
Removed for COVID-19 diagnosis; no AER noted	4	0	0	4
Appendicitis diagnosis; no AER noted	1	0	0	1
Improper storage; no AER noted	6	0	0	6
Incorrect dose given; no AER noted	40	0	0	40
Underage administration; no AER noted	29	35	6	70
Not vaccine related; No AER noted	6	0	0	6
Duplicate entry removed	1	1	0	2
Total Removed	**87**	**36**	**6**	**129**
Final Cases	**159**	**1**	**3**	**163**

Data Coding. Each VAERS entry was screened by one of the three authors, coded by another, and reviewed by the third, with a rotating list of entries for each author, ensuring that each entry was seen and checked by all three members of the authorship team. Any entries that were unclear were resolved by discussion. Each identified AER that appeared two or more times was coded into a separate category, for a total of 43 identified categories of AERs related to the COVID-19 vaccines. Sixteen category names utilized wording obtained from the side effects listed on the information sheets provided by the manufacturer for each vaccine.[14,15] The additional 26 categories were named based on medical and lay terms for the AER identified (i.e., diaphoresis/cold sweats). Additionally, there was a category named "other" for 22 individual entries that did not fall into the identified AER categories. Within all 43 categories, there were a total of 409 separate AERs reported. Table 2 shows the AER categories identified with the breakdown of number of coded entries in each.

Data Analysis. Descriptive statistics were used to describe AERs reported by vaccine manufacturer (Pfizer®, Moderna®, and J&J) and gender (male and female). Traditional statistical analyses were not performed beyond calculating the inter-rater reliability, as this is a purely descriptive study of reported AERs and causal inferences are unable to be performed due to the nature of the VAERS system.

Table 2. Specific AERs indentified (Pfizer® only).

Syncope (fainting)	40	Loss of appetite	5
Fever	28	Redness	5
Dizziness	24	Sore throat	5
Fatigue	23	Weakness	5
Headache/migraine	23	Abdominal pain	4
Nausea	20	Body aches	4
Dyspnea (shortness of breath)	14	Numbness	4
Pallor/pale skin	14	Tachycardia (fast heartbeat)	4
Pain at injection site	13	Abnormal menses	3
Chest pain	12	Confusion	3
Muscle/joint pain	12	Cough/congestion	3
Pruritus (tingling/itching)	12	Ear pain/tinnitus	3
Diaphoresis (cold sweats)	11	Angioedema (swelling)	2
Rash	11	Arm pain	2
Vomiting	11	Bruising	3
Mental health issues	9	Diarrhea	2
Seizure	9	Eye pain	2
Vision issues	9	Hematuria (blood in urine)	2
Chills/shaking	8	Incontinence	2
Urticaria (hives)	8	Insomnia	2
Hypotension	6	Other	22
Allergic reaction	5	**Total**	**409**

RESULTS

Adverse Events or Reactions (Table 2). For ages 6 through 17 in Kansas, 209,215 individuals have been vaccinated out of 516,487 eligible adolescents for a vaccination rate of 40.5%. A total of 159 individuals reported adverse events out of the 209,215 adolescents vaccinated (0.08%). Overall, there were a total of 409 AERS reported with the Pfizer® vaccine, with an average of 2.6 per person (± 1.7), median of 2, and a range of 1 to 10. Females (n = 95) reported 237 AERs, with an average of 2.5 each (±1.7; median of 2, range 1 to 8); while males (n = 64) reported 172 AERs, with an average of 2.7 each (± 1.8; median of 2, range 1 to 8). The most common adverse event associated with Pfizer® vaccination was syncope/fainting (Table 2). The second most common AER reported was fever (n = 27), followed by dizziness (n = 24), fatigue (n = 23), and headache/migraine (n = 23). Females were more likely to report syncope (n = 23), dizziness (n = 18), fever (n = 13), and headache/migraine (n = 12); while males were more likely to report syncope (n = 17), fever (n = 14), headache/migraine (n = 11), fatigue (n = 10), and nausea (n = 10).

Moderna®/NIAID/BARDA and Johnson & Johnson's Janssen® Vaccines. While the Moderna® vaccine has been approved only for ages 18 and older, there was one underage administration to a female who reported tachycardia, dyspnea, headache, fever, arm pain, and dizziness. The J&J vaccine has been approved for ages 16 and older, but three people with underage administration (two females, one male) reported the following AERs: dizziness (one female), body aches (one male, one female), headache (one male), and fever (one female).

Other Adverse Events or Reactions Reported. Overall, there were 22 AERs that were outliers, meaning they were only reported in VAERS once and they did not fall into one of the 43 identified categories. All "other" AERs were reported with the Pfizer® vaccine: cerebral venous thrombosis (blood clot), hemoptysis (coughing up blood), acute dacryoadenitis (lacrimal gland inflammation), vasculitis (inflammation of blood vessels) in both feet, autism, hypoglycemia, bump on head, subacute progressive emergence of obsessive compulsive disorder-like behaviors, methicillin-resistant staphylococcus aureus, pneumothorax (collapsed lungs), ageusia (loss of taste), Bell's Palsy, non-specified heart failure, hearing loss, vision loss, vulvodynia (vulvar pain), epistaxis (nosebleed), breast lump, pneumonia, pulmonary embolism, motor tics, and vocal tics.

DISCUSSION

Similar to a prior manuscript,[11] causality between adverse events and vaccination was difficult to establish. No deaths in this vaccinated cohort were seen, however, and reported serious adverse events were limited. Other studies have noted similar results.[16-18] Notably, no reports of myocarditis were identified within our VAERs analysis, which was a point of concern for many individuals in the academic and lay community alike regarding the Pfizer® vaccine in particular.[19,20] Of further note, some of the adverse events like syncope/fainting could be unrelated to the actual action of the vaccine and more associated with anxiety over vaccine administration, which could trend adverse events even lower. Given these facts, this study further may enshrine the narrative that adverse events, of all levels of severity, are rare and the risk-benefit ratio was in favor of receiving a COVID-19 vaccine.

One troublesome note in our study was that 38.3% of original adverse event entries (n = 110) were screened out due to vaccine administration to underage individuals, or the incorrect dosage was given. These issues were concerning given research is still underway regarding the safety of these vaccines in certain pediatric populations. Furthermore, the J&J COVID-19 vaccine, as of the completion of this project, has not been approved and is not recommended for individuals under 18 years of age, and nine individuals in our study received that vaccine. In this regard, research and quality improvement studies may be needed to reduce the amount of vaccine administration errors seen with the rollout of the COVID-19 vaccines, due to the potential negative health outcomes of such errors.

Given the small number of children who have received a COVID-19 vaccination in Kansas, the main issue at hand was addressing the concerns that individuals and their families have regarding vaccine uptake. A survey by the Kaiser Family Foundation reported that only 27% of parents of 5 to 11 year olds across the country were keen to immunize their child for COVID-19.[21] Furthermore, a recent study found that a cohort of parents felt that vaccine side effects were the most significant factor associated with COVID-19 vaccine hesitancy.[22] A main underlying concern that likely gives rise to the hesitancy associated with concerns of vaccine side effects was the fact that COVID-19 vaccines are relatively novel. A 2021 study by Trojano and colleagues found that the most observed reasons for refusal of COVID-19 vaccination were concerns about safety/thinking that a vaccine produced in a rush is too dangerous.[23] These two concerns of safety and novelty often were equated to each other, and more research may be needed on the appropriate ways to educate individuals to make informed decisions when it comes to COVID-19 vaccinations. As with our prior manuscript,[11] it is the hope that this study can be used as a valuable resource for those who are unsure about receiving a COVID-19 vaccine themselves or allowing their children to be vaccinated.

Limitations. The Pfizer® vaccine was approved for adolescents five and older, however, our study focused on persons aged 6 to 17 due to limitations in the VAERS self-reported age categories. Additionally, VAERS is a passive reporting system, which means that anyone can report adverse events or reactions to the system. There was no guarantee that all AERs were reported, nor can any definitive link be established between the AER reported and the vaccine administered. Underreporting of AERs was also a possibility as some may not consider a particular adverse event important enough to report.

CONCLUSIONS

Currently, COVID-19 vaccines are only authorized for use in adults, adolescents, and children ages 6 to 11. Children under the age of five were the last remaining group in the U.S. pending full FDA approval for COVID-19 vaccination. COVID-19 vaccines have undergone intensive monitoring and safety regulations since the onset of the coronavirus, and with over 616 million doses administered in the U.S.,[24] there is compelling evidence that the COVID-19 vaccines are

to receive the COVID-19 vaccine could be a major step towards achieving herd immunity and mitigating the spread of the virus. The CDC, FDA, and healthcare providers agree that COVID-19 vaccines can help protect children against severe COVID-19 disease.[2,7,9,25-27]

With over 66% of the U.S. population fully vaccinated, along with other relief efforts, the effects of COVID-19 slowly are starting to diminish. Public health experts, elected officials, and healthcare professionals should take heed to provide reliable information to the public to encourage vaccine uptake.[28] Informing the public about the potential AERs of the COVID-19 vaccines in children can help to alleviate vaccine hesitancy and provides an additional source of information to strengthen vaccination confidence.

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A Qualitative Study of Traditional Bone Setters in South India: A Case Series

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ABSTRACT

Introduction. There are approximately 60,000 Traditional Bone Setters (TBS) in India, who have no formal education or training in modern medicine but treat approximately 60% of bone related trauma. This study investigated the history of TBS, why they are so popular, and their methods.

Methods. From a list of TBS from four states in South India, a purposive and convenience sampling method identified participants. One lead TBS from each state was interviewed. With recommendations from these TBS, a total of six participants were interviewed on Zoom® in their native dialect and these interviews were transcribed into English. The data were analyzed using a constant comparative method which included several iterations to refine common themes and determine counterfactual and specific focal points from each interview.

Results. Six overarching themes emerged: (1) history of traditional bone setters, (2) occupations outside bone setting, (3) training, certification, education, accolades, (4) patient characteristics and success stories, (5) infrastructure and approach to diagnosis/treatment, and (6) limitations of practice, challenges, and social relevance. The history of traditional bone setting is thousands of years old and passed down within families generationally.

Conclusions. In rural India, where a large part of the population lives in poverty and without access to modern medicine, traditional healers provide a much-needed service, often without charge, and consequently, the income is not sufficient without other occupations such as farming. They follow a similar approach to diagnosis and treatment of simple fractures and dislocations as modern medical practitioners. Most would like to share their knowledge and collaborate with ayurvedic and allopathic practitioners and simply want to be respected and supported.

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INTRODUCTION

Traditional Bone Setters (TBS) are so called "un-qualified practitioners" who have no formal education or training in medicine and treat dislocations and fractures using methods that have been passed down for generations. Reportedly, these traditions have survived for as long as 3,000 years.[1,2] There are approximately 60,000 TBS in India, and they treat approximately 60% of bone related trauma cases.[3] Accessibility is one of the main reasons for the popularity of TBS especially in rural areas, where a large population of the country resides, and where there are almost no orthopedic services available.[1,2]

Despite rapid urbanization and many advances in modern medicine, TBS continue to be a popular choice for many who do not want to undergo surgical intervention, or for whom the cost of seeing an orthopedic surgeon is too high.[3] Education level was not a factor in who patronized TBS.[4] With the widespread use of TBS, there has been concern that many complications such as malunion, compartment syndrome, and gangrene may be consequences of the methods employed by TBS.[5-18] These complications invariably require surgical intervention to fix, and the chance of good outcomes is reduced considerably.

The practice of traditional bone healing is popular in many developing countries such as some African countries,[19-21] China,[22,23] and the Indian subcontinent.[3,24-27] One such method is known as "Puttur Kattu" which literally translates to "bandage of Puttur," a town located in Chittoor District of Andhra Pradesh in South India.[2] Puttur also is popular for its numerous TBS practitioners. There are about 60 TBS despite its small population of 54,092. This traditional method has a legacy dating back to the late 19th century. They use splints made of bamboo sticks and a paste of an herb called "Kasamarda" that they gather in the wild.

The purpose of this study was to (1) explore why the art of traditional bone healing continues to flourish and the reasons for their success and failure and (2) investigate if there is a physiological basis to their methods, what processes and rigors of training they undergo to practice their art, their key skills and infrastructure requirements, and if there are processes of accreditation and verification of services by the State and by patients.

METHODS

This project was approved by the Institutional Review Board at the University of Kansas Medical Center. A qualitative study was designed to explore the history of traditional bone setting and the basis behind the methods used by TBS in South India. Interviews were conducted by the first author (SI-P) with TBS to learn more about their current practice of bone setting. The Foundation for Revitalisation of Local Health Traditions (FRLHT) and The University of Trans Disciplinary Health Sciences and Technology (TDU) in Bangalore collaborated to identify representative TBS interviewees.

The sampling frame was a list of TBS from the four south Indian states of Andhra Pradesh, Kerala, Tamil Nadu, and Karnataka shown in Figure 1. This list was provided by Mr. G. Hariram Murthi, Head of the Centre for Local Health Traditions at TDU. With the help of TDU collaborators, an introductory webinar for TBS was held to explain the purpose of the study and to build rapport, as many were reluctant to participate in a project conducted by a U.S. medical student. TBS typically experienced bias from the allopathic medical community which added to their apprehension. However, with the help of Mr. G. Hariram Murthi, whom they trusted and held in high regard, a sizable turnout resulted.

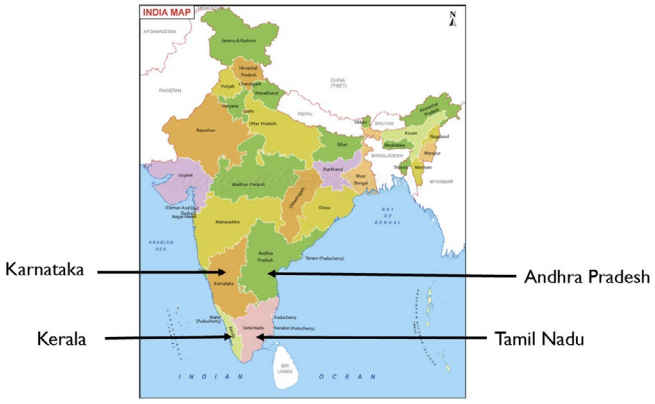

Figure 1. Map of South India.

Purposive and convenience sampling methods were used to identify TBS who met inclusion and exclusion criteria. Inclusion criterion included a TBS practicing in South India who was willing to do a virtual interview on Zoom®. Interviews were conducted on Zoom® and recorded with permission of the interviewees. Prior to the start of the interview, participants were given an information sheet and consent form which was signed by the field researcher, a local researcher/interpreter in India. These forms were written in English as well as translated in to the four south Indian languages, Telegu, Malayalam, Tamil, and Kannada. The interviews were conducted as a collaboration with field researchers from TDU who were fluent in these local dialects, using an interview guide with general questions regarding TBS practices (Appendix). The guide consisted of open-ended questions to gather data. These interviews were transcribed into English by the first author (SI-P). The interview guide was piloted with one lead TBS from each state of south India. Snowballing was used by asking these pilot interviewees to recommend additional TBS interviewees.

Data analysis was managed using the software program, NVivo®. This program allowed the use of a constant comparative method, which included several iterations to determine common themes and counterfactual/specific focal points from each interview.

RESULTS

Six TBS were interviewed from the four South Indian states (Table 1). Six themes emerged from the interviews.

Table 1. List of interview participants.

Subject	Location	Language	Generation	Years in Practice
Participant 1	Andhra Pradesh	Telegu	4th	37
Participant 2	Kerala	Malayalam	2nd	35
Participant 3	Tamil Nadu	Tamil	5th	39
Participant 4	Karnataka	Kannada	3rd	50
Participant 5	Andhra Pradesh	Telegu	4th	40
Participant 6	Tamil Nadu	Tamil	6th	32

Theme 1: History of Traditional Bone Setters. Participant 1 trained as an apprentice to his grandfather for 17 years, since he was 12 years old. His grandfather started bone setting in 1890 on cattle and as he found success, he began doing the same on humans. His fame grew by word-of-mouth. After learning from his grandfather, Participant 1 practiced with his father and passed the knowledge on to his own children and grandchildren. Two of his sons assisted him and another was studying to be a physiotherapist and helped in the clinic when not at school. His daughter assisted with herbal preparations. His wife apprenticed with him after their marriage. Thus, a sub-theme developed involving women TBS. Participant 1's wife was the reason he could travel to satellite facilities to see patients in remote areas, as she managed the patients in the clinic at home. His mother treated patients with jaundice using traditional medicines which she learned from her mother. Because of his family history of treating livestock, Participant 1 continued to get calls from veterinarians for bone setting of animals.

Participant 2 learned the tradition from his father who was a traditional venom healer (e.g., snake bites). He also trained in various schools of the Kalari martial art of Kerala, preparing medicated oils to use for massage as part of the martial arts, as well as practicing traditional bone setting which in turn he learned from his father. His early apprenticeship included collecting herbs to prepare "Thailams", the oils used in massage. His sister, wife, and daughters practiced TBS with him, and he had many students, both male and female.

Participant 3 learned this tradition from his father and grandfather. While his father treated animals, Participant 3 did not learn to treat animals. TBS was known by different names in different regions, and in this area of the state, called Sathuvachari, it is known as "Elumbu Murivu Vaidyar".

Participant 4 learned the tradition from his grandfather whose occupation was agriculture and treated animals before he used the same techniques on humans. He taught TBS to all his children and grandchildren, including women.

Participant 5's father was the first to establish a TBS clinic in their small village. Since then, their large family of several brothers, sisters, children, grandchildren, and in-laws practiced TBS all over the state of Andhra Pradesh. The roots of TBS in his Kshatriya warrior community were based on his ancestors hunting in forests where they collected herbs and plants for medicinal purposes, initially to use on domestic animals and later humans.

Participant 6 began his apprenticeship at the age of four years from his uncle who raised him. As a young apprentice, he climbed into barrels of Arishta and Asava (fermented Ayurveda formulations) to titrate these mixtures as he was small enough to fit in the barrels. Ayurveda is a traditional source of medicine combining various products such as plants, animals, and minerals. As Participant 6 advanced in age, he collected plants and made the medical pastes and oils. His sisters also learned this art from their uncle. Two of his sisters practiced with him, while other sisters and their children had their own independent establishments. He estimated that within his family they were probably the 6th or 7th generation in this tradition and the story in his family was that the teacher of his ancestors was a guru named Putru Maharishi.

Theme 2: Occupations Outside Bone Setting. Participant 1 and his family were farmers. They grew crops and had mango orchards.

These crops were their main source of income. They had a TBS clinic in Puttur and conducted camps in various underserved areas around the state.

Participant 2 worked as a salesman in the Middle East for several years, but now was involved full time in practicing and teaching martial arts and TBS. He had a registered martials arts academy at his home. He also had two TBS clinics.

Participant 3 had no other occupation outside of TBS. Participant 4 and his family were engaged in agriculture. Participant 5 was the headmaster of a primary school. Participant 6's father passed away when he was very young, so he did manual labor to earn enough while he was an apprentice until he established an independent practice. Now, TBS was his only occupation.

Theme 3: Training, Certification, Education, Accolades. Participant 1 learned medical terminology from looking at x-rays or reports that patients brought into his office. He read books to learn more. He had been invited by ayurvedic universities to talk about traditional bone setting practices and received honorary certificates. He was a member of an organization known as a Traditional Vidya Sangha which is an open forum of traditional healers who get together and share knowledge of their respective fields. He was writing a book about the various techniques used in bone setting along with case studies/success stories. While he did not have a formal degree/certificate for traditional bone setting, in his 37 years of service he had never been asked for these credentials.

Participant 2 completed a basic high school education, while learning Kalari, a traditional martial art and traditional bone setting from his father as his apprentice. As mentioned, he had a licensed martial arts academy which included students who learn Kalari and traditional medicine and he went through a rigorous process with the sports counsel to acquire and maintain this license. His students were expected to master Kalari first before they learned traditional bone setting practices as he believed that it set the foundation on which to learn more. They learned human anatomy, movement, and kinesiology and built the mental and physical strength required to do the procedures. He participated in the World Ayurveda Congress in New Delhi and was involved in research about medicinal plants and Kalari. He also was a member of an association of traditional bone setters who met monthly for conferences where they shared their skills, methods, and cases. He had a certificate from this association, but no other formal credentials. He was a Gurukul or disciple of Kalari. Many of his patients referred to him as "doctor" but he told them that he was simply "Vaidyar" or "Traditional Healer".

Participant 3 acquired his skills from his father, and in turn imparted them to his children. His education was through the "gurukula" system where the "guru" imparted his knowledge to a "shisya" or student, and in turn the student's duty was to be a guru to the next generation. It was a sacred relationship and was how most traditional medicine practices were passed down. He learned TBS this way and had over 30 students/apprentices whom he mentored over the years. He always was learning new things from them, as well as from other bone setters and believed that continuous learning was the only way to improve one's skills.

Participant 4 learned this tradition as an apprentice and had several students including his own children. He was a member of several associations of bone setters and other traditional healers, as well as associations related to ayurvedic medicine. He served on a forestry department board and taught others about medicinal plants. He had a certificate from FRLHT endorsing his status as a traditional healer and received many awards for his service. He had been consulted by many because of his knowledge of medicinal plants.

Participant 5 had a bachelor's in science and education. When he was a young college student, he would assist his father at the TBS clinic after class. It initially was a hobby to him, but he found that he had a passion for it.

Participant 6 studied civil engineering for a few years but due to the death of his father he had to stop his college education. He expressed some regrets about not completing his degree. He apprenticed with his uncle from the age of 4 and began independently practicing as a TBS at age 25. He was certified in "varma" which was an Indian traditional art of vital points and "marma" which was a special massage technique. He traveled to Thailand where he participated in workshops about these techniques. At Vivekananda Kendra in Kanyakumari, which was a social and religious organization, he was a respected teacher of marma where he had taught more than 5,000 students. He had a certificate from the Red Cross Society and from FRLHT endorsing his status as a traditional healer. He was awarded an honorary doctorate for his expertise in marma. He had several apprentices, who undergo a screening process which involved teaching them how to "behave" like a vaidyar, by abstaining from alcohol and tobacco. He had both male and female students, and the bulk of the education was hands-on learning in the clinic. There was some didactic teaching for which he used ancient manuscripts written on palm leaves, as well as modern textbooks on ayurveda. He also taught them how to collect medicinal plants and to make them into preparations used for treatment. He claimed this was the "weed-out" exercise for his students as many do not want to go through the trouble of foraging for plants. He was a student of "Silambam", a weapon-based Indian martial art originating in South India and taught it to his students. He founded an organization to unite Indian folk healers including tribal healers. They participated in knowledge exchange forums periodically and formed a co-operative trust. He received several awards by the state bio-diversity board for his work. He envisioned an academy on 400 acres of land that they have acquired through this trust, where students will receive a rigorous education from age 4 to 18. After which, students may stay and teach or leave and serve their communities.

Theme 4: Patient Characteristics and Success Stories. About 90% of people treated by Participant 1 lived in poverty. He saw approximately 200 patients a month. Medical students have visited him for treatment, but once they finish their studies, he thought they developed "an attitude" and no longer visited him. However, there was a primary care doctor in their village who sent patients to him and his brother. His charges were between Indian Rupees (INR) 100 - 500 (based on

the current exchange rate = $1.33 - $ 6.66), but if someone could not afford it, he would not only treat them for free, but also give them food and bus fare. Hence, a sub-theme of cost of treatment was developed. Participant 1 was confident that his son will continue this charitable work despite growing up and living in a more capitalistic society.

Participant 2 did not provide an estimate of his patient volume but as his popularity increased by word-of-mouth advertising, he saw more patients. He made house calls and traveled considerable distances if his services were requested. His fees were in the range of INR 100 - 500, though he sometimes asked his patients to buy some of the items such as bandages and herbs, in which case he charged less. He also provided free services to patients who could not pay.

Participant 3 estimated that approximately 75% of his patients lived in poverty or were lower middle class, but he also saw a few patients who were affluent. He did not have a set fee. He allowed his patients to donate what they could, but typically provided free services. He also relied on word-of-mouth advertising and had only good responses from his patients.

Participant 4 saw between 5 - 15 patients a day. They were not only from his village but from many nearby towns and villages. Many of his patients came to him after they had been treated by an orthopedic surgeon, sometimes because their previous treatment was unsuccessful, and other times to supplement their treatment/recovery with herbal remedies and massage. His fees only reflected the cost of some of the raw materials in the range of INR 50 - 100 but he did not charge for his services/time.

Participant 5 had the highest volume of patients of all participants in the range of 400 or more a day. He started 6 am and continued until 10 pm. He appeared to be very popular and claimed that many celebrities have visited his clinic. He had not heard a bad report from any of his patients. His fees were in the range of INR 100 - 500. However, he had an x-ray machine and charged extra for the cost of films but claimed that his prices were much lower than an allopathic facility. There were four orthopedists within a reasonable distance to his town, but people chose to go to him because of his lower cost.

A large percentage of patients visited Participant 6 because they had failed treatment in other systems of medicine especially allopathic, and he was able to treat them successfully. He also gained popularity by word-of-mouth publicity. His patients honored him with gifts and considered many of his treatments to be "miracles" as many of his cases were those that modern medicine was not able to fix. He also was developing a project, funded by donations, that would enable him to provide free treatment for those who cannot afford it.

