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Maternal Knowledge, Attitudes, and Practices Concerning Interpregnancy Interval

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ABSTRACT

Introduction. Few studies have examined maternal intentions and practices related to interpregnancy interval (IPI). IPI less than 18 months has been linked to increased preterm birth and infant mortality. This manuscript reports on a cross-sectional survey of mothers conducted to understand maternal knowledge, attitudes, and practice of IPI in Sedgwick County, Kansas.

Methods. New and expectant mothers and mothers of neonatal infant care unit (NICU) graduates (n = 125) were surveyed regarding the issues surrounding IPI. Front desk staff handed out self-administered surveys, which were returned to a nurse upon completion. NICU participants were emailed a link to the survey hosted on SurveyMonkey®.

Results. Fewer than 30% of mothers reported previously receiving information about IPI from any source. When asked about risks associated with IPI, women frequently (n = 58, 45%) identified increased risk for birth outcomes with no known association with short IPI. Findings regarding maternal attitudes surrounding optimal IPI were mixed with many mothers defining ideal IPI as less than 18 months (n = 52, 42%), while broadly reporting they believed that a woman's body needs time to heal between pregnancies. Respondents from the NICU sample generally reported shorter optimal IPI values than the other participants. When IPI was estimated from participants' past pregnancies, half of IPIs were less than 18 months. Mothers reported they favored healthcare providers as a source for IPI education. Face-to-face discussions or printed materials were the preferred modes of education.

Conclusions. Women were aware of the need for spacing between pregnancies, however, that knowledge was unassociated with past behavior. These findings should be taken into consideration when formulating future interventions. ***Kans J Med 2018;11(4):86-90.***

INTRODUCTION

The infant mortality rate in the United States (U.S.) historically has been higher than other developed countries.[1] Reducing this rate requires innovative multifaceted interventions and interdisciplinary collaborations. Interpregnancy interval (IPI) less than 18 months is associated with increased odds of infant mortality[2,3] and other adverse birth outcomes, including preterm birth and low birth weight.[3-7]

In Sedgwick County, Kansas, the local infant mortality rate (7.2 per 1,000 live births) has been consistently higher than Kansas and U.S. rates.[8] Short IPI was identified as a risk factor, especially for African Americans, using perinatal periods of risk (PPOR) analysis.[9] This analytic framework uses vital statistics (Sedgwick County 2008 - 2012) to elucidate causes of infant mortality by separating deaths into categories based on birth weight and age at death.[10] Based on these analyses, nearly 150 fetal infant deaths may have been avoidable, including a disparity with regard to race. Both non-Hispanic Black and Hispanic infants were at increased risk of death compared to White non-Hispanics. These findings, combined with birth outcome data from these populations[11] suggested that one of the local contributors to stillbirth and sudden and unexpected infant death was inadequate IPI.

Few studies have examined maternal intentions and practices related to IPI. A qualitative study of a diverse group of low-income postpartum women found knowledge gaps regarding outcomes associated with short IPI.[12] Similar findings were reported in a study that interviewed mothers of premature infants in the neonatal intensive care unit (NICU).[13]

This manuscript reports on a cross-sectional survey of mothers conducted to understand maternal knowledge, attitudes, and practice of IPI in Sedgwick County.

METHODS

Participants. Participants included a convenience sample of mothers of infants less than one year of age and pregnant women (hereafter mothers) attending a combined obstetrical/pediatric primary care resident/faculty clinic between September and December 2015. The clinic was selected as it serves many minority patients and only 11% of the county identified as African American.[11] Clinic participants were eligible if they had a scheduled appointment for themselves or for their infant. Front desk staff handed out self-administered surveys, which were returned to a nurse upon completion.

Mothers of NICU graduates who delivered in 2015 also were enrolled. The 85-bed, level III NICU is located in the hospital that provides 80% of the deliveries in Sedgwick County. The NICU was selected to target those with a likelihood of recent preterm delivery, a complication of short IPI. NICU participants were emailed a link to the survey hosted on SurveyMonkey® (SurveyMonkey Inc., Palo Alto, CA).

Mothers who were less than 18 years old, unable to understand written English, or unable to consent were excluded. The study was approved by institutional review boards at the University of Kansas School of Medicine-Wichita, Wichita State University, and the Wichita Medical Research and Education Foundation.

Measurement. Because no existing tool was identified, a 23-item Interpregnancy Interval Knowledge, Attitudes, and Practice survey was developed. Items were based on a review of the literature and input from medical professionals and qualitative researchers. The survey was assessed by an expert panel for wording, complexity, and content validity.

Knowledge questions (n = 3) addressed perception of recommended IPI and its associated impact on pregnancy outcomes. Attitude questions (n = 7) included preferred IPI, contributing factors for this choice and perceived influence of recommendations from healthcare providers. Practice (n = 6) was assessed using actual IPI history. Since mothers were anticipated to not know their conception date, IPI was estimated from birthdates of previous children, allowing conservatively for 28 weeks gestation if mother's reported that their infant was born premature or 37 weeks gestation otherwise. Demographic questions (n = 7) included age, race/ethnicity, marital status, income, and insurance type.

Analysis. Analyses were conducted in SPSS (SPSS Version 22, Armonk, NY: IBM Corp.).

RESULTS

Demographics. Participants included 147 mothers (Table 1). Of these, 22 were excluded for missing key questions or more than 50% of responses. Women had given birth to 0 to 7 children (median = 2); 13 women (11%) were pregnant at the time of the survey. Parity ranged from 0 to 15 (median = 2). Mothers were white (61%) with a high school education or less (43%). Mothers from the NICU were significantly older (t(120) = 4.2, p < 0.001) and differed in race/ethnicity (χ2(4, N = 123) = 21.8, p < 0.001), marital status (χ2(3, N = 123) = 22.1, p < 0.001), and insurance (χ2(5, N = 122) = 50.4, p < 0.001).

Knowledge. Mothers were queried about their knowledge regarding a set of complications that were associated with short IPI. No mother accurately categorized all complications related to short IPI, and the average mother was unable to categorize correctly half of the complications. The list of complications had only four items related to short IPI (small for gestational age, congenital malformations, difficult child birth, and preterm labor); however, 58 mothers (45%) attributed at least one unrelated complication to short IPI (e.g., morning sickness, postpartum depression).

In total, 34 mothers (27%) reported receiving prior information on IPI. Mothers from the NICU were no more likely than those from the primary care clinic to have received information (χ2(1, N = 125) = 3.8, p = 0.052). Those who received information most often identified medical providers as their source. Family, friends, and media were reported less frequently as sources of this information (Table 2).

Attitudes. Many mothers (43%) believed an appropriate IPI to be less than 18 months, with an additional 5% believing ideal IPI should be greater than 60 months (Table 3). NICU mothers reported generally shorter optimal perceived IPI, with 56% advocating for IPI less than 18 months (Exact, p = 0.005); however, no difference was found when the question was phrased in terms of how far apart in age they would like their children (Exact, p = 0.663). For the latter category, 99 mothers (79%) reported that they would desire an age gap of at least two years between their children.

The most frequently cited reason for perceived optimal IPI length was to allow for physical healing between pregnancies (53%), followed by time to nurture current infant (21%), personal preferences (16%), and sibling interactions (3%). However, when the question was framed in terms of differences in children's ages, the reasoning differed, with 29% of mothers identifying sibling interactions, followed by personal preference (21%), nurturing current infant (19%), and maternal health (10%). Of reasons provided by respondents, only desire for siblings to be close in age was associated significantly with perceived optimal IPI. In all four cases, mothers reported perceived optimal IPI as less than 18 months (Exact, p = 0.028). Mothers who wanted children close in age were nearly three times as likely to endorse delivering their children less than 24 months apart (χ2(1, N = 125)=10.0, p = 0.002).

Table 1. Participant characteristics.

Characteristic	Clinic (n = 83)	NICU (n = 42)	All Participants (n = 125)
Age*, mean (SD)	25.8 (5.5)	30.1 (4.9)	27.2 (5.7)
Race/Ethnicity*, n (%)			
White	39 (48)	36 (88)	75 (61)
Hispanic	24 (29)	2 (5)	26 (21)
Black	12 (15)	1 (2)	13 (11)
Mixed Race	5 (6)	0 (0)	5 (4)
Other (please specify)	2 (2)	2 (5)	4 (3)
Education, n (%)			
Less than High School Diploma	16 (19)	2 (5)	18 (14)
GED/High School Diploma	34 (41)	2 (5)	36 (29)
Some College	24 (29)	11 (26)	35 (28)
Associate's Degree	2 (2)	6 (14)	8 (6)
Bachelor's Degree	4 (5)	15 (36)	19 (15)
Master's Degree or greater	2 (2)	6 (14)	8 (6)
Other	1 (1)	0 (0)	1 (1)
Marital Status*			
Married	29 (36)	33 (79)	62 (50)
Not married, but in a relationship	29 (36)	6 (14)	35 (28)
Never married	19 (23)	1 (2)	20 (16)
Divorced/separated	4 (5)	2 (5)	6 (5)
Insurance Coverage*			
Covered by Medicaid	62 (78)	7 (17)	69 (57)
Insurance provided through baby's father's employer	8 (10)	17 (40)	25 (20)
Insurance provided through baby's mother's employer	5 (6)	14 (33)	19 (16)
Other private insurance	1 (1)	3 (7)	4 (3)
Don't know	4 (5)	0 (0)	4 (3)
Other	0 (0)	1 (2)	1 (1)

*Significantly different between groups; p < 0.05.

Table 2. Source of IPI information among mothers who previously had received information on IPI.

	Clinic (n = 18)	NICU (n = 16)	All Participants (n = 34)
Health care providers			
Obstetrician (OB)	9 (47)	6 (38)	15 (43)
Family doctor	6 (32)	6 (38)	12 (34)
Hospital	4 (21)	1 (6)	5 (14)
Pediatrician	2 (11)	1 (6)	3 (9)
Nurse	1 (5)	1 (6)	2 (6)
Midwife	0 (0)	0 (0)	0 (0)
Doula	0 (0)	0 (0)	0 (0)
Other healthcare worker	0 (0)	2 (13)	2 (6)
Friends/Family			
Family	7 (37)	4 (25)	11 (31)
Friends	3 (16)	4 (25)	7 (20)
Media			
Internet	4 (21)	3 (19)	7 (20)
Books/magazines	2 (11)	4 (25)	6 (17)
Television	1 (5)	1 (6)	2 (6)
Other	1 (5)	3 (19)	4 (11)

Table 3. Mother's beliefs/desires about IPI.

	Clinic (n = 18)	NICU (n = 16)	All Participants (n = 34)
Perceived ideal IPI*			
Less than 6 months	0 (0)	1 (2)	1 (1)
6 - 11 months	7 (8)	2 (5)	9 (7)
12 - 17 months	23 (28)	19 (45)	42 (34)
18 - 23 months	14 (17)	12 (31)	27 (22)
2 - 5 years	32 (39)	7 (17)	39 (31)
More than 5 years	7 (8)	0 (0)	7 (6)
Desired difference in children's ages			
Less than 12 months	1 (1)	0 (0)	1 (1)
12 - 17 months	7 (8)	3 (7)	10 (8)
18 - 23 months	8 (10)	7 (17)	15 (12)
2 - 3 years	41 (49)	24 (57)	65 (52)
3 - 5 years	23 (28)	7 (17)	30 (24)
More than 5 years	3 (4)	1 (2)	4 (3)

*Significant difference between groups, Chi-square, p = 0.020.

Practice. Of the 62 mothers reporting more than one child (excluding multiples), 60 provided their children's birthdates. Estimating IPI from these birthdates, 30 (50%) reported short IPI for at least one pregnancy. Additionally, 11 (18%) had at least one pregnancy preceded by an IPI greater than 60 months. Reported history of short IPI was unassociated with perceived optimal IPI less than 18 months ($\chi2(1, N = 60) = 0.7, p = 0.417$).

Data on beliefs and histories did not support associations between race/ethnicity and endorsement of short IPI ($\chi2(4, N = 123) = 0.2, p = 0.237$). Further, only 33% of African Americans in our sample reported a short IPI, not significantly different from our total sample (Exact, p = 0.472). Similarly, 23% of African American respondents reported appropriate IPI as less than 18 months ($\chi2(1, N = 123) = 0.2, p = 0.235$).

Education planning. Mothers preferred learning about IPI from their healthcare providers, including pediatricians (Table 4). They were less inclined to want to receive information from television, books/magazines, or the internet. Most mothers favored learning about IPI shortly after baby's birth or before any pregnancy. Mothers desired to hear about IPI in a face-to-face discussion, or from a brochure or handout, rather than other media sources (video, email, social media, or text message).

Table 4. Desired learning environment for IPI information.

	Clinic (n = 83)	NICU (n = 42)	All Participants (n = 125)
Trusted sources for IPI information			
Obstetrician (OB)	53 (66)	38 (90)	91 (75)
Family doctor	54 (68)	30 (71)	84 (69)
Pediatrician	46 (58)	26 (62)	72 (59)
Nurse	32 (40)	24 (57)	56 (46)
Hospital	26 (33)	24 (57)	50 (41)
Family	30 (38)	7 (17)	37 (30)
Midwife	11 (14)	15 (36)	26 (21)
Friends	15 (19)	5 (12)	20 (16)
Doula	3 (4)	10 (24)	13 (11)
Internet	5 (6)	7 (17)	12 (10)
Books/magazines	4 (5)	7 (17)	11 (9)
Television	0 (0)	0 (0)	0 (0)
Other healthcare worker	3 (4)	3 (7)	6 (5)
Other	3 (4)	3 (7)	6 (5)
Best time for IPI information delivery			
Before any pregnancy	32 (39)	22 (52)	54 (44)
During pregnancy	26 (32)	19 (45)	45 (36)
At the time of my baby's birth (in hospital)	18 (22)	14 (33)	32 (36)
Shortly after my baby's birth	42 (51)	24 (57)	66 (53)
Other	8 (10)	0 (0)	8 (6)
Best way to deliver IPI information			
Face-to-face discussion	55 (68)	36 (90)	91 (75)
Brochure or handout	35 (43)	22 (55)	57 (47)
Brief video	11 (14)	7 (18)	18 (15)
Email	10 (12)	4 (10)	14 (12)
Social media (e.g., Facebook)	5 (6)	5 (13)	10 (8)
Text message	7 (9)	1 (3)	8 (7)

DISCUSSION

Sedgwick County mothers had varied knowledge, attitudes, and practice related to IPI. As demonstrated by previous literature, knowledge about possible negative health consequences associated with a short IPI often was lacking.[12] One study found, while nearly 70% of mothers with infants in the NICU had heard of risk factors for preterm birth, such as smoking and infection, less than 32% had heard of short IPI.[13]

In terms of attitudes, most mothers recognized the importance of allowing their body to heal between pregnancies, but underestimated the time needed to do so. However, when the question was phrased in terms of differences in child age, maternal health was less likely to be reported as a decision factor, suggesting pregnancy interval may be a better way to frame educational statements related to birth spacing. Further, mothers who expressed interest in having children close in age were significantly more likely to endorse a short IPI and may be a priority group for future education.