Theme 5: Infrastructure and Approach to Diagnosis/Treatment. Participant 1 had one clinic at his home in Puttur, as well as clinics in other locations. He also traveled to conduct bone-setting camps. He did not have an x-ray machine but many of his patients brought various imaging and radiology reports, which he sometimes used to aid in diagnosis. His approach to diagnosis was by inspection, palpation, and testing range of motion. For rib fractures, he asked the patient to breathe and inspected the chest and back. He conducted various musculoskeletal tests to test for specific joints. He diagnosed 95% of his cases by this method, although he sometimes recommended that they have an x-ray or magnetic resonance imaging for a definitive diagnosis. Aside from bone setting, he also treated kidney stone and jaundice. In general, his approach to treatment included reducing the fracture, splinting, and bandaging. He used an ointment made from several native plants, coconut oil, camphor, and other ingredients. He also gave oral herbal supplements that may have analgesic properties. For young children, he recommended only gooseberry juice. He also made a powder with ayurvedic herbs and egg-shell powder. He was not sure if this provided calcium supplementation, but it yielded good results. He made these ointments and powders on his own. Originally, these ingredients were sourced from forests, but with deforestation this has been a challenge. Some ingredients were grown on tribal lands, and others were bought at local shops. He emphasized a healthy diet as key to recovery, which included local fruits, vegetables, sesame seeds, honey, whole grains, chicken, and clarified butter. He did not recommend eating root vegetables as they seemed to increase blood glucose due to their starch content.

Participant 2 had two clinics in different towns. Dislocations and fractures were the majority of cases. He believed that before he can start any treatment, gaining the trust of the patient was most important. His approach to diagnosis involved taking a thorough history. Then, he used "Darshana", which was inspection and "Sparshana" which was palpation. If a joint was dislocated, he repositioned it and wrapped it with a bandage. Fractures were reduced before dressing. He took care to make sure that the pressure point of the bandage was not over the nearby nerves. He did not have an x-ray machine at his clinic. He did not use x-rays for diagnosis as he believed that speedy first-aid and treatment will benefit the patient more than imaging. However, if the patient chose, he encouraged post-treatment x-rays. He checked "vital points" of the patients to assess their humoral status and assessed which class of medicines should work.

Once the issues had been diagnosed, Participant 2 applied an oil which he made from the juice of various medicinal leaves. This juice was added to a paste of sesame oil, clarified butter, sambrani (a natural resin), and incense. Next, Participant 2 prepared an ointment with various ingredients and applied it. These medicines were custom made based on what he determined the patient needed and might include 10-12 ingredients. Next, medicinal leaves were applied before splinting and dressing. He used bamboo sticks and coconut palm stalks as splints. He also sometimes used a wood ruler to splint. They were held in place with cloth bandages, and knots were placed strategically based on the nature of the injury (Figure 2). The dressing was changed every 3-4 days. The ingredients in his preparations were sourced from forests and shops that sold folk medicine. As availability of certain ingredients have dwindled, he has altered some of his recipes. He helped patients with the traditional medicine methods of physical therapy. He advised patients to drink goats' milk, and to consume a broth made from mutton bones, especially the bone marrow and believed that the collagen helped with faster recovery. He emphasized a healthy diet and active lifestyle. For pain relief, he did not recommend allopathic over-the-counter

medicines, but instead recommended a tea made with ingredients that included nuts and seeds. Some patients took acetaminophen if they could not handle the pain, however, he did not prescribe it as it is illegal for him to prescribe Western medicines.

Figure 2. Patient with probable subluxation of the patella. Shown are materials used for the treatment which includes medicinal oils and pastes, plus cotton and bandages which the TBS used to treat this patient.

Participant 3 believed it was important to gain the trust of his patients before treating them. Inspection and palpation were also the mainstays of his approach to diagnosis. He used a soft cotton bandage to treat fractures and dislocations. If the pain was unbearable, he asked patients to consult an allopathic doctor. Massage and physiotherapy were part of his treatment. Besides TBS, Participant 4's scope of practice included treating gastrointestinal ailments, asthma, fistulas, and abnormal vaginal discharge. He ran his clinic out of his home. Diagnosis involved inspection and palpation. Range of motion and special tests further localized the injury. Treatment included oil massage, which aided in reducing the dislocation or fracture. He used bamboo sticks to splint and tied it with a cotton cloth bandage. It required a series of dressing changes. He also gave patients supplements prepared mostly from plant-based products. Some ingredients used in his remedies were bought from local markets, some were sourced from nearby forests, and some were cultivated on his own land.

Participant 5 had a busy clinic in which he treated a wide range of fractures and dislocations. He began with inspection, then palpation to diagnose a problem. He had an x-ray in his clinic to aid in diagnosis. He used sandbags to stabilize a fracture if needed. He also used an oil that he concocted using herbal ingredients to massage the affected area. He then applied another herbal preparation. He believed that these help in reducing swelling and pain and have antibiotic properties. He sourced these plants from his native village, which he visited 2-3 times a year. His relatives who lived there collect these plants from the forests and dry them. Some items were bought from local shops. He used eggs in his bandage, but it was unclear as to what the exact purpose was. His treatment included physiotherapy, and he prescribed over-the- counter calcium and multi-vitamin supplements. He emphasized following a healthy diet that included whole grains and adequate protein. He was emphatic about eating no white rice.

Participant 6 treated not only fractures and dislocations, but also kidney stones, liver cirrhosis, and uterus related issues. He has had clinics in several locations, but his current clinic was acquired from a grateful patient who was a retired military captain. Participant 6 had treated the captain's psoriasis, and the grateful captain converted a piece of land under a trust and gifted it to him for his clinic. His treatment was focused mainly on marma points. Marma points are specific anatomical locations in the body through which the energy of these elements is believed to flow. Marma points therapy is the practice of stimulating these spots through gentle massage therapy. Participant 6 asked the patient to lie supine and palpated these points with his fingers which helped him identify fractures, spinal problems, and other conditions. He also used gait to make a quick initial assessment, specifically when they walked into his clinic. There are specific marma points to relieve pain at particular sites, and he claimed to be able to relocate the pain site. For instance, pain from the hand could be transferred to the spinal region and from there it could be relieved. This "vayu" point in spine stimulation was his "style" and it was known colloquially as Vayukkalam, one who treats using the vayu point. He also used pulse points to aid in diagnosis.

When a patient first comes to Participant 6, his primary objective was pain relief. He did not use x-rays in his diagnosis, but his patients were free to get one if they chose. Based on the injury, he used bamboo stick splints and bandages. For smaller bandages, he used stalks of a pine tree and sometimes parts of the coconut leaf. Most of the time, he used a gauze bandage. For a typical wrist dislocation, he provided pressure to a particular point at the palm and the fingers were pulled to reduce it back in place. He even used ice cream sticks as splints for some cases. He poured a generous amount of oil called kaya thirumeni, made from herbs on the skin, which aided in reducing inflammation. Some oils were ingested, along with Arishta or Asava so as to overcome the gastric uneasiness of consumption of a strong oil. His ingredients were of both plant and animal origin and he believed that all parts of plants and animals were useful. He sourced most ingredients from local markets, and from some local tribes. He also procured items from folk medicine raw drug shops as well as forests and villages. He was experimenting with growing certain plants indigenously and collaborating with a group to cultivate them.

Theme 6: Limitations of Practice, Challenges, and Social Relevance. Participant 1 did not treat humoral neck fractures as it had a high risk of avascular necrosis. He also did not treat spinal cord injuries. These cases were sent to allopathic hospitals. If he had anything more than a 10% lack of confidence in a particular case, he allowed them to decide if they wanted to continue with the treatment. Patients who consumed excessive alcohol or smoke and those with diabetes, hypertension, and other chronic problems were challenging and did not heal well. He faced considerable bias from the modern medical community. He believed that if people were patient and gave natural remedies a

chance, they would be surprised at the favorable results. He would like to expand the Traditional Vidya Sangha to include allopathic doctors and envisions more collaboration. He accepted that there were TBS who were untrained and gave their community a bad reputation. He had been instrumental in organizing training programs for those interested.

Participant 2 regretted to say that while he has had great success, he also had a few failures. He speculated that it was perhaps a mistake he made, but sometimes cases were complicated, or patients were allergic to certain items in the herbal remedies. He also knew his limitations and did not treat cases of cardiac arrest, patients receiving cancer treatment, or immunocompromised patients. In such cases, he might administer first-aid, then referred them to an allopathic hospital. If he thought that the patient could not afford to go to a private hospital, he sent them to a government hospital. He faced several challenges as a TBS. For example, it was difficult to procure certain rare ingredients. He was saddened by the lack of support from the Indian government. They did not provide any recognition, certification programs, or support. He had treated the chief minister of his state and other traditional healers with good success, but they did not do anything to advance their cause. He believed that TBS uses a holistic approach and healing was designed for the whole mind and body. He regretted that many traditional healers simply took their skills and knowledge to their grave as there was no documentation or official system to pass on this knowledge. He believed that TBS were relevant in India, where a large portion of the population lived in poverty or did not have access to modern medical care. There was a lot of politics between folk healers, ayurvedic doctors, and modern allopathic physicians and he wished that there was more collaboration.

Participant 3 remarked that cancer was a challenge, and he was interested in finding a medicine for this disease. He did not hesitate to refer a patient who required care that was beyond his expertise. The patient was the focus and pride should not cloud judgment. He found that patients have been more appreciative to him for guiding them to appropriate treatment, rather than regarding it as a failing on his part. He also echoed the thoughts of other TBS regarding government support. He did not care much about having a certificate to hang on a wall but wanted to legitimize folk medicine, so practitioners have good training and treat patients safely.

Participant 4 did not treat fractures with open wounds as he believed that needed to be handled in a sterile way, including sutures and internal fixation. He also did not have the confidence or expertise to treat head injuries. These cases were referred to an allopathic hospital. He also lamented about the lack of government support. He knew of several TBS who were very poor and did not have money to produce the raw materials for treatment. He wished that government would allow TBS to grow plants and be self-supporting.

Participant 5 referred complicated cases, especially multiple fractures and open wounds. He echoed the thoughts about government involvement.

Participant 6 let his patients know if he found that the case was too complicated and gave them the choice to visit other practitioners/other disciplines of medicine. Some of his challenges regarded procurement of raw materials. Many species of native plants have become impossible to find because of invasive species that have been introduced. For example, a factory in their area planted easy to grow plants which have destroyed the normal flora. He also would like to collaborate with ayurvedic and allopathic practitioners and envisioned an India in which folk healers were respected and supported.

DISCUSSION

Many TBS learned their skills by treatment of cattle and other animals and as they found success, they began doing the same on humans.[2] Many continued to treat both animals and humans. Puttur was considered a center of excellence for TBS and their method. Their history of bone setting stems from fixing fractures of soldiers in the battlefield. One significant contributor to TBS history was Mr. Subbarao from the Chittoor district.[2] Subbarao was known for pioneering newer methods and advancing the scope of TBS to more complex procedures. As his success spread, Chittoor also gained popularity as a center of excellence like Puttur. These methods spread to other states in south and central India. Subbarao established a clinic called Subbarao Orthopedic Center where he provided free food, lodging, and in-patient treatment for a large volume of patients. Legend has it that his patrons included Mahatma Gandhi.

TBS was multigenerational and our cohort ranged from 3rd to 6th generation TBS. The participants passed down the knowledge in their family including to women. Most had hundreds of years within the same family. Most participants had occupations outside TBS as their main source of income. While most TBS were apprentices to their parents, grandparents, or other family members, as medicine evolved, they were also self-taught by learning medical terminology from x-rays and radiology reports that patients sometimes brought in, and by reading textbooks.

Collaborators from TDU/FRLHT provided a certification program which two of our participants completed. All the participants were involved in "professional" organizations or associations, many founded by these participants. The main aim of these associations was to bring together various folk healers, meet periodically and exchange ideas, case studies, and hold workshops.

All participants were high school educated, and two had a bachelor's degrees. Most of their patient population lived in poverty and were from rural areas around the respective villages, though many traveled considerable distances because of their faith in certain bone setters or their reputation. While the majority fit this demographic, there were also patients from a higher socio-economic background and visited TBS because allopathic medicine treatment had failed, they had a bad experience, or chose to supplement their allopathic treatments with herbal remedies. Many TBS made house calls, traveled to remote areas, and held 2 to 3-day long camps in underserved areas.

The typical cost of treatment ranged from INR 100 - 500. They also provided free services to those who could not afford to pay. They did this work as a service to the needy. They also sometimes gave these patients food, clothes, and bus fare in addition to the free treatment.

The principles to diagnosis involved building rapport with the

patient, gaining their trust, taking a comprehensive history, inspection, palpation, checking range of motion, conducting special tests, and accessing gait. This approach was similar to that used by modern allopathic practitioners. One participant had an x-ray machine in his clinic, but the rest did not use imaging as a primary diagnosis tool. Approach to treatment included reducing the fracture, massage, splinting, and bandaging. Massage with medicated oils was key to their treatment.

Some TBS focused on marma points. They use oils and ointments made from several native plants, and each one had their own recipe. Many of them revealed the names of ingredients, but not the whole recipe as they do not have patents available to them and did not want to give away their secrets. Turmeric was an ingredient common to most of these preparations, and they affirmed its anti-inflammatory properties. These ingredients were sourced from folk medicine shops, local markets, and foraged from nearby forests, and some were cultivated. The pharmacological value of these plants were not investigated in this study and perhaps could be a topic of further research. While most TBS had homemade concoctions for analgesia and tonics for faster recovery, some asked their patients to take multivitamin and calcium supplements. They did not prescribe acetaminophen but did not discourage its use. Massage and physiotherapy were a major part of traditional medicine. They also emphasized a strict diet and active lifestyle.

All participants knew their limitations and did not treat complicated cases. They believed that the patient should be the focus and should get the appropriate treatment that was best for them. As in modern medicine, they also factored in comorbidities such as diabetes, hypertension, and heart disease into their treatments and experienced frustration when treating patients who smoked or consumed excess alcohol.

All participants expressed facing considerable bias from the modern medical community because of their lack of formal education. They were frustrated by the lack of formal support from the government, as it did not provide formal recognition, certification programs, or tangible support to folk healers. Lastly, many species of native plants have become impossible to find because of deforestation, and lack of grants and land to grow/cultivate these plants. Invasive species were also a problem for native plants to thrive.

Limitations. The practice of TBS is an understudied field. This paper was a socio-cultural exploration through an in-depth case series of six TBS, and not a representative sample. A country-wide study of TBS from all parts of India with a larger cohort where data saturation can be reached would provide a more comprehensive view of this subject.

CONCLUSIONS

In rural India, where a large part of the population lived in poverty and without access to modern medicine, traditional healers provided a much-needed service, based on indigenous knowledge passed down generations of TBS. Many provided free care, and consequently, the income from their practice was not sufficient to support themselves and their families. Most did this work as a service to the underserved. At first glance, they followed a similar approach to diagnosis and treatment of simple fractures and dislocations as modern medical practitioners. Most would like to share their knowledge and collaborate with ayurvedic and allopathic practitioners and simply wanted to be respected and supported. The medicinal value of the ingredients used in folk medicine preparation was not explored but could be an interesting area of future research.

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Keywords: traditional medicine, India, bone and bone tissue, orthopedics, qualitative research

APPENDIX

Interview Guide

Thank participant for their time. Introduce self and purpose of this study. Ask if any questions? Show Information Sheet and seek consent. Show Consent Form and seek consent for the use of an audio recorder and repeat voluntariness of the interview and ability to stop at any time. Additional material such as photographs, video recording of procedures, location and instruments will be welcome with privacy of individuals ensured and acknowledgement of sources as per the TBHs wishes.

Questions

1. Background Information, Family Inherited practice, Initiation into the practice
    1. How did you get into this work?
        a. Inter-generational (how many generations since this practice is passed on to you?)
        b. Which generation is yours?
        c. How long are you in this practice?
        d. Previous and other occupations if any
        e. Age of joining this profession
        f. Is it the sole occupation at present?
        g. What are the other occupations at present?

2. Practice methods, specialization, how does the uniqueness develop, what are standards that are sought/reached
    1. What does your practice cover?
        a. Presenting symptoms: fracture, dislocation, injury, trauma, etc.
        b. Process used to diagnose the problem: physical exam, xray, etc.
        c. Treatment: reduction, realignment, splinting, bandage, etc.
        d. Medicines: pastes, oils, herbal remedies, pain relieving or wound healing etc.
        e. Do you use herbs or animal products in your treatment? If yes, are they locally available for you to collect from the wild or do you buy them from raw drug shop? Do they cultivate them themselves?
        f. Rationale behind these therapies.

3. Form and coverage of training" the art of skill development and growth of knowledge.
    1. Membership with an Association/Medical College/Place of Affiliation/Accreditation.
    2. Was there any sort of apprenticeship or training? What did it cover and for how long?
        a. Where was the training?
        b. What subjects are covered (e.g., Anatomy, Pharmacology, Physiotherapy, Ayurveda)?
        c. Any certification processes? By whom?
        d. Any refresher training? Continuing education?
        e. Any interface with the formal schools of medical education (Western/English, Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH))
    3. Have you taught the knowledge and skills to your children? If no, why? If yes, from when? Are they also trained in Allopathy, Ayurveda, Siddha, Physio-therapy, etc.?

4. Challenges faced at the level of individual practice, patients, society, government, etc
    1. What have been your key areas of success and key problematic treatments/conditions and why so?
        a. Specific successes: muscular, joint, ligament, others.
        b. Reasons for success: time of presenting the problem, ease of handling, lack of need for surgery, etc.
        c. Specific problematic situations: fracture, dislocation, injury, trauma, etc.
        d. Reasons for failure/problematic outcomes: time of presenting the problem, lack of skills, infrastructure, costs, need for surgery, etc.
    2. Are their situations where you refer your patients to a formal hospital set up? When, where, why?
        a. Does this referral help?
        b. Is there scope for this? Why, why not?
    3. How did you decide to set up your practice in this location? Who are your patients? How do they know about you? Do they ask for degrees, success stories, costs?
    4. What are your main challenges in this practice? Do you see it sustaining/flourishing over time? Why/why not?

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Burnout, Depression, Anxiety, and Stress Among Resident Physicians 18 Months Into the COVID-19 Pandemic: A Cross-Sectional Study

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ABSTRACT

Introduction. Burnout among resident physicians has been an area of concern that predates the COVID-19 pandemic. With the significant turmoil during the pandemic, this study examined resident physicians' burnout, depression, anxiety, and stress as well as the benefits of engaging in activities related to wellness, mindfulness, or mental wellbeing.

Methods. A cross-sectional survey of 298 residents from 13 residency programs sponsored by the University of Kansas School of Medicine-Wichita was conducted in October and November 2021. A 31-item questionnaire measured levels of burnout, depression, anxiety, and stress. A mixed method approach was used to collect, analyze, and interpret the data. Descriptive statistics, one-way ANOVA/Kruskal-Wallis tests, adjusted odds ratios (aOR), and immersion-crystallization methods were used to analyze the data.

Results. There was a 52% response rate, with 65.8% (n = 102) of the respondents reporting manifestations of burnout. Those who reported at least one manifestation of burnout experienced a higher level of emotional exhaustion (aOR = 6.73; 95% CI, 2.66-16.99; p < 0.01), depression (aOR = 1.21; 95% CI, 1.04-1.41; p = 0.01), anxiety (aOR = 1.14; 95% CI, 1.00-1.30; p = 0.04), and stress (aOR = 1.36; 95% CI, 1.13-1.64; p < 0.01). Some wellness activities that respondents engaged in included regular physical activities, meditation and yoga, support from family and friends, religious activities, time away from work, and counseling sessions.

Conclusions. The findings suggested that the COVID-19 pandemic poses a significant rate of burnout and other negative mental health effects on resident physicians. Appropriate wellness and mental health support initiatives are needed to help resident physicians thrive in the health care environment. ***Kans J Med 2022;15:403-411***

INTRODUCTION

The first case of coronavirus disease 2019 (COVID-19) in the United States was confirmed by the U.S. Centers for Disease Control and Prevention in January 2020.[1] In March 2020, the World Health Organization designated the worldwide outbreak of COVID-19 as a pandemic.[2] Even before this outbreak, burnout had been called a public health crisis in the U.S.[3] and a disturbingly high rate of professional burnout existed among medical trainees and physicians.[4-7]

Burnout is an experience in response to long-term exposure to chronic job-related stress, characterized by emotional and physical exhaustion, depersonalization, and feelings of low self-worth.[5,8] Burnout among health care professionals has been associated with mood disorders, substance and alcohol use disorders, suicidal ideation, and accidents.[9-11] Professional burnout also has been associated with a decrease in quality of patient care,[12-14] and lower patient satisfaction scores.[15,16] Prior studies have shown that the impact of professional burnout begins in medical school and continues throughout graduate medical education (GME).[4,6,7,17] The COVID-19 pandemic has increased stress on health care professionals dramatically through heightened personal risk of illness, more frequent poor outcomes in patients with few proven treatment options to prevent morbidity and mortality, and overwhelming demand for healthcare resources.[18-20] Resident physicians experience these same pandemic-related stresses, but they were compounded by added worry regarding training interruptions and limitations.

At the time of this study, our community-based medical school sponsored 12 residency programs and one fellowship program, encompassing 298 resident physicians. In 2019, prior to the COVID-19 pandemic, 51% (67 of 131) of our resident physicians reported symptoms of professional burnout, such as emotional exhaustion, cynicism, and reduced professional efficiency.[17] Studies of resident physicians in other settings have demonstrated burnout rates of 46-53%, with increased stress, depression, and anxiety, especially in those physicians caring for COVID-19 patients or who experienced childcare and home school related stress.[21,22]

Given that the global community continued to be affected by the worsening spread of COVID-19, it was prudent to assess the effects on resident physician well-being. In this study, investigators (1) evaluated the prevalence of burnout and other types of emotional distress experienced by resident physicians during the second year of the pandemic; and (2) assessed respondents' activities related to wellness, as well as solutions they considered necessary to affect a positive change in their experiences with psychological distress.

METHODS

Study Design and Participants. In October and November 2021, 298 resident physicians from 13 residency/fellowship programs sponsored by the University of Kansas School of Medicine-Wichita (KUSM-W) were surveyed. Each resident physician received an email invitation to participate, along with a link to a 31-item survey (Appendix). A sample size of 100 was calculated as necessary for adequate power (> 0.85) to detect significant relationships between the variables with 1 degree of freedom, p < 0.05, and 0.21 effect size.[23] The KUSM-W Institutional Review Board granted exemption for the study.

Study Measures. The survey included two validated measures: the two single-item measures of emotional exhaustion and depersonalization (MBI-2)[24] adapted from the full Maslach Burnout Inventory (MBI-22)25 and the Depression Anxiety Stress Scales-21 (DASS-21).[26-28] The survey also included items on demographic information (age, gender, year in residency, and specialty).

Burnout. The emotional exhaustion item ("I feel burnout from my work") and depersonalization item ("I've become more callous toward people since I became a physician") have been shown to be useful screening questions for burnout.[24,29] These two items have shown the highest factor loading[24,30,31] and strongest correlation[24,32] with their respective emotional exhaustion and depersonalization domains in the MBI-22.[24] The two single items have been used in previous studies to measure emotional exhaustion, depersonalization, and manifestations of burnout among physicians and medical trainees.[4,6,7,24,33]

The respondents recorded the degree to which each item applied to them on a seven-point Likert scale (0 = Never, 6 = Every day). The scores of each domain were grouped into low, moderate, and high burnout categories using established cutoffs.[6,7,23,24,34] Higher scores on emotional exhaustion and depersonalization domains are indicative of greater emotional exhaustion and depersonalization, and greater burnout. Consistent with convention,[6,7,23,25,34] residents who scored high on depersonalization and/or emotional exhaustion domains were considered as having at least one manifestation of professional burnout.

Depression, Anxiety, Stress. The resident physicians' emotional state was measured using the DASS-21, which is a validated research tool that has been used widely to assess quality of life and consists of 21 questions in three scales designed to measure negative emotional states of depression, anxiety, and stress.[26,27] These scales have been found to have high internal consistency and can be used in a variety of settings to measure an individual's current emotional state and changes over time.[27,28] Respondents recorded how much a statement applied to them over the past week on a four-point Likert scale (0 = never, 3 = almost always). Scores for the seven questions specific to each of the three scales were summed with a possible score ranging from 0 to 21. Higher scores indicated greater levels of the corresponding emotional state. All the measures have been used in previous studies with a medical education population.[17,33,35-37]

Statistical Analysis. Standard descriptive statistics, One-way ANOVA/Kruskal-Wallis tests, generalized linear mixed models, and adjusted odds ratios (aOR) were used to analyze the quantitative data. Covariates included age, gender, year in residency, and specialty. All analyses were two-sided with an alpha of 0.05. The study team analyzed content of the open-ended responses (qualitative data) individually and in group meeting using an immersion-crystallization approach.[17,38,39]

RESULTS

Quantitative Results

Respondent Characteristics. The response rate was 52% (155 of 298). As shown in Table 1, the average age of respondents was 27.9 (SD = 3.3); 35.5% were female; 22.6% were third-year residents; and 37.4% were from the family medicine specialty. Most of the respondents (73.5%) reported to have engaged in activities related to their wellness, mindfulness, or mental wellbeing since the declaration of the COVID-19 pandemic. About 32% reported that their activities increased, 19.4% reported no change, and 15.5% reported decreased activities compared to before the pandemic. There was a ± 5.46% margin of error at a 95% confidence interval between the study sample and population of all the resident physicians, demonstrating that our sample generally represented the population of all GME resident physicians at KUSM-W.[40]

Burnout, Depression, Anxiety, and Stress. In aggregate, 65.8% of all respondents met the criteria for manifestations of burnout; 41.3% reported severe or extremely severe depression; 48.4% reported severe or extremely severe anxiety; and 36.8% had severe or extremely severe stress (Table 2). The respondents who reported at least one manifestation of burnout experienced a higher level of emotional exhaustion (aOR = 6.73; 95% CI, 2.66-16.99; $p < 0.01$), depression (aOR = 1.21; 95% CI, 1.04-1.41; $p = 0.01$), anxiety (aOR = 1.14; 95% CI, 1.00-1.30; $p = 0.04$), and stress (aOR = 1.36; 95% CI, 1.13-1.64; $p < 0.01$).

To determine if a benefit threshold exists between wellness activities and the outcomes measured, comparisons among the three activity levels (decreased, no change, and increased) were conducted using one-way ANOVAs with follow-up post-hoc analyses. The results revealed significant differences among groups on all measures (Figure 1): emotional exhaustion ($F[2, 102] = 13.76$; $p < 0.01$; $\eta^2 = 0.22$), depersonalization ($F[2, 102] = 10.67$; $p < 0.01$; $\eta^2 = 0.18$), depression ($F[2, 98] = 7.95$; $p < 0.01$; $\eta^2 = 0.14$) , anxiety ($F[2, 98] = 5.10$; $p < 0.01$; $\eta^2 = 0.10$), and stress ($F[2 ,99] = 7.72$; $p < 0.01$; $\eta^2 = 0.14$). The follow-up post-hoc analyses revealed significant differences between all the groups ($p < 0.01$) on all the measures.

Qualitative Results. Nearly 74% of the respondents reported that they had engaged in activities related to wellness, mindfulness, or mental wellbeing since the declaration of the pandemic (Table 1). Eight themes regarding the type of wellness, mindfulness, or mental wellbeing activities emerged: engage in regular physical activities/exercises, practice meditation and yoga, engage support from family and friends, engage in religious activities, engage in hobbies, take time away from work, attend counseling sessions, and other (Table 3).

Nearly 36% (55 of 155) of the participants provided responses to the wellness promotion question. Eight themes emerged as activities and resources that can promote wellness among physicians: administrative, program, and system modification; sustainable workload and time away from work; supportive work community; enhanced leadership; promotion and access to mental health resources; access to fitness programs; choice and control; and other activities (Table 4).

DISCUSSION

Burnout among resident physicians was an area of concern that predated the COVID-19 pandemic with studies demonstrating up to 54% of resident physicians experienced burnout across all specialties.[41,42] Our data suggested that the burnout rates within GME programs sponsored by a community based medical school were high during the COVID-19 pandemic. In this study, 65.8% of the resident physicians experienced at least one manifestation of professional burnout during COVID-19 compared to 51% prior to the pandemic.[17] The prevalence of depression, anxiety, and stress was 41.3%, 48.4%, and 36.8%, respectively. The resident physicians who experience at least one manifestation of burnout were more likely to report greater levels of negative emotional state. Specifically, the resident physicians who experienced burnout, compared to those who did not, were seven times more likely to report higher levels of emotional exhaustion, even after we adjusted

for the covariates. These findings suggested that resident physicians are "covidout". While the negative effects of the pandemic are not limited to a specific medical specialty as our survey covered 13 medical specialties, the high rates of burnout and other forms of emotional distress among the respondents further validates the call to understand and address burnout within GME programs.[43,44]

Table 1. Demographic characteristics of responding resident physicians.[a]

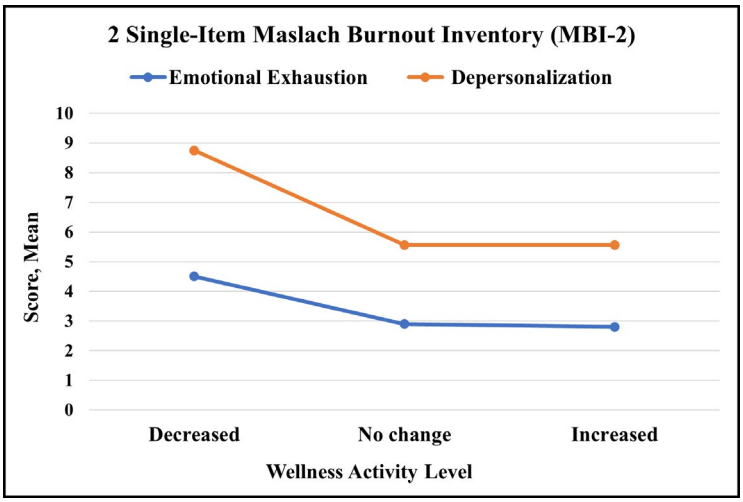
Characteristics	Respondents (N = 155)
Age	
Mean (SD), years	27.9 (3.3)
Median	28
Minimum	24
Maximum	47
Gender, no. (%)	
Male	54 (34.8)
Female	55 (35.5)
Prefer to not answer	16 (10.3)
Missing*	30 (19.4)
Year in Residency	
First-year residents	23 (14.8)
Second-year residents	27 (17.4)
Third-year residents	35 (22.6)
Fourth-year residents	8 (5.2)
Fifth-year residents	6 (3.9)
Missing*	99 (63.9)
Specialty	
Anesthesiology	2 (1.3)
Family Medicine	58 (37.4)
Internal Medicine	11 (7.1)
Medicine/Pediatrics	2 (1.3)
Obstetrics/Gynecology	9 (5.8)
Orthopaedic Surgery	7 (4.5)
Pediatrics	11 (7.1)
Psychiatry	7 (4.5)
Radiology	7 (4.5)
Sports Medicine	0 (0)
Surgery	9 (5.8)
Missing*	32 (20.6)
Engaged in wellness, mindfulness, or mental wellbeing?	
Yes	114 (73.5)
No	41 (26.5)
How has participation in wellness, manfulness, or mental wellbeing activities changed?	
Increased	49 (31.6)
No change	30 (19.4)
Decreased	24 (15.5)
Missing*	52 (33.5)

[a]Data are presented as No. (percentage) unless otherwise stated.
*The number of participants who completed the survey but did not provide an answer to this specific question.

Table 2. Respondents' burnout, depression, anxiety, and stress (N = 155).[a]

Variable	Respondents
Manifestations of burnout	
Burnout	102 (65.8)
Not burnout	41 (26.5)
Missing*	12 (7.7)
Emotional Exhaustion	
High score	74 (47.7)
Moderate score	49 (31.6)
Low score	20 (12.9)
Missing*	12 (7.7)
Depersonalization	
High score	99 (63.9)
Moderate score	37 (23.9)
Low score	7 (4.5)
Missing*	12 (7.7)
DASS-21, Mean (SD)	
Depression	9.38 (5.91)
Anxiety	8.67 (6.11)
Stress	10.53 (5.81)
Depression	
Normal	33 (21.3)
Mild	13 (8.4)
Moderate	28 (18.1)
Severe	15 (9.7)
Extremely severe	49 (31.6)
Missing*	17 (11.0)
Anxiety	
Normal	39 (25.2)
Mild	10 (6.5)
Moderate	14 (9.0)
Severe	13 (8.4)
Extremely severe	62 (40.0)
Missing*	17 (11.0)
Stress	
Normal	53 (34.2)
Mild	15 (9.7)
Moderate	14 (9.0)
Severe	28 (18.1)
Extremely severe	29 (18.7)
Missing*	16 (10.3)

Note. DASS-21, Depression Anxiety Stress Scale-21
[a]Data are presented as No. (percentage) unless otherwise stated.
*The number of participants who completed the survey but did not provide an answer to this specific question.



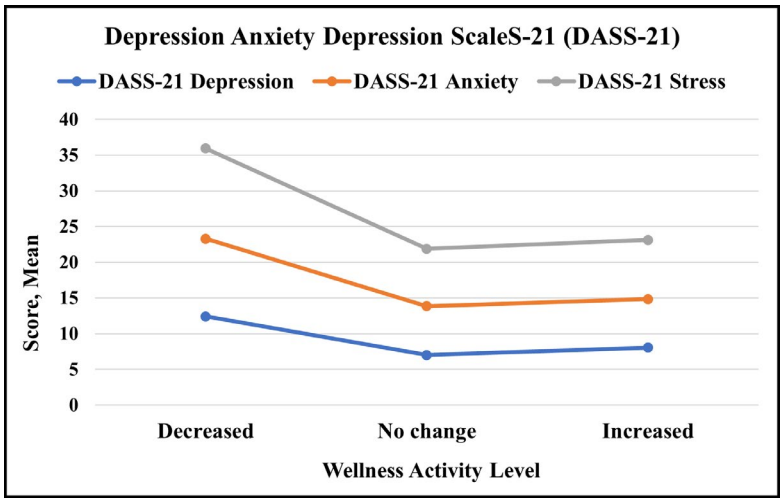


Figure 1. Means of the outcome measures assessed by the wellness activity level.

Table 3. Open-ended comments regarding respondents' activities related to wellness, mindfulness, or mental wellbeing.

Themes	Quotes from Participants
Engage in regular physical activities/exercises	"Daily exercise." "Increasing exercise." "Rock climbing, dancing, rollerblading, cycling."
Practice mindfulness, meditation, and yoga	"I engage in mindfulness exercises and try to relax more." "Mindfulness activities and yoga." "Meditating." "Meditation and yoga."
Engage support from family and friends	"The power of support from family and friends has been helping me through the challenging times." "Spending time with family." "Enjoying friends more often." "Talking to friends and family more."
Engage in religious activities	"Church activities." "Praying more." "Quiet time, church and Bible study."
Engage in hobbies	"Creative hobbies (painting, music), journaling." "Working on hobbies." "Cooking hobby."
Take time away from work	"Set aside time to not work." "Taking time off to relax." "Time off for leisure." "Vacation to a cabin and lake house."
Attend counseling sessions	"Regular counseling." "Counseling."
Other activities	"Being thankful for the gift of life." "Music therapy." "Going to comedy clubs." "Running COVID coach app." "Group debriefings."

Table 4. Open-ended comments regarding wellness promotion.

Themes	Quotes from Participants
Administrative, program, and system modification	"Working EHR system, not having to fight with insurance companies." "We are not secretaries, why we do so much secretarial work? Let staff do the secretarial work." "Less busy work like HCA modules or compliance modules. These are unnecessary busy work type activities that health care administrators make us do that actually cause more burnout." "Scribes."
Sustainable workload and time away from work	"More reasonable resident work/call schedules, work life balance (currently non-existent)." "More time away from work to decompress." "Time to take care of our physical and emotional health. We start residency healthy and pretty but look beaten up by the time we graduate. Not good." "Maybe quarterly or monthly wellness half day to do something fun with other residents or catch up on work that may be piling up causing feelings of being overwhelmed."
Supportive work community	"Faculty that cares about wellbeing of residents." "Truly supporting residents." "Scheduled by the program, dinners, relaxing events to kick back and enjoy spending time with others in similar situations." "Better clinical support."
Enhanced leadership	"Program leadership caring more." "Leadership should lead by example." "Support from leadership."
Promotion and access to mental health resources	"For wellness to be integrated into residency training and not just a mandatory one-time checkbox." "Time off for counseling." "Easy access to mental health professionals." "Free mental health from insurance."
Access to fitness programs	"Exercise facility at work to help us engage in active lifestyle." "Access to fitness." "Discounted gym/exercise membership."
Choice and control	"Dedicated time for us to work on ourselves." "Free time to pursue one's own wellness activities." "Having at least one day off per week (as opposed to working multiple weeks and then having multiple days off)" "Quarterly gatherings with the residents in my program outside of work that includes spouses and children."
Other activities	"Prayers, church service, family and friends." "Money to buy fiction books! Hearing stories of attendings feeling the same way." "Making patients more nice." "Meditation."

Our study sought to assess potential mitigating factors of negative mental health related to the COVID-19 pandemic on resident physicians. Almost 74% of resident physicians in our data indicated that they engaged in activities related to wellness since the start of the pandemic, and those resident physicians were less likely to experience burnout and other forms of emotional distress than those who reported no engagement in wellness-related activities. This finding suggested that wellness activities can make a difference in mitigating burnout and other types of emotional distress, such as emotional exhaustion, depression, anxiety, and stress.[9-11,37,45] However, wellness activities alone may not be sufficient to address this problem, particularly as 51% of participants had no change or increase in wellness activities and yet burnout remained high across the population. Greater resources within hospitals and institutional systems are needed.

The qualitative data regarding activities related to wellness provided insight into the resident physicians' personal experience. Several common themes of wellness, mindfulness, and mental wellbeing activities emerged from the analysis of qualitative data. This information should be explored further to assess for effectiveness as physician support and resilience initiatives. The qualitative data regarding ideas to promote greater wellness, were consistent with the National Academy of Medicine's burnout framework aimed to promote wellbeing and resilience among physicians.[46] The qualitative comments suggested recognition for individual action on the part of the resident physicians to use the available resources, including discounted gym membership, time off for counseling, and easy access to mental health professionals. An opportunity exists for local partners to promote availability of these resources to the resident physicians.

The comments echoed the need for administrative and system modification, including enhanced leadership. For example, the requests to improve electronic health record and ensure better clinical support highlighted areas where healthcare as a system can improve to support all physicians, including resident physicians. A reframing of expectations for managing wellness may be critical to ensure that both individual and system solutions are considered as the problem of burnout and other forms of emotional distress is addressed.

Study Limitations. This study had limitations. First, the study was limited to 13 community-based residency programs sponsored by a medical school in the Midwestern United States, so the findings may not be generalizable to other areas. Second, the cross-sectional nature and inability to establish a direct causal relationship between COVID-19 and psychological distress reduced the generalizability of the results. Third, data were collected via a self-reported online survey, which may have allowed for recall and selection biases. Fourth, data regarding respondents' wellness and mindfulness activities were subjective. Additional studies evaluating the effectiveness of such activities on mental health symptoms are needed. Finally, given the size of our programs we could not report specialty-specific programs' burnout scores without compromising anonymity.

CONCLUSIONS

The findings suggested that the COVID-19 pandemic posed a significant rate of burnout and other negative mental health effects on resident physicians. These findings indicated a particularly timely need for further advances in implementing appropriate wellness and mental health support initiatives at local, state, and national levels to help reduce the negative impact of the pandemic on medical trainees and all health care professional.

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Keywords: COVID-19, graduate medical education, Kansas, occupational burnout, surveys and questionnaires

APPENDIX

Survey on How Graduate Medical Trainees are Responding to COVID-19

1. Since the declaration of the COVID-19 pandemic (March 2020), have you engaged in any activities related to your wellness, mindfulness, or mental wellbeing?
   Yes___ No___

   - If yes, please describe the wellness, mindfulness, or mental wellbeing activities in which you have engaged since the declaration of the COVID-19 pandemic in March 2020 ____
   - How has your participation in these wellness, mindfulness, or mental wellbeing activities changed compared to before the pandemic?
     i. Increased
     ii. No Change
     iii. Decreased

2. For each of the following statements, please check the box that most accurately reflects your response:
   - I feel burned out from my work as a result the COVID-19 pandemic
   - I've become more calloused towards people as a result the COVID-19 pandemic

The rating scale is as follows:

0. Never
1. A few times a year
2. Once a month or less
3. A few times a month
4. Once a week
5. A few times a week
6. Every day

3. For each statement below, please indicate how you have been feeling during the past week:

I found it hard to wind down
I tended to over-react to situations
I felt that I was using a lot of nervous energy
I found myself getting agitated
I found it difficult to relax
I was intolerant of anything that kept me from getting on with what I was doing
I felt that I was rather touchy
I was aware of dryness of my mouth
I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)
I experienced trembling (e.g., in the hands)
I was worried about situations in which I might panic and make a fool of myself
I felt I was close to panic
I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)
I felt scared without any good reason
I couldn't seem to experience any positive feeling at all
I found it difficult to work up the initiative to do things
I felt that I had nothing to look forward to
I felt downhearted and blue
I was unable to become enthusiastic about anything
I felt I wasn't worth much as a person
I felt that life was meaningless

The rating scale is as follows:

0. Did not apply to me at all
1. Applied to me to some degree, or some of the time

2. Applied to me to a considerable degree or a good part of time
3. Applied to me very much or most of the time

4. Please identify your specialty
   - Anesthesiology
   - Family Medicine
   - Internal Medicine
   - Medicine/Pediatrics
   - Obstetrics/Gynecology
   - Orthopaedic Surgery
   - Pediatrics
   - Psychiatry
   - Radiology
   - Sports Medicine
   - Surgery

5. Please identify your PGY level
   - PGY 1
   - PGY 2
   - PGY 3
   - PGY 4
   - PGY 5

6. What is your gender?
   - Male
   - Female
   - Prefer to not answer
   - Other (please specify)

7. What year were you born? ___

8. What resources and/or activities would help professionals like you in promoting wellness?

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Quadriceps Strength and Knee Function After Anterior Cruciate Ligament Reconstruction with Quadriceps Tendon Bone Autograft: A Preliminary Report

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ABSTRACT

Introduction. The purpose of this study was to evaluate quadriceps strength and knee function after anterior cruciate ligament (ACL) reconstruction using a quadriceps tendon bone (QTB) autograft.

Methods. Preliminary data were extracted from an ongoing prospective cohort study in which the operative extremity was compared to non-operative extremity. Patients from 14 to 40 years of age who had an ACL reconstruction with QTB autograft volunteered to have knee assessment including quadriceps isokinetic strength measures and functional knee testing at 6 and 12 months post-operatively. Paired t-tests were conducted to compare post-operative strength and function scores on participants who had minimum one-year post-surgical follow-up.

Results. Patients had a significant recovery of quadriceps strength as determined by isokinetic testing and single leg hop test. For 31 participants, quadriceps strength of the operative leg measured at 60 deg/sec was 63% of the non-operative leg at six months, increasing to 79% at one year ($p < 0.001$); when measured at 180 deg/sec, these values were 68% at six months, increasing to 82% at one year ($p < 0.001$). For 30 participants, single leg hop functional scores of the operative leg were 80% of the non-operative leg at six months, increasing to 91% at one year ($p < 0.001$).

Conclusions. After QTB autograft for ACL reconstruction, there were significant gains in quadriceps strength and knee function from six months to one year post-operative. These findings indicated the QTB is an acceptable ACL reconstruction option.

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INTRODUCTION

An estimated 200,000 anterior cruciate ligament (ACL) injuries are reconstructed each year in the United States.[1] While surgical reconstruction is the current standard treatment for ACL tears in active patients, there is debate regarding which autograft is the best choice for the procedure. Options include bone patella tendon bone (BPTB), hamstring tendon (HT), quadriceps tendon bone (QTB), or all soft tissue quadriceps tendon (QT).

The gold standard for ACL reconstruction has been BPTB or HT autograft,[2] but the harvest of either graft may be associated with significant morbidity. For example, the disadvantages of the BPTB graft include patellofemoral pain, increased risk of patella fracture, and predisposition to knee arthrosis.[1,3] On the other hand, HT autograft has been associated with weakness in knee flexion,[1] tunnel widening,[4] and the potential for deficient graft width.[5]

Quadriceps-based autografts have been used for ACL reconstruction with increasing frequency owing to less graft harvest morbidity. In one study, just 9% of patients had residual discomfort at the donor site;[6] in another study, anterior knee pain was even less common, occurring in about 6% of those who had QTB autograft.[7] In addition to a favorable donor site morbidity profile, a systematic review of 15 clinical trials by Hurley et al.[8] showed that the QTB autograft had statistically similar outcomes compared to BPTB and HT autografts, including comparable knee stability, knee function, and re-rupture rates. Investigations such as these assessing quadriceps strength after a QTB ACL reconstruction typically have used isokinetic strength measures.[6-10]

A preliminary analysis in an ongoing study at our institution was conducted to determine the efficacy of QTB autograft in ACL reconstructions. The purpose of the ongoing prospective cohort study was to test the strength of the donor quadriceps muscle after QTB ACL grafting, comparing isokinetic strength and function of the operative leg to the non-operative leg. Combining isokinetic quadriceps strength data with functional testing data may improve our understanding of how strength deficits affect the recovery process.

METHODS

Patient Selection. A cross-section of data was selected from an ongoing cohort study in which the operative extremity (experimental) was compared to non-operative extremity (control). Inclusion criteria were patients who suffered a torn ACL, were between the ages of 14 and 40 years, and who had minimum one-year post-surgical follow-up. Informed consent was obtained at the six-week post-operative appointment. Study participants were incentivized with a modest stipend and agreed to have knee function and quadriceps strength testing at six months and one-year post-surgery. The study was approved by the University of Kansas Medical Center (KUMC) Institutional Review Board.

Patients were excluded due to previous ACL injury of either knee, multiple knee ligament tears, previous knee surgery of injured or contralateral knee, or history of any fracture of the lower extremity that caused deformity or hindered activity. Patients were not excluded if they had a concomitant meniscus tear.

Surgical Technique. Participants had the ACL injury treated surgically with a QTB graft performed by one of two sports medicine fellowship-trained surgeons. The procedure performed was an arthroscopic-assisted ACL reconstruction. The central portion of the quadriceps tendon was harvested using an open incision over the anterosuperior aspect of the knee. Graft size was dependent on patient size with average width being 8-10 mm. A 10-mm-length superior patella bone plug in continuity with the quadriceps tendon also was harvested. The patella defect was filled with bone graft and the quadriceps tendon defect was closed. While the graft was prepared for insertion,

arthroscopic ACL tunnel preparation was performed using separate tibial and femoral tunnel drill sites. The prepared quadriceps tendon was placed in the tunnels and secured on the femoral side and the tibial side with interference screws.

Rehabilitation. Post-operatively, all patients followed a standardized rehabilitation process. The first phase of the rehabilitation protocol focused on controlling knee swelling, passive and active knee range of motion (ROM), and quadriceps strengthening exercises such as heel slides and quad sets. A hinged knee brace was used during the initial rehabilitation period and, thereafter, a functional brace was used at the surgeon's discretion. The second phase of rehabilitation was focused on progressive knee ROM, restoring normal gait, and protecting graft fixation. Phase three involved preparing the patient for activities and was focused on progressive weight training, balance, and proprioception. The first three phases of rehabilitation took place between post-operative day one and 12 weeks post-operative if all rehabilitation milestones were met. To protect the ACL graft, no impact activities such as running, jumping, pivoting, or cutting were permitted until phase three had been completed.

After three months, patients were advanced to activities such as jogging and running in a straight line, further strengthening and proprioception training, and balance training. During the rehabilitation program, each patient was evaluated individually for return to sports at six months post-surgery based on ligament laxity, isokinetic strength testing, and functional testing.

Outcome Measures. The 2000 International Knee Documentation Committee (IKDC) Subjective Knee Evaluation Form is a 10-item survey that evaluates symptoms, highest level of sports activity, and knee function. Responses to each item are scored using an ordinal method, such that a score of 0 is given to responses that represent the lowest level of function or highest level of symptoms. The instrument is scored by summing the rating for each item with the calculated value ranging from 0 to 100. The 2000 IKDC score is interpreted as a measure of function such that higher scores represent higher levels of function and lower levels of symptoms. A score of 100 means no limitation with activities of daily living or sports activities and the absence of symptoms. Higgins et al.[11] found that the 2000 IKDC score was a reliable and valid instrument worthy of consideration for use in a broad patient population.

The Lysholm Knee Scoring Scale is an eight-item survey designed to give the clinician information on the participant's ability to manage everyday life. Each item response option is assigned a value and scores are totaled based on the respondent's selections. Scores range from 0 to 100 with higher scores indicating greater ability to manage daily activities. Test-retest reliability for the overall Lysholm score is ICC = 0.94 (95% confidence interval, 0.88 - 0.96).[12]

At six months and one-year post-surgery, study participants had comprehensive evaluation by a single physical therapist (RCM). All tests were performed on both operative and non-operative legs for control comparison. First, the KT-1000 arthrometer was used to test for ligamentous stability of the graft. Second, quadriceps strength was assessed using a Biodex™ System 3 Isokinetic device. Finally, functional testing was comprised of the single leg hop test and Lower Extremity Functional Test (LEFT) as described by Davies et al.[13]

Data Collection. Study data were collected and managed using Research Electronic Data Capture (REDCap®) system hosted at KUMC.[14,15] Participant demographics included patient age, gender, body mass index (BMI), history of tobacco use, sport played when injured, and mechanism of injury. Participant responses to questionnaires administered at baseline (prior to surgery) also were included and post-operatively at 6 and 12 months. The questionnaires included the 2000 IKDC score, Lysholm score, and Tegner scores. The Tegner scores were excluded later from analysis because many participants failed to follow instructions for completing that outcome form.

Measured outcome data for the isokinetic strength tests and the functional tests for both operative leg and non-operative side also were entered into the REDCap® system. Parameters included KT-1000 ligament stability scores, isokinetic strength peak torque scores, the single leg hop tests, and the LEFT outcomes. For the isokinetic strength and the single leg hop data, side-to-side comparisons were done by calculating the Limb Symmetry Index (LSI). LSI is the mean score for the operative leg divided by the mean score for the non-operative leg times 100. LSI ≥ 90 indicates that performance of the operative leg is ≥ 90% of the non-operative side, generally corresponds to a favorable result, and suggests the patient may be ready to return to sports activity.[16] In addition, the IKCD ratings associated with the KT-1000 stability tests were categorized as normal (0-2 mm), nearly normal (3-5 mm), abnormal (6-10 mm), or severely abnormal (> 10 mm).