Birth spacing was inconsistent among women, with half experiencing a short IPI and nearly 20% waiting more than five years between pregnancies. About one third of U.S. pregnancies experience short IPI, suggesting our sample may represent a population with greater propensity toward IPI of less than 18 months.[14] Study findings were not consistent with literature[4] or PPOR findings[10] reporting an association between African American race and short IPI.

The majority of respondents wanted to hear about birth spacing shortly after the baby's birth. While for many mothers, the six-week post-partum visit is sufficient for discussion and provision of birth control, for others it may be too late to prevent subsequent high-risk pregnancy. In interviews with general practitioners in the United Kingdom, doctors expressed concern that, for lower socioeconomic status and younger women, sexual activity has resumed by six weeks.[15] In addition, many of these women miss their six-week appointment.

Such results have led to considerations of alternative solutions, such as a family planning clinic adjacent to the NICU[13], insertion of long-acting reversible contraceptives at delivery, or co-occurrence of mother's contraceptive care with the well-baby visit.[16] Mothers from the current study reported they would trust their healthcare providers, including pediatricians, to share information with them regarding birth spacing during face-to-face interactions. All providers who deliver health services to new mothers should promote healthy IPI. Pediatricians may be an untapped resource for providing accurate IPI information and family planning conversations, as infants attend a greater number of appointments, including several before six weeks of age. Interventions designed to leverage this trusted relationship to provide IPI information should be considered. Of note, one of the NICU participants in this study reported learning about IPI from the hospital. Similar to prior interventions to promote safe sleep[17,18] and breastfeeding[19] in the NICU setting, it may be prudent to engage the neonatal providers in promoting optimal IPI.

There are potential barriers to adoption of appropriate IPI. This study observed that mother's perception of optimal IPI was not associated significantly with their reported practices. While this study did not access the medical records of included mothers to confirm their reported IPI, these data suggested mothers may get pregnant sooner than they intended. This is congruent with previous literature suggesting that nearly 50% of pregnancies in the U.S. are unplanned.[20] The authors suggest that health systems should provide education for all mothers in the perinatal period at multiple touch points, and provide resources, including comprehensive contraception counseling, to help mothers maintain a healthy IPI.

Limitations. This study is limited as it presents a convenience sample of mothers from a combined obstetrical/pediatric clinic and a single NICU. The NICU sample was less ethnically diverse and higher educated than clinic mothers, which may be due to sampling bias related to electronic survey methods. The self-reported nature of the data and the fact that IPI was estimated from reported birthdates also were limitations.

CONCLUSION

Maternal knowledge of IPI is less than optimal and may be improved through direct communication with healthcare providers, especially pediatricians. However, knowledge and intentions did not correspond necessarily with practice, suggesting additional barriers may exist for women looking to adhere to birth spacing recommendations. Increased birth spacing interventions may address short IPIs and improve the health of infants and mothers.

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Keywords: maternal-child health services, pregnancy, reproductive history, birth intervals, infant mortality

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Assessing Medical Student's Ability to Interpret Traumatic Injuries on Computed Tomography Before and After the Third Year Clerkships

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ABSTRACT

Introduction. Exposure to radiologic images during clinical rotations may improve students' skill levels. This study aimed to quantify the improvement in radiographic interpretation of life-threatening traumatic injuries gained during third year clinical clerkships (MS-3).

Methods. We used a paired-sample prospective study design to compare students' accuracy in reading computed tomography (CT) images at the beginning of their third year clerkships (Phase I) and again after completion of all of their third year clerkships (Phase II). Students were shown life-threatening injuries that included head, chest, abdomen, and pelvic injuries. Overall scores for Phase II were compared with Phase I, as well as sub-scores for each anatomical region: head, chest, abdomen, and pelvis.

Results. Only scores from students participating in both Phase I and Phase II ($N = 57$) were used in the analysis. After completing their MS3 clerkship, students scored significantly better overall and in every anatomical region. Phase I and Phase II overall mean scores were 1.2 ± 1.1 vs. 4.6 ± 1.8 ($p < 0.001$). Students improved the most with respect to injuries of the head and chest and the area of least improvement was in interpreting CT scans of the abdomen. Although improvements in reading radiographic images were noted after the clerkship year, students accurately diagnosed only 46% of life-threatening images on CT scan in the trauma setting.

Conclusions. These results indicated that enhanced education is needed for medical students to interpret CT scans.

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INTRODUCTION

No published evidence currently exists demonstrating improvement in a medical student's ability to read and interpret traumatic radiographic images during their clinical rotations. Intuitively, exposure to radiologic images during clinical rotations should improve medical students' skill with regard to reading and interpreting images of life-threatening injuries. However, as of 2009 - 2010, only a quarter of United States medical students were required to complete clinical rotations in radiology.[1] In contrast to those statistics, the majority of undergraduate medical students surveyed by Saha et al.[2] believed that becoming proficient in radiology was necessary to become a "competent doctor". Additionally, a majority of General Surgery program directors believe it is essential for a surgeon to recognize common abnormal findings on abdominal x-ray, and to have a systematic approach of viewing a CT of the abdomen and pelvis.[3,4]

Exposure to radiology in the clinical or hospital setting, even when implemented in the early phases of medical education, can influence how students perceive an image and its subsequent interpretation.[3,5,6] However, investigations have varied with regard to incorporating image reading and interpretation into curricula. Lufler et al.[6] provided medical students with CT scans of their cadavers during their anatomy course. Students who had access to the CT scans were 3.6 times more likely to score greater than 90% on their exam than the students who did not have access. Another study incorporated a web-based radiology curriculum during students' clinical clerkships.[3] Surveys from the students showed that 88% of the students found this course expanded their knowledge and understanding of radiology; however, no objective data were examined with this study, or other studies, to show evidence of improvement.

Residents believe that a working knowledge of radiology is important. Saha et al.[2] conducted a survey of interns and found that two-thirds are asked to make a preliminary diagnosis on multiple modes of imaging several times a week. Of the residents surveyed, 93.4% thought it important to be able to read a chest x-ray accurately as an intern, and 79.3% thought it important to interpret abdominal radiographs correctly. Program directors in General Surgery list the reading and interpreting of radiological images as a skill that is important, but 41.7% indicated that incoming residents lack adequate radiology skills and knowledge.[4] This means that interns will be expected to interpret images, sometimes on their own, whether program directors think they have adequate knowledge or not.

No formal objective study has been performed to ascertain level of improvement made in identifying life-threatening traumatic injuries on CT scan. Therefore, the purpose of this study was to observe and compare the baseline knowledge of CT interpretation of traumatic injuries for medical students before and after completing their clinical clerkships. Objectively evaluating a cohort of students before and after their required clinical clerkships will guide future discussions of improving the radiologic knowledge of medical students, especially during their clerkships as they prepare to enter residency.

METHODS

Study setting. This study took place at the University of Kansas School of Medicine-Wichita, which utilizes a four-year program of study. The first two years are didactic and the second two are composed of clinical clerkships and clinical electives. During the third year surgery clerkship, students are exposed to trauma call on the weekends and periodically on overnight trauma call.

Students are integrated into all aspects of the trauma experience, and trauma residents are instructed to teach students how to interpret CT imaging in the trauma situation. A majority of students received a lecture by a trauma surgeon during their third year specifically designed to teach them how to interpret CT scans in the trauma setting. Many times in overnight trauma call, trauma residents are expected to make a preliminary diagnosis based on imaging, which guides clinical decision-making.

Study selection and consent procedures. The Institutional Review Board of the sponsoring hospital approved this study for implementation. Study participants were medical students of the University of Kansas School of Medicine-Wichita who voluntarily consented to participate. A cohort of third-year medical students were asked to participate in a timed, open-ended survey just prior to beginning their third year clerkships (MS-3) to assess their ability to diagnose life-threatening injuries on CT scan that were typical of the trauma population. The survey was conducted during a scheduled time of their orientation for clinical clerkships, but was not a mandatory part of their curriculum. Students of the same cohort again were asked to participate voluntarily in a similar survey after completion of all of their third year clerkships in transition between their third and fourth year of medical school (MS-4). Informed consent was obtained from all volunteers for both surveys, and they were informed that they were under no obligation to participate and that all answer sheets would be de-identified.

Radiographic image selection and survey procedure. The trauma registry of an American College of Surgeons-verified Level 1 trauma center was used to find representative images of different traumatic injuries diagnosed by CT. The final images to be used in the study (Tables 1 and 2) were selected by a fellowship-trained trauma surgeon with 11 images being selected for MS-3 (Phase I) and 10 for MS-4 (Phase II) students. Images chosen were representative of four different anatomical regions: head, chest, abdomen, and pelvis. The images chosen were deemed to represent the injuries to be identified and as such should have minimized the need to scroll through the images as would be available in real life. The images were de-identified and loaded onto Microsoft® PowerPoint slides for viewing. There were an unequal number of CT images used in each phase (11 in the MS-3 session; 10 in the MS-4 session). Since a comparable colon mesenteric injury was not presented after completion of the third year clerkship, scored answers for that image were removed from analysis. The students were gathered in a theater style lecture hall, instructed that each slide represented a life-threatening injury, and given two minutes to render their answers on each injury. The students were not allowed to discuss the images with each other; it was a test of their independent ability. They were asked two questions on each injury for a total of 22 questions for MS-3 and 20 for MS-4 students: what was the diagnosis and what intervention would they recommend for the injury.

Table 1. Life-threatening computed tomography injuries used for survey 1 for MS-3 students.

Anatomical Area	Injury
Head	Epidural Hematoma Subdral Hematoma Intraparenchymal Hemorrhage
Chest	Pulmonary Contusion and Pneumothorax Pulmonary Contusion and Pneumothorax
Abdomen	Liver Laceration Splenic Laceration Renal Injury Small Bowel Thickening Colon Mesenteric Injury*
Pelvis	Pelvic Fracture

*This image was not used in the paired comparison for abdominal injuries, as a comparable injury image was not shown during the MS-4 survey.

Table 2. Life-threatening computed tomography injuries used for survey 2 for MS-4 students.

Anatomical Area	Injury
Head	Epidural Hematoma Subdral Hematoma Intraparenchymal Hemorrhage
Chest	Pulmonary Contusion and Pneumothorax Pulmonary Contusion and Pneumothorax
Abdomen	Liver Laceration Splenic Laceration Renal Injury Small Bowel Thickening and Renal Injury
Pelvis	Pelvic Fracture

Survey scoring and data analysis. After completion of the survey, the forms were de-identified and scored independently by two trauma surgeons. The surgeons then reviewed the scores and disagreement in scoring was reviewed and resolved by mutual agreement and a final score for each student determined. Students were given one point for a correct response, one-half point for a partially correct response, and zero points for incorrect answers. Students were scored only on the first question (What was the diagnosis?). The second question (What intervention would they recommend for the injury?) was not scored, as the correct answer to this question is dependent on first getting the correct diagnosis.

The mean score with standard deviation was calculated for the four anatomical regions that were tested in both sessions, as well as the overall score in each of the two sessions. For analysis, comparisons of continuous data were conducted using a Wilcoxon signed rank test due to the skewed nature of the assessment scores. All statistical tests were two-sided and analyses were considered significant when the resultant p value was ≤ 0.05. All analyses were conducted using SPSS release 19.0 (IBM Corp., Armonk, New York).

RESULTS

A total of 65 MS-3 students agreed to participate in the study. Of those, 57 students were re-surveyed with a similar survey as MS-4 students. Overall, the cohort scored considerably better as MS-4s than as MS-3s (Table 3). The overall MS-4 score was 4.6 compared to 1.2 as MS-3s out of 10 possible. Statistically significant improvement was made by the cohort in every anatomical region tested with all p values less than or equal to 0.005 (Table 3). The largest improvement was made in interpreting CT images of the chest (0.14 vs. 1.45, $p < 0.001$). The smallest improvement was made in interpreting CT images of the pelvis (0.25 vs. 0.52, $p = 0.005$). Specific injuries tested in each anatomical region are in Tables 1 and 2.

Table 3. A comparison of correct CT interpretation scores for medical students in years 3 and 4 (n = 57).

Body Region	Maximum Possible Score	Mean Score ± SD		Significance[a]
		MS3	MS4	
Overall	10	1.16 ± 1.00	4.62 ±1.75	$p < 0.001$
Head	3	0.74 ± 0.56	1.83 ± 0.83	$p < 0.001$
Chest	2	0.14 ± 0.44	1.45 ± 0.66	$p < 0.001$
Abdomen	4	0.11 ± 0.34	0.83 ± 0.91	$p < 0.001$
Pelvis	1	0.25 ± 0.43	0.52 ± 0.49	$p = 0.005$

[a] Non-parametric test of significant differences were used due to the atypical distribution of one or more of the comparison groups.

DISCUSSION

Integrating the appropriate radiological training into medical school has long been a source of debate. This debate may be expected to continue as the use of diagnostic imaging has been increasing dramatically over the previous few decades.[18] There have been studies to show that medical students feel that they increase their ability to diagnose common abnormalities with training.[1-3] Interns of multiple specialties often are asked to render preliminary diagnoses and identify common pathologies such as pneumonia, small bowel obstruction, pneumoperitoneum, and intracranial hematoma.[2] The ability to diagnose gross life-threatening injuries quickly is important on a trauma service where many injuries happen at night, access to radiologists is limited, and clinical decisions largely based on imaging must be made to direct patient care decisions.

Our study showed that students' ability to identify life-threatening images on CT scan improve during their third year clerkships. However, they still misidentify a substantial number of injuries. Students performed best when evaluating head injuries, while the area in which we observed the greatest improvement was that of chest CTs. Students' largest deficit of knowledge appeared to be in identifying abdominal injuries. This likely was reflective of the complexity of the abdomen with multiple organ systems; however, this finding also highlighted the need for continued radiological exposure and training.

The trauma service that this cohort was exposed to only allowed for specific trauma training in regards to CT interpretation during the students' on call duties, yet they still showed improvement. It was also evident that this same cohort of students had a strong deficit of knowledge when interpreting CT and required more training. This training could come from multiple sources, but an organized approach to teaching and evaluating students is critical to ensuring all students are receiving similar experiences. Students at this institution have the option of an elective radiology rotation during their MS-4 year, which could improve this skillset. The majority of this cohort was subjected to a dedicated lecture on interpreting CT scans in trauma. A web-based radiology curriculum, such as was instituted by Chorney and Lewis[3] seemingly could be useful and has the perception of being a good use of resources and time, and provides increase in knowledge by the subjects included in the studies' surveys. Studies comparing students' ability to interpret radiological pathology after implementing a web-based curriculum should be undertaken.

Several limitations are evident in this study. This study was performed in one small cohort at a single institution, thus its generalizability to non-similar programs and students may be lessened. Images representative of injuries on CT were presented to the students as a single slide to the entire cohort simultaneously. This is not a scenario representative of clinical practice. Having the ability to scroll through images and look at different reconfigurations clearly is helpful in identifying abnormal anatomy and the magnitude of injury. If students had the ability to scroll through the CT scans as they would in clinical practice their identification of injuries may have been higher. However, the images shown were chosen for their clarity and the need to mitigate this limitation. Students rotate through the surgery service at different times of the year, with different residents teaching them. This adds variability to each set of students experience in trauma. The curriculum is built to be the same, but we could not control for quality of resident teaching, nor of seasonal injuries. Most students only exposure to trauma was during their on-call duties, but one to two students in each rotation were placed on the trauma service, and spent a dedicated month on trauma, greatly increasing their exposure. This was not taken into account in this study. Finally, there is a possibility of selection bias resulting from performance differences in students who chose to volunteer vs those who did not; however, we believe this is unlikely to have affected our results. With an average of approximately 70 students in each class, the vast majority of students participated in our study, making it unlikely that any effect on our results would significantly affect our interpretations and conclusions.

CONCLUSIONS

Standard methods for evaluating medical students' ability to interpret radiographic imaging are lacking. In addition, the best practices to facilitate proficiency in evaluating radiographic imaging still are debated. This study showed that medical students improve in their ability to identify life-threatening traumatic injuries on CT during the course of clinical rotations. However, improved though they may be, a deficit remains between acquired skill and what may be expected as interns.

In one year, those students will be expected to render preliminary diagnoses based on CT and implement clinical interventions based on their interpretations as intern residents. This study suggested that medical students need focused training in interpreting CT scans. The method of this training and standards used to evaluate the student should be the subject of future study.

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Evaluation of Online Consumer Health Information for Idiopathic Scoliosis Identified by a Google™ Search

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ABSTRACT

Introduction. This study sought to assess the quality of online consumer health information about idiopathic scoliosis. Previous studies showed that quality of online health information varies and often lacks adherence to expert recommendations and guidelines. Nevertheless, 72% of internet users seek health information online. A 2005 analysis of online scoliosis information found that the information was limited and of poor quality.

Methods. Two reviewers vetted the top 10 websites resulting from a GoogleTM search for "scoliosis." Content was organized into categories and rated by three physician evaluators using a 1 - 5 scale based on quality, accuracy, completeness of information, readability, and willingness to recommend. Additional information, such as number of ads and Flesch-Kinkaid reading level, also was collected.

Results. The average overall physician score was 47.6 (75 possible). All websites included content that was mostly accurate but varied in completeness. Physicians unanimously recommended Mayo Clinic, MedicineNet, and Kids Health; none recommended the Google™ Knowledge Graph. The Scoliosis Research Society website reached the highest overall physician score. Readability ranged from 7th grade to college level; only that of Kids Health was below 10th grade level.

Conclusions. Most essential information provided by the websites was accurate and generally well rated by physicians. Website ranking by physicians was inconsistent with the ranking order by Google™, indicating that health seekers reviewing the top Google™-ranked websites may not be viewing the websites rated highest by physicians. Physicians should consider patient literacy in website recommendations, as many have an above average literacy level.

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INTRODUCTION

Idiopathic scoliosis (IS), which accounts for 80% of scoliosis in adolescents, is a "three-dimensional torsional deformity of the spine and trunk" of unknown origin.[1] It is divided into three main classifications by age of onset: infantile, juvenile, and adolescent. Approximately 90% of IS cases develop in adolescent patients between 11 - 18 years of age. Overall, adolescent idiopathic scoliosis (AIS) is estimated to affect 0.47 - 5.2% of the global population.[2]

For decades, scoliosis screenings were a routine part of school physical examinations of adolescents.[3] In 2004, the U.S. Preventive Services Task Force (USPSTF) published a recommendation against routine screening, concluding that screening does not increase probability of early diagnosis significantly due to the variable accuracy of the forward bending test and poor follow-up of patients diagnosed in screening.[4] Furthermore, USPSTF concluded that potential detriments of screening (unnecessary referral, radiation exposure, and bracing) outweighed the benefits of potential earlier diagnosis.

Several physician organizations, including Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT),[1] Scoliosis Research Society, Pediatric Orthopedic Society of North America, American Academy of Orthopedic Surgeons, and American Academy of Pediatrics, hold that additional research on scoliosis screening since the 2004 USPSTF recommendation has documented benefits of earlier detection and non-surgical treatment of IS.[5] An updated 2018 USPSTF recommendation concluded that there is currently insufficient evidence to weigh the harms and benefits of adolescent idiopathic scoliosis screening.[6]

Evident lack of consensus in the scientific community on scoliosis screening and lack of conclusive scientific evidence on the effectiveness of conservative treatments (like observation, physical therapy, and bracing) and surgical treatments confer great import to patient preferences. Therefore, SOSORT recommends that patient/caretaker education, psychotherapy, assessment of patient co-operation, support groups, and internet forums be available to help patients and caretakers navigate the scoliosis treatment process.[1]

The internet can be a valuable source of information on scoliosis, particularly considering the ambiguity of screening recommendations and complexity of IS treatments. Those concerned with scoliosis may use online information to self-screen or look for treatment options. A 2013 Pew Research Center survey reported that 87% of American adults use the internet and 72% had searched online for health information within the past year. Most (77%) used a general search engine like Google™ or Bing™.[7] Online search information influences how consumers manage their care and may serve as a substitute for seeking treatment from a medical professional.[8,9] However, online information often lacks peer review and must be scrutinized carefully.[8,10]

Regarding internet-informed self-diagnosing, 41% reported that their self-diagnosis was confirmed by a medical professional and 18% reported medical professional disagreement, while 35% did not visit a clinician for confirmation.[9] Studies evaluating internet health information for such topics as concussions[11,12], child safety education[13], nutrition[14], breast cancer[15-19], inflammatory bowel diseases[20-23], acute low back pain[24-26], and eye conditions[27] have shown such information to be lacking in adherence to expert recommendations and guidelines. In fact, an earlier analysis of online scoliosis information (evaluated 2003, published 2005) found that the information was limited and of poor quality and concluded that physicians must assume primary responsibility for patient education.[28]

Patients searching for health information online face the obstacle of high literacy requirements. The vast majority of online sources have reading levels that are inappropriate for the general U.S. population.[29-32] Daraz et al.[29] showed mean reading levels between 10th to 15th grades of nearly 8,000 websites, depending on the scale used to measure reading level. According to the 2003 national assessment of adult reading levels by the National Center for Education Statistics, the average reading level of a typical American is between 7th to 8th grade level. The U.S. Department of Health and Human Services (USDHHS) developed a scale that qualifies material under a 6th grade reading level as "easy to read;" between 7th to 9th grade level as "average difficulty," and above 9th grade level as "difficult." Most online health sources have a "difficult" reading level on this scale.[32] According to the USDHHS, limited health literacy is correlated with poorer health outcomes.[33] Thus, it is important that online information on scoliosis has a reading level accessible to most of the U.S. population.

Overall, patient education is important for patients with scoliosis due to the controversy over screening and treatment. Patients and their caretakers need ready access to accurate health information at an appropriate reading level, and most patients rely on the internet to supply such health information. However, internet health information on scoliosis has not been evaluated systematically for several years. Thus, this study aimed to evaluate online scoliosis information for accuracy and readability.

METHODS

In June 2016, websites containing information about IS were identified using the keyword "scoliosis" on the search engine Google™. Google™ scored the highest in search validity in a comparative study on the quality of search engines for online medical information.[34] The top 10 ranked non-media-related scoliosis websites were evaluated[35] because the average online health consumer views only the first few websites and rarely goes beyond the first page of results.[36,37]

Each website was vetted individually by two investigators (SH and MW) and organized into categories. "Essential information" was defined via information typically required by patient informed consent forms[38] and included definition, types of scoliosis described, demographics of those affected, causes and risk factors, signs and symptoms, screening and diagnosis, types of curves, treatment options, self-management tips, and complications of untreated scoliosis. "Additional information" included myths about scoliosis, current research, surgery recommendations, chiropractic cures, and extra information. Non-evaluated descriptive information also was collected: recommendations for speaking with a physician and routine scoliosis screening, Flesch-Kincaid reading grade levels, the number of front-page advertisements, availability of patient handouts and privacy policies, and the presence of research article citations. The researchers merged their individual content assessments and resolved any content discrepancies through discussion.

Website content information was blinded for source (host and universal resource locator [URL]) evaluation by copying and pasting website material into standardized forms. This content was reviewed by three physicians: two family medicine physicians and an orthopedic spinal deformity specialist. The physicians were asked to review and evaluate the categorical information and score the information on a scale of one (1 = Poor) to five (5 = Excellent) based on quality, accuracy, and completeness of information. Categories listed on the physician evaluation forms as containing "no information" provided by the website were assigned scores of zero (0) for consistency. There were two missing physician scores (out of 450 possible); these were replaced with the average of the other two physician scores for that section. Physicians' scores were averaged by category and the total essential (50 possible) and overall (75 possible) scores for each website were calculated. The "essential" score was calculated from the score totals in the "essential categories," as listed above. The "overall" score was calculated from the score totals in all the categories, including "essential" and "additional" ones, as listed above. Physician rankings were created using the website essential scores and the overall (essential plus additional category) scores. The physicians also rated their "willingness to recommend this website to patient consumers" between "strongly disagree", "disagree", "agree", or "strongly agree". These ratings were dichotomized to agree/disagree for analysis. Three-way interrater agreement was assessed by using intraclass correlation coefficient[39] per SPSS for Windows Version 23.[40] Interpretation was based on the classification suggested by Landis and Koch.[41] Correlation between the Google™ ranking and the physician ranking was analyzed using the Spearman rank order correlation coefficient.

RESULTS

Table 1 lists the web addresses for all ten websites evaluated in Google™-ranked order. Tables 2 and 3 contain categorical evaluations of the top ten Google™-ranked websites, including the Google™ Knowledge Graph sidebar. The mean physician evaluation scores for each category are found in Table 2, along with the essential and overall physician scores and rankings. Table 3 contains the website ratings for the "additional information" categories and descriptive information about the websites.

Table 1. Listing of top 10 Google™ websites and URLs from search "scoliosis".

Website	URL Used for Evaluation
WebMD	http://www.webmd.com/osteoarthritis/guide/arthritis-scoliosis
Mayo Clinic	http://www.mayoclinic.org/diseases-conditions/scoliosis/home/ovc-20193685
Medicine Net	http://www.medicinenet.com/scoliosis/article.htm
Niams.nih.gov	http://www.niams.nih.gov/health_info/scoliosis/
Spine Health	http://www.spine-health.com/conditions/scoliosis/scoliosis-what-you-need-know
Wikipedia	https://en.wikipedia.org/wiki/Scoliosis
Scoliosis Research Society	http://www.srs.org/
Medical News Today	http://www.medicalnewstoday.com/articles/190940.php
Kids Health	http://kidshealth.org/en/kids/scolio.html
Google™ Knowledge Graph	N/A

Table 2. Physician overall and essential information scores of top 10 hits using "scoliosis" as search term in Google™.

		Website	Scoliosis Research Society	Spine Health	Medicine Net	Mayo Clinic	Wikipedia	Niams.nih.gov	WebMD	Medical News Today	Kids Health	Google
	Rank	**By overall physician scores**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		By essential physician scores	**4**	**2**	**1**	**5**	**3**	**6**	**7**	**8**	**9**	**10**
		Google™	**7**	**5**	**3**	**2**	**6**	**4**	**1**	**8**	**9**	**Knowledge Graph**
Physician Scores (Average)	**Overall Information**	Physician would recommend	2/3 Agree	2/3 Agree	3/3 Agree	3/3 Agree	1/3 Agree	2/3 Agree	2/3 Agree	2/3 Agree	3/3 Agree	0/3 Agree
		Average overall physician score (out of 75)	62.67	57.33	56.00	55.67	54.67	53.67	49.00	36.33	35.33	15.67
	Essential Information	What is scoliosis?	4.00	4.33	4.67	2.33	4.00	3.67	4.67	4.67	4.00	3.67
		Types of scoliosis	4.67	5.00	5.00	3.00	4.00	4.33	4.67	4.33	3.67	0
		Demographics of scoliosis	3.67	4.33	5.00	1.67	4.00	3.33	4.00	3.00	3.33	1.33
		Causes/risk factors	4.67	4.33	4.67	3.33	4.33	4.33	4.33	3.33	3.67	0
		Signs & symptoms	4.67	4.33	4.67	4.33	4.00	4.00	4.33	4.33	4.33	2.67
		Screening/diagnosis	4.33	4.67	4.67	5.00	4.00	4.67	3.67	4.33	4.33	3.00
		Types of curves	4.33	5.00	4.33	4.00	4.33	4.00	2.67	3.00	0	0
		Treatment information	4.67	5.00	5.00	5.00	4.33	4.67	4.33	3.67	4.67	2.00
		Self-management tips	4.67	4.67	4.67	5.00	4.00	4.67	3.67	0	0	3.00
		Complications	0	3.33	4.33	4.33	4.67	0	0	2.50	0	0
		Total physician essential score (out of 50)	39.67	45.00	47.00	38.00	40.33	37.67	36.67	32.33	28.00	15.67

Table 3. Physician evaluation of additional information and recommendations of top 10 hits using "scoliosis" as search term in Google™.

		Website	Scoliosis Research Society	Spine Health	Medicine Net	Mayo Clinic	Wikipedia	Niams. nih.gov	WebMD	Medical News Today	Kids Health	Google
	Additional Information	Debunking myths	5.00	4.67	0	4.33	0	4.67	4.33	0	0	0
		Current research	4.33	0	0	4.33	4.67	4.67	0	0	0	0
		Surgery above Cobb Angle	4.67	0	4.33	0	5.00	0	4.00	0	3.00	0
		Chiropractic cures	4.67	2.67	0	4.67	0	3.50	4.33	0	0	0
		Extra information	4.33	5.00	4.67	4.33	4.67	4.33	0	4.00	4.33	0
Descriptive Information	Recommend	Speak with physician	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
		Routine scoliosis screening	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
	Information	Patient handouts	No	No	No	No	No	Yes	No	No	Yes	Yes
		Privacy policy	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Citations present	Yes	Yes	No	No	Yes	No	Yes	No	No	No
		# Front page ads	0	0	3	2	0	0	5	4	0	0
	Reading Level	Grade	College	College	10th	11th	College grad +	10th	11th	College	7th	10th

The overall average physician scores were 47.63/75, with 6/10 websites scoring 50 or above. Scoliosis Research Society scored the highest with 62.67/75 and Google™ Knowledge Graph scored the lowest with 15.67/70. When the outlier score of 15.67 for the Google™ Knowledge Graph was dropped, the average score increases to 51.19. The top three rankings by method included: WebMD, Mayo Clinic, and Medicine Net as ranked by Google™; Medicine Net, Spine Health, and Wikipedia as ranked by essential information scores; and Scoliosis Research Society, Spine Health, and WebMD as ranked by the overall physician scores. Medical News Today, Kids Health, and the Google™ Knowledge Graph ranked consistently in the 8th, 9th, and 10th spots respectively, regardless of ranking method. The Spearman correlation test resulted in a significant correlation between physicians' ranking of essential information and overall scores ($p < 0.005$) and not significant between physicians' ranking of overall scores and the Google™ ranking ($p = 0.187$). The physicians unanimously agreed to recommend only three (Mayo Clinic, Medicine Net, Kids Health) of the ten websites evaluated; none were willing to recommend Google™ Knowledge Graph. Overall, the correlation coefficient was 0.308 (CI: -1.107, 0.816), indicating interrater agreement was fair.[41]

Table 2 lists the individual scores for each category of content on each website. It also includes the total scores for the essential categories and overall categories on each website. Regarding essential information, the average physician score total was 36.03/50. Medicine Net scored the highest with 47/50 and Google™ Knowledge Graph scored the lowest with 15.67/50. When the outlier score of 15.67 for the Google™ Knowledge Graph was dropped, the average essential score increases to 38.30. All (10/10) websites had information but considerable variations in score ranges in the categories describing scoliosis (2.33 - 4.67), demographics (1.33 - 5.0), sign and symptoms (2.67 - 4.67), screening/diagnosis (3.0 - 5.0), and treatment information (2.0 - 5.0). Half (5/10) of the websites were missing identifiable information describing complications. The information on the Google™ Knowledge Graph was sparse (9/15 categories contained no information, 4 in essential [types, causation/risk, curves, and complications]) and consistently received low scores.