Statistical Analysis. Descriptive statistics were used to summarize all measures. Categorical measures were reported as frequencies (n) and percentages (%). Continuous measures were reported as means, standard deviations (SD), and ranges with minimum and maximum values. Bivariable analyses were conducted to compare post-operative strength and function scores using paired t-tests. Analysis of variance for repeated measures was conducted to compare IKDC scores over time. Analyses were conducted in IBM SPSS Statistics, version 26 using two-sided tests with alpha level of 0.05.

RESULTS

Demographics of patients in the study cohort are shown in Table 1. Mean age at time of injury was 19 with a range of 14 to 28 years. There were 12 men and 19 women in the study with an average BMI of 23. Most participants incurred sport-related knee injuries. The 31 patients who completed one-year strength and knee function testing were included in the bivariate analysis of the preliminary data.

Table 1. Participant demographics (n = 31).

Characteristic	Value
Age at time of injury[a]	19.0 (4.3); 14 - 28
Body mass index (BMI)[a]	22.9 (3.2); 18 - 32
Gender, male[b]	12 (38.7)
Leg injured, right[b]	16 (51.6)
Activity when injured[b]	
Recreation	4 (12.9)
Sports	27 (87.1)
Work related	0

[a]Values are mean (standard deviation); minimum - maximum.
[b]Values are n (%).

Self-reported assessments of those who completed the study showed improvement in outcome measures over time (Table 2). Mean pain rating of the injured knee decreased over time, from 22 at baseline to 7 at one year. Mean IKDC score and mean Lysholm score increased from 69 to 88 and from 0.81 to 0.91, respectively. Almost half of participants (48%) had achieved an excellent rating on the Lysholm scale one year after surgery. A linear upward trend was observed for the mean 2000 IKDC Subjective Knee Evaluation from 69 at baseline, to 79 at six months after surgery, to 88 at one-year post-operative. For the 18 paired observations not shown in the table, analysis of variance for repeated measures showed significant between-subject effects ($p < 0.001$) demonstrating continued improvement in overall function after ACL reconstruction.

Table 2. Lysholm Knee Scores.

Outcome Measure	Baseline (n = 26)	Six Months (n = 19)	One Year (n = 27)
Pain Rating[a]			
Injured knee, past 24 hours	22.19 (27.32); 0 - 80	14.67 (17.86); 0 - 67	6.89 (15.73); 0 - 77
Uninjured knee, past 24 hrs	6.73 (19.73); 0 - 100	2.72 (10.1); 0 - 43	1.04 (2.6); 0 - 11
Pain rating difference	15.46 (30.74); -65 - 72	11.94 (20.98); -32 - 67	5.19 (15.57); -5 - 77
Lysholm Knee Score[a]	0.81 (0.21); 0.28 - 1.00	0.87 (0.09); 0.68 - 1.00	0.91 (0.09); 0.69 - 1.00
Lysholm Knee Rating[b]			
Excellent (95 - 100%)	9 (34.6)	4 (21.1)	13 (48.1)
Good (84 - 94%)	6 (23.1)	9 (47.4)	10 (37)
Fair (65 - 83%)	6 (23.1)	6 (31.6)	4 (14.8)
Poor (< 65%)	5 (19.2)	0 (0)	0 (0)
Mean IKDC Score[a]	68.5 (26.0); 12.6 - 100.0	78.9 (15.1); 43.7 - 100.0	88.0 (12.4); 41.4 - 100.0

[a]Values are mean (standard deviation); minimum - maximum.
[b]Values are n (%).

Post-operative isokinetic strength tests at six months and one year for the 31 subjects who completed the study are shown in Table 3. Significant differences were observed for the LEFT, the single leg hop test, and Biodex™ peak torque at 60 deg/sec and 180 deg/sec ($p < 0.001$ for each comparison). The mean LEFT outcome was about nine seconds faster from six months to one year post-operative. LSI for the single leg hop test was 80% at six months and 91% at one year indicating readiness to return to sports activity. LSI for the Biodex™ peak torque at 60 deg/sec was 63% at six months post-operative and 79% at one year after surgery. Similarly, LSI for Biodex™ peak torque at 180 deg/sec was 68% at six months and 82% at one year. Thus, these tests indicated that participants achieved overall increased strength and function during the period of observation.

An evaluation of side-to-side difference of the manual max KT-1000 test using the IKDC rating showed the operative leg was normal (0-2 mm) or nearly normal (3-5 mm) in 90% of patients at six months and at one year post-operative (Table 4). Only 3 of 31 patients (10%) had abnormal (6-10 mm) IKDC scores and no patients were rated severely abnormal (> 10 mm).

Regarding individual item responses, 24% of patients reported they could perform only light activities as the most strenuous activity at baseline, improving to 9% at one year post-operative. Conversely, while only 14% could perform very strenuous activities at six months after surgery, 57% reported being able to do so at one year post-operative. Regarding knee stiffness, 29% reported no stiffness at six months, which improved to 54% at one year post-operative. Most reported that the operated knee did not lock or catch, 75% at six months and 89% at one year after surgery.

DISCUSSION

This cross-sectional study was derived from an ongoing prospective cohort study designed to test the strength and function of the donor quadriceps muscle after ACL grafting with a QTB. The study demonstrated that ACL reconstruction using a QTB autograft does not produce significant quadriceps strength deficit. Indeed, the preliminary evidence showed there were significant gains in quadriceps strength from six months to one year post-operative. Improved knee function between six months and one year post-operative was demonstrated by satisfactory ligament stability, near full recovery of quadriceps strength, single leg hop test outcomes equivalent to the non-operative leg, and significant improvement in the LEFT performance. Patient-reported outcomes also demonstrated significant improvement from the initial visit to six months and one year post-operative.

Historically, BPTB and HT grafts have been the mainstay of treatment for ACL ruptures. The use of the QTB graft has been gaining popularity due to fewer adverse effects and superior biomechanical strength.[17] However, until recently, there has been a paucity of evidence supporting the use of this autograft. Our study demonstrated that the QTB graft was a suitable alternative graft option as there was minimal loss of quadriceps strength and knee function after quadriceps tendon harvest.

Table 3. Bivariate analysis of postoperative isokinetic strength and functional knee tests (n = 31 except as noted).

Outcome Measure	Six-Month Follow-Up[a]	One-Year Follow-Up[a]	Difference[b]	p Value
LEFT (seconds)	133.2 (27.3); 101.3 - 215.1[c]	124.5 (21.8); 167.7 - 180.7[d]	16.1 (9.5)	< 0.001
Single leg hop test				
Non-operative leg (cm)	49.6 (9.6); 26.3 - 66.7d	50.7 (10.2); 27.0 - 66.3	7.4 (7.0)	< 0.001
Operative leg (cm)	39.9 (11.3); 15.7 - 64.7d	46.4 (11.6); 14.3 - 60.7	1.7 (4.8)	0.061
Limb symmetry index (LSI)	79.9 (14.8); 41.8 - 97.8d	90.6 (11.6); 53.1 - 106.3	11.6 (11.8)	< 0.001
Biodex peak torque, 60 deg/sec				
Non-operative leg	119.0 (31.2); 57.3 - 201.1	130.0 (40.0); 64.4 - 243.1	11.0 (18.8)	0.003
Operative leg	76.0 (34.1); 34.5 - 183.6	104.0 (41.8); 48.1 - 195.4	28.0 (17.2)	< 0.001
Limb symmetry index (LSI)	62.8 (17.4); 31.2 - 102.5	78.7 (14.0); 50.3 - 108.3	15.8 (12.8)	< 0.001
Biodex peak torque, 180 deg/sec				
Non-operative leg	83.5 (26.2); 21.8 - 164.5	91.1 (29.2); 20.7 - 160.9	7.6 (10.6)	< 0.001
Operative leg	55.8 (23.4); 25 - 129.6	74 (27.2); 23.5 - 140.5	18.2 (11)	< 0.001
Limb symmetry index (LSI)	67.8 (18.1); 31.8 - 124.8	81.5 (12.3); 57.4 - 113.5	13.6 (10.6)	< 0.001
KT-1000, 15 lbs (mm)				
Non-operative leg	3.4 (1.7); 1 - 9	3.5 (1.4); 1.5 - 8	0.1 (1.3)	0.781
Operative leg	3.9 (1.8); 2 - 9	3.7 (1.4); 2 - 8	-0.2 (1.5)	0.367
KT-1000, 20 lbs (mm)				
Non-operative leg	5.1 (1.9); 2.5 - 11	5.0 (1.8); 2.5 - 9	-0.1 (1.3)	0.612
Operative leg	6.0 (2.1); 3 - 12	5.9 (2.2); 3 - 12	-0.1 (1.9)	0.706
KT-1000, 30 lbs (mm)				
Non-operative leg	6.7 (2); 4 - 14	6.5 (2.1); 3.5 - 12	-0.2 (1.5)	0.522
Operative leg	8.0 (2.7); 5 - 15	7.8 (2.5); 4 - 14	-0.2 (1.9)	0.544
KT-1000 manual max (mm)				
Non-operative leg	8.2 (2.7); 4 - 15	8.2 (2.2); 4.5 - 14	0.0 (1.4)	0.898
Operative leg	10.0 (2.6); 6 - 15	10.0 (2.6); 5.5 - 15	0.0 (2.4)	0.970
Side-to-side difference	2.3 (2.1); 0 - 8	2.3 (1.9); 0 - 6	0.0 (1.8)	0.884

[a]Values are mean (standard deviation); minimum – maximum.
[b]Values are paired mean difference (standard deviation).
[c,d]Comparisons are based on n = 31 except for [c]n = 15 and [d]n = 30.
LEFT = Lower Extremity Functional Test
Limb Symmetry Index = (mean score of operative leg / mean score of non-operative leg) x 100.
Statistical significance is reached if p < 0.05.

Table 4. IKDC scores at follow-up evaluations (n = 31).

IKDC Score	Six Months	One Year
Normal (0-2 mm)	21 (67.7)	19 (61.3)
Nearly normal (3-5 mm)	7 (22.6)	9 (29.0)
Abnormal (6-10 mm)	3 (9.7)	3 (9.7)
Severely abnormal (> 10 mm)	0	0

Values are n (%).
IKDC = International Knee Documentation Committee.

Moreover, the QTB autograft has been shown to have a higher load to failure than the BPTB autograft. In a biomechanical study, Shani et al.[17] found the QTB graft tolerated a load of 2,186 N before failure compared to 1,581 N before failure in the BPTB autograft. Another study demonstrated the maximum load to failure for a quadrupled semitendinosus graft was 1123 N, quadrupled gracilis tendon graft was 1068 N, and combined gracilis and semitendinosus quadrupled graft was 806 N.[18] Among these constructs, the QTB had the highest load to failure, even higher than the native ACL, which Markatos et al.[19] quantified as 1725 N.

Other studies have compared quadriceps strength in QTB and BPTB patient cohorts. For example, at 6 to 23 months post-surgery, Hunnicutt et al.[3] found no difference in isokinetic strength in the QTB and BPTB autograft groups. The investigators also found that knee extensor isokinetic strength at 60 deg/sec was a median of 70% of the contralateral leg. This compared well to our findings at six months and one-year post-operative and dispelled the concern that quadriceps function may be compromised after a QTB autograft harvest.

Fisher et al.[20] assessed knee extensor and flexor muscle strength in two patient cohorts having QTB and HT autografts. At one year after ACL reconstruction, the study demonstrated that there was a significantly lower quadriceps strength and a significantly higher hamstring strength in the QTB group compared to the HT group. The authors suggested having a higher hamstring to quadriceps strength ratio in the QTB group may be associated with lower stress on the maturing ACL graft and thus may protect against graft failure postoperatively.

Determining safe return-to-sports parameters has been much debated in the literature. Grindem et al.[21] suggested that determination of return to level 1 sports should be based on time from surgery as well as functional testing. They opined that safe return to sports may be expected with 90% return of quadriceps strength at nine months after ACL reconstruction. Reinjury rates were not increased by additional improvement in quadriceps strength or further delay in return to sports. Using this metric and the functional testing reported in our study, we may predict that sufficient quadriceps strength is regained post-operatively to permit safe return to sports.

In another study, Novaretti et al.[22] demonstrated that quadriceps strength deficit six months after surgery did not predict return to pre-injury sports level. In fact, the authors argued against using strength assessment as a metric for return to sports. Regardless of the criteria used for return to sports, whether time, strength, or a combination of the two, our present study supported the use of QTB as a reasonable graft choice for ACL reconstruction.

Our study was limited by the small number of participants who completed the preliminary assessment. This may be attributed in part to the pandemic, since the study was conducted during the peak incidence of COVID-19 at our location, when participants were reluctant to have personal contact with members of the research team. To mitigate the drop-out rate, we considered using handheld dynamometers to obtain strength measurements during routine clinic follow-ups. However, these measurements would have been less accurate and more highly variable than those obtained in separate extended evaluations by the physical therapist. The Biodex™ strength data and the functional test results collected at these separate encounters provided the best assessment of the knee after ACL reconstruction.

Despite this limitation, our preliminary results provided crucial information for the ongoing study. An updated effect size for a power analysis allowed us to calculate the number of participants required for the ongoing study. Using the effect sizes from the average single leg hop test for the operative leg, with 80% power to detect a paired mean difference of 1.7 (sd 4.8) between six months and one year and alpha level set at 5%, computations showed that about 65 participants would be required. Assuming a dropout rate of 30%, the total sample size to be recruited for the ongoing study would be about 100 participants.

CONCLUSIONS

This preliminary study showed that using QTB autograft for ACL reconstruction did not cause significant quadriceps strength deficit. Moreover, significant gains in quadriceps strength and knee function were observed from six months to one year post-operative. These findings, taken together with the lower morbidity of QTB autograft harvest, indicated that the QTB was an acceptable option for ACL reconstruction.

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Keywords: anterior cruciate ligament tear, knee joint, anterior cruciate ligament reconstruction, isokinetic quadriceps strength, quadriceps muscle

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Is Two Better Than One? A Retrospective Study on Colorectal Surgery Outcomes Using the Da Vinci® Dual-Console Robot

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ABSTRACT

Introduction. The da Vinci® surgical system has become standard in many specialties. The dual-console system has increased console time for residents during their training. This study evaluated patient outcomes using the single- versus dual-console system in resident training.

Methods. A retrospective case-control study was conducted of patients who underwent various colorectal surgeries using either the single- or dual-console da Vinci® system. Patient demographics, comorbidities, and outcomes were collected.

Results. Seventy-one patients (54.2%) utilized the single-console and 60 (45.8%) utilized the dual-console. There were no statistically significant differences in patient demographics, procedures performed, conversion to open, ICU admissions, total length of stay, need for blood transfusion, adequacy of surgical margin, number of lymph nodes harvested, anastomotic leak, discharge disposition, or readmission, wound infection, or need for reoperation within 30 days. There was a nonsignificant decrease in operative time with the dual-console system (200.6 vs. 220.2 minutes, p = 0.111).

Conclusions. While this study showed no statistically significant differences between patient outcomes utilizing the single- versus dual-consoles, it showed that it is safe for use in training, and that more research is needed in this area. ***Kans J Med 2022;15:418-421***

INTRODUCTION

Since the first robotic surgery in 1997, the robot has quickly established its foothold in not only general surgery, but across almost every surgical specialty. Estimates showed approximately 877,000 surgical procedures were performed with the da Vinci® Surgical System in 2017, an increase of approximately 16% from the year before.[1] More surgeons are using the da Vinci® system to perform the majority of their colorectal surgeries which traditionally were done laparoscopically. As the technology evolves, improvements continue in patient outcomes and decreases in costs.[2,3]

With the improved accessibility and functionality of newer models, surgeons are able to perform procedures more easily that were technically difficult to perform laparoscopically. Additionally, with the increased maneuverability and three-dimensional visualization afforded by the robot, the learning curve for these surgeries is declining sharply.[3-5] This is also becoming important to resident surgeons and surgical education. While these technical surgeries are difficult to perform laparoscopically, surgical residents are able to grasp the technique more quickly and safely with the advent of robotics.[6,7] Improvements for both medical students and residents in surgical technique were noted when using the robotic training system.[6,7]

With the implementation of the dual-console robotic system introduced by Intuitive® in 2009, surgical education was changed forever. This technology allowed both trainee and instructor to sit side-by-side working simultaneously controlling the robotic arms, allowing real time critiques and better functionality of the working pair. Additionally, the quality of the robot as a teaching tool was improved by allowing surgeon and resident to interact more fluidly.[7,8]

While there are studies showing no change in patient outcomes between single- and dual-console robotic surgery, there appeared to be a lack of these studies in the colorectal literature.[3,8] It was the goal of this study to evaluate outcomes of single- versus dual-console robotic colorectal surgery at our Residency Review Committee accredited general surgery program. It was hypothesized that patient outcomes would be comparable or improved with the da Vinci® Xi dual-console robotic system implementation as compared to the single-console.

METHODS

This study was approved by the Ascension Vis Christi Hospitals, Wichita, Inc. Institutional Review Board with a waiver of informed consent. A retrospective chart review was conducted of 131 patients undergoing colorectal surgery using the da Vinci® Xi single- or dual-console surgical system. All procedures were performed by a single surgeon with six years of experience with the da Vinci® system, operating with a general surgery resident between March 5, 2017 to March 5, 2019. All data collected for the single-console group were from procedures performed between March 5, 2017 to March 5, 2018, and all data for the dual-console group were from procedures between March 6, 2018 to March 6, 2019. Similar calendar time-periods were utilized so that resident experience would be similar across study periods.

Once eligibility was determined, data were abstracted from each patient's medical record and included: demographic information (age, gender, and race), single- or dual-console robotic system, procedure performed, diagnosis, and comorbidities. These variables were used to assess for potential confounders and effect modifiers. Outcome variables included intensive care unit (ICU) admission, hospital length of stay, operative time, adequacy of surgical margin, number of lymph nodes, anastomotic leak, discharge status, readmission within 30 days, wound infection within 30 days, need for reoperation within 30 days, and conversion to open.

Data were summarized by calculating means and standard deviations for normally distributed continuous data, medians and interquartile ranges for skewed continuous data, and proportions for categorical data. An Independent Samples t-test was used to compare normally distributed continuous data. The Mann-Whitney U-Test was used to compare skewed continuous data, and Chi-square was used to compare categorical data. All analyses were run as two-tailed tests, and results of analyses were considered significant if the resultant p value was less than or equal to 0.05. Analyses were run using SPSS release 19.0 (IBM Corp., Armonk, NY).

RESULTS

A total of 131 patients who underwent colorectal surgery utilizing the da Vinci® surgical system were evaluated during the study period. Of the patients studied, 71 (54.2%) underwent surgery using the single-console and 60 (45.8%) using the dual-console robotic system. Patient ages for the single- and dual-console groups were 58.8 ± 13.9 years and 59.9 ± 15.6 years, respectively. Proportion of women and Caucasian patients in the single- and dual-console groups were 56.3% (n = 40) vs. 45.0% (n = 27) and 87.3% (n = 62) vs. 90.0% (n = 45), respectively. Patient demographics were equivalent between the study groups with the majority of the patients being Caucasian (88.5%, n = 116) and female (51.1%, n = 67) with a mean patient age of 59.3 ± 14.7 years.

The most common diagnosis was colon cancer (34.4%) followed by diverticulitis (17.6%; Table 1). The most common listed procedure was colon resection (85.5%) followed by colon resection with diversion (6.9%; Table 2). There were no significant differences in demographics, diagnosis, or procedure performed between groups. Furthermore, when evaluating the two groups there was no significant differences noted when comparing the procedure details and outcomes (Table 3).

When comparing the two arms one might anticipate finding differences in operative time, seeing as there would be less time in transit between the patient bed and console. While there was no statistically significant difference in operative time (single 220 min vs. dual 200 min; p = 0.111), there was a notable numerical decrease toward the dual-console arm having a shorter operative time. Additionally, when comparing nodes harvested, there were on average 2.4 more lymph nodes harvested with the dual-console system (single 17.1 vs. dual 19.5; p = 0.266), although this was not statistically significant. The other measured values in Table 3 revealed no statistically significant differences between the single- and dual-console arms in need for ICU admission (4.2% vs. 8.3%; p = 0.496), total length of stay (three vs. two days; p = 0.102), requirement for blood transfusion (4.2% vs. 3.3%; p = 1.000), adequacy of surgical margin (positive margin 1.4% vs. 1.7%; p = 0.953), and anastomotic leak (2.8% vs. 3.3%; p = 1.000).

Table 1. Comparison of patient diagnoses between patients undergoing colorectal procedures using either a single- or dual-console robotic system.*

Diagnosis Category	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Diagnosis categories				0.823
Colon cancer	45 (34.4%)	23 (32.4%)	22 (36.7%)	
Diverticulitis	23 (17.6%)	11 (15.5%)	12 (20.0%)	
Unresectable polyp	16 (12.2%)	8 (11.3%)	8 (13.3%)	
Rectal cancer	12 (9.2%)	7 (9.9%)	5 (8.3%)	
Colon mass	11 (8.4%)	7 (9.9%)	4 (6.7%)	
Fistula	10 (7.6%)	5 (7.0%)	5 (8.3%)	
Other	14 (10.7%)	10 (14.1%)	4 (6.7%)	

* Values are presented as number (%) or mean ± standard deviation.

Table 2. Comparison of primary procedure performed between patients undergoing colorectal procedures using either a single- or dual-console robotic system.*

Primary Procedure	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Colon resection	112 (85.5%)	57 (80.3%)	55 (91.7%)	0.522
Colon resection with diversion	9 (6.9%)	6 (8.5%)	3 (5.0%)	
Abdominoperineal resection	2 (1.5%)	1 (1.4%)	1 (1.7%)	
Rectopexy	2 (1.5%)	2 (2.8%)	0 (0.0%)	
Tamis	2 (1.5%)	1 (1.4%)	1 (1.7%)	
Total colectomy	2 (1.5%)	2 (2.8%)	0 (0.0%)	
Colostomy reversal with parastomal hernia repair	1 (0.8%)	1 (1.4%)	0 (0.0%)	
Proctocolectomy	1 (0.8%)	1 (1.4%)	0 (0.0%)	

* Values are presented as number (%).

Table 3. Comparison of procedure details and outcomes between patients undergoing colorectal procedures using either a single- or dual-console robotic system.*

Parameter	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Need for ICU admission	8 (6.1%)	3 (4.2%)	5 (8.3%)	0.469
Total length of stay (days)	3 (2-4)	3 (2-4)	2 (2-4)	0.102
Blood transfusion required	5 (3.8%)	3 (4.2%)	2 (3.3%)	1.000
Operative time (min)	211.2 ± 69.2	220.0 ± 74.5	200.6 ± 61.5	0.111
Adequacy of surgical margin				0.953
Negative	88 (67.2%)	47 (66.2%)	41 (68.3%)	
Positive	2 (1.5%)	1 (1.4%)	1 (1.7%)	
N/A	41 (31.3%)	23 (32.4%)	18 (30.0%)	
Number of lymph nodes harvested	18.3 ± 10.7	17.1 ± 9.2	19.5 ± 12.1	0.266
Anastomotic leak	4 (3.1%)	2 (2.8%)	2 (3.3%)	1.000

* Values are presented as number (%), median (IQR), or mean ± standard deviation.

With regards to discharge and 30-day post-discharge parameters, there were no statistically significant differences between the two study arms (Table 4). The majority of patients were discharged to home in both study arms (single 94.4% vs. dual 83.3%; p = 0.077). Readmission within 30 days, wound infection within 30 days, need for reoperation within 30 days, and conversion to open were similar between the study arms. Reasons for conversion to an open procedure were tracked and listed in Table 5.

Table 4. Comparison of discharge destination and 30-day post-discharge parameters between patients undergoing colorectal procedures using either a single- or dual-console robotic system.*

Parameter	Composite	Treatment Group		p Value
		Single-Console	Dual-Console	
Number of observations	131 (100%)	71 (54.2%)	60 (45.8%)	---
Discharge status				0.077
Home	117 (89.3%)	67 (94.4%)	50 (83.3%)	
Home health	7 (5.3%)	1 (1.4%)	6 (10.0%)	
Rehabilitation	1 (0.8%)	1 (1.4%)	0 (0.0%)	
Skilled nursing unit	6 (4.6%)	2 (2.8%)	4 (6.7%)	
Readmission within 30 days	14 (10.7%)	10 (14.1%)	4 (6.7%)	0.257
Wound infection within 30 days	11 (8.4%)	7 (9.9%)	4 (6.7%)	0.548
Reoperation within 30 days	4 (3.1%)	1 (1.4%)	3 (5.0%)	0.332
Conversion to open	11 (8.4%)	4 (5.6%)	7 (11.7%)	0.344

* Values are presented as number (%).

Table 5. Conversion to open reasons.

Single-Console	Dual-Console
Adhesions	Adhesions
Body habitus, obesity, bowel distension	Bleeding, fistula
Difficult anatomy	Dense adhesions
Tumor adherent to retroperitoneum	Dense adhesions
	Difficult dissection
	Initial positive margin
	Tumor size and local invasion

DISCUSSION

Laparoscopic assisted robotic surgery is becoming more common as robotic surgical systems become more readily available in hospital settings. With the implementation of the da Vinci® dual-console system, two surgeons may be at the console working simultaneously. This provides closer observation and direct feedback during residency training. While robotic surgical systems have been around since 1997, the dual-console system is a newer tool in the surgeon's arsenal, first being implemented in 2009.