Only 2/3 physicians said they would recommend each of the top two overall ranked websites to patients; however, 3/3 physicians would recommend the 9th ranked website, Kids Health.

Over half (6/10) of the websites were missing information on current research; half (5/10) also were missing information regarding myth debunking, surgery above a given Cobb angle, and chiropractic cures. Google™ Knowledge Graph did not include any of the additional information evaluated.

Most websites (8/10, including Google™ Knowledge Graph) recommended speaking with a physician and almost all (9/10, not including Google™ Knowledge Graph) recommended routine screening. Half (5/10) provided patient handouts and half (5/10) cited research. Half (5/10) had advertisements on their front pages with the number of ads ranging from 2 - 5. Most (9/10) listed privacy policies (not including Scoliosis Research Society). Reading grade levels ranged from 7th grade to college; only Kids Health had a reading grade level below 10th grade.

DISCUSSION

This study sought to evaluate accuracy and readability of scoliosis information available on the top ten Google™-ranked websites. Most websites provided accurate, but not complete, information. Most provided "essential information," though explanations about curves, self-management tips, and information about complications more often were neglected. "Additional information" was absent on many websites, though available information generally was rated well by the physicians. Such information may not be critical for decision-making about treatment options but may be helpful for patients.

The evolution of internet information on scoliosis is evident in comparing this study with an earlier evaluation of online scoliosis information published by Mathur et al. in 2005.[28] In the Mathur study, 50 websites from five search engines (MSN, Yahoo, AltaVista, Google, and Lycos) were considered. Currently, most searches are powered by Google™ (64.0%) and Bing (21.4%).[42] Six of the 10 websites assessed in this study had predecessors assessed in the Mathur study. In both the Mathur study and this study, srs.org, the official website of the Scoliosis Research Society, was ranked #1 for accuracy and completeness by physician reviewers. Notable among the four websites not included in the Mathur study are Wikipedia (now the 5th most visited website with over 4.75 million articles, but in 2003 relatively new with just over 100,000 articles[43]) and the Google™ Knowledge Graph, a new addition by Google™ as of 2015.[44] In the Mathur study[28], 90% of websites surveyed scored under 50% in content quality (completeness), and 36/50 websites scored 50% or less in accuracy. Our study showed that 7/10 websites surveyed scored over 50% in average overall physician score (quality and completeness), and 8/10 websites surveyed would be approved for content quality, accuracy, and readability by at least 2/3 of physician examiners. The quality of readily available online information on scoliosis appeared to increase considerably in the 13-year time span between the content evaluation of these two studies.

The Google™ Knowledge Graph, a relatively new feature released in 2015 to provide relevant medical information on specific conditions, indicates the continuing need to evaluate content of online information. The official Google™ blog reports that a team of physicians from Google™ and/or Mayo Clinic compiled the information, but includes the disclaimer that the search results are not intended as medical advice.[44] This feature appears as a sidebar on a standard computer screen or at the top of a mobile Google™ search. It contains three categories of information, "About," "Symptoms," and "Treatments," with brief information on the relevant condition. However, it consistently ranked 10th on both the overall and essential physician scores lists (the graph was not given a Google™ ranking since it takes the form of a sidebar). This evaluation indicates that the highly visible Knowledge Graph was not complete in the information provided for scoliosis. Further research is necessary to evaluate the quality of information provided by the Google™ Knowledge Graph feature.

Regarding readability, this study seems to confirm that the high reading level of health information online remains a significant concern. Five websites were found to be written at a 10th or 11th grade level; four at a college level; and one at a college graduate level. The average reading level of American adults is 7th or 8th grade level,[32] but only the Kids Health website scored within those grades per the Flesch-Kinkaid reading level assessment. Information should be at a level of completeness, accuracy, and readability suitable for an average non-medically-trained patient.

A serendipitous finding of this study was the incongruence of physician recommendation patterns with the overall physician rankings of the websites. Although the spine specialist almost always scored the quality and completeness of information lower than the family practitioners did, the specialist only disagreed with recommending two of the websites to patients, while both family practitioners disagreed with recommending four (not all the same). Evaluation notes left by the physicians indicated that the family physicians were concerned with the complexity and readability of the information. This may be due to differing purposes of website recommendation. Family practitioners may consider ease of use and readability of information more often because they are introducing patients to scoliosis. Spine specialists work with patients that have been diagnosed already and may be seeking more detailed information, particularly treatment information, online.

This study may be limited by the number of evaluating physicians (three) and variance on responses. This study was limited to the use of Google™ and did not include other search tools, such as Bing™, which may result in different search result rankings. Another limitation is that the physician evaluation of the websites was not randomized; systematic bias may have been introduced, as they all were reviewed in the same order as Google™ rank. Also, two opportunities for scoring were overlooked by the evaluating physicians and replaced with the mean of the other two evaluators; this may contribute to unrepresentative scores. Finally, only 10 websites were evaluated (per reported consumer behavior[36,37]); an assessment of a larger number of scoliosis websites might provide a more complete perspective on online scoliosis information reliability.

Recommended future research should assess the accuracy and completeness of the Google™ Knowledge Graph information for various common conditions, per its stated purpose, since it is so visible under search results. This is critical because consumers often rely on information immediately available on the web.[37] An assessment of how patients respond to and use scoliosis information would inform more relevant website design and content. Furthermore, evaluating the priorities of differing specialties for recommendation of health information websites would be worthwhile, as this study noted that there were considerable differences. Finally, content on scoliosis and other healthcare websites should be evaluated regularly to inform practitioners as to the quality of information their patients may be using for decision-making.

CONCLUSION

Healthcare consumers with scoliosis concerns likely will use the internet to seek information regarding scoliosis for better understanding and treatment decision making.[37] Our study showed that most of the top ten websites found when searching for the term "scoliosis" using Google™ have relatively accurate and complete information, but did have variation. Patients should seek for information from multiple sources to get complete information. Furthermore, patients should not rely on the ranking order given by Google™, as the Google™ rankings were not aligned with the physician scored rankings (overall or essential).

For recommendations on websites concerning scoliosis, practitioners should consider the needs of their patient population. Physicians, especially in primary care, should account for literacy of patients. Specialists may need to encourage patients to read websites with higher reading levels because detailed information becomes increasingly important for patients seeking specialist care.

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Keywords: scoliosis, eHealth, consumer health information, internet, patient education

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Patient Perception of Medical Learners and Medical Education during Clinical Consultation at a Family Medicine Residency

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ABSTRACT

Introduction. Experience in treating patients under supervision of faculty is an important factor in medical education at all levels. However, unpleasant patient experiences with a medical learner during clinical consultation can damage the relationship between the medical learner, physician supervisor, and patient. A goal of this study was to examine patient experiences and preferences regarding medical learners during clinical consultation at a family medicine residency clinic. Another goal was to determine factors relating to patients' experiences and preferences regarding medical learners.

Methods. This cross-sectional study relied on patients completing a survey designed from extant questionnaires to measure patients' experiences and preferences relating to interactions with medical learners at a family medicine clinic. Data were collected from 216 patients between December 2016 and August 2017. We correlated patients' feelings, overall experiences with medical learners and the importance of medical education.

Results. There was a 93% participation rate. The patients rated their overall experiences with medical learners as 3.8 on a 5-point scale, suggesting positive experiences. Eighty-eight percent prefer not more than three medical learners to be involved in their care during clinical consultation. Patients' overall experiences with medical learners participating in medical care correlated with their preferences regarding medical learners' involvement in their treatment ($r[209] = .524$; $p = 0.01$). Patients' perception of medical learners participating in medical care correlated with the importance of medical education ($r[209] = .878$; $p = 0.01$).

Conclusions. The results showed that most patients have positive experiences with medical learners and are generally in favor of medical education.

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INTRODUCTION

As medical education curricula around the U.S. develops, one consistent movement is the drive to provide earlier patient encounters for medical learners. For the purposes of this study, medical learners are individuals in training to become physicians, including residents and medical students. Medical learner and patient interactions come in real and simulated scenarios, both with their own merits. Real patient experiences have been shown to be more authentic and instructive, whereas simulated patients prepare learners for real life encounters, practice sensitive exams, and obtain feedback in a safe environment.[1] This interaction provides context to what medical learners learned in the classroom and helps them learn clinical, communication, and professional skills. Patient exposure in the preclinical years, even in a classroom setting, has been shown to enhance empathy, improve knowledge retention, and bring joy to the participating learners.[2]

What requires further investigation is how these experiences affect patients. There is a relative paucity of research in this area. The research that exists showed the relationship between patients and learners to be positive.[3-6] Recent data in the primary care literature suggested that patients were satisfied with encounters where medical learners are involved, but patients were less inclined to share sensitive or personal issues with their personal physicians when medical learners are present.[7]

The aforementioned discussion demonstrated that the educational experience for the learner is enhanced by interactions with real patients.[8] However, this relationship could be damaged when patients' needs conflict with medical educational requirements,[9] especially when patients have unpleasant experiences with medical learners during health care consultation. Therefore, the current study sought to: (1) explore patients' experiences with medical learners and learn about patients' overall views toward the presence of medical learners during consultation at a medical educational clinic; (2) identify patients' preference regarding medical learners' involvement in their treatment; and (3) find factors that relate to patients' experiences and preferences regarding medical learners' involvement in patients' treatment.

METHODS

Study design. This cross-sectional study involved adult patients completing a survey after their outpatient clinic visits at the University of Kansas School of Medicine-Wichita Family Medicine Residency Program at Via Christi Hospitals. The clinic is one of three family medicine residency programs that serves the healthcare needs of people in the Wichita area and rural Kansas.[10] The Via Christi Health and the University of Kansas School of Medicine-Wichita Institutional Review Boards approved the study. A sample size of 100 was calculated as necessary for adequate power ($> .85$) to detect significant correlations of 0.5, $p < 0.01$ between variables.[11]

Procedure. Adult patients checking out after their clinic visits, who had experiences with medical learners (residents and/or medical students) during their clinic consultations, were asked to participate. Extant questionnaires[12-14] were tailored to the study purposes. Data were collected from 216 patients from December 2016 to August 2017. Patient identification was not collected.

Data analysis. Standard descriptive summary statistics were used to examine patients' perception of medical learners. We used correlations to determine association between patients' experiences with medical learners and the importance of medical education. A statistical critical value of 0.05 was specified for all tests.

RESULTS

Two hundred twenty-two patients met the inclusion criteria; 216 agreed to participate in the study for a participation rate of 97.3%. The average age of participants was 38.6 ± 17.6 years (Table 1). There were more women (59%) than men in the sample; 76% were Caucasians; 49% had never been married; and 26% had bachelor's degrees. The study findings are summarized in Tables 2 - 5. Generally, the patients had positive feelings about medical learners' involvement in their care, but 51% had no opinion as to whether medical learners involvement in care improves the physician supervisor's competence, while 49% of the patients were neutral on whether medical learners involvement in the care improved the quality of care they receive (Table 2). As shown in Table 3, some patients expressed concerns about the group size of the medical learners. In particular, 88% would not allow more than three medical learners to be present while being examined during clinical consultation (Table 3). Eighty-six percent indicated that they would allow medical learners to be present while discussing medical concerns with their attending doctor.

Similarly, most patients expressed that their encounters with medical learners are important for future training of medical doctors. While 45.5% of the patients reported that they do not mind the presence of medical learners during clinical consultation, 85.3% indicated that involvement of medical learners in patient care is very important/important for medical education (Table 4). As shown in Table 5, the patients' overall experiences with medical learners participating in medical care significantly correlated with the (1) patients' preferences regarding medical learners' involvement in their treatment and (2) importance of training future doctors. In addition, patients' perception of medical learners participating in medical care correlated with the importance of medical education (r[209] = .878; p = 0.01).

DISCUSSION

The study provided information regarding patients' experiences, preferences, and attitudes about medical learners during clinical consultation at a family medicine residency program. The findings demonstrated that most patients not only have positive perceptions about medical learners, they think that having the medical learners participate in their care is important in medical education. These data appeared to confirm previous findings that have showed a majority of patients do not object to medical learners participating in their care.[12,15] The study findings should be reassuring to community physicians who take medical learners in their practices. Having learners present during clinical consultation is generally a positive experience for all parties involved, and it is unlikely to affect the relationship between the attending physician and their patients.

A major finding of the study demonstrated the importance of group size on patient preferences. The majority of patients preferred no more than three medical learners to participate in their care. This finding is consistent with another study,[14] and it is important information, as it allows medical educators to plan for appropriate group sizes for clerkships in outpatient family medicine practices. More than half of the patients have no opinion while 27% thought that involvement of medical learners in patient care improves the physician supervisor's competence, suggesting that the patients did not think the presence of the medical learners would affect the physician supervisor's competency. This revelation is similar to the finding of a previous study where many patients had no opinion or thought medical learners' involvement in patient care improves physician supervisor's competence.[12] Our study also highlighted the presence of medical learners and its effects on quality of care patients receive. Almost half of the patients did not think medical learners' involvement affected the quality of care they receive. Consistent with previous studies,[16,17] our data supported the assertion that medical learners' involvement in patient care did not affect the quality of care patients receive at residency clinics adversely.

Table 1. Demographic profile of participants.

Demographic of Participants	Measure
Sex	
Male	40.8 (87)
Female	59.2 (126)
Missing	3
Age (years)	
Range	18 to 84
Mean (SD)	38.6 (17.6)
Ethnicity/Race	
African American	12.3 (26)
Caucasian	75.9 (161)
Hispanic/Latino	5.2 (11)
Asian	2.4 (5)
Bi-racial	2.4 (5)
Other	1.9 (4)
Missing	3
Marital Status	
Single (never married)	48.8 (103)
Married	45.5 (96)
Separated/divorced	2.8 (6)
Widow/widower	2.8 (6)
Missing	5
Educational Level	
No high school	3.8 (8)
Did not complete high school	21.8 (46)
Graduated from high school	6.2 (13)
Some college	18.0 (38)
Technical	2.4 (5)
Associate's degree	8.1 (17)
Bachelor's degree	25.6 (54)
Master's degree	11.4 (24)
Doctorate degree	2.8 (6)
Missing	5

Data are % (n) unless otherwise indicated.