Our study showed that when comparing outcomes for one colorectal surgeon performing colorectal surgery with a surgical resident at a single facility, there were no statistically significant differences between the two groups. While this did not show a clear benefit in using the dual-console over the single-console system, other studies have shown the benefit of the robotic dual-console system in surgical training.[6] A study in the obstetrics and gynecology literature showed that training programs with dual console systems were more likely to obtain robotic certification for the residents upon graduation, as well as having more residents perform the cases prior to graduation vs. programs with the single console.[6] Additionally, while not statistically significant, the overall operative time, nodal harvest, and 30-day readmission rates were improved in the dual-console arm. A higher-powered study might have shown statistically significant improvements with regards to these measures.

Our outcomes were similar to those in the literature with regards to patient morbidity and oncologic outcomes.[9-12] The current guidelines in colorectal surgery recommended a nodal harvest of at least 12 lymph nodes. In our study, both arms averaged more with 17.1 ± 9.2 in the single-console arm and 19.5 ± 12.1 in the dual-console arm, showing adequacy of the robotic platform with regards to this measure.[10] Our anastomotic leak rates were not statistically different between the two groups; 2.8% in the single-console and 3.3% in the-dual console, but were acceptable when compared to national data which quote the acceptable leak rate between 3-6%.[11] In evaluating our 30-day outcomes, our rates were comparable with a 30-day readmission rate of 10.7% overall with other studies showing 10.5% as an acceptable rate.[12] Comparing our outcome measures with the data from the literature endorsed the safety and feasibility of performing these surgeries robotically.

Limitations. The current study had limitations. It was a retrospective chart review of cases performed by a single surgeon at a single facility. As such, the results may not be generalizable to other surgeons or facilities. Evaluating other surgeons/specialties/communities would help to extrapolate the data. Secondly, a larger study size would delineate the significance of our findings and increase the overall power of the study. It was also difficult to determine confounding factors such as actual resident operating time. It also would be beneficial to extend this data to three and five years to evaluate overall oncologic outcomes to compare differences, but not limited to, cancer related mortality, recurrence, need for adjuvant chemoradiation, and interval free survival. Additionally, while further studies may show improved outcomes with the da Vinci® robotic system, it is important to factor cost into the overall picture, and further studies comparing the overall cost between robotic and laparoscopic surgeries would be beneficial to discuss.

CONCLUSIONS

The da Vinci® surgical system is becoming a standard part of many surgical practices. The dual-console surgical system is a valuable tool for resident education, allowing closer monitoring by the attending during surgery, with increased autonomy for the resident. While autonomy during residency is important for training, autonomy cannot be more important than patient safety and patient outcomes.

Our study showed that for our patient population there were equal outcomes when comparing the single- and dual-console systems in a single colorectal surgeon's practice. There appeared to be a possible trend in more nodes harvested and shorter operative times with the dual-console system, though further studies with higher number of

patients and in different communities may be able to determine if this is just an anomaly or if there is any significance to it. Additionally, this type of study could be performed with different specialties in different educational and private settings to compare outcomes.

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Keywords: robotics, colorectal surgery, internship and residency, colectomy

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Blueprint for Implementing and Improving Eligible Inferior Vena Cava Filter Retrieval Across Institutions

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ABSTRACT

Introduction. Placement of removable inferior vena cava filters (rIVCFs) has increased, but this has not been accompanied by timely removal, with retrieval rates as low as 8.5% at some institutions. Failure to remove rIVCFs that were not medically necessary resulted in increased complications. This study discussed the development of an inferior vena cava (IVC) filter follow-up protocol.

Methods. A method to monitor IVC filter placement and retrieval was developed. A weekly report was generated detailing placement and removal of rIVCFs. A standardized retrieval calculator was utilized to determine efficacy of removal. An IVC filter Retrieval Assessment Form was developed. Managing physicians and patients with medically unnecessary filters were sent letters with a retrieval checklist and order form. If not removed within one year, additional letters were sent. Standardized IVC filter reporting templates were created and utilized after insertion of all filters with retrieval status. Letters eventually were built into the electronic medical record for direct routing.

Results. From 2015 to 2020, IVC filters were placed in 719 patients. Of those, 58% were eligible for retrieval. Initial rates of rIVCF removal in eligible patients were as low as 30-33% in 2015. The retrieval rate of eligible filters rose to 44% in September 2018. The rate of retrieval rose to 61% in January 2021.

Conclusions. Employing a systemic protocol to aid in follow-up of patients following rIVCF placement may improve rates of retrieval. Regular evaluation and revision of the process demonstrated a significant role in achieving an increase in retrieval rates.

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INTRODUCTION

Placement of removable filters (rIVCFs) has increased dramatically over the past decade, with prophylactic indications accounting for more than 50% of all filter placements.[1] Increasing use of rIVCFs has not been accompanied by follow-up and timely removal, with retrieval rates as low as 8.5% at some institutions.[2] Failure to remove rIVCFs that were not medically necessary have resulted in increased risk of complication, including embedment, scarring, fracture, penetration, and venous thromboembolism.[3]

Reasons for insufficient filter follow-up vary, whether the primary physician was unaware of its presence, because of prolonged dwell time risks, or the indwelling filter was simply forgotten (among many other reasons). It was hypothesized that implementing a protocol by which deployed filters were followed in a data set with prospective reminders sent to referring primary care physicians would result in improved eligible retrieval rates. Moreover, those filters not eligible for retrieval would be identified, resulting in closure for the patient.

METHODS

A systematic method was developed to monitor IVC filter placement and retrieval and facilitate patient follow-up through interdisciplinary communication. Institutional Review Board (IRB) approval was obtained. The patient participation in the study was voluntary and consent was obtained from each patient.

Beginning in 2015, a weekly report was generated prospectively detailing placement and removal of rIVCFs in the interventional radiology (IR) department at the investigators' institution. Information was stored in an electronic database and consisted of the patient's medical record number, filter placement date, indication for placement, patient age, clinical disposition, and likelihood that the filter would end up needing to be retrieved using a standardized retrieval calculator. This information was queried monthly, reviewed, and any filters in place 90 days or longer were analyzed using a novel IVC filter Retrieval Assessment Form (Figure 1) as well as the electronic medical record. The retrieval assessment form aided in determining appropriate candidates for filter retrieval. rIVCF's deemed no longer medically necessary initiated paper letters sent to the patient reminding them to consult their primary physician about potentially getting the filter removed. The managing physician also was notified with a retrieval checklist and order form (Figure 2). The letter sent to the managing physician would discuss risks associated with leaving unnecessary rIVCFs in place, including device migration, filter fracture, embolization (movement of the entire filter or fracture fragments to the heart or lungs), perforation of the IVC, lower limb deep vein thrombosis, and IVC occlusion.

Once the letter was sent, it was recorded in the database. Of note, patients who did not come to the investigators' institution for filter retrieval presumably did not get it removed at an outside health system unless specified by the patient. If it became known that a patient's filter was removed at an outside institution, they were excluded from the study results.

As the study progressed, data collection continuously was revised and improved. The most significant data collection improvement included the implementation of procedural dictation identifying the filter and the adaptation of a universal stratification mechanism to determine filter retrieval probability. Initially, a total tally of filters placed compared to filters removed was used to calculate retrieval rates. In 2018, data collection was revised to exclude deceased patients and those requiring filters permanently, allowing for more accurate results. Also beginning in 2018, if a filter was not retrieved within one year of the original letter being sent, additional letters were sent to both the patient and managing physician on an annual basis until the filter was removed or deemed permanent due to a change in clinical status. Standardized IVC filter dictation templates were created and utilized after insertion of all filters with retrieval status, which alerted clinicians to anticipate follow-up from the department. Lastly, the burden of letter generation, patient re-location, and time constraints resulted in letters being built

into the electronic medical record (EMR) at the investigator's institution (Epic™) allowing for direct routing. Electronic letters also were sent directly to patients through the myChart™ platform.

Patient Name		
MRN		
Age		
Sex	☐ Male	☐ Female
Filter Type, Brand/Model	☐ IVC	Brand _____ Model _____
Filter Placement Date		
IR Staff		
IP/OP Status	☐ IP	☐ OP
Clinical Indication		
Likelihood of Retrieval Calculator	_____ % Permanent	
IR staff Reviewing		
Date		
Retrieval Indicated?	☐ Yes	☐ No
Reason if not	☐ Comorbidities	☐ Other
Target	☐ Letter to Patient	☐ Letter to Provider
PCP or Managing Provider		
Medical History, ECOG score		
Current AC		
Notes		

Figure 1. IVC filter retrieval assessment form.

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IVC Filter Retrieval Readiness Checklist

- ☐ The patient successfully completed at least 2-3 weeks of anticoagulation
- ☐ Patients currently taking warfarin should have a stable INR and no evidence of bleeding
- ☐ If filter was placed for lower extremity VTE or prophylaxis, please complete lower extremity duplex venous ultrasound to confirm resolution or absence of thrombus
- ☐ The patient has no signs or symptoms of new, recurrent, or progressive VTE that may include:
  - Lower extremity VTE
    - Leg pain or tenderness of the thigh or calf
    - Leg swelling
    - Skin that feel warm to the touch around the painful area
    - Redness or streaks near the painful area
  - PE
    - Unexplained shortness of breath
    - Rapid breathing
    - Chest pain anywhere under the rib cage (may be worse with deep breathing
    - Fast heart rate
    - Light headedness or syncope
- ☐ ECOG Performance Status of 0-2

GRADE	ECOG PERFORMANCE STATUS
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all selfcare but unable to carry out any work activities; up and about more than 50% of waking hours
3	Capable of only limited selfcare; confined to bed or chair more than 50% of waking hours
4	Completely disabled; cannot carry on any selfcare; totally confined to bed or chair
5	Dead

- ☐ The patient is deemed no longer at risk for VTE

Please contact the Clinical Nurse Specialist, MSN, APRN, AGCNS-CCRN for Interventional Radiology at [EMAIL] for questions or feedback.

Figure 2. IVC filter retrieval checklist sent to primary care physician.

RESULTS

From 2015 to 2020, our institution's interventional radiology department placed IVC filters in 719 patients. Of those patients, 15% (n = 106) required filters permanently (did not need retrieval per the risk stratification calculator) and would not be eligible for removal. Twenty-seven percent (n = 194) of patients had been pronounced deceased. Fifty-eight percent (n = 419) of the patients who had an IVC filter placed were deemed eligible for filter retrieval per the stratification calculator. Initial rates of rIVCF removal in eligible patients were as low as 30-33%. After implementation of the clinical protocol, the retrieval rate of eligible filters rose to 44% from inception of the study in 2015 to September 2018, which was calculated following the data revisions discussed previously. Following the previously discussed protocol revisions, the overall rate of retrieval rose to 61% (n = 254) as of January 2021 (Figure 3). Table 1 offers an overview of filters placed and retrieved according to year of filter placement. The filters eligible for retrieval were accomplished at a 100% success rate.

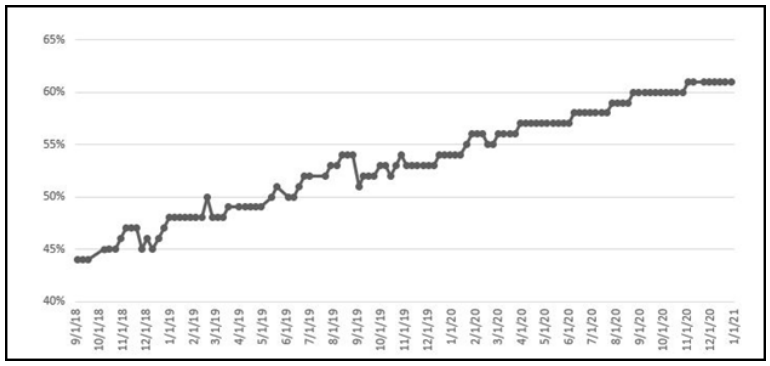

Figure 3. Percentage of eligible filters removed from 2015-2021. Data shown was acquired following the revisions made in 2018 to exclude patients requiring permanent filters and deceased patients.

DISCUSSION

This protocol highlighted the necessity of initiating communication with providers regarding implanted IVC filters. A small implant such as an IVC filter is easy to remain out of site and out of mind. Rates of removal of eligible IVC filters doubled, with rates initially 30-33% rising to 61% at the end of the study, which may be attributed to initiating regular communication with patients and their primary care providers.

Need for follow-up after IVC filter placement has been well established per the aforementioned risks with increased dwell time. With ever-increasing rIVCF placement across the U.S., health systems and providers need to have systems in place to ensure proper management and follow-up of patients.[1] IVC filters are accepted widely as a low morbidity method of preventing pulmonary embolism, though there was evidence that longer dwell times were associated with increased incidence of complications.[4] While removal of a chronically implanted filter is often complex, prolonged dwell times were not a contraindication to retrieval, as there were many reported cases of filters being removed safely using supplementary retrieval methods.[5,6] Study limitations included limited follow-up on patients who elected to receive care at an

Table 1. Overview of IVC filter retrieval rates.

	2015	2016	2017	2018	2019	2020	Totals	% of Total	Average
Total placed and reviewed for eligibility	159	130	118	144	133	35	719		120
Assigned permanent status after 90-day assessment	38	19	8	19	20	2	106	15%	18
Expired Patients	40	31	47	37	29	10	194	27%	32
Retrievable	81	80	63	88	84	23	419	58%	70
Retrieved	57	50	41	46	47	13	254	35%	42
% Retrieved/Retrievable	70%	63%	65%	52%	56%	57%	61%		60%

outside institution following rIVCF placement, as well as the initial use of paper letters for which delivery to intended recipients could not be guaranteed for reasons such as incorrect addresses or relocation. Electronic methods tend to reach the patient in a more efficient manor, as all appointments, procedures, and results are provided to the patient in the same manor. Additionally, use of Epic™ and myChart™ for communication in the latter half of the study may limit generalizability of results to institutions with similar EMR systems. A strength of the study was the availability to which a similar protocol may be applied at outside institutions, establishing a foundational protocol which can be customized for the individual institution to improve rates of eligible IVC filter retrieval, assuming no current protocols are in place.

In conclusion, employing a systemic protocol to aid in proper follow-up of patients following rIVCF placement can improve rates of retrieval in the appropriate clinical setting. Regular evaluation and revision of the process played a significant role in achieving a two-fold increase in preliminary retrieval rates. The percentage of retrievals will never be 100% due to multiple factors such as determined permanence, loss to follow up, and disease process. However, the direction of retrieval formats should be ever evolving with the common denominator being physicians will need to presume all accountability for appropriate retrieval per standardized guidelines. Processes have been put in place across the country to limit those patients who are not identified for retrieval and this study provided high yield markers to help throughout this process.

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Keywords: vena cava filters, hospital radiology department, radiology information systems

KANSAS JOURNAL of MEDICINE

Do Two Rights Make a Wrong? A Case Report on Reversible Neurotoxicity Induced by Coadministration of Clozapine and Lithium

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INTRODUCTION

The combination of clozapine and lithium can be utilized in the treatment of refractory schizophrenia, schizoaffective disorder, and bipolar disorder with rapid cycling. Lithium induces leukocytosis which improves bone marrow suppression caused by clozapine but it has a very narrow therapeutic window.[1] When lithium blood concentration is kept within therapeutic levels it is regarded, by and large, as a safe medication.[2] Lithium's therapeutic range lies between 0.30 and 1.30 mEq/liter with 1.50 mEq/liter representing the lower limit for toxicity.[3] At levels above 2.0 mEq/liter, patients experience symptoms of lithium toxicity including nausea, vomiting, diarrhea, tremor, hyperreflexia, ataxia, fasciculations, spasticity, rigidity, extrapyramidal symptoms, seizure, stupor, and coma.[4]

The effectiveness of lithium has been confirmed and it is regarded as a cornerstone of long-term treatment for bipolar disorder and schizoaffective disorder.[5] The Canadian psychiatrist, Paul Grof, introduced the term "excellent lithium responders" for patients who responded to lithium monotherapy with no further recurrences of their illness.[6] However, the percentage of patients in remission from their affective illness on lithium monotherapy was only about one-third.[7] Therefore, in lithium "non-responders", it is necessary to consider different therapeutic agents. Other mood stabilizers, such as, valproic acid or carbamazepine may be used as alternative or adjunctive drugs with good results.[8] Antipsychotics, alone or in combination with lithium, are considered appropriate first line options in acute mania, independent of the presence of psychotic features.[9] Most recently, clozapine in combination with lithium is used for refractory schizophrenia,[10] schizoaffective disorder,[11] and bipolar disorder.[12]

There is a paucity of literature on the combination of these agents and the potential side effects or interactions that can occur. Blake et al.[13] reported four cases in which patients experienced reversible neurologic symptoms while taking clozapine and lithium, despite the blood concentrations of both medications remaining within the therapeutic range. They concluded that achieving lithium levels no greater than 0.5 mEq/liter might yield therapeutic results while minimizing side effects. Another case report by Lee et al.[14] discussed a case of a patient with bipolar disorder treated with clozapine and lithium who developed reversible toxic neurologic symptoms even though the lithium concentration was below 0.5 mEq/L. These reports described adult patients and there are no known published findings about the adolescent population.

In this report, a challenging case of an adolescent is presented who, while taking a combination of lithium and clozapine, appeared to develop reversible toxic neurologic symptoms with a lithium concentration below 1.30 mEq/liter.

CASE REPORT

A 16-year-old female with a past psychiatric history of major depressive disorder with psychotic features and cannabis use disorder was hospitalized at our institution for increasing aggression, disorganization, and hallucinations including command auditory hallucinations to kill her family. The patient had two previous psychiatric admissions, and, at her last hospitalization discharge, two years prior, she was prescribed olanzapine and sertraline.

This was an arduous case because of the patient's lack of cooperation and her family's inability to provide pertinent information including her developmental history. It was concluded that the patient had not seen a psychiatrist for over a year, had stopped going to school due to overwhelming anxiety, and had not left the home for over six months at the time of her third hospitalization. Moreover, during that six-month period, she had not talked to her family and had mostly isolated to her room until the week leading up to her third admission. At that time, the patient was brought to the emergency department because she became violent against her family as they tried to interact with her. At the time of her admission to the hospital, she was responding to internal stimuli and displaying disorganized behavior, such as, laughing inappropriately and displaying abnormal oral-facial movements.

On admission, the patient, who was obese, was started on aripiprazole 2 mg daily for symptoms of psychosis due to concern for further weight gain and metabolic adverse effects from olanzapine to which she had a positive response in the past. The following day, escitalopram 5 mg was started for symptoms of depression and social anxiety. During the first few days of her hospitalization, the patient displayed self-care failure by refusing to shower or brush her teeth, was irritable, and mostly isolated to her room, refusing to attend group therapy.

Aripiprazole was titrated upward and reached 10 mg on hospital day seven with good tolerability. On hospital day 11, escitalopram was increased to 10 mg to target the patient's depressive and anxiety symptoms. Two days later, on hospital day 13, the patient's speech became more pressured and rapid. She began to sleep less with nursing reporting only four hours of sleep at night. The patient also was seen pacing the halls and presented with psychomotor agitation. Her mood became extremely irritable, and she expressed grandiose delusions, such as, graduating from college, owning the hospital where she was admitted, being rich and being married to multiple husbands. This change in mental status was conceptualized as a possible SSRI-induced activation or precipitation of a manic episode, hence, the patient's escitalopram was decreased to 5 mg daily. Aripiprazole did not appear to improve the patient's psychotic symptoms and, over concern for akathisia, on hospital day 14, this medication was stopped by cross tapering it with olanzapine, to which the patient positively responded to in the past.

Based on important information finally obtained by the patient's prior outpatient provider, a few important details provided by the family, and the patient's response to escitalopram, it was concluded that the patient suffered from schizoaffective disorder, bipolar type, two weeks

into her hospital stay. Escitalopram was discontinued and lithium 300 mg twice a day was initiated. Due to the persistence of manic symptoms, lithium initially was increased to 300 mg in the morning and 600 mg at bedtime on hospital day 21, and on hospital day 26 to 600 mg twice a day after her lithium level was found to be 0.65 mEq/L and she was still symptomatic. The patient's olanzapine was titrated slowly up to 12.5 mg at bedtime. However, the patient could not tolerate this increased dose due to excessive sedation hence olanzapine was tapered down to 10 mg at bedtime. On hospital day 32, the patient's lithium level was 0.70 mEq/L, and the dose was increased to 600 mg in the morning and 900 mg at bedtime. On this dose, the patient's lithium level was 0.83 mEq/L when re-checked seven days later.

During the following days, the patient continued to be disorganized, illogical, and endorsed paranoid and grandiose delusions. Due to the patient not tolerating an increase in olanzapine, it was decided to try a different antipsychotic. After carefully sifting through the available information, it became clear that the patient had failed two adequate trials of antipsychotic medications and was treatment resistant. The hospital pharmacist agreed that it would be worthwhile to start the patient on clozapine. On hospital day 39, the patient was started on clozapine 12.5 mg at bedtime. Clozapine was increased gradually to 50 mg in the morning and 100 mg at bedtime by hospital day 55. During this time, the patient became overly sedated. She began sleeping more and started to refuse to leave her room. Four days later, on hospital day 59, the patient was reported to have a coarse hand tremor.

On neurologic and physical exam, the patient had stable vital signs, but displayed lethargy, hyperhidrosis, and a slightly unsteady gait with possible ataxia as she was seen using the wall for assistance. The patient was not cooperative with testing for deep tendon reflexes, myoclonus, or more formal ataxia testing. She also endorsed nausea but was unsure whether she had diarrhea. The patient's lithium level came back at 1.23 mEq/L and lithium was decreased to 600 mg twice a day with a further decrease the next day to 300 mg twice a day. The patient's neurological symptoms subsided except for continued lethargy. Lithium was decreased further and discontinued completely on hospital day 64. Clozaril was titrated gradually up until the patient was taking 50 mg in the morning and 150 mg at bedtime on hospital day 66. The patient's neurotoxic symptoms resolved after lithium was discontinued.

It was initially difficult to differentiate the patient's increased sedation due to lithium toxicity from the antihistaminergic effect of clozapine. By the time of the patient's discharge from the unit on hospital day 70, her sedation had improved but she was mildly disorganized even though she appeared to have improved as compared with her presentation at admission. At the time of discharge, the patient's delusions and hallucinations had resolved and she was no longer aggressive and a danger to self or others.

Since discharge from the hospital, the patient was followed in the outpatient psychiatric clinic. She continued to be compliant with clozapine 50 mg every morning and 150 mg at bedtime with vast improvement in psychiatric symptoms and did not experience any neurologic sequela. At clinic encounters, the patient became more cooperative, pleasant, organized, and talkative with a reactive affect. She isolated much less at home and spent time with her family. Her anxiety improved to the point that she left the home to go to social events and liked to go shopping. She has not had any aggressive episodes or experienced hallucinations or delusions. The family reported that the patient could take care of herself and her pets. The patient had been showering regularly and cooking for herself. Her mother was pleased to see her help with chores around the home.

DISCUSSION

This patient case suggested that typical clinical practice needs to be adjusted in certain circumstances. Normally, it is sensible to achieve a lithium concentration of 0.30 to 1.30 mEq/L and concentrations above 1.50 mEq/L begin to raise concern for lithium toxicity. For our patient, her neurotoxic symptoms developed when clozapine was added to her lithium regimen with a level of 0.83 mEq/L. The patient was tolerating lithium well prior to this addition and no change in dose was made to lithium. The temporal correlation along with the pathognomonic signs and symptoms were highly suggestive of lithium toxicity.

Blake et al.[13] described four patients treated with the combination of clozapine and lithium who developed reversible neurologic symptoms. For those patients, the clozapine dose was 900 mg daily and the lithium dose was between 900 and 1,200 mg daily. The lithium blood concentrations ranged from 0.7 to 0.8 mEq/L.

Our patient was on a lower dose of clozapine totaling 150 mg daily but on a higher dose of lithium (1,500 mg daily). Prior to the initiation of clozapine, on this lithium dose, our patient had a lithium level of 0.83 mEq/L. After the addition of clozapine, the patient's lithium level increased to 1.23 mEq/L, with no change in lithium dose. In the literature, there was no evidence of a drug-drug interaction between lithium and clozapine. Lithium is an intracellular ion that is not metabolized by the liver but is excreted purely by the kidneys while clozapine depends on the cytochrome P450 1A2 for its metabolism.[15]

The mechanism for the increased risk of neurotoxicity when lithium is combined with clozapine is unknown. The combined serotonergic effect of clozapine and lithium has been proposed as a possible culprit.[16] Therefore, one important recommendation for providers is to use caution when prescribing this combination. Decreased dosages of both medications and stringent monitoring of side-effects seem to be crucial. Also, it is important to monitor continually the mental status of patients taking a combination of lithium and clozapine. If there is any concern for toxicity, more frequent lithium concentration levels should be obtained. Blake et al.[13] suggested that when combined with clozapine, the lithium concentration should be kept at no more than 0.5 mEq/L.

The final lesson from our patient was related to clozapine delayed treatment response. The delay to onset hypothesis for antipsychotics has been refuted in the past.[17] In fact, treatment response to antipsychotics began in the first week and accumulated over time, with greater improvement in the first two weeks compared to the subsequent two weeks.

Conversely, clozapine efficacy in the treatment-resistant population

has long observation periods lasting up to 20 months.[18] It took several weeks for our patient's symptoms to ameliorate appreciably, and they continued to improve in the outpatient setting on the same clozapine regimen. This result highlighted the importance of using patience when assessing the efficacy of clozapine which will take many weeks to be fully paramount.