Table 2. Patients' experiences with medical learners during family medicine clinical rotations.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Score
	(Scoring 1)	(Scoring 2)	(Scoring 3)	(Scoring 4)	(Scoring 5)	Mean
Patient Experiences Items (α = 0.69) (N = 216)	%	%	%	%	%	(SD)
How much do you agree with the following statements:						
Seeing the medical learner is enjoyable.	1.4	0.9	21.8	37.0	38.9	4.1 (0.9)
Having medical learner participate takes too much time (reverse scoring).	3.2	3.7	19.4	35.2	38.4	4.0 (1.1)
Having medical learner involved interferes with the relationship I have with my doctor (reverse scoring).	1.9	2.8	17.1	36.1	42.1	4.1 (0.9)
Having medical learner participate decreases my time with my doctor (reverse scoring).	1.4	6.0	19.0	38.9	34.7	4.0 (1.0)
Having medical learner involved improves my doctor's competence.	6.0	15.7	50.9	17.1	10.2	3.1 (1.0)
Having medical learner involved improves the quality of care I receive.	4.6	6.9	46.8	24.1	17.6	3.4 (1.0)
Overall Patient Experiences						**22.8 (3.6)**

Table 3. Patients' preferred number of medical learners to be present and/or examine them during clinical consultation.

	Present During Consultation		**Examine During Consultation**	
# of Medical Learners	**Number**	**Percentage**	**Number**	**Percentage**
0	13	6.2	16	7.6
1 - 3	181	86.2	183	87.6
4 - 8	9	4.3	4	1.9
More than 8	7	3.3	6	2.9
Total	**210**	**100.0**	**209**	**100.0**

Table 4. Respondents' perception about medical learners and medical education.

	Possible Category and Scoring						
	Very Comfortable[a] or Very Important[b]	Comfortable[a] or Important[b]	Do Not Mind[a] or Not Sure[b]	Uncomfortable[a] or Unimportant[b]	Very Uncomfortable[a] or Very Unimportant[b]		Score
	(Scoring 1)	(Scoring 2)	(Scoring 3)	(Scoring 4)	(Scoring 5)	Missing	Mean
Questions	%	%	%	%	%	*n*	SD
How do you feel about medical learners being present while you are talking to the doctor about your problem?[a]	25.8	23.5	45.5	4.2	0.9	3	2.3 (0.9)
How important for the training of future doctors is it that medical learners are present while patients are seeing their doctors?[b]	62.4	22.4	13.8	1.4	-	6	1.5 (0.8)
How important for the future training of doctors do you think it is that medical learners examine patients?[b]	60.7	25.1	13.3	0.5	0.5	5	1.6 (0.8)

Possible score range for all scales: 0 - 100.
[a] = response categories for items denoted with a.
[b] = response categories for items denoted with b.

Table 5. Correlations of respondents' experiences with medical learners and the importance of medical education.

Measure		1	2	3	4
1. How do you feel about medical learners being present while you are talking to the doctor about your problem?	Pearson Correlation	-			
	Sig. (2-tailed)				
	N				
2. How important for the training of future doctors is it that medical learners are present while patients are seeing their doctors?	Pearson Correlation	0.405**	–		
	Sig. (2-tailed)	0.000			
	N	210			
3. How important for the future training of doctors do you think it is that medical learners examine patients?	Pearson Correlation	.445**	.878**	-	
	Sig. (2-tailed)	0.000	0.000		
	N	211	210		
4. Overall patients' experiences with medical learners during clinical consultation as indicated in Table 2.	Pearson Correlation	.407**	.492**	.524**	-
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	213	210	211	
	Mean	2.31	1.54	1.55	22.79
	Standard Deviation	0.94	0.78	0.78	3.62
	Range	1 - 5	1 - 5	1 - 5	6 - 30

**Correlation is significant at the 0.01 level (2-tailed).

The study had limitations. First, it was conducted in an outpatient family medicine practice, potentially limiting generalizability to other contexts, such as inpatient interactions. It would be worth determining if these findings were consistent across all specialties, as well as inpatient versus outpatient scenarios. This study also was limited in its diversity. It was conducted in a practice where a majority of the participants were Caucasian. Based on cultural beliefs, patients from other ethnic groups might have different opinions regarding medical learners' participation in their care. Further research is needed to determine if the findings are consistent across all races and cultures. Patients' self-reported clinical experiences also limit the findings of the study.

In conclusion, this study has drawn attention to patients' experiences with medical learners in the clinical setting. The overall positive patient perception of medical learners should be comforting to physicians who teach, recognizing that having medical learners participate in patient care has little negative impact on their patients' perception of care. The positive correlation between patients' overall experiences with medical learners and views regarding medical education suggested that patients will be in favor of medical education when they have better experiences with medical learners.

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Keywords: patient preference, medical education, family practice

KANSAS JOURNAL of MEDICINE

Transgender Health Medical Education Intervention and its Effects on Beliefs, Attitudes, Comfort, and Knowledge

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ABSTRACT

Introduction. Transgender health disparities have been well documented in the literature in recent years, as have the lack of transgender health issues in medical education programs across the country.

Methods. A prospective study was conducted with an hour-long didactic lecture on transgender health being given to faculty, medical students, and residents at the University of Kansas School of Medicine-Wichita. The didactic lecture included educational information and presentations by transgender persons. A pre-intervention and two post-intervention survey was given to assess attitudes, comfort level, knowledge, and beliefs regarding the treatment of transgendered persons and associated health concerns. A second post-intervention survey was given at 90 days. The question of what attendees planned to do differently as a result of the intervention was asked.

Results. The intervention provided a significant positive increase in attitudes, comfort levels, and knowledge with respect to transgender health issues between the pre- and post-intervention surveys, however, did not provide a significant positive increase in beliefs on transgender health issues. There was no significant change in attitude, comfort levels, knowledge, or beliefs from the post-survey after 90 days. Four categories of what attendees planned to do differently as a result of the intervention also were identified.

Conclusions. A didactic lecture on transgender health issues can positively change attitudes, comfort levels, and knowledge on transgender health issues significantly with the changes sustaining after 90 days. Beliefs tend to be much harder to change.

Kans J Med 2018;11(4):106-109.

INTRODUCTION

The term "transgender" is used to describe individuals whose preferred gender identity and/or gender roles do not conform to their sex assigned at birth.[1] Recent estimates showed that 1.4 million individuals in the United States identify as transgender, accounting for 0.6% of the population.[2]

Studies regarding transgender persons have increased in recent years and have shown a high prevalence of negative health outcomes including sexually transmitted diseases, mental health issues, and substance use disorders.[3,4] There also has been an increase in the number of studies published on the topic of transgender health between the years of 2008 - 2018. The Institute of Medicine (IOM) published the first comprehensive report of its kind on lesbian, gay, bisexual, and transgender (LGBT) health and showed that transgender people experience stigma and discrimination from childhood to later adulthood.[5] One report showed that 70% of transgender individuals experience discrimination, particularly in the healthcare setting.[6] In a study on discrimination of delay of healthcare in transgender men and women, 30.8% of participants were found to delay or not seek needed health care due to discrimination. All of this has prompted organizations such as the IOM, Association of American Medical Colleges, American Medical Association, and the American Psychiatric Association to call for improved provider education on transgender issues to target these health disparities, starting from medical school to graduate medical education and onwards.

A recent survey of 176 medical schools in the United States and Canada showed the median reported time dedicated to LGBT-related content in the entire medical school curriculum was five hours.[7] Furthermore, nine schools reported that no time was spent on LGBT-related content during preclinical years, and 44 schools reported that no time was spent during clinical years. Another survey of 464 residents and attending physicians showed that the majority of respondents did not discuss sexual orientation or gender identity with their patients, with 41% stating they did not discuss these topics with sexually active adults, citing a lack of training in dealing with these topics.[8]

In an assessment on the current state of transgender health care, Stroumsa wrote that "bias against transgender people takes an enormous toll on their health through direct harm, lack of appropriate care, and a hostile environment and through transgender people's avoidance of the medical system as a result of discrimination and lack of respect".[9] She pointed out that the medical establishment has a duty to provide proper healthcare to transgender individuals and that this must be incorporated into medical curricula.

There have been many reports of interventions aimed at changing knowledge, attitudes, and beliefs of resident physicians and medical students. One intervention included a 90-minute workshop for psychiatry residents with pre-, post-, and 90-day follow-up surveys to "assess perceived empathy knowledge, comfort, interview skill, and motivation for future learning".[10] With this intervention, there was a statistically significant increase in perceived empathy, knowledge, comfort, and motivation for future learning in the short term. In another intervention, medical students attended a lecture and completed surveys assessing transgender health knowledge, attitudes, and skills, with follow-up surveys upon graduation.[11] Participants showed significantly increased levels of competency compared to students who had not received the lecture, with higher average summary scores for overall self-reported knowledge, more positive attitudes, and skills. They also showed low baseline receipt of transgender education prior to entering residency.

In light of these reports and successes, an intervention was conducted with the aim of positively improving knowledge, attitudes, comfort, and beliefs in dealing with transgender health issues.

METHODS

Residents and residency faculty, as well as medical students, attended an hour-long didactic lecture on transgender health. These didactic sessions included educational information about transgender health and appropriate medical treatment[4], as well presentations from a male-to-female and a female-to-male transgender person regarding their transition and the medical care they received during that time in their life.

Participants received a pre-intervention survey before the session and an identical post-intervention survey at the end of the session to measure immediate change in beliefs (what they think about transgender patients), attitudes (how well they understand issues faced by transgender patients), comfort (how they feel treating transgender patients), and knowledge (what they know about medical care for transgender patients). Examples of questions regarding beliefs were "I think God made man and woman, anything else is abnormal" and "I think transgender people are sick". Examples of questions regarding attitudes were "I understand the types of discrimination that transgender people face" and "I understand the difference between biologic sex, gender identity, and sexual orientation". Examples of questions regarding comfort were "I feel comfortable using language that respects gender identity" and "I feel comfortable discussing options for gender confirming hormone therapy". Examples of knowledge questions were "I know what resources about transgender health are available to me as a medical provider" and "I know ways to make a medical practice more transgender-friendly".

The post-intervention survey was nearly the same as the pre-intervention survey, but included an open-ended question regarding what they planned to do differently in their practice as a result of the session. A 90-day post-intervention survey identical to the pre-intervention survey was given to participants who provided their email at the didactic lecture. A convenience sample of residents and faculty completed the survey. No identifiable information was collected and all participation was voluntary. The hosting Institutional Review Board approved the study as non-human subjects research.

Statistical analysis. Responses were calculated for the four variables of beliefs, attitudes, comfort, and knowledge regarding transgender patients. Responses to survey questions were scored on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Paired samples t-tests were used to compare the population means and to assess for significant changes in each field between pre- and post-intervention surveys. Post-intervention data were compared to the 90-day post-intervention survey data. All data analyses were performed using SPSS version 24.0 (IBM, Armonk, NY) and Microsoft Excel©.

RESULTS

One hundred and sixty three individuals completed the pre-intervention survey. Of these, 53 were from family medicine (FM), 28 from internal medicine (IM), 23 from pediatrics, 46 from psychiatry, and 13 were medical students. Of the initial 163 participants, 115 (70.6%; 24 IM, 20 pediatrics, 35 psychiatry, and 13 medical students) participated in the post-intervention survey. The 90-day post-intervention survey was completed online by 18 individuals (11%; 12 IM, 6 medical students). Means and standard differences are shown in Table 1 for all four scales. Figure 1 shows a visual representation of the differences in the four scales for each time period.

Table 1. Beliefs, attitudes, comfort, and knowledge changes toward transgender patients.

	Pre-Intervention		Post-Intervention		90-day Post-Intervention	
	M	SD	M	SD	M	SD
Beliefs	2.68	0.44	2.74	0.50	2.81	0.61
Attitudes	2.62	0.81	4.12	0.58	4.00	0.80
Comfort	2.54	0.81	3.42	0.55	3.26	0.59
Knowledge	2.36	0.90	3.74	0.81	3.37	0.78

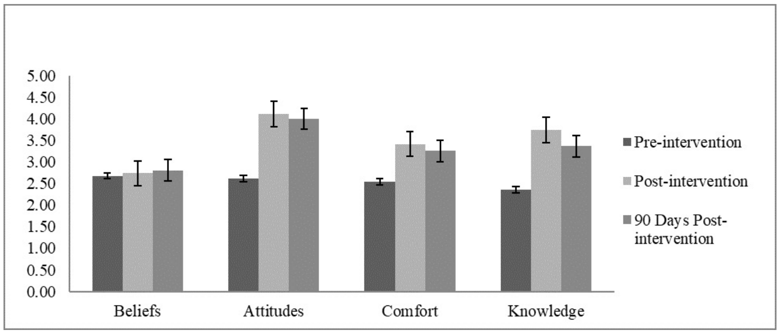

Figure 1. Beliefs, attitudes, comfort, and knowledge changes toward transgender patients from time one (pre-intervention), to time two (post-intervention), and time three (post 90-day intervention).

Beliefs. There was no significant change in mean difference between pre- and post-intervention survey responses for beliefs regarding transgender patients (t[272] = 1.05, p = 0.24, 95% CI -0.05 to 0.17), with mean responses of 2.68 (± 0.44) pre-intervention and 2.74 (± 0.50) post-intervention. There was also no significant change in beliefs between post-intervention and 90-day post-intervention surveys, with a mean score 90-day post-intervention survey being 2.81 (± 0.61) and a mean difference of 0.07 (t[130] = .52, p = 0.60, 95% CI -0.19 to 0.33).

Attitudes. There was a significant change in the mean difference between pre and post-intervention survey responses for attitudes towards transgender patients (t[271] = 16.90, p < 0.0001, 95% CI 1.33 to 1.67), with the mean responses being 2.62 (± 0.81) pre-intervention and 4.12 (± 0.58) post-intervention. There was no significant change in positive attitudes when comparing the post-intervention and 90-day post-intervention survey with mean score 90-day post-intervention survey being 4.00 (± 0.61) and a mean difference of -0.12 (t[129] = -0.79, p = 0.43, 95% CI -0.42 to 0.18).

Comfort. There was a significant change in the mean difference between pre and post-intervention survey responses for comfort in treating transgender patients (t[267] = 9.95, p < 0.0001, 95% CI 0.71 to 1.05), with the mean responses being 2.54 (± 0.81) pre-intervention and 3.42 (± 0.55) post-intervention. There was no significant change in comfort when comparing the post-intervention and 90-day post-intervention survey with mean score 90-day post-intervention survey being 3.26 (± 0.59) and a mean difference of -0.12 (t[126] = -1.11, p = 0.27, 95% CI -0.45 to 0.13).

Knowledge. There was a significant change in the mean difference between pre- and post-intervention survey responses for knowledge regarding transgender patients (t[264] = 12.83, $p < 0.0001$, 95% CI 1.17 to 1.59), with the mean responses being 2.36 (± 0.90) pre-intervention and 3.74 (± 0.81) post-intervention. There was no significant change in knowledge when comparing the post-intervention and 90-day post-intervention survey with mean score 90-day post-intervention survey being 3.37 (± 0.78) and a mean difference of -0.12 (t[125] = -1.76, p = 0.08, 95% CI -0.79 to 0.05).