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Keywords: neurotoxicity syndromes, clozapine, lithium, schizoaffective disorder, adolescent

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MPO-ANCA Rapidly Progressive Glomerulonephritis with Immune Deposits

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INTRODUCTION

Antineutrophil cytoplasmic autoantibody associated (ANCA) vasculitides include a group of disorders that affect predominantly small-sized arteries. ANCA-associated conditions include granulomatosis with polyangiitis and microscopic polyangiitis.[1] These conditions typically present as focal necrotizing lesions without immune complex depositions on histology. There are two major categories of ANCA based on different autoantibody targets. Cytoplasmic ANCA (c-ANCA) refers to the diffuse cytoplasmic pattern of autoantibodies on immunofluorescence microscopy while perinuclear ANCA (p-ANCA) demonstrates perinuclear staining. Anti-proteinase 3 antibodies commonly are found in c-ANCAs while anti-myeloperoxidase is the major p-ANCA antibody. Induction therapy consists of steroids with either cyclophosphamide or rituximab. ANCA vasculitides classically demonstrate pauci-immune glomerulonephritis on microscopic examination, however, there were reported cases of immune complex deposition. This case report presents a patient with immune complex deposition and nephrotic range proteinuria.

CASE REPORT

A 40-year-old male with a past medical history of hypothyroidism and hypertension presented to the emergency department (ED) with complaints of headaches, weakness, and shortness of breath for seven days. The patient also reported back pain that worsened with deep inspirations.

Prior to arriving to the ED, the patient was evaluated at his primary care provider's office and was found to be hypertensive, so he was advised to go the ED. The initial blood pressure in the ED was 189/109 mmHg; all other vital signs were normal. Initial labs were significant for a serum sodium of 130 mmol/L, creatinine of 2.84 mg/dL, and a white blood cell count of 12.5 k/cumm.

A chest radiograph was obtained for evaluation of his shortness of breath, which revealed faint bilateral interstitial opacites. A brain computed tomography demonstrated an old left lacunar infarct but was otherwise unremarkable.

On review of systems, the patient endorsed decreased food and fluid intake as well as bloody urine. Initial urinalysis, obtained in the ED, demonstrated 2+ protein, 3+ blood, and 2+ leukocyte esterase. Microscopic examination of the urine sample demonstrated 20-50 red blood cells per high power field (hpf), and 10-20 white blood cells per hpf. He was admitted to the intensive care unit for hypertensive emergency; however, his blood pressure was controlled by a single dose of hydralazine that was administered in the emergency department. The patient was started on antibiotics for his presumed community acquired bacterial pneumonia.

Diagnostic work-up of his acute renal failure revealed normal kidneys bilaterally without hydronephrosis on renal sonogram, and a fractional excretion of sodium was calculated to be 3.1% suggesting intrinsic renal disease. The patient's renal failure was attributed to glomerulonephritis. Complement C3 and C4 levels were found to be normal. Nephrology was consulted and a renal biopsy with serology demonstrated diffuse necrotizing and crescentic glomerulonephritis with immune-complex deposition. Immunofluorescence demonstrated heavy IgM, C3 deposition. The patient was started on intravenous methylprednisolone.

Urine protein to creatinine ratio was calculated to be 7.5 which was in the nephrotic range. Serologies were remarkable for p-ANCA titer of 1:320 and anti-myeloperoxidase of 20:9 which was consistent with microscopic polyangiitis. All other serologies were negative. The patient was given an infusion of rituximab while admitted and discharged with oral prednisone with plans for an outpatient infusion of rituximab.

DISCUSSION

This patient presented with rapidly progressing glomerulonephritis and subsequently was diagnosed with microscopic polyangiitis, renal limited. Microscopic polyangiitis typically does not display immune complex deposition on immunofluorescence microscopy, however, immune complex deposition has been reported in a growing number of studies.[2]

Immune complex deposition, poor renal function (sCr > 3.62 mg/dL), sclerotic histopathology, low albumin (< 3 g/dL), low hemoglobin (9 g/dL), and persistently low serum C3 concentrations were associated with poor renal survival.[3,4] This patient presented with immune complex deposition, poor renal function, and low albumin. However, he had a normal serum C3, non-sclerotic histology, and hemoglobin > 9 mg/dL.

CONCLUSIONS

The degree to which immune complex depositions can predict prognosis is an area for further research, but the presence of these complexes has been a positive prognostic indicator for glomerulonephritis. In two different studies, a greater number of immune complexes was associated with increased findings of proteinuria. This could make the percentage of immune complexes a significant predictor of renal outcomes.[5,6] Additionally, these new findings change the way pauci-immune vasculitis could be classified in the future. Colloquially, the absence/minimal immune complex deposition places MPO in the "pauci" vasculitis group. However, this case report amongst previous studies provided a rationale for further research into determining the extent of immune complex deposition in pauci-immune pathologies. Therefore, this case report contributed to that discussion while also providing a different presentation of MPO that had more of a nephrotic picture.

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Keywords: MPO deficiency, ANCA, immune complex diseases, glomerulonephritis, pauci-immune vasculitis

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COVID-19 Confinement Unmasking PFAPA Syndrome

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INTRODUCTION

Periodic fever, aphthous stomatitis, pharyngitis, and cervical adenitis (PFAPA) syndrome is characterized by recurrent episodes of fever of unexplained origin, pharyngitis, oral aphthous ulcers, and cervical lymphadenopathy.[1] It was first described in 1987 and was known as the Marshall's syndrome until the abbreviation PFAPA was introduced in 1989.[2] Generally, the onset is before the age of five years and resolves spontaneously before the adult age[3] with febrile episodes lasting for four to five days and recurring every three to six weeks.[4] Patients with PFAPA are usually healthy children with normal developmental milestones and growth. The lack of evidence of infection and the asymptomatic intervals between the flare-ups are characteristics of this syndrome.

The pathophysiology and etiology of PFAPA syndrome remain unknown. However, it appears to be multifactorial with a familial predisposition. The swift response of the febrile attack to a single dose of steroids and the absence of an infectious microorganism suggests an autoinflammatory origin of the disease.[5] Furthermore, emotional stress may play a role in the development of PFAPA exacerbations. For example, during the Coronavirus Disease (COVID-19) pandemic outbreak and the global lockdown, the level of stress, whether familial or personal, acted as a trigger to the induction of flare of PFAPA.[6]

In fact, in the era of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and COVID-19, the medical community has witnessed a dramatic change in how healthcare is delivered and experienced. The impacts of COVID-19 were noticeable at multiple levels of care: initial screening, diagnosis, treatment initiation, and during ongoing care.[7] Moreover, after the implementation of public health measures, the incidence of common viral and bacterial infections has decreased,[8,9] while the incidence of autoimmune and autoinflammatory diseases increased.[10]

We hereby describe a series of five patients presenting to our outpatient pediatric department with PFAPA syndrome between December 2020 and March 2021.

CASE REPORT

Five children with a mean age of 3.7 years presented to the same clinic between December 2020 and March 2021 with high-grade fever of 39.4°C and above, lasting three to four days with one or more of the following: pharyngitis, tonsilitis, aphthous ulcers, and cervical adenitis (Figure 1). All of them had similar episodes recurring with an interval of five to six weeks with asymptomatic periods in between. They were previously healthy, with no reported sick contacts, daycare attendance, or similar symptoms in the family. Family history was negative for autoimmune diseases except for one patient whose brother had Familial Mediterranean Fever and another patient whose father has psoriasis. A rapid streptococcal antigen test was performed during the febrile episode in most of the patients and was negative. The five children were given one dose of prednisolone 1 mg/kg and an excellent response was observed the second day (Table 1).

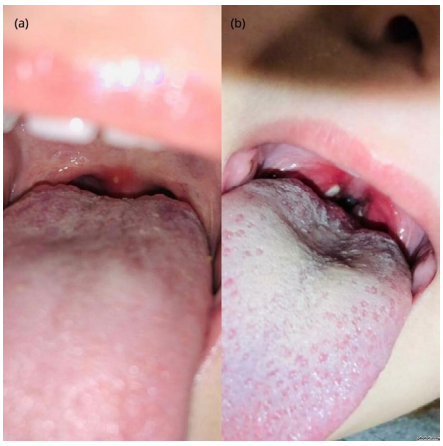

Figure 1. Picture during episodes of tonsilitis in one of the patients with 40 days in between. (a): a distinct white ulcer on the uvula base. (b) erythema of the tonsils with right sided exudate.

DISCUSSION

PFAPA syndrome is a common autoinflammatory disease during childhood and an essential differential diagnosis in children with recurrent fevers.[3] Its exact incidence remains undetermined as the data concerning the epidemiology was limited. The most conclusive data came from a Nordic study that reported an incidence of 2.3 per 10,000 children up to five years of age.[11] With the ongoing COVID-19 confinement and the lack of outside impact of infectious exposure, PFAPA syndrome seemed easier to ascertain and diagnose in clinical practice.[12]

The diagnosis of PFAPA is based on the Modified Marshall's diagnostic criteria which require the presence of recurring fevers with either aphthous stomatitis, cervical lymphadenitis, or pharyngitis in a normally developing child less than five years of age.[13] Despite the presence of these criteria, PFAPA remains a challenge with the diagnosis based solely on clinical judgment after exclusion of other causes of recurrent fevers. Because of the absence of specific diagnostic tests and the incomplete knowledge and awareness of this disease, the diagnosis commonly is delayed to up to 28 months (2.3 years) after presentation, and the disease is misinterpreted as recurrent infections.[14]

In the present report, the diagnosis of PFAPA syndrome did not come to our attention straightaway leading to a one-year delay in diagnosis on average. The recurrent nature of the symptoms and the clear lack of exposure due to home confinement guided us to make a PFAPA diagnosis. The response to a single corticosteroid dose confirmed our suspicion making a PFAPA diagnosis even more likely. The diagnosis particularly was challenging in the context of constant infectious exposures in the community and at schools, where PFAPA commonly is misinterpreted as streptococcal or viral tonsillitis by primary care

Table 1. Summary of findings of the patients.

Patient	1	2	3	4	5
Age at first episode (years)	2.8	1.8	2.7	2	3.7
Age at diagnosis (years)	3.4	4.4	3.1	2.8	4.8
Time to diagnosis (years)	0.6	2.6	0.4	0.8	1.1
Total number of episodes	4	8	4	9	9
Time between episodes (days)	46	45	42	41	40
Average temperature (°C)	39.5	39.1	39.4	39.8	39.5
Pharyngitis*	Yes	Yes	Yes	Yes	Yes
Tonsilitis**	Yes	Yes	Yes	Yes	Yes
Aphtous ulcers	Yes	Yes	Yes	Yes	Yes
Cervical adenitis	No	No	No	No	Yes
Asymptomatic between episodes	Yes	Yes	Yes	Yes	Yes
Daycare/Nursery/Sick contact	No	No	No	No	No
Previously healthy	Yes	Yes	Yes	Yes	Yes
Family history of autoimmune diseases	Brother with FMF***	No	No	No	Father with psoriasis
Rapid strep test result[a]	Negative	Not done	Not done	Negative	Negative
Prednisolone 1 mg/kg	Once	Once	Once	8 times	5 times
Response to single dose of prednisolone	Complete resolution	Complete resolution	Complete resolution	Complete resolution	Complete resolution

* Refers to the inflammation of the pharynx between the tonsils exclusively.
**Refers to inflammatory changes localized at the tonsils.
***FMF= Familial Mediterranean Fever
[a] Strep test performed at the time of febrile attack.

physicians. Hence, patients undergo multiple unnecessary medical examinations, emergency department visits, throat swabs, and laboratory tests and often will receive inappropriate antibiotics treatment.

With the start of the COVID-19 pandemic and the implementation of public health measures including home confinement, mask use, frequent handwashing, physical distancing, and closure of schools, playground, and public places, the exposure to pathogens has decreased, thus making the diagnosis of PFAPA in the right clinical context less susceptible to misinterpretation. This could explain this cluster of five patients that presented to our clinic within a short period of time.

Another explanation to this finding could be justified by the Hygiene Hypothesis: a decrease in exposure to microorganisms is correlated with an increased incidence of autoimmune diseases. This hypothesis remains relevant during the COVID-19 pandemic with the stricter hygienic practices and more robust public health measures.[15]

Despite having a benign clinical course with no long term sequalae, PFAPA significantly impacts the life of the patients. In fact, children with PFAPA were found to have lower scores of quality of life, physical and psychosocial functioning, and higher levels of fatigue when compared to children with Familial Mediterranean Fever.[16] Additionally, the extensive medical workup has a significant economic burden on the family and the healthcare system.[13]

Therefore, the aim of our report was to increase awareness and shed the light on the importance of prompt recognition of PFAPA syndrome by primary care physicians and pediatricians particularly in the era of COVID-19. Keeping PFAPA high on the differentials will lead to a faster diagnosis, earlier treatment with steroids, a decline in overall medical expenses, and the avoidance of unnecessary antibiotics use.

CONCLUSIONS

Although common, PFAPA probably remains underdiagnosed in children and symptoms often are misinterpreted especially in the setting of sick contacts and exposures to infections at home or at school. This report suggested that confinement and school closure during the COVID-19 pandemic were key to uncover our cluster of PFAPA cases. It also raised questions about a potential association between PFAPA and COVID. Increasing awareness during these times leads to prompt recognition of the disease which is crucial as it would shorten the duration of the illness and improve the quality of life.

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Physician Advocacy: Identifying Motivations for Work Beyond Clinical Practice

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ABSTRACT

Introduction. Advocacy is a perceived social and professional obligation of physicians. However, many feel their training and practice environment do not support increased engagement in advocacy. The aim of this qualitative project was to delineate the role that advocacy plays in physicians' careers and the factors driving physician engagement in advocacy.

Methods. Physicians engaged in health advocacy in Kansas were identified by personal contacts and referrals through snowball sampling. They received a standardized email invitation to participate in a short interview. These interviews were recorded and transcribed using Apple Voice Memos and Google Dictation. Two team members independently identified themes from interview transcripts, while a third member served as a moderator if themes identified were dyssynchronous.

Results. Of the 19 physicians invited to participate, 13 were interviewed. The most common reasons for engaging in advocacy included the desire to change policy, obligation to go beyond regular clinic duties, giving patients a voice, and avoiding burnout. Physicians reported passion for patients and past experiences with disparities as the most common inspiration. Most physicians did not receive formal advocacy training, but identified professional societies and peers as informal guides. Common supports for advocacy were professional organizations, community partners, and employers. Time was the most common barrier to conducting advocacy work.

Conclusions. Physicians have a broad number of reasons for the importance of doing advocacy work, but identify key professional barriers to further engagement. Providing accessible opportunities through professional organizations and community partnerships may increase advocacy participation. ***Kans J Med 2022;15:433-436***

INTRODUCTION

There is increasing support for the idea that advocacy is a core component of the professional obligations of physicians. In 1996, the Royal College of Physicians and Surgeons of Canada recognized "Advocate" as one the seven essential physician roles.[1] The perceived social responsibility of practicing physicians was highlighted in the American Medical Association's Principles of Medical Ethics: "a physician shall recognize a responsibility to participate in activities contributing to the improvement of the community and betterment of public health".[2] Advocacy has been defined as "action by a physician to promote to social, economic, educational, and political changes that ameliorate the suffering and threats to human health and well-being that he or she identifies through his or her professional work and expertise".[3] Physicians are perceived by society to have a duty not only to improve the health of their individual patients, but also improve the well-being of society as a whole.[4]

Despite increasing pressure to perform as advocates, many physicians feel that their training and practice environment do not support engagement in advocacy.[5] Modernization of the health system, increased administrative demands, and changes in reimbursement structure may serve as barriers to further involvement.[6] To promote the idea that advocacy is an integral aspect of modern practice, it is necessary to characterize its definition and scope further. The role of being a physician advocate can be challenging and there are many barriers that must be overcome to engage in advocacy work.

Initially involving oneself in advocacy activities may seem overwhelming.[3] Additionally, time constraints can play a role in limiting a physician's ability to participate in advocacy projects.[3,7] Some residency programs have begun requiring formal advocacy training within the curriculum to alleviate these barriers.[8-10] In addition, national models exist to fund advocacy efforts surrounding various health issues, for example, in work surrounding HIV.[11] Initiatives have been proposed to facilitate involvement of physicians in advocacy work. One such initiative proposed standardizing a portfolio, so that physicians can better quantify the successes of their advocacy and promote them as scholarly work.[12]

The purpose of this study was to delineate further the role advocacy plays in a physician's career. Specifically, this project aimed to investigate the driving factors that influence and inspire, as well as the barriers that limit physicians' decisions to engage in advocacy work.

METHODS

The Institutional Review Board indicated that this project did not require ethics review, as it is educational research, did not involve patients, and posed no risk to the participants.

Participants and Setting. Physicians were identified using a snowball sampling technique, which is a form of convenience sampling that includes members of the population who are available to the researcher.[13] Using this method, an initial list of physicians well-known for their advocacy work in this region was compiled by the researchers. From this list, those contacted recommended other physicians to add to the invitee list. This project was completed during the month of February 2020.

Data Collection. Data were collected through an interview process. Potential interviewees were contacted initially via email, using a standardized template. An in-person interview was preferred. If the physician was not available for in-person interview, a phone interview was conducted. Each participant verbally consented for interviews to be audio-recorded and transcribed. Interviewees were asked not to disclose personal patient information during the interview. Each interview lasted approximately 15-20 minutes, using a structured interview guide of predetermined questions (Table 1). Interview audio was recorded

using Apple Voice Memos software on a mobile device. Interview transcription was recorded using Google Dictation. The transcriptions were corrected manually by referencing the audio recording. Interview transcripts then were uploaded to a shared drive for review.

Table 1. Interview structure.

Demographics Collected	1. Specialty of practice
	2. Number of years in practice
	3. Gender
Questions Asked	1. What does physician advocacy mean to you and how it is incorporated in your practice?
	2. What inspired you to engage in advocacy work?
	3. Tell me about any formal or informal advocacy training that you had.
	4. What support have you found for doing advocacy work?
	5. What barriers have you found for advocacy work?
	6. What suggestions do you have for physicians wanting to get involved in advocacy work?

Data Analysis. From these transcripts, themes were developed using thematic analysis methods. Each transcript was reviewed independently by two researchers, who both listened to and read the text to become familiar with the interview. They coded the interview, by selecting key words, phrases, and motifs from the transcripts. The research panel, consisting of five coders, then convened to compare the transcripts. Motifs that were mentioned in multiple interviews were felt to reflect an over-arching theme.[14] Following identification of the most prevalent themes, each theme was characterized further by identifying direct quotes from the interviews to be included in discussion.

RESULTS

Invitation to participate was sent to 19 physicians. Four physicians did not respond, 2 did not respond in time to participate, and 13 responded within the study time frame. Of these 13 interviewees, 10 were male (76%) and 3 were female (23%). These physicians practiced in a variety of areas, including Obstetrics and Gynecology, Family Medicine, Pediatrics, and subspecialists including Hepatology, Otolaryngology, Pulmonary Critical Care, Maternal-Fetal Medicine and Palliative Care. They had been in practice for ranges of 1-5, 6-10, 20-29, and 30+ years. Their areas of practice included academic, community, and rural medicine.

Question 1: What does physician advocacy mean to you? Most participants (8/13) reported that the meaning of advocacy was working to change policy, with one saying "if I'm not in the legislators' face and telling them about what is important to me, they're not knocking on my door to find out." Eight physicians also reported that advocacy was going above and beyond clinical duties. One physician expressed, "So really advocacy is a many faceted kind of word, it starts with the individual patient but it also spreads out to the whole to take every opportunity you can to improve the opportunities for your patients to be healthy and to be safe". Another echoed, "I think that just everyday as a physician you try to do those things to advocate for each individual patient, but to be able to expand upon that further is identifying a passion or purpose beyond your clinical duties."

Beyond these two major themes, a few interviewees discussed helping others using "our" stronger physician voice. It was mentioned that advocacy can be used in practice as a means to avoid burnout. Overall, the meaning of advocacy to these physicians was reflected in this statement by one, who said "I think it's just trying to advocate, speak up, whatever the definition of advocate is. Speak up, argue for, improving patient care above and beyond the examination room."

Question 2: How is advocacy incorporated into your practice? Nine physicians discussed their involvement in politics or policy work in response to this question. One expressed, "if you care about something in health care, maybe it's your specialty and access to your specialty, or access to certain medicines. If you're not going to talk to your representatives, then it kind of feels like you're not being a full health care professional, and I think that was a really big frame shift for me to see that is easy to do and it slowly moves the needle." Beyond political work, some physicians discussed advocacy being incorporated into their practice on a day-to-day basis, helping patients beyond their clinic visit. An example one physician gave was "calling the medical director of an insurance company that has denied a claim is advocacy. It's personal, it's one-on-one advocacy, fixing one problem at a time, but I don't think it has to be getting legislation done. That's a full-time job. If you're going to do that you really have to settle in. But there are lots of ways. Calling someone at WIC (Women, Infants, and Children program) saying no this baby really needs this formula not this, that's advocacy."

Overall, physicians discussed incorporating advocacy into their practice both in and out of the direct patient care setting. One recalled, "it's not like seeing a patient in the comfort of an exam room or hospital room, you're not really among peers but you're out in the community." Fewer physicians identified serving in leadership organizations, or training physicians in ways that they act as advocates.

Question 3: What inspired you to engage in advocacy work? Physicians interviewed drew inspiration from a variety of factors. At the center of this inspiration, was the patient. About half (6/13) of physicians identified passion for both patients and their specialty as inspiration for their involvement, saying "I think it can be so rewarding as a physician that you're helping patients you'll never even see". Others discussed their experience with vulnerable populations. "So what inspires me? People in vulnerable positions. That's what inspires me, whether it's financial, physical, whatever, and so I can't help myself. When I see people like that I get involved and do things." Expressed less often were involvement in a professional society, a sense of responsibility, interest in public education, and mentorship.

Question 4: Tell me about any formal or informal advocacy training you have had. Most (8/13) physicians reported having no formal training surrounding advocacy. They became involved in advocacy work after having been in practice. Some (6/13) felt they had received informal advocacy education through large medical organizations. Two expressed learning from specific peers or mentors. Only one received formal training through their residency program. One discussed working with medical students in his training, saying he was

"actually working at the level of individual students, trying to inoculate values of advocacy for these patients".

Question 5: What support have you found for doing advocacy work? Eight physicians identified either community partner or professional organization support, with one noting that "most of my support has always come from professional associations". Another saying that "there are a lot of community resources that are looking for a physician on certain issues to be there, and they're more than willing to help in any way they can". Six discussed support for advocacy from employers, peers, or family members. One discussed "having other peers who are doing it that you can talk to".

Question 6: What barriers have you found for doing advocacy work? Professional time was the barrier identified most often by physicians, mentioned in seven interviews. One discussed that advocacy work has "evolved into a requirement of a lot of work that has to occur outside of regular work hours", and with a "pretty significant clinical obligation, it's sort of hard to carve out free time for this". Physicians also identified conflict of opinion as being a barrier to getting involved in advocacy work, as well as fear of damage to personal or professional reputation. One physician stated there are many circumstances that can "probably make some people more reticent to speak out openly for fear that it will reflect poorly on them, their associates, or their organization. So there has to be a way to allow the community, the physician community in particular, to use their voice without fear of repercussion or without concern of misinterpretation in a way that could have a potential negative impact on their reputation or their career." Barriers identified less often were money and unfamiliarity with advocacy work.

Question 7: What suggestions do you have for physicians wanting to get involved in advocacy work? Ten interviewees discussed working with and learning from mentors. Advising physicians to "look at people that are doing this and learn from both the good and the bad". Another expressed, "Don't reinvent the wheel. There are people who know what they're doing, and you need to find them." Seven physicians advised, "just do it". Five physicians expressed the importance of finding a passion, saying "Identify your passion, because you can't advocate for something that you don't really believe in". In summary, to get involved in advocacy work, identifying a passion, connecting with a mentor who is involved in that area if possible, and jumping right in is the best possible way to get started.

DISCUSSION

This project elucidated physician attitudes towards advocacy and further characterized the role advocacy plays in their careers. This case series of physician perspectives helped illustrate what advocacy means to them and how it can be incorporated into practice. Most echoed the idea that going above and beyond clinical practice is an important role of physicians. This project explored barriers that exist as well as advice for those wanting to overcome these barriers. The barriers that these physicians identified in this study included professional time, conflict of opinion when it comes to policy making, as well as fear for damage to a personal or professional reputation. This was echoed in other literature. Luft et al.[3] expressed that "financial and time pressures in practice may make it difficult for practicing physicians to take on anything more than the pressing clinical problem at hand". They also noted that "fear of being ostracized and straying from guideline, and evidence-based medicine may also impact the willingness of physicians to be strong advocates".

A strength of this study was conducting open-ended interviews with physicians from a variety of backgrounds and experience levels. One limitation of this study was recruitment bias. The snowball sampling technique unintentionally may have included physicians who have similar views when it comes to advocacy. The majority of interviewees in this study represented the researchers' home institution. Through this method of sampling, female physicians were under-represented. Another limitation was that the nature of the questioning may have prompted interviewees to think about advocacy in a positive way, and answered accordingly.

A similar future project could be conducted to question physicians who are not involved in advocacy work. In presenting this analysis of physicians' perspectives, it may help learners in the medical field and practicing physicians identify ways to engage in work beyond clinical care. More formal training may need to be implemented to educate physicians about their role as advocate. Systems should work to remove time barriers, to allow maximal time available for advocacy work to achieve results. Physicians identified working with a mentor as an important way to learn. A platform to help physicians to connect and network specifically surrounding their advocacy work could prove beneficial.

CONCLUSIONS

Advocacy work in practice can look different for each individual physician. Physicians in this study had a number of reasons to participate in advocacy work. Many had an understanding of the barriers that patients face and acted to eliminate socioeconomic and policy pitfalls through advocacy initiatives or policy work. They felt overall that advocacy meant going above and beyond your clinical duties to patients. They identified key professional barriers to furthering advocacy work. There were still many lessons to be learned moving forward regarding the meaning of advocacy, and how it might benefit both patients and healthcare professionals alike.

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The Adequacy of Prenatal Care in Rural Kansas Related to Distance Traveled

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ABSTRACT

Introduction. Prenatal care is essential for optimizing the health of a woman and her baby. Multiple factors have created barriers in the access to prenatal care in rural Kansas. Over 120 rural hospitals in the United States have closed since 2010, 5 in Kansas. Seventy-seven of the 105 Kansas counties do not have maternity care services. This study investigated differences in prenatal care received by women in rural Kansas counties related to distance traveled. Differences in timing of initiation of care, number of visits, and services received were compared between two cohorts: those who drove < 19 miles and those who drove ≥ 20 miles for prenatal care.

Methods. A survey was distributed to women who had delivered a child in the last three years in rural Kansas at participating clinics. Measures of adequacy of prenatal care were determined with questions regarding timing of first prenatal visit, number of prenatal visits, and services received at visits. An index was created using these variables and compared between the two cohorts using two-tailed t-tests for continuous data and chi square analysis for categorical data.

Results. Women who traveled ≥ 20 miles for prenatal care received statistically significant less services, and had less prenatal care visits in the second trimester and overall in their pregnancy compared to women who traveled < 19 miles for prenatal care. Rurality did not impact adequacy of prenatal care.

Conclusions. Women traveling ≥ 20 miles to receive prenatal care had significantly fewer prenatal visits during their second trimester and overall in pregnancy and self-reported less prenatal care services. These results indicated the importance of lessening barriers to prenatal care in rural Kansas, such as transportation and financial barriers.

Kans J Med 2022;15:437-440

INTRODUCTION

Early and regular maternal care is essential for optimizing the health of a woman and her fetus. According to the American College of Obstetricians and Gynecologists, perinatal care visits should be on a frequent enough basis to assess the health and well-being of the woman and fetus, provide ongoing education, complete recommended health screening studies and review results, and to detect chronic or new medical and psychosocial issues.[1] Maternity care includes prenatal care, as well as care received during childbirth and postpartum. Multiple factors have changed the landscape of healthcare in rural areas, creating barriers in access to maternity care, including the closure of rural hospitals and decreased number of physicians that deliver babies in rural counties.[2] More than 5 million women live in counties termed "maternity care deserts", where access to maternity health care services are limited or absent, either through a lack of services or due to barriers to a woman's ability to access care.[3] The Center for Medicaid and Medicare Services found that in the U.S. less than 50% of women who reside in rural areas have access to prenatal care within a 30-mile drive from their home and that more than 10% of rural women drive 100 miles for prenatal care.[2]

According to the University of Minnesota Rural Health Research Center, Kansas experienced a 5.8% drop in the percentage of hospitals with maternal services within the 86 non-urban counties in Kansas.[4] Many hospitals that have managed to stay open have stopped providing maternal care. A 2016-18 survey of physicians who provide maternity care services in Kansas revealed 32 of 89 rural counties offered maternity care services.[5] This study also predicted that maternity care deserts likely will expand by 2030 to only 24 rural counties with maternity care services. Historically, Family Medicine (FM) physicians have provided maternity care services in rural counties and most infants delivered in rural Kansas were being delivered by FM physicians; however, the number of FM physicians performing routine deliveries has decreased.[6]

The current study expanded on a 2018 study by Blythe et al.[7] suggesting there may be a correlation between the rural-urban commuting area (RUCA) code of the zip codes in which women reside and maternal satisfaction of the care they received. The specific aim was to investigate potential differences in prenatal care received by women who reside in rural counties in Kansas through a patient survey that quantified the relationship between distance traveled to receive medical care and adequacy of prenatal care received.

METHODS

Setting, Study Design and Participants. A multicenter, cross-sectional survey was used to collect data for this study. The survey was a retrospective recall that accounted for timing of initiation, total number of prenatal care visits, and services provided at prenatal care visits. The variables used were chosen based on their presence in other tools that have worked to expand use to assess adequacy of prenatal care, such as The Content and Timing of care in Pregnancy (CTP) tool[8] and the Adequacy of Prenatal Care Utilization (APNCU) Index.[9] Specific data points gathered were modified to adapt our survey to the maternal recall format.

Medical students administered the surveys to women presenting in clinics during their rural elective. Surveys were distributed to all women presenting to the clinics at which the students were assigned and who were pregnant or had been pregnant within the last three years. The time frame for data collection for this study was, June 22 - July 17, 2020. Inclusion criteria included any woman at least 18 years or older who sought medical care from clinics in Kansas within three years of their last child being born in rural Kansas. Exclusion criteria included women who delivered within the last three years in urban counties, counties outside of Kansas, mothers who were under the age of 18 at the time of survey collection, or who had multiple gestation pregnancy. Surveys were only available in English and Spanish. This study was approved by the Institutional Review Board at the University of Kansas Medical Center.

Tools to assess adequacy of prenatal care are critical to identifying disparities in prenatal care and to improving prenatal care accessibility and birth outcomes. In this study, a retrospective recall survey was developed that accounted for timing of initiation, total number of prenatal care visits, and services provided at prenatal care visits. The variables used were chosen based on their presence in other tools as mentioned above.[8,9] Some variables were simplified or excluded as it was not appropriate or attainable to retrieve those answers from all women when considering recall bias and the need to specify all variables to avoid medical jargon. Examples of excluded variables included head circumference at birth, weight gained during pregnancy, and blood pressure measurements throughout pregnancy.

Data Collection. Women who met the inclusion criteria were recruited by medical students to complete the survey when they presented for medical care. Study data were collected and managed using REDCap® electronic data capture tools hosted at the University of Kansas Medical Center.[10,11]

The variables collected for this project included:

1. Participant demographics (age, education level, income level)
2. When was prenatal care initiated?
3. How many prenatal care visits occurred during the first trimester?
4. How many prenatal care visits occurred during the second trimester?
5. How many prenatal care visits occurred during the third trimester?
6. Weight and length of the child?
7. Reported estimated gestational age (EGA) of the child?
8. Were the following prenatal care services received?
    a. Glucose Challenge Screening
    b. Group B Streptococcus
    c. Anomaly Ultrasound
    d. Tetanus, Diphtheria, Pertussis vaccine
    e. Dating Ultrasound
    f. Fetal Heart Rate
    g. Urine Test Screening

Data Analysis. The responses to the survey were examined as a function of the self-reported distance traveled by the patient. Distance traveled was reported by the participants in 20-mile increments and separated into two cohorts: those who had traveled < 19 miles for prenatal care and those who had traveled ≥ 20 miles for prenatal care. Participants also were separated into cohorts representing the relative rurality of the county where the mother received prenatal care. Zip code was used to identify the RUCA code and then rurality was simplified in a four-category RUCA of Urban, Large Rural, Small Rural and Isolated, as described by the University of Washington, Washington, Alaska, Montana, and Idaho Rural Health Research Center.[12,13] Using the collected variables above, distance traveled for prenatal care and rurality of the participant's residence was evaluated to determine effect on adequacy of prenatal care.

A Quantile-Quantile plot was utilized to determine if there was a normal distribution. This plot is a graphing method that compares two different data samples and determines if they are from the same population.[14] Responses to the following variables were distributed normally: timing of initiation of prenatal care, number of prenatal care visits in each trimester, number of total prenatal care visits. Comparison of the means between the two distance cohorts were accomplished using the 2-tailed t-test for continuous data and chi square analysis for categorical data. RUCA codes were compared for their influence in adequacy of prenatal care via the ANOVA test for continuous data and the chi square test for categorical data. The following variables were not normally distributed: EGA, weight at birth, and length at birth. They were analyzed utilizing a Mann-Whitney as they were continuous data sets.

RESULTS

A total of 101 participants from 27 of the 32 (84%) rural counties that provided maternity care consented and filled out the survey. Eighteen incomplete surveys were removed. Six other surveys were excluded based on exclusion criteria. Ultimately, 77 responses were utilized. These 77 participants were separated into cohorts, both based on the distance driven for prenatal care, as well as based on RUCA code (Table 1).

Table 1. Demographics and RUCA Code classification.

Demographic	Cohort 1 (< 19 miles): n = 49 (63%)	Cohort 2 (≥ 20 miles): n = 28 (37%)
Age of mother	29.9	28.4
White	41 (84%)	27 (97%)
Hispanic	5 (10%)	1 (4%)
American Indian	1 (2%)	0 (0%)
Black or African American	1 (2%)	0 (0%)
Asian	1 (2%)	0 (0%)
Married	40 (82%)	23 (83%)
Single, never married	9 (18%)	3 (11%)
Mean household income < $50,000	14 (18%)	11 (39%)
Mean household income > $50,000	35 (72%)	18 (42%)
Bachelor, Associates, or Graduate degree	33 (67%)	21 (75%)
High school diploma or equivalent	9 (18%)	3 (11%)
No high school diploma or equivalent	7 (15%)	5 (18%)
Currently pregnant	6 (12%)	4 (14%)
Mean number of children	2.7	1.89
RUCA Classification for Counties Where Participants *Received* Care		
Urban	0 (0%)	0 (0%)
Large Rural	26 (53%)	14 (50%)
Small Rural	8 (16%)	5 (18%)
Isolated	15 (31%)	9 (32%)

Table 1. Demographics and RUCA Code classification. *continued.*

Demographic	Cohort 1 (< 19 miles): n = 49 (63%)	Cohort 2 (≥ 20 miles): n = 28 (37%)
RUCA Classification for Counties Where Participants *Reside*		
Urban	1 (2%)	0 (0%)
Large Rural	24 (49%)	7 (24%)
Small Rural	8 (16%)	4 (14%)
Isolated	16 (33%)	18 (66%)

When comparing adequacy of prenatal care in relation to the distance traveled (Figure 1), cohort 1 (< 19 miles traveled) received statistically significantly more prenatal care visits in trimester two (p = 0.003) and overall (p = 0.045) compared to cohort 2 (≥ 20 miles traveled). Cohort 1 consistently received significantly more prenatal services than cohort 2 (p = 0.003). Sixty-four percent of cohort 1 had seven services versus 20% of cohort 2. Eighty-five pecent of cohort 1 had six or more services versus 62% of participants in cohort 2 (Figure 2). No statistically significant difference in number of prenatal care of visits was found for timing of initiation of care and number of prenatal care visits in the third trimester (p = 0.19 and p = 0.91). Distance was not found to affect number of prenatal care visits in the first trimester, as all participants met guidelines.

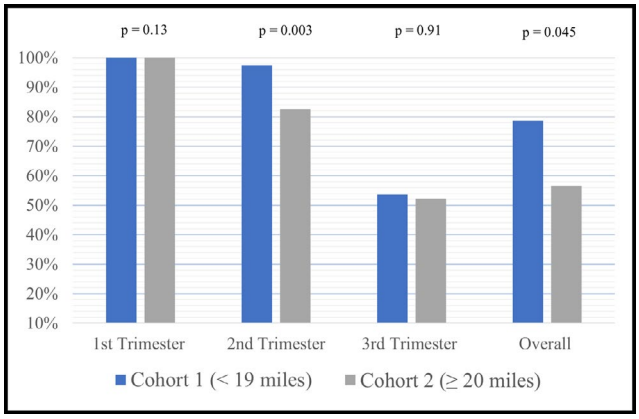

Figure 1. Percent of patients who received adequate prenatal care visits in each trimester and overall.

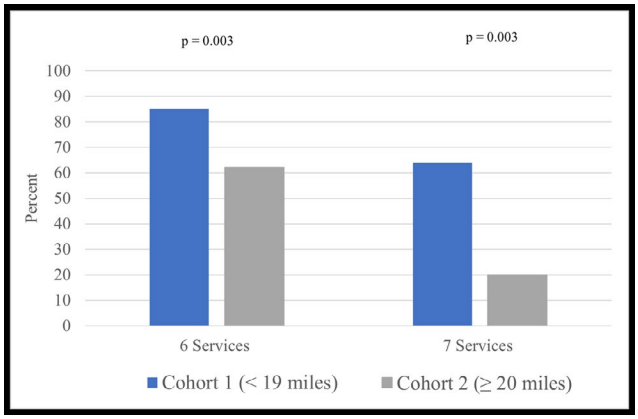

Figure 2. Percent of patients receiving six or seven prenatal care services.

By RUCA code classification, cohort 1 versus cohort 2 participants received their maternity care in Large Rural (53% vs. 50%), Small Rural (16% vs. 18%), and Isolated (31% vs. 32%). Cohort 1 and 2 participants resided in Large Rural (24% vs. 24%), Small Rural (16% vs. 14%), and Isolated (33% vs. 66%). Rurality of the county where the mother received maternal care was not found to impact adequacy of prenatal care. Utilizing ANOVA, no statistically significant differences in timing of initiation of prenatal care (p = 0.79), or total number of prenatal care visits the first trimester (p = 0.25), second trimester (p = 0.379), third trimester (p = 0.53), or overall (p = 0.141) were found. A chi square analysis revealed rurality of the county where the mother resided did not impact the number of services received (p = 0.827).

DISCUSSION

A statistically significant difference was found between the number of prenatal care visits in the second trimester and overall during the pregnancy between women who had to drive ≥ 20 miles for prenatal care relative to those who traveled < 19 miles. Although not statistically significant, women who had to drive ≥ 20 miles for prenatal care had less visits in the third trimester of their pregnancy. This result may be due to the increasing number of prenatal care visits necessary in the second and third trimesters. In the first trimester, women are instructed to seek prenatal care every 4 weeks until 28 weeks gestational age compared to every 2 weeks till 36 weeks, then weekly until delivery.[1] For some women, this can mean driving long distances every week for over a month which may be unattainable. These results indicated distance to travel for prenatal care was a barrier to care for many women in rural counties of Kansas. Additionally, rurality of the county where the woman received prenatal care did not show significant differences in number of prenatal care visits or adequacy of prenatal care. This finding may suggest that distance traveled for prenatal care was the barrier, rather than the rurality of the prenatal care facility.

Limitations of this project included the time frame of the study during the COVID-19 pandemic. Due to COVID-19 restrictions, the original time frame of data collection for this study was shortened from two months to one month as medical students could not participate in clinical rotations, and the number of participating clinics declined from 29 to 27. The survey methodology of this project allowed for potential recall bias, due to the differing understandings and memory of participants in what prenatal care they received and recalling events that occurred as long as three years ago. Another limitation included variables that were not collected, but would have given more insight on prenatal care received and birth outcomes, including blood pressure screening, offered genetic screening, and prenatal vitamin intake.

One strength of this study was that it retrieved information not found on birth certificates. Previous data that were based on birth certificate data looked at the county of delivery, not the county of residence.[15] Investigation of the relationship between distance and adequacy of prenatal care has not been studied adequately. According to the Kansas Pregnancy Risk Assessment Monitoring System (PRAMS) data from 2018, 12.3% of women indicated that lack of transportation was a barrier to prenatal care.[16] This barrier was not delineated to understand if distance to travel was included, however, in rural Kansas there is not access to the bus system or ride-share services, removing one option

to accessible transportation. Because distance traveled to prenatal care negatively impacted the number of prenatal visits during the second and third trimester, uncovering ways to improve the transportation barrier identified in PRAMS data would be prudent. In addition, identifying other health resources women are utilizing, if any, is necessary to understand the impact of this barrier on mothers and rural healthcare systems.

The increased usage of telemedicine during the COVID-19 pandemic may be a potential method for increasing access to prenatal care. In May of 2020, American College of Obstetricians and Gynecologists released guidance outlining when telehealth medicine could be utilized, minimizing potential COVID-19 exposure.[17] These guidelines included what prenatal care visits and services should be done in person versus those that could be done remotely with telehealth. There may be reason to incorporate these COVID-19 telehealth guidelines to make prenatal care more accessible for women who otherwise would miss the prenatal care visit entirely due to the travel distance for prenatal care visits.

CONCLUSIONS

Women traveling ≥ 20 miles to receive prenatal care had statistically significantly lower number of prenatal visits during their second trimester of pregnancy and overall. Women also self-reported less prenatal care services, indicating a possible decrease in the adequacy of prenatal care. Further study is required to understand if there are other impacts to mothers that were not captured by self-reported birth outcomes, such as financial stress, psychological stress, and socioeconomic stressors. This study demonstrated the need to further study distance traveled for maternity care and interventions to alleviate the barriers present for pregnant women in rural Kansas.

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Keywords: prenatal care, rural health services, Kansas, travel

KANSAS JOURNAL of MEDICINE

Obstetric Point of Care Echocardiography

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INTRODUCTION

Due to advancements in diagnostics, surgeries, and fertility treatments, the obstetric population is getting older and sicker,[1-3] which requires the practice of obstetric anesthesia to evolve to provide exceptional care for this at-risk population. Early detection and optimization of disease processes in obstetric patients decreases morbidity and mortality.[4] Point of care ultrasound is a tool that can be used quickly and efficiently to gain knowledge of a patient's current physiologic status. It provides knowledge to the entire obstetric team on which to base decisions. Anesthesiologists play a key role in evaluating, diagnosing, and managing these patients to optimize and improve outcomes.[5]

We present a case where bedside echocardiography allowed early diagnosis and subsequently altered management to improve patient outcomes significantly in an obstetric patient with new onset and undiagnosed cardiomyopathy. In addition, caution is recommended when employing the algorithmic use of labetalol for the treatment of the pregnancy-induced hypertension given the concern for the use of beta blockers in acute heart failure settings.

CASE REPORT

Written, informed consent was obtained from the patient prior to the preparation of this report. A 42-year-old woman, gravida 6, para 2 at 32 weeks 6 days gestational age, was referred to labor and delivery due to chronic hypertension with superimposed pre-eclampsia with severe features. She had a past medical history significant for morbid obesity and chronic hypertension. Significant familial history included her father's death at age 42 due to ischemic cardiomyopathy.

The patient was admitted and started on magnesium and labetalol protocol for pre-eclampsia, and induction of labor was initiated with oxytocin. She received one dose of 20 mg intravenous labetalol, but developed bradycardia three hours later with a heart rate of 29 bpm. The anesthesiologist was contacted to assist with bradycardia. A bedside transthoracic echocardiogram (TTE) showed global hypokinesis with likely ejection fraction (EF) < 20% seen in the parasternal short axis view (PSAX). Electrocardiogram showed bigeminy and inferior wall ischemia. The anesthesiologist recommended immediate cessation of induction for further cardiac optimization.

Desiring a multidisciplinary approach, the anesthesiologist ordered telemetry, intensive care unit (ICU) nursing staff, formal echocardiogram, chest x-ray, labs including magnesium level, and cardiology consult. The anesthesiologist emphasized the urgency of evaluation and importance of optimization to reduce the possibility of mortality. Test results showed pulmonary edema on chest x-ray indicating volume overload and venous congestion in the lungs secondary to decreased cardiac function. The TTE showed EF < 20% with diffuse hypokinesis, pulmonary artery pressure 60 mmHg, and a dilated inferior vena cava. There were no significant valvular abnormalities. It was decided to halt magnesium, begin diuresis, maintain blood pressure control, and plan for cesarean section the following morning.

A repeat bedside TTE prior to cesarean section showed improved EF to 35% as seen in PSAX following diuresis and appropriate afterload reduction that did not combine beta blockade in the mechanism of action. The carefully devised anesthetic plan avoided general anesthetic by utilizing a low dose combined spinal-epidural that was raised slowly with the epidural catheter. Hemodynamics were maintained using an arterial line for monitoring and an epinephrine infusion with boluses for blood pressure and inotropic support. The cesarean section was successful without complication, and the patient went to ICU postoperatively. Her ICU course consisted of blood pressure control and management of multiple episodes of ventricular tachycardia. On post operative day two, she had a left heart catheterization which revealed a non-ischemic cardiomyopathy and ejection fraction of 20%. She was discharged on post-operative day four with medical management including a life vest and follow-up to cardiology.

DISCUSSION

Obstetric patients are presenting with more multi-medical problems, including heart disease and obesity, resulting in increasingly complex care requirements. Often, obstetric patients present acutely with incomplete workups and/or are unaware of significant medical comorbidities, mistaking symptoms for "normal" changes in pregnancy. Therefore, optimal care plans have the potential to be delayed or overlooked at the time of delivery.[1,2] Most concerning is that cardiac conditions are a large portion of these comorbidities and are a leading cause of morbidity and mortality in obstetrics.[6]

Having a multi-disciplinary approach to managing obstetric patients has shown to improve outcomes.[6] Fortunately, anesthesiologists are members of the obstetrics care team and are most suited to evaluate, diagnose, and help treat these conditions. The Rapid Obstetric Screening Echocardiography protocol can be utilized to tailor appropriate blood pressure management strategies to optimize the patient's condition.[7] This protocol can be used to evaluate ejection fraction, volume status, valvular abnormalities, and other basic cardiac pathological conditions which are important factors in managing complex physiologic changes occurring peripartum. Point of care ultrasound allows these evaluations to happen quickly, so management can be tailored to the patient's current physiologic status. Since delayed diagnosis was a contributing cause in approximately half of all maternal deaths,[4] the importance of bedside ultrasound is invaluable in the initial evaluation so expedited treatment plans can be made.

Maternal morbidity and mortality are increasing due to a variety of factors.[1] Obstetric anesthesiologists are an invaluable member of the obstetric team due to a skill set which can identify and guide treatment using technical skills, such as echocardiography, and communication between other members of the obstetric team. This places obstetric anesthesiologists in an optimal position to improve maternal morbidity and mortality, as seen in this case report.

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Keywords: obstetrics, point of care testing, echocardiography, anesthesiology

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Unique Challenges in Diagnosing IgG4-Related Tubulointerstitial Nephritis with Arteritis

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INTRODUCTION

Tubulointerstitial nephritis (TIN) can be part of the systemic disease immunoglobulin G4 related disease (IgG4-RD).[1,2] IgG4-RD can affect an isolated organ, or it can involve multiple organs, synchronously or metachronously.[3,4] IgG4-RD diagnosis is challenging due to the presentations of nonspecific findings that mimic many diseases, including malignancy.[5]

Regarding IgG4-TIN, common laboratory abnormalities, outside of elevated creatinine (Cr) and blood urea nitrogen (BUN) included elevated serum total IgG or IgG4 (79% of patients), hypocomplementemia (56%), eosinophilia (33%), and positive ANA (31%).[6] Proteinuria (30%) and hematuria (22%) occurred less often.[3,6] On imaging, renal cortical nodules, round or wedge shaped lesions, or diffuse patchy involvement can be seen.[6] Outside of the kidneys, inflammatory masses can be seen in any organ in patients with IgG4-TIN, with autoimmune pancreatitis, sclerosing cholangitis, retroperitoneal fibrosis, sialadenitis, and aortic aneurysms constituting the more commonly reported extra-renal comorbidities.

Ultimately, renal biopsy, combined with supporting clinical, laboratory, and radiographic findings, is needed to diagnose IgG4-TIN. IgG4-TIN biopsies revealed plasma cell-rich TIN with over ten IgG4+ plasma cells/high power field (HPF).[6] Additional histological findings included tubular basement membrane immune complex deposits and an expansile or "storiform" interstitial fibroinflammatory process. One unusual case of IgG4-TIN with arteritis has been reported previously.[7]

In this report, a patient presented with an acute kidney injury (AKI) and heart failure and, after a complex workup, ultimately was diagnosed with IgG4-TIN with arteritis.

CASE REPORT

A 72-year-old man with past medical and social histories significant for rheumatoid arthritis (RA), anemia of chronic disease, resolved hepatitis C (HCV) infection, serum IgM kappa paraprotein, presented with two months of paroxysmal nocturnal dyspnea, night sweats, unintentional twenty-pound weight loss, fatigue, and a rash on his fingers. He had discontinued his RA disease modifying anti-rheumatic drugs (DMARDs), hydroxychloroquine, and leflunomide, secondary to ocular pain around the time of his symptom onset.

On exam, he was afebrile with blood pressure of 150/110 mmHg and heart rate of 92 beats per minute. Body mass index was 18.11 kg/m^2. Jugular venous distention was present. There were many punctuate, purple colored, non-tender, maculopapular 0.5 cm lesions on the palmar and dorsal surfaces of his fingers bilaterally. Laboratory abnormalities included: elevated Cr (1.89 mg/dL, increased from 1.0 mg/dL during a hospitalization for pneumonia one month prior), elevated BUN (25 mg/dL), decreased hemoglobin (10.1 g/dL), elevated B-type natriuretic peptide (1994 pg/mL), mildly elevated troponin (0.063 ng/dL), elevated erythrocyte sedimentation (54 mm/hr), and elevated C-reactive protein (12.9 mg/dL). Urinalysis was unremarkable, and fractional excretion of sodium was 1.50%.

An echocardiogram revealed an ejection fraction of 35% without valve vegetations. The patient received furosemide for decompensated heart failure. While his heart failure symptoms improved with diuresis, his Cr worsened to 2.53 mg/dL. Rehydration with lactated ringers minimally improved his Cr; however, this worsened his heart failure symptoms. Given the patient's medical history, discordant cardiac and renal function, and cutaneous lesions, further evaluation was pursued.