Changes identified in post-intervention survey. Of the 115 attendees who completed a post-intervention survey, fifty-seven answered the open-ended question of "what do you plan to do differently in your practice as a result of this educational session?" Two members of the research team categorized the responses and came to a consensus of four categories: increased consideration for transgender patients, increased screening for gender dysphoria, continuing education into transgender medicine, and providing more treatment options for patients ($\alpha = 0.85$). Any disagreements between the categories of quotes were broken by the third member of the research team. Some answers had multiple categories identified in one response for an overall number of 68 individual quotes in the four categories. Below are the categories and examples of the responses in each.

1. Increased consideration for transgender patients (n = 33, 49%)
   - "Integrating easy administrative changes in the office"
   - "Think about and ask carefully the questions and unconscious roles I assign"
2. Increased screening for gender dysphoria (n = 15, 22%)
   - "Be more aware of unique transgender screening needs"
   - "Be more thorough about screening for gender dysphoria"
3. Continuing education into transgender medicine (n = 11, 16%)
   - "Alter counseling and education to address medical issues specific to trans health"
   - "Do more reading/research on this topic"
4. Providing more treatment options for patients (n = 9, 13%)
   - "Learn more about possible treatments and labs"
   - "I plan to discuss options with patients"

DISCUSSION

Within the study participants, the intervention showed a significant positive increase in attitudes, comfort, and knowledge towards transgender individuals between the pre- and post-intervention intervention surveys. The intervention, on the other hand, did not impact beliefs about transgender individuals. This may be due to already favorable beliefs about transgender individuals prior to the intervention. With respect to the 90-day post-intervention survey results, there were no significant changes, which is good, as this shows stable levels after 90 days. However, the 90-day post-intervention survey suffered from a low response rate of only 11%. Another limitation was that there were no post-intervention surveys with the family medicine audience. Also, individual responses were not able to be paired between the three administrations of the survey.

Of note, the lowest mean pre-intervention score was knowledge about transgender individuals, with the highest mean difference post-intervention, pointing to a possible deficiency within this program with respect to transgender health issues in the medical education curriculum. The fact that many people were going to make an effort to show more consideration for transgender patients, as well as increase screening and education, potentially means they had not thought about this issue previously.

This study was special in that it included participants from multiple residency programs as well as medical students, but this may have limited generalizability. While this increased the sample size of participants, it decreased our ability to focus in on deficiencies within particular residency programs as the sample sizes when each group were sampled individually were reduced. Questions regarding intent to treat transgendered patients also would be a helpful addition to the survey in the future to see if the intervention changed these intentions at all, as would repetition of the survey on a longitudinal basis to judge changes over a longer period of time. Utilizing larger groups from the different medical specialties in order to evaluate program differences would also be a useful change in future iterations of this intervention.

An area of future research is to look at individual programs and see if any program has greater deficiencies or benefits more from the intervention than others. Another possible area of interest would be to see if individual participants had any prior training on transgender health issues and if that increased their baseline knowledge, attitudes, comfort, and beliefs on the subject. Finally, if didactic lectures could be standardized and distributed to be included as part of the medical education curriculum, both at the medical school and residency levels in multiple programs, then results could be pooled and impact could be seen at each level with a larger sample size.

CONCLUSION

Exposure to educational information has the potential to impact attitudes, comfort in treating, and knowledge regarding transgendered persons, even in small doses. The more that medical students and physicians learn about transgender health issues, the better care they will be able to provide for this growing population. This is an important first step in improving the healthcare provided to transgendered persons.

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Keywords: health services for transgendered persons, LGBT persons, healthcare disparities, medical education

KANSAS JOURNAL *of* MEDICINE

Comparison of Continuous Versus Interrupted Chest Compressions during CPR in a Rural Community

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ABSTRACT

Introduction. Cardiopulmonary resuscitation (CPR) in patients with out-of-hospital cardiac arrest (OHCA) have interruption of manual chest compressions for airway management and breathing when performed by medical personnel trained by Advanced Cardiac Life Support (ACLS) standards. This interruption likely reduces blood flow and possibly survival. Traditional CPR (30:2 compressions to ventilations) was compared with continuous chest compressions, CCC (also termed Cardiocerebral Resuscitation, CCR) in a rural community.

Methods. A retrospective cohort analysis of three years of traditional CPR (June 2008 - May 2011) for OHCA was compared to three years of using CCC protocols (June 2011 - May 2014). Primary outcomes were survival at one and six months.

Results. There were 58 0HCA patients in the six year study period (June 2008 - May 2014). Forty (69%) received CPR and 18 (31%) received CCC. Two (5%) survived at least one month with CPR and eight (44%) survived at least one month with CCC ($p = 0.0007$). After six months, 0/40 (0%) who received CPR had survived and 6/18 (33%) who received CCC survived ($p = 0.0018$). For the patient found in ventricular fibrillation or tachycardia (a shockable rhythm), 0/13 (0.0%) survived one month after CPR and 7/9 (78%) survived with CCC ($p < 0.01$). After six months 0/13 (0.0%) survived with CPR and 6/9 (67%) survived with CCC ($p < 0.05$).

Conclusions. For patients in a rural environment with OHCA, CCC had a more favorable outcome than traditional CPR. For the patient found in ventricular fibrillation or ventricular tachycardia, there was a profound survival benefit of CCC over CPR.

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INTRODUCTION

Heart disease is the leading cause of death in the United States.[1] Out-of-hospital cardiac arrest (OHCA) is often a precursor of cardiac death.[2-4] To date, the most common care of patients with OHCA by health professionals is initiation of cardiopulmonary resuscitation (CPR) and advanced cardiac life support (ACLS). Since 2008, the recommendation for nonmedically trained bystanders has been chest compression only CPR.[5-7] According to the American Heart Association (AHA) in 2015, the United States had greater than 350,000 OHCA victims, 46.1% received bystander CPR but only 12% survived.[8]

Currently, physicians, nurses, nurse practitioners, physician assistants, and emergency medical personnel are taught 30:2 compressions to respirations ratio as initial resuscitation efforts.[8] Even with immediate treatment by bystanders or first responders, survival remains dismal. OHCA survival has remained low for several decades.[3] Non-traumatic cardiac arrest with any rhythm treated by emergency medical services (EMS) had a survival to the hospital of 7.3%.[1] Survival of those found in ventricular fibrillation with bystander CPR was 31.4%.[1] Clearly, any intervention that provides hope to prolong ventricular fibrillation and perfusion is worth repeated evaluation.

McPherson County, Kansas is a rural community of approximately 29,000 people, located 60 miles north of Wichita, the closest large urban center. McPherson Hospital serves the local community with 41 licensed beds, an emergency department staffed with board certified emergency medicine physicians or family physicians. McPherson emergency medical services provide paramedic led emergency services to the county as well as back up to smaller volunteer services throughout the area. It is staffed with paramedics trained in basic and advanced cardiac life support.

CCC (as defined in Figure 1) provides chest compressions only during the first several cycles of resuscitation, with timely defibrillation and pharmacotherapy when available.[9] CCC is at least equivalent if not superior to standard CPR in laboratory studies as well as cohort studies.[9-24]

By early 2011, the McPherson medical staff and EMS personnel became committed to transitioning to CCC for OHCA. This was based on a review of the data[9-24] and personal contact with Dr. Gordon A. Ewy, an early proponent of CCC.

This project evaluated traditional American Heart Association CPR performed over three years to three years of using CCC following OHCA in a rural environment. The primary end points were out-of-hospital survival at one and six months.

METHODS

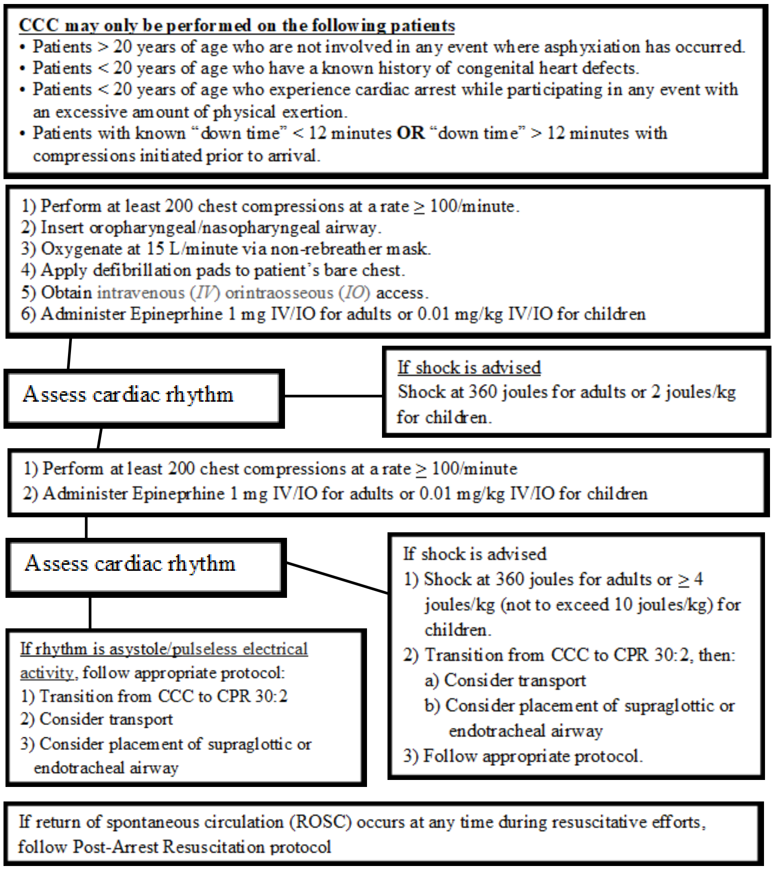
A retrospective cohort analysis compared traditional CPR used from June 2008 to May 2011 to the CCC protocol used from June 2011 to May 2014. Data were collected from the cardiac arrest database maintained by the EMS service as well as hospital records. Date of arrest, gender, race, type of resuscitation performed, time of call, time of initiation of resuscitation efforts, time of first epinephrine dose, time of the return of spontaneous circulation (ROCS), time from initial 911 call to initiating CPR or CCC, time from initiating CPR or CCC to return a spontaneous circulation and final patient outcomes were collected.

Prior to 2011, traditional ACLS protocols for CPR were used by trained medical personnel. Beginning January 2011 initial education was conducted with medical staff, EMS crews, first responders, emergency dispatch operators, and interested members of the community. This education consisted of presentations covering the rationale of CCC, education regarding the technique, and finally practical application of the new skill set.

After six months of education, beginning in June 2011, the CCC protocol (Figure 1) was initiated as standing orders for county wide EMS crews (responders to the OHCA event). Starting in December 2011, using proprietary 911 phone instructions, emergency dispatchers instructed callers (bystanders to the OHCA event) to start chest compressions with no breaths (ACLS standard for bystanders since 2008)[5-7] on patients who were deemed to be experiencing OHCA until EMS arrived on scene. Chest compressions quality and timing was dictated by AHA recommendations. Initial airway management included insertion of an oral or nasopharyngeal airway, administration at 15 L per minute of oxygen via a non-rebreather mask to provide passive oxygenation. Only after three rounds of 200 chest compressions (at a rate of 100 compressions per minute) were advanced airway techniques and positive pressure ventilation considered by EMS providers (Figure 1). Post resuscitation care was provided at the discretion of the emergency department physician upon arrival to the hospital.

Statistical analysis. Differences in categorical data, such as mortality at one and six months were calculated using the Fisher's Exact test. Differences in mean values, such as age and time to events, were calculated using the Student t test. P value less than 0.05 was considered statistically significant.

This project was approved by the Institutional Review Board of the University of Kansas School of Medicine.



CCC may only be performed on the following patients
- Patients > 20 years of age who are not involved in any event where asphyxiation has occurred.
- Patients < 20 years of age who have a known history of congenital heart defects.
- Patients < 20 years of age who experience cardiac arrest while participating in any event with an excessive amount of physical exertion.
- Patients with known "down time" < 12 minutes **OR** "down time" > 12 minutes with compressions initiated prior to arrival.

1) Perform at least 200 chest compressions at a rate ≥ 100/minute.
2) Insert oropharyngeal/nasopharyngeal airway.
3) Oxygenate at 15 L/minute via non-rebreather mask.
4) Apply defibrillation pads to patient's bare chest.
5) Obtain intravenous (*IV*) orintraosseous (*IO*) access.
6) Administer Epinephrine 1 mg IV/IO for adults or 0.01 mg/kg IV/IO for children

Assess cardiac rhythm

If shock is advised
Shock at 360 joules for adults or 2 joules/kg for children.

1) Perform at least 200 chest compressions at a rate ≥ 100/minute
2) Administer Epinephrine 1 mg IV/IO for adults or 0.01 mg/kg IV/IO for children

Assess cardiac rhythm

If rhythm is asystole/pulseless electrical activity, follow appropriate protocol:
1) Transition from CCC to CPR 30:2
2) Consider transport
3) Consider placement of supraglottic or endotracheal airway

If shock is advised
1) Shock at 360 joules for adults or ≥ 4 joules/kg (not to exceed 10 joules/kg) for children.
2) Transition from CCC to CPR 30:2, then:
   a) Consider transport
   b) Consider placement of supraglottic or endotracheal airway
3) Follow appropriate protocol.

If return of spontaneous circulation (ROSC) occurs at any time during resuscitative efforts, follow Post-Arrest Resuscitation protocol

Figure 1. McPherson Emergency Medical Service protocol for continuous chest compressions (CCC).

RESULTS

There were 58 non-traumatic OHCA patients in the six-year study period (June 2008 - May 2014). Study demographics and pertinent population differences are shown in Table 1; study results are shown in Tables 2 and 3. From June 2008 until May 2011, there were 40 patients with OHCA who received traditional CPR. From June 2011 until May 2014, there were 18 who received CCC. The mean age was 68 years. The only statistical significant difference was earlier administration of epinephrine in the CPR group.

Bystander CPR was reported if it was initiated within ten minutes of the 911 call. There was a trend toward the CCC time period having a higher percentage of bystander CPR (50% vs. 32.5%) but it was not statically significant.

Two (5%) survived at least one month with CPR and eight (44%) survived at least one month with CCC (p = 0.0001). After six months, 0/40 (0%) who received CPR had survived and 6/18 (33%) who received CCC survived (p = 0.002).

Thirteen patients in the CPR group were in ventricular fibrillation or tachycardia. Seven survived but lived less than 30 days, usually only one or two days. None lived past 30 days. Of the nine CCC patients with ventricular fibrillation or tachycardia, all lived 30 days, seven lived one to six months, and six lived over six months. Those CCC patients who survived to leave the hospital were all confirmed to be neurologically intact. Others have documented a similar result.[25] Neurologic status was confirmed by interview with patients or family concerning level of function in 2017, if alive, compared to prior to OHCA event.

Table 1. Demographics and pertinent differences between subjects receiving CPR versus CCC.

Demographics	CPR	CCC	Total	p value
Average years	69.6	64.5	68	> 0.05
Female patients	9 of 40	1 of 18	10/58 (17.2%)	0.114
Time of epinephrine administration (n) if given	5.85 (36)	9.00 (14)	7.48 min. (40)	.007*
Presented in ventricular fibrillation and tachycardia	13 of 40 (32.5%)	9 of 18 (50%)	22/58 (37%)	0.25
Average time to CPR or CCC by trained EMS personnel	6.275 min. (40)	6.07 min. (18)	6.21 min. (58)	0.765
CPR or CCC performed by a bystander	13 of 40 (32.5%)	9 of 18 (50%)	22/58 (37%)	0.249
Average time to bystander CPR or CCC	2.25 min. (n = 12)	1.0 min. (n = 9)	1.71 min.	0.236

*Results are statistically significant.

Table 2. Study results for subjects receiving CPR versus CCC.

Outcome	CPR	CCC	Total	p value
Time of the return of spontaneous circulation in minutes (n)	17.23 (17)	17.20 (10)	17.21 (27)	0.89
Survived 1 - 30 days	13 of 40 (32.5%)	11 of 18 (61%)	24/58 (43%)	0.0495*
Survived 1 - 6 months	2 of 40 (5%)	8 of 18 (44%)	10/58 (17%)	0.001*
Survived over 6 months	0 of 40 (0%)	6 of 18 (33%)	6/58 (10%)	0.002*
CPR or CCC performed by trained EMS personnel	13 of 24 (54%)	9 of 13 (69%)	22/37 (59%)	0.373
Left hospital alive after bystander response	1 of 13 (7.7%)	4 of 9 (44%)	5/22 (23%)	0.116

*Results are statistically significant.

Table 3. Patients with ventricular fibrillation/tachycardia with ROSC.

Outcome	CPR	CCC	Total	p value
Survived 1 - 30 days	7/13 (54%)	9/9 (100%)	16/22 (73%)	0.074
Survived 1 - 6 months	0/13 (0%)	7/9 (78%)	7/22 (31%)	< 0.01*
Survived over 6 months	0/13 (0%)	6/9 (67%)	6/22 (27%)	< 0.05*

*Results are statistically significant.

DISCUSSION

The implementation of CCC in our rural community has been a welcome change at all levels. Paramedics who had practiced over 20 years and never had a long term survivor with a field save, immediately experienced field saves with good outcomes. One of the most striking results was that those who were in a shockable rhythm (ventricular fibrillation or ventricular tachycardia) and received CCC, 100% regained a pulse in the field and 67% survived long term. CPR resulted in fewer field saves and no one survived long term.

The expectation is that the patient who is found in ventricular fibrillation or ventricular tachycardia will survive. As with the rest of the country, the participation rate for bystander CPR was low and most likely contributed to increased morbidity and mortality. This improved some with the implementation of the 911 phone advice protocols six months into the CCC study period, but this was not statistically significant. The EMS staff and the greater medical community were accepting of the new CCC protocol as presented after a six month education process. This process is reproducible. The outcome will need confirmation with larger numbers.

Our study had some weaknesses. Bystander 911 protocols were initiated six months after CCC protocols. Bystander CPR, therefore, may have been more effective, adding to the survival rate.[25-26] Time of administration of epinephrine was earlier on average in CPR. The data were retrospective and sample size small even over six years since it was collected in a rural county. However, this confirms work done by Garza et al.[21] Of note, one of the investigators was a survivor of a cardiac arrest event in which CCC was utilized by bystander and EMS personnel during the study period.

The 2017 ILCOR[27] summary statement notes knowledge gaps in three areas for OHCA:

1. What is the effect of delayed ventilation versus high quality CPR?
2. Which elements of the bundled care (compressions, ventilations, delayed defibrillation) are most important?
3. How effective is passive oxygen insufflation?

This study provides a limited retrospective look at these issues in the rural environment.

It has long been recognized that keeping or finding patients in a shockable rhythm (ventricular fibrillation or ventricular tachycardia) is the key to good outcome.[1] It has been theorized that within the first ten minutes of a cardiac event with loss of circulation, the red cells carry an adequate amount of oxygen.[7, 10, 12] It also has been theorized that stopping chest compressions, even briefly, to give a breath causes loss of perfusion and therefore oxygenation.[7,10,12-16] If this is the case, CCC has the potential to extend the period of successful defibrillation electrically to up to ten minutes.[7,10,12-16] These are valuable minutes that could make survival possible.[7,10,12-16] While the numbers are small, the experience in McPherson has been dramatic and statistically significant. A small but important change in how we approached the patient with cardiac arrest has yielded an important outcome that should be reproducible in any rural community. Our statistical OHCA survival in a small rural environment compares favorably to the standard that is published the best urban centers.[28-29] Going forward, our community has made it a focus to make sure that we have defibrillators available to fire rescue, police and sheriff departments, churches, sporting arenas and any area that has large numbers of individuals in one place. Donations and foundation support has been raised to help with this.

While it took us six months to implement this protocol, with help from leaders in this area such as Dr. Ewy, the protocol is simple. It took acceptance from medical and emergency personnel. It should be noted that most of the data in the literature pertained to out of hospital arrests. No conclusions should be reached for the hospitalized patient based on these data.

For the patients in ventricular defibrillation or tachycardia there was dramatic survival benefit, lending credence to the possibility of CCC prolonging the window for successful defibrillation.

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Initial Diagnosis and Management for Acute Charcot Neuroarthropathy

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INTRODUCTION

Charcot neuroarthropathy, also known as Charcot foot, is a complication of diabetes mellitus where there is progressive degeneration of the joints, but it potentially is devastating in its consequences.[1] It commonly affects the middle of the foot, hind-foot joints, the ankle, and forefoot joints, and it is believed to result from inflammation in the foot that becomes abnormally protracted due to the underlying neuropathy.[2-8] The prevalence of Charcot neuroarthropathy is up to 13% in individuals with diabetes.[9-11] Patients with Charcot neuroarthropathy encounter increased morbidity and decreased quality of life and mortality.[2,4,5,12,13] If there is a delay in treatment, Charcot neuroarthropathy could result in ulceration and infection which can lead to amputation of the limb.[12-16] These patients have a significant financial impact on the health care system through primary care, community care, outpatient costs, increased bed occupancy, and prolonged stays in hospital.

Charcot neuroarthropathy poses many clinical challenges in its diagnosis and management. The often asymptomatic nature of the condition is very similar to ankle sprain, cellulitis, venous thrombosis, inflammatory arthritis, or gout in a healthy patient.[5,16-22] Missed diagnosis is as high as 79% which ultimately leads to a delay in treatment for an average of 29 weeks.[11,16,17,20,23-25]

Charcot neuroarthropathy is caused by multiple factors, but essentially it is the result of peripheral neuropathy which is a complication associated with many diseases.[2,4,5] The underlying peripheral neuropathy can skew the pain perception the patient experiences and can mislead the clinician on their differential diagnosis of an "inflamed foot". A thorough neurological examination of the foot can uncover the underlying inflammatory and osteolytic disease process of Charcot neuroarthropathy.[2,4,11,19,26-29]

Early recognition and intervention is imperative to avoid the rapid progression toward permanent foot deformity, ulceration, and the possibility of limb loss.[16,30,31] There are multiple review articles about Charcot neuroarthropathy[2,11-13,16,23,25,28,32-34], but a lack of guidance on foot screen strategies for primary care and emergency room physicians. There is a need for a comprehensive guideline for initial diagnoses and management on foot care to advocate for increased awareness, thereby leading to earlier diagnosis and treatment by a multi-disciplinary team.

In the current study, a thorough literature review of Charcot neuroarthropathy was conducted to evaluate efficacious methods of protocol design and potential barriers to implementation. The literature review also encompassed treatment goals for patients with Charcot neuroarthropathy. Based on the literature review, a foot screen strategies protocol for Charcot neuroarthropathy was devised by the authors and reported here. This protocol contains three parts: (1) pathophysiology of acute Charcot neuroarthropathy to highlight the relationship between the clinical findings and the development of the disease, (2) a comprehensive guideline on how to screen and evaluate Charcot neuroarthropathy, and (3) a brief overview on prevention of Charcot neuroarthropathy in patients with diabetes and other forms of peripheral neuropathy.

Pathophysiology. The underlying cause for Charcot neuroarthropathy is due to peripheral neuropathy, which is a loss of function of the nerves in the periphery of the body.[2-4] The primary episode of inflammation can result from a number of factors, but ultimately leads to an increase in pro-inflammatory cytokines (interleukin-1β and tumor necrosis factor-α) which leads to receptor activator of the nuclear factor-κB ligand (RANKL-NFκB) pathway. Osteoclasts are activated leading to bone lysis followed by clearing of debris. In the presence of autonomic neuropathy, there is increased blood flow to the area, which acts to clear away bony material demineralizing the bone, cartilage, and soft tissue in the region.[3] However, in the presence of diabetic neuropathy, the patient does not have the protective pain perception. Therefore, they continue to walk on the inflamed foot exacerbating the progressive pathway of osteolysis and osteopenia and weakening the pedal skeleton, leading to the high risk for dislocation and/or fracture.[5-8,34,35]

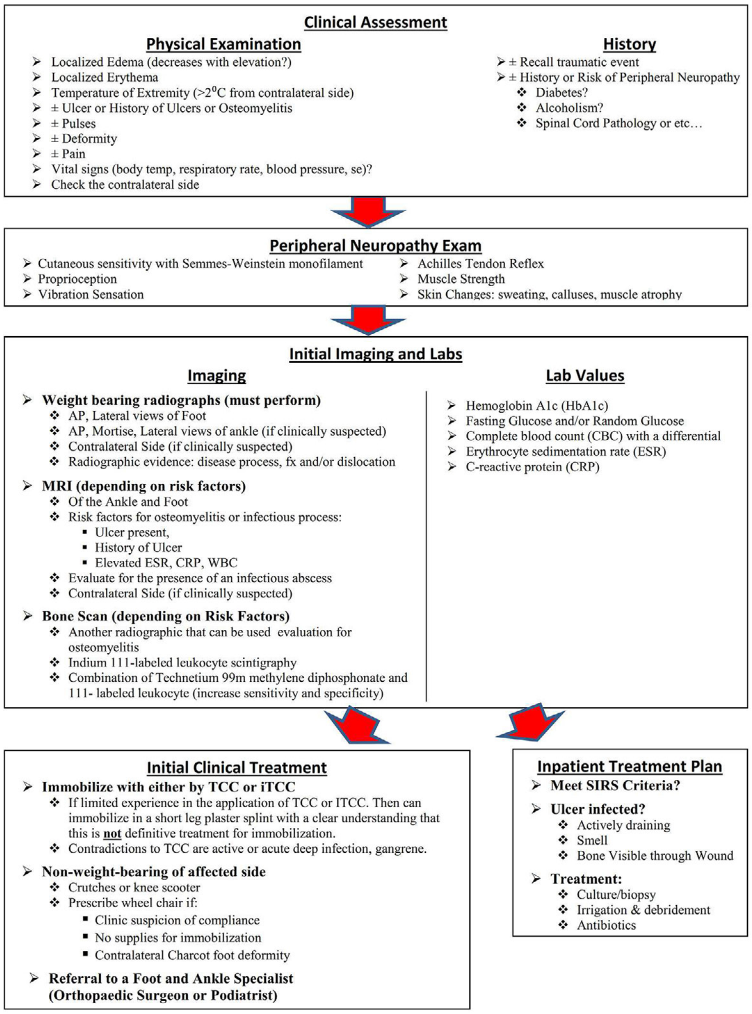
Charcot neuroarthropathy screening guideline. Figure 1 shows the step-by-step process from initial diagnosis of a patient presenting with symptoms of an inflamed foot in a primary care setting to managing the patient with acute Charcot neuroarthropathy. The detailed pathway/algorithm for initial clinical diagnoses and management of acute Charcot neuroarthropathy should be divided into several phases: clinical assessment, peripheral neuropathy evaluation, initial imaging and lab studies, diagnosis, management, and recommendation. Each phase includes the how, the why, and a step-by-step guideline to making an early diagnosis easier and providing appropriate and immediate management for these patients.

Clinical assessment. A high degree of suspicion of Charcot neuroarthropathy is necessary with thorough history and physical examination when a patient presents with an acute erythematous, warm, or edematous foot, with or without any significant history of trauma or surgery, especially for patients with diabetes and peripheral neuropathy with these symptoms.[36]

History. A thorough patient history of a traumatic event or peripheral neuropathy should be assessed. Approximately 50% of patients with Charcot neuroarthropathy would remember a precipitating, minor traumatic event, and if no traumatic episode was recalled, the time frame for which the patient noticed changes in their foot shape and/or gait should be documented. About 25% of patients develop similar changes in the contralateral foot.[11,17,18,22,30,34,37-39]

Often, the precipitating factor for acute Charcot neuroarthropathy is not a traumatic event, but rather repetitive micro-trauma on an insensate foot.[11,17,18,29]

A chronic history of diabetes longer than 10 years has a strong association with peripheral neuropathy and potential development of Charcot neuropathy.[11,12,34,40-44] Due to the strong association between elevated hemoglobin A1c (HbA1c) and the development of Charcot neuropathy, the patients' compliance to their diabetic treatment should be assessed and documented.[2] Some patients also may be unaware of an underlying diagnosis of diabetes at the time of presentation, thereby diabetes screening is essential. Other potential causes of peripheral neuropathy also should be evaluated such as alcohol abuse, syringomyelia, spinal pathology, vitamin B12 deficiency, heavy metal poisoning, leprosy, tertiary syphilis, and idiopathic form.[2,3,8,45] Other potential risk factors that can lead to the development of Charcot neuroarthropathy include obesity, advanced age, renal failure, iron deficiency, osteoporosis, and rheumatoid arthritis.[2,3,8,45]


Clinical Assessment

Physical Examination
- Localized Edema (decreases with elevation?)
- Localized Erythema
- Temperature of Extremity (>2°C from contralateral side)
- ± Ulcer or History of Ulcers or Osteomyelitis
- ± Pulses
- ± Deformity
- ± Pain
- Vital signs (body temp, respiratory rate, blood pressure, se)?
- Check the contralateral side

History
- ± Recall traumatic event
- ± History or Risk of Peripheral Neuropathy
  - Diabetes?
  - Alcoholism?
  - Spinal Cord Pathology or etc…

Peripheral Neuropathy Exam
- Cutaneous sensitivity with Semmes-Weinstein monofilament
- Proprioception
- Vibration Sensation
- Achilles Tendon Reflex
- Muscle Strength
- Skin Changes: sweating, calluses, muscle atrophy

Initial Imaging and Labs

Imaging
- **Weight bearing radiographs (must perform)**
  - AP, Lateral views of Foot
  - AP, Mortise, Lateral views of ankle (if clinically suspected)
  - Contralateral Side (if clinically suspected)
  - Radiographic evidence: disease process, fx and/or dislocation
- **MRI (depending on risk factors)**
  - Of the Ankle and Foot
  - Risk factors for osteomyelitis or infectious process:
    - Ulcer present,
    - History of Ulcer
    - Elevated ESR, CRP, WBC
  - Evaluate for the presence of an infectious abscess
  - Contralateral Side (if clinically suspected)
- **Bone Scan (depending on Risk Factors)**
  - Another radiographic that can be used evaluation for osteomyelitis
  - Indium 111-labeled leukocyte scintigraphy
  - Combination of Technetium 99m methylene diphosphonate and 111- labeled leukocyte (increase sensitivity and specificity)

Lab Values
- Hemoglobin A1c (HbA1c)
- Fasting Glucose and/or Random Glucose
- Complete blood count (CBC) with a differential
- Erythrocyte sedimentation rate (ESR)
- C-reactive protein (CRP)

Initial Clinical Treatment
- **Immobilize with either by TCC or iTCC**
  - If limited experience in the application of TCC or ITCC. Then can immobilize in a short leg plaster splint with a clear understanding that this is **not** definitive treatment for immobilization.
  - Contradictions to TCC are active or acute deep infection, gangrene.
- **Non-weight-bearing of affected side**
  - Crutches or knee scooter
  - Prescribe wheel chair if:
    - Clinic suspicion of compliance
    - No supplies for immobilization
    - Contralateral Charcot foot deformity
- **Referral to a Foot and Ankle Specialist (Orthopaedic Surgeon or Podiatrist)**

Inpatient Treatment Plan
- **Meet SIRS Criteria?**
- **Ulcer infected?**
  - Actively draining
  - Smell
  - Bone Visible through Wound
- **Treatment:**
  - Culture/biopsy
  - Irrigation & debridement
  - Antibiotics

Figure 1. Charcot neuroarthropathy screening and management guideline.