Infectious evaluation was negative. Rheumatological was negative except for a positive ANA with a 1:80 titer and a positive p-ANCA on indirect immunofluorescence assay. Notably, on multiplex immunoassay, anti-proteinase 3 (PR3) and anti-myeloperoxidase (MPO) antibodies were negative. Studies indicated the patient's anemia of chronic disease and elevated serum free kappa and lambda proteins were relatively unchanged from previous studies.

Renal ultrasound was without abnormalities. Skin biopsy indicated keratosis with granuloma annulari and nonspecific chronic inflammation. Given the lack of a clear diagnosis after this workup and the patient's persistently elevated Cr with unremarkable urinalyses, a renal biopsy obtained. A renal biopsy initially was interpreted as pauci-immune crescentic glomerulonephritis (PICGN) and arteritis/arteriolitis based on the presence of a crescent-like structure in one glomerulus (of 20 glomeruli on the light microscopy sample) and associated arteritis. The patient was started on methylprednisolone 1000 mg followed by prednisone 50 mg/day.

During the initial treatment, a second opinion of the renal biopsy was interpreted as a primary tubulointerstitial disease pattern of injury with associated arteritis and a glomerular "pseudo-crescent". Light microscopy revealed 20 glomeruli, with one being globally sclerotic. There was moderate interstitial fibrosis and tubular atrophy with a multifocal interstitial inflammatory cell infiltrate of mononuclear cells, numerous plasma cells, occasional eosinophils, and associated mononuclear cell tubulitis. There was a well demarcated border between normal kidney parenchyma and tissue with interstitial fibrosis and inflammation (which can be a feature of IgG4-TIN).[6] Within an area of interstitial inflammation and fibrosis, there was inflammation surrounding one glomerulus, which showed one pseudo-crescent (also known as an "interstitial crescent") associated with capsulitis, without rupture of the glomerular basement membrane or Bowman's capsule; this type of pseudo-crescent is an unusual but characteristic feature of IgG4-TIN.[8] No true crescents were identified. Three arteries showed mononuclear

cells and plasma cells in the thickened intima, and some arteries showed inflammation in the media and adventitia (Figures 1 and 2). No vessel fibrinoid necrosis was identified. No renal parenchyma was available for immunofluorescence. By electron microscopy, no immune deposits were identified. Immunoperoxidase staining for IgG4 showed over 50 IgG4+ plasma cells/HPF.

Based on these renal biopsy findings, the patient was diagnosed with IgG4-TIN. Because the initial treatment for both PICGN and IgG4-TIN involves steroid immunosuppression,[9,10] his steroids were continued. Serum IgG4 levels were within normal limits, although these were collected during immunosuppression, which can decrease serum IgG4 levels.[11]

During follow-up, the patient's Cr remained stable around 2.0 mg/dL despite readmissions for steroid related side effects. Three months after diagnosis, his steroids were tapered to 20 mg/day and hydroxychloroquine and leflunomide were resumed for RA control.

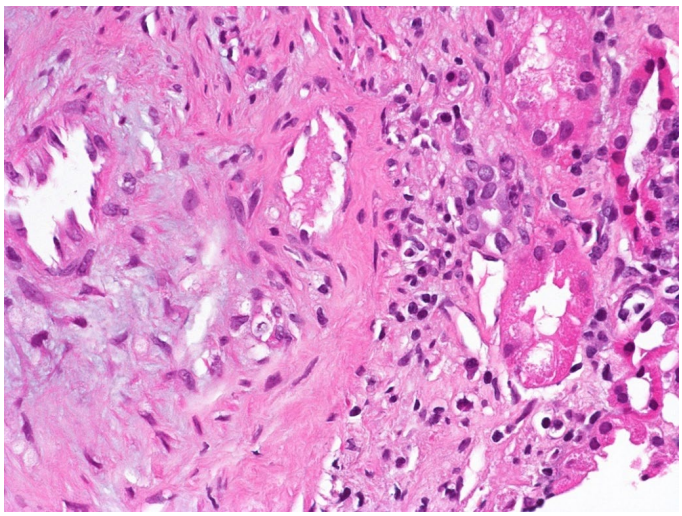

Figure 1. Tubulointerstitial disease pattern of injury with associated arteritis.

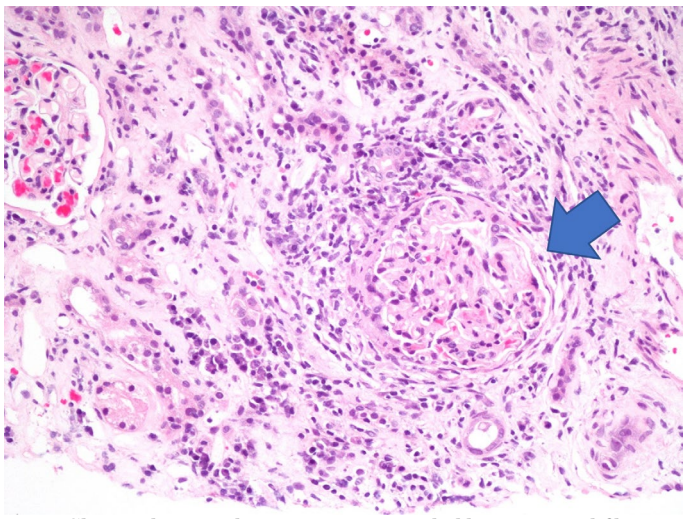

Figure 2. Glomerular pseudo-crescent surrounded by interstitial fibrosis and tubular atrophy with a multifocal interstitial inflammatory cell infiltrate of mononuclear cells, numerous plasma cells, occasional eosinophils, and associated mononuclear cell tubulitis.

DISCUSSION

The patient was similar to the average demographic profile of an IgG4-TIN patient (a male near age 65).[6] His presentation of decompensated heart failure and cutaneous lesions concerning for endocarditis or vasculitis, combined with his DMARD non-adherence, imaging limitations due to retained shrapnel, and false positive p-ANCA created diagnostic challenges. Notably, the patient's renal biopsy contained a pseudo-crescent and arteritis, which are uncommon features of IgG4-TIN.[7,8]

While renal failure is the most common presentation of IgG4-TIN,[6] this patient's AKI initially was thought to be due to a prerenal etiology based on his cardiac symptoms. While IgG4-RD is associated with coronary arteritis, periaortitis, and pericarditis,[12-14] it has not been associated with heart failure, as in this patient. Whether correlation between the diagnoses of heart failure and IgG4-TIN implied causation is difficult to discern without cardiac magnetic resonance imaging (MRI),[14] which was intolerable due to the patient's retained shrapnel. Therefore, it remains unknown if this patient's heart failure was related to IgG4-RD or was a coincidental co-occurrence.

The cutaneous lesions were considered during the cardiac evaluation. There was concern for endocarditis; however, this was deemed unlikely with a low modified Duke score.[15] After ruling out endocarditis, the skin lesions, combined with the patient's history of RA and HCV, which are associated with systemic vasculitis,[16,17] prompted additional studies. Cutaneous lesion biopsies revealed granuloma annulare, effectively excluding vasculitis associated lesions. Granuloma annulare is a common condition associated with a variety of diseases ranging from diabetes mellitus to autoimmune thyroiditis,[18] but it has not been associated with IgG4-TIN.[19,20] While the cutaneous lesions resolved with corticosteroid treatment, it is difficult to determine if this patient's granuloma annulari was related to IgG4-RD.

The patient's RA with DMARD non-adherence further complicated the evaluation. Half of RA patients have elevated serum IgG4 levels,[21] but it is unusual for RA patients to experience IgG4-TIN.[9] This patient's symptom onset near the discontinuation of DMARDs created questions: Were the patient's DMARDs suppressing IgG4-RD? Does abrupt cessation of DMARDs predispose to rebound development of IgG4-RD? Are hydroxychloroquine or leflunomide possible treatments for IgG4-TIN? Continued research into IgG4-TIN, RA, and ideal immunosuppression regimens are needed.

While this patient had unusual extra-renal findings possibly related to IgG4-RD that complicated the workup, the most striking finding was his kidney biopsy, specifically the arteritis and interstitial plasma cell infiltrates with over 40 IgG4+ plasma cells/HPF. These interstitial inflammatory infiltrates met the first criteria to diagnose IgG4-TIN.[6] Besides renal histological findings, definitive diagnosis of IgG4-TIN required elevated serum IgG4, renal imaging abnormalities, or specific secondary organ involvement. Determining if the patient met criteria to diagnose IgG4-TIN was challenging. The patient received steroids

before his serum IgG and IgG4 levels were evaluated; therefore, these values could have been falsely normal.[11] Definitive evaluation for renal abnormalities would be aided by MRI,[22] which was intolerable. Imaging via contrast computed tomography is a possible alternative,[23,24] but the patient was reluctant to receive contrast. The patient did not have a history of extra-renal diseases associated with IgG4-TIN,[6] but evaluation for inflammatory lesions in the heart was unable to be performed. Thus, while the patient did not meet a second diagnostic criteria for IgG4-TIN, given the renal biopsy findings with lack of a more likely diagnosis, the patient was diagnosed with and treated for IgG4-TIN.

Outside of the imaging limitations in the patient's evaluation, this case highlighted the clinical and histopathological overlap of two distinct diseases: IgG4-TIN and ANCA-associated disease. This patient had a positive ANA and indirect immunofluorescence p-ANCA test with negative anti-MPO and anti-PR3. ANA can produce a "false positive" p-ANCA result due to the indirect immunofluorescence technique.[25] Anti-MPO and anti-PR3 studies are more specific for PICGN and were negative, making this diagnosis unlikely.[26] Still, like IgG4-TIN, ANCA-associated disease can show increased IgG4+ plasma cells.[6] Recognition of "pseudo-crescents" that may occur in IgG4-TIN, rather than true crescents, and recognition of associated non-necrotizing plasma cell arteritis, facilitate diagnosis of IgG4-TIN rather than PICGN.[8] Conversely, increased IgG4+ plasma cells in an infiltrate are insufficient to diagnose IgG4-TIN. These diseases may be treated similarly, with steroids and rituximab, although the first line treatment for IgG4-TIN is generally steroids alone, which is an insufficient treatment for ANCA-associated disease.[27]

CONCLUSIONS

IgG4-RD remains an underdiagnosed, immune-medicated condition that can affect the kidneys. IgG4-TIN should be included in the differential diagnosis for patients presenting with an intrinsic AKI. Ultimately, biopsy is required for diagnosis, and unique histological findings, including pseudo-crescents and non-necrotizing plasma cell arteritis, may aid the diagnostic process. Recognizing the unusual presentations of IgG4-TIN can aid in the diagnostic distinction between PICGN and IgG4-TIN, which is necessary for optimal treatment.

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Keywords: IgG4-related disease, tubulointerstitial nephritis, arteritis, kidney glomerulus

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Pacemaker Malfunction Due to Electric Blanket: A Rare Case of Electromagnetic Interference

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INTRODUCTION

History of cardiac pacing began in the 1950s with the development of pacemakers tethered to an extension cord.[1] It was followed by the first fully implantable pacemaker in Arne Larson in 1958 by Ake Senning and Rune Elmqvist. The original system lasted only for eight hours, and Arne Larsson had to undergo over 20 pacemaker replacements, but he outlived both his surgeon and device engineer.

Since then, a remarkable collaboration among surgeons, physicians, engineers, businessmen, and patients has led to an extensive development in this field, including the development of leadless pacemakers. Today, there are three basic kinds of pacemakers: single chamber, dual chamber, or biventricular pacemakers.[2] The common indications for permanent pacemaker include sick sinus syndrome, symptomatic second- or third-degree atrioventricular blocks, bifascicular block, alternating bundle branch block, and recurrent syncope with ventricular asystole > 3 seconds. The modes of pacemaker are based on generic codes known as NBG code and typically consists of 4- or 5-letter code, in which the first position identifies the chamber paced (A for atrium, V for ventricle, D for dual), the second position: chamber sensed, the third position: device response to sensed events (I for inhibit, T for trigger, or D for dual), the fourth position: whether rate response is on, and the fifth position (when used), indicates whether multisite pacing is employed in the atrium (A), ventricle (V), or both (D).[3]

Being an electric device, pacemakers come with challenges that include battery failure, change in programming due to the patient's condition, circuit failures sourcing from lead damage, and electromagnetic interference (EMI).[4,5] EMI can be caused by the electromagnetic waves generated by electromagnetic devices or procedures such as magnetic resonance imaging, cell phones, defibrillation, radiofrequency ablation, and radiation therapy. The incidence of EMI is variable but can occur in around 50% of patients with pacemakers.[6] The EMI can lead to ventricular oversensing and inhibition of the pacing. Rarely, EMI can lead to mode switch.[7-9] The current pacemakers with their noise-filtration techniques are fairly resistant to the common EMI sources like cellphones.[7] The electromagnetic waves hamper the functionality and programming of the pacemaker, which puts the functionality of the device, as well as the patient, at risk.

In this report, a case of a rare pacemaker malfunction related to electromagnetic interference (EMI) from an electric blanket is presented. The case also emphasized the importance of good history taking and putting it in a relative clinical context to make a correct diagnosis.

CASE REPORT

An 85-year-old woman with past medical history of hypertension, dyslipidemia, coronary artery disease status post percutaneous intervention, sick sinus syndrome status, post dual-chamber pacemaker (St. Jude Medical®, device model Zephyr DR 5820), and paroxysmal atrial fibrillation on antiarrhythmic therapy with sotalol (demonstrating sinus rhythm) presented with complaint of the intermittent sense of pacemaker vibration at the generator site and occasional neck pulsations for the prior two weeks. She reported mild dyspnea and tiredness of relatively new onset.

Jugular venous pressure was normal with no evidence of leg edema. Physical examination was unremarkable. The patient denied any new activity or change in any dietary or medication regimen. Chest x-ray demonstrated normal lung parenchyma and normal pacemaker leads position. Pacemaker interrogation demonstrated that device was in VVI mode (while being in normal sinus rhythm) at the minimum backup rate which had stayed the same without variation for the prior two weeks, although it was last set at DDDR mode (the DDDR mode stands for D-dual chamber pacing, D-dual chamber sensing, D-response to sensed event which in this device case does both inhibit and trigger, and R-rate modulation which will increase paced heart rate in response to sensed "exercise").

The patient's symptoms correlated with the device mode change. On objective inquiry to rule out possible causes, the patient denied unusual exposure to an electromagnetic interference including having undergone any exposure to magnets or unusual electrical devices. The device was reprogrammed to normal settings DDDR mode, and she felt better but returned two days later with similar symptoms. The device again was found to be reset in VVI mode.

The recurring auto resetting to VVI mode led to the suspicion of an external EMI interference. A comprehensive objective interrogation was conducted again and subsequently led to the final diagnosis and correct management. The patient recalled having been using an electric warming blanket (Sunbeam® brand) during sleep. In retrospect, the patient realized that she woke up with her symptoms after its first use, but initially could not comprehend the correlation between the electric blanket and the subsequent symptoms. Thus, she failed to disclose this information on her first presentation.

The pacemaker was reprogrammed to DDDR mode which resulted in resolution of symptoms. After discontinuing the use of the electric warming blanket, the recurrence of symptoms was not observed.

DISCUSSION

In general, EMI can originate from a variety of sources that have the potential to affect a pacemaker's function adversely, like device failure, device overheating, and hinderance in sensing ability.[10] Some of the common sources of EMI with potential pacemaker effects are listed in Table 1.

Table 1. Possible pacemaker response based on electromagnetic interference exposure.

Type of Interference	Damage to Pacemaker	Total Inhibition	Rate Response
Cellular Phones	No	Yes	Yes
Magnetic Resonance Imagining	Yes	No	Yes
Electrocautery	U	Yes	Yes
Defibrillation	U	No	No
Extracorporeal Shock-Wave Lithotripsy	U	Yes	U
Therapeutic Radiation	Yes	No	No
Radiofrequency Ablation	U	Yes	U
Electroshock Therapy	U	U	U

U = Unlikely but may be possible.

Unipolar pacemakers are usually more susceptible to EMI interference than bipolar pacemakers because the sensing circuit encompasses a larger area compared with bipolar sensing.[11] Factors that affect EMI interference have to do with the source of interference, proximity to the pacemaker generator, and type of pacemaker. Usually, MRIs are contraindicated in patients with pacemakers, however, patients with newer MRI conditional pacemakers can undergo MRI scans safely without any adverse effects.[12]

Sources of EMI at home and the office usually do not pose a problem with patients, however, there is a potential concern that electronic surveillance devices found commonly in retail stores can interfere with pacemaker function, especially if patients are exposed to these devices for a prolonged period of time.[13,14] The EMI can lead to a variety of responses to pacemakers, such as:

1. Inhibition of pacing output: this can be life threatening for the patients who are pacemaker dependent.
2. If the EMI is interpreted as atrial events by the pacemaker, then inappropriate ventricular pacing may occur in patients with DDD pacemakers, since these pacemakers attempt to track these events, which are interpreted as atrial activity.
3. EMI often results in electrical noise that causes the pacemaker to function in a noise reversion mode. The actual function of this mode differs among the different pacemakers, but this mode usually involves switching to an asynchronous pacing mode and acts as a protective algorithm from spurious signals. After elimination of the interference, pacers generally revert back to previously programmed mode.
4. Electric (power-on) reset: strong EMI can lead to high voltage within device circuit which can cause reset of DDDR mode to VVI or VOO mode (Figure 1). Other causes of reset include electrocautery or external defibrillation. The reset mode does not revert to normal upon removal of EMI source (electric blanket in our case) and resolution requires programming by device.
5. Rare strong EMI can cause permanent damage to the pacemaker.

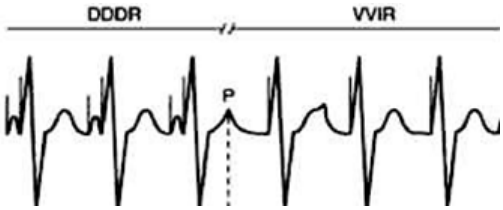

Figure 1. Schematic illustration of EMI-induced conversion to VVI pacing from DDDR pacing mode after electromagnetic interference.

In studies which examined interactions between pacemakers and cellular phones, it was noted that cell phones may cause intermittent pacemaker dysfunction.[15,16] Various electronic devices can cause similar problems in pacemaker patients, but it is difficult to draw a firm line because of diversity of different electronic devices and pacemakers (especially newer models) that have different shielding capabilities and thresholds against EMI.

CONCLUSIONS

Although minor, the risk of interreference between electromagnetic field and implanted medical devices is real. Pacemakers and implantable cardioverter defibrillators are subject to EMI, from many sources both within and outside the hospital environment, which are being implanted all around the world in modern medical era. The patients and the physicians who are responsible for follow-up of the pacing systems may be faced with challenges regarding the various types of EMI. To avoid these unwanted EMI effects, physicians and patients should be aware of these potential side effects of EMI on implantable electronic devices. Physicians must be vigilant and should demonstrate excellent history taking skills to formulate a correct diagnosis and management plan.

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Keywords: artificial pacemaker, cardiac arrhythmias, electromagnetic fields

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Using a 3D Printed Model to Create a Surgical Disaster Simulation for Resident Training: How We Did It

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INTRODUCTION

The use of simulation continues to become a major part in training surgical residents. Most simulations in orthopedics focus on developing technical skills.[1] There is a gap in non-technical skills training focusing on communication, teamwork, decision making, situational awareness, and managing stress.[2] Lapses in technical and nontechnical skills have been reported as contributing factors to surgical errors, with increased incidence of errors in emergent settings.[3]

Senior orthopedic surgery residents were provided with a simulation designed to stress communication skills and operative management during an unexpected surgical emergency.

This simulation was created by members of the Departments of Orthopedic Surgery and Anesthesiology at the University of Kansas Medical Center, and our simulation institute (Zamierowski Institute for Experiential Learning (ZIEL)) to train both technical and nontechnical skills. The surgical simulation was presented as the removal of a soft tissue tumor of the lower extremity. Unknown to the residents, during the dissection the surrounding tissue would begin to simulate a massive hemorrhage, causing hemodynamic instability. This intraoperative emergency required them to manage the operative field appropriately and communicate effectively with the operating room (OR) team. This scenario created ample need for teamwork and communication between the orthopedic and anesthesiology residents, and the nursing team. This afforded the residents an opportunity to manage an emergent OR situation prior to completing residency and beginning independent practice.

The educational objectives of this simulation were to:

1. Demonstrate appropriate management of sustained intraoperative hemorrhage.
2. Perform effective interprofessional communication.
3. Express increased confidence in ability to manage intraoperative 'disaster'.

SIMULATION

Tumor Model. The model used for the simulation was designed using a 3D printer. This was a new addition to our simulation, facilitating preparation and reproducibility of the model (Figure 1). The tissue of the model was comprised of a gelatin solution, with a plum at the center serving as the tumor. Four sets of tubing were placed at various depths in the model that would be turned on as the resident reached the specific depth, increasing the amount of bleeding in proportion to the dissection depth (Figure 2). In previous years during assembly of the model, the different tubing depths would shift as the gelatin was poured, creating variability between different models. This led to development of a 3D printed to model with side mounts for tubing to assist in reproducibility and assembly of the models.

Figure 1. 3D printed model with color coded guideposts glued in place.

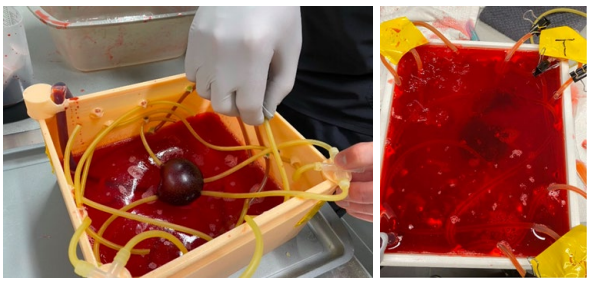

Figure 2. [Left] Placement of the tumor (plum) and the remaining vessels through their guideposts prior to pouring the second layer of gelatin. [Right] Final model after pouring of gelatin layer. Corners of model are labeled corresponding to the tubing depth.

Setting and Participants. The simulations were performed in the simulation center. The simulated operating room was set up with the model draped and prepped before the resident entered the OR (Figure 3). For the simulation, three Embedded Simulation Persons (ESPs) were involved. A medical student as the first assist and operating room volunteers as the surgical scrub technician and circulating nurse.

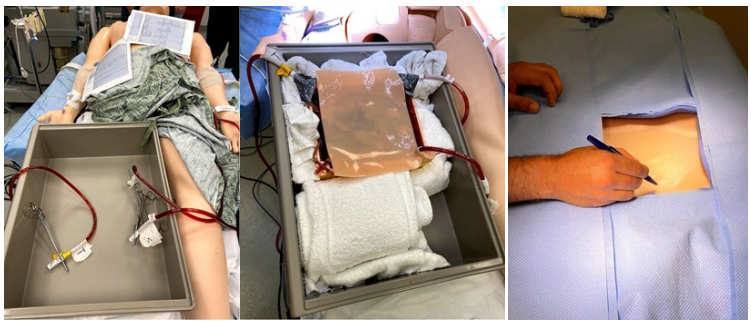

Figure 3. [Left] Container for placement of model to catch overflow artificial blood. Primed tubing from blood pump ready to be connected to the model. [Center] Model connected to blood pump, placed in container, and stabilized with towels. Artificial skin placed to complete preparation of model. [Right] Model draped and marked in preparation for start of simulation.

The anesthesiology and orthopedic residents were given history and physical exam notes, similar to a note that would be found in the electronic health record. The notes contained relevant information for the residents. Prior to beginning the simulation, they were informed that they would have access to anything they would have in a fully functional OR, including blood products. The ESPs were informed of the massive hemorrhage and were used to relay information regarding the tissue depth of the resident so the various blood pump lines could be turned on at the proper time. All vital signs, the blood pump for the model, and communication with the assistants were managed from a one-way mirror control room in addition to various cameras around the room for observation. Orthopedic and Anesthesiology faculty were present to observe the simulation and debrief the residents.

Simulation Debrief. Following each simulation, the two residents and the observing attending physicians participated in a debrief session. The session was used to discuss the thoughts and emotions experienced by the residents and to examine their team communication experience. Much of the discussion centered around communication and teamwork, with experienced attendings offering comments on strengths and opportunities for improvement. Technical skills also were discussed with instruction regarding massive hemorrhage management from the surgical and anesthesia perspective. At the final debriefing session, all learners were offered feedback on communication by the scrub technician and circulating nurse involved in their simulation.

DISCUSSION

Our goal was to provide senior residents with an opportunity to experience a high-stress scenario and manage a surgical emergency in a simulation environment as this is an important part of their training before entering into practice. The value of this simulation was to allow instruction of residents' non-technical skills, particularly focusing on areas of improvement in communication and teamwork during times of high-stress intraoperative events.

The use of 3D printing was an important aspect of this simulation. Models built for initial simulations had inconsistencies in the tubing, caused by shifting during assembly. This led to models not bleeding as intended which ultimately led to variability in the experience that the residents received. By printing the model container with guideposts for the tubing, models were able to be reproduced with minimal variability for each learner experience. Additionally, the models were able to be preserved for later use. After printing, each model was coated in FlexSeal®, which allowed for quick cleanup and storage of the model to be used again in subsequent simulations. The ability to reuse models has reduced the cost of the simulation.

CONCLUSIONS

In summary, simulation training is becoming an increasingly common and useful tool to train surgical residents. Our hope is to provide other programs an outline of how we have implemented a simulation designed to stress non-technical skills using a reproducible 3D model. This simulation provided trainees a simulated surgical emergency that provides a rare learning opportunity for resident surgeons and anesthesiologists. Further developments will continue to enhance the teaching of non-technical and technical skills during a surgical emergency for training physicians.

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