Physical examination. The classical physical examination findings for an acute Charcot neuroarthropathy are often unilateral localized inflammatory symptoms of the foot, such as edema, erythema, and increased foot temperature of the extremity.[2-4,11,21,22,28,34,41] A simple physical exam that can be helpful to distinguish between an infectious process and Charcot neuroarthropathy is to have the patient lay supine and elevate the affected extremity for 5 - 10 minutes. Localized edema will decrease with elevation of the extremity in Charcot neuroarthropathy while an infectious process is less likely to decrease.[11,46,47]

The infrared cutaneous temperature monitor to detect foot skin temperature changes is one of the most accurate tools for diagnosis acute Charcot neuroarthropathy. It may be used in the areas of forefoot, mid-foot, and hind-foot. A temperature difference of 2°C from the contralateral foot indicates an active Charcot neuroarthropathy.[48-50]

The presence of ulcers or a history of ulcers indicates the need to screen for an active infection. Signs and symptoms, such as purulence, foul smell, or wet gangrene, should be noted.[2,4,51] An ulcer with the size over 2 cm^2 and visualization of bone increases the risk of developing and/or presence of osteomyelitis.[52,53]

Clinical assessments such as foot tenderness, pedal pulses, and foot deformity should be evaluated.[2-4,11,21,22,28,34,41] Cutaneous changes such as increased sweating, calluses, and muscle atrophy should be documented.[2] Owing to the possible presence of peripheral neuropathy, pain may not always be present; with only 50% of patients reporting pain.[28,36,37]

Charcot neuroarthropathy can present as an infectious process and screening of the patient's vital signs for systemic signs of infection such as fever, chills, elevated heart rate or respiratory rate can be helpful.[2,4,54] However, lack of these symptoms may not rule out an infectious process.

Peripheral neuropathy examination. The existence of little or no pain may mislead the patient and physician[38], as peripheral neuropathy is likely to be an essential prerequisite for the onset of the Charcot neuroarthropathy process. Bilateral neurologic examination should be assessed for numbness, paresthesia, and dysesthesia by evaluating cutaneous sensitivity using Semmes-Weinstein monofilament, proprioception, tuning fork vibration sensation, or Achilles tendon reflex (Figure 2).[2,4,55-57] The Semmes-Weinstein monofilament test is a noninvasive, low-cost, rapid, and easy-to-apply test that is the most sensitive test in diagnosing peripheral neuropathy.[55,56] The locations for this test on both feet include the first, third, and fifth metatarsal heads and plantar surface of the distal hallux and third toe, but avoid callused areas. Neuropathy usually starts in the first and third toes and progresses to the first and third metatarsal heads. Seven or less of 10 different touch sensation locations on the patient's foot is an indication of peripheral neuropathy.[52,56,58]

Imaging. Radiographs are the primary imaging method for initial evaluation of the foot in patients, as they provide information on bone structure, alignment, and mineralization.[4,15,59,60] They also are useful in diagnosing the pathology, locating the area of involvement, evaluating quality of bone, and identifying if the process is acute or chronic. It is essential to get plain radiographs on patients present with a symptomatic foot. Unfortunately, radiographic changes of Charcot neuroarthropathy typically are delayed and have low sensitivity. The plain radiographs can be negative for up to three weeks with the only finding being soft tissue swelling. Figure 3 shows an example of the Charcot neuroarthropathy progression on plain radiographs.

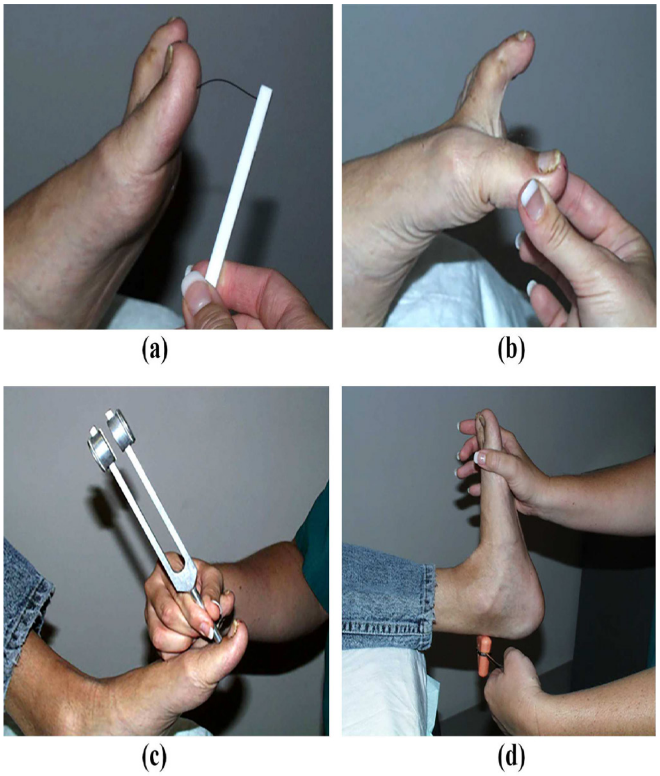


Figure 2. Neurologic examinations. (a) Semmes-Weinstein Monofilament test; (b) proprioception test on a big toe; (c) tuning fork vibration sensation test; and (d) Achilles reflex test using a reflex hammer.

The initial radiographic images should include anteroposterior and lateral weight-bearing views of the affected foot and/or full series ankle views (anteroposterior, mortise, and lateral views) depending on clinical suspicion.[4,60,61] Evidence of demineralization, bone destruction, and periosteal reaction on plain radiographic images can lead towards a diagnosis of Charcot neuroarthropathy, although this also can be seen in chronic osteomyelitis.

If Charcot neuroarthropathy is suspected, magnetic resonance imaging (MRI) allows detection of subtle changes in the early stages when the plain radiographic images appears normal.[25] MRI also is useful to rule out osteomyelitis, especially in the presence of an ulcer, history of ulcers, elevated erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), or leukocytosis.[2,5,25,45,62-69] The sensitivity and specificity are reported greater than 77% and 80% respectively in differentiating acute Charcot neuroathropathy from osteomyelitis.[2,45,62-68] Osteomyelitis on MRI often displays diffuse marrow involvement that usually only affects a single bone like the metatarsal heads and the calcaneus,[4,70] whereas Charcot neuroarthropathy more classically exhibits periarticular and subchondral bone marrow edema affecting several joints.[4,71]

Bone scan is another imaging tool that can be used to differentiate osteomyelitis from Charcot neuroarthropathy. A technetium-99m methylene diphosphonate scintigraphy is less useful than leukocyte scintigraphy because there is enrichment on both osteomyelitis and Charcot neuroarthropathy, whereas leukocyte scintigraphy is only positive in osteomyelitis.[2,62] The combination of technetium-99m methylene diphosphonate scintigraphy with indium-111 white blood cells, labeled leukocyte scintigraphy may improve sensitivity (87%) and specificity (81%) for differentiating acute Charcot neuroarthropathy and osteomyelitis.[4,59,72-75]

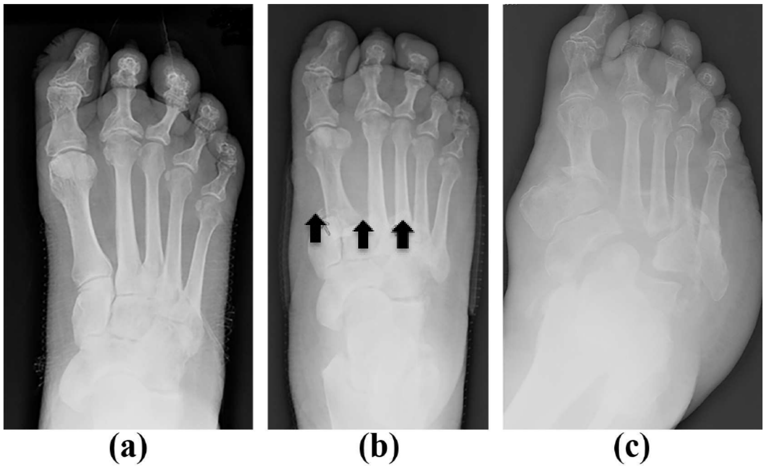


Figure 3. Progression of a foot Charcot neuroarthropathy on plain radiographs: (a) Initial anteroposterior view of an acute Charcot neuroarthropathy foot; (b) 6-month follow-up, which shows the persistent and progressive joint effusion, narrowing of the joint space, soft tissue calcification, minimal subluxation, osteopenia, and bone fragmentation; and (c) 2-year follow-up, which shows severe destruction of the foot without proper management.

Laboratory tests. There is a strong association between the duration of diabetes, elevated HbA1c, and the development of Charcot neuroarthropathy.[9,11,76] The patient should be screened initially for uncontrolled diabetes by evaluating fasting glucose, HbA1c, and/or random glucose levels. Even if the patient has no known diabetes history, they should be screened because of the high prevalence of diabetes.[25,33,77] If these lab values are not elevated and the patient has no known diabetes, then further evaluation should be made for the cause of peripheral neuropathy.

Initial lab orders should include complete blood count (CBC) with a differential, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP). Elevations in ESR, CRP, and leukocytosis are more in line with an infectious process like osteomyelitis.[2,3,34,78] An ESR greater than 70 mm/h has an 11-fold increased risk for the presence of osteomyelitis.[52,79] A slight elevation in ESR with normal white blood cell count (WBC) may occur in Charcot neuroarthropathy.[80] Normal inflammatory markers may be noticed occasionally in chronic osteomyelitis; the diagnosis may depend on other modalities like radiographs and MRI.[2,51]

Treatment. The most important aspect of the success for a foot screen protocol is early management of these suspected Charcot neuroarthropathy patients. Many cases of acute Charcot neuroarthropathy are mistreated because the condition is not recognized widely outside specialist clinics. If the suspected Charcot neuroarthropathy is complicated by ulceration or infection, then an inpatient treatment plan should be implemented before sending the patient home. The gold standard of conservative management strategy for Charcot neuroarthropathy has been immobilization and non-weight bearing.[81]

Inpatient treatment plan. Patients with confirmed or suspected infection, such as cellulitis, deep tissue infection, abscess or osteomyelitis, should be admitted for evaluation, when they have at least two of the following criteria from Systemic Inflammatory Response Syndrome (SIRS): body temperature ≥ 38°C or < 36°C, heart rate > 90 beats/minute, respiratory rate > 20 breaths/min. or arterial carbon dioxide tension (PaCO2) < 32 mmHg, abnormal white blood cell count ≥ 12,000/μL or ≤ 4,000/μL or > 10% immature (bands) forms.[82-84] Infection in the Charcot neuroarthropathy patient poses great challenges. Discussion with a foot and ankle specialist is recommended about treatment plans such as irrigation and debridement, culture/biopsy of the wound, and antibiotic treatment. Immobilization of the affected foot continues until complete resolution of the acute phase. Patient education regarding the diagnosis, estimated length of treatment, and expected outcomes is an important component of Charcot neuroarthropathy management. If the patient understands the nature of this limb-threatening condition, they may be more motivated to adhere to the management plan. Emphasis on the importance of strict immobilization and attending regular follow-up reviews may improve the outcome of Charcot neuroarthropathy.

Initial clinical treatment. The initial clinical treatment for a patient suspected of Charcot neuroarthropathy should be immobilization and non-weight bearing of affected foot.[2,4,11,15,81,85-87] The goals are to stop the inflammation-mediated damage, relieve pain, and maintain or protect the skeleton of the foot and ankle from further deformity on the affected limb until definitive diagnosis can be made. The use of a total contact cast (TCC; Figure 4), instant total contact cast (iTCC) with the use of crutches, or a knee scooter is recommended. If the clinician has limited experience in the application of TCC or iTCC, they can immobilize the patient in a short leg splint with a clear understanding that this is not the definitive treatment for immobilization. A wheelchair should be prescribed in cases where there is clinical suspicion of non-compliance or a question of bilateral involvement. These treatments are not definitive and the patient should be referred to a foot and ankle specialist (orthopedic or podiatrist) to establish a multidisciplinary team approach for definitive treatment.

Figure 4. Total contact cast (TCC).

Preventive medicine. Patients with diabetes mellitus and mild-to-severe peripheral neuropathy have high potential of developing Charcot neuroarthropathy. It affects 415 million people globally. This number is predicted to rise to 642 million by 2040.[88] These patients have a significant impact on health care costs, so prevention is important.[11,25,76,89] Like most complications of diabetes, the key is to control patients' glucose and HbA1c levels either by diet and/or medication.[90] The American Diabetes Association 2016 guidelines[90] recommended a glycemic target of HbA1c < 7.0% (53 mmol/mol), preprandial capillary plasma glucose of 80 - 130 mg/dL (4.4 - 7.2 mmol/L), and peak postprandial capillary plasma glucose < 180 mg/dL (10 mmol/L) for non-pregnant adults.

Patient education is an essential component of the long-term management, focusing on the importance of appropriate footwear, offloading, regular follow up reviews, and the risk of further complications.[27,28] Lifestyle changes for obesity, nutrition, smoking and alcohol abuse should be addressed.[2] A thorough diabetic foot exam to check for any skin abnormalities and a neurological exam should be performed at least two times a year, if the patient shows signs of peripheral neuropathy. It is recommended that the patient be prescribed a hard shoe, diabetic foot wear, or foot orthoses, and advised against wearing sandals to prevent development of Charcot neuroarthropathy. Footwear is an important component of the long-term management of the insensate chronic Charcot neuroarthropathy, ensuring that it remains accommodated and protected. Patients should be educated on regular self-examinations of their feet for skin break down, swelling, erythema and ulcers, and encouraged to evaluate their shoes for any foreign bodies before putting them on.

CONCLUSION

A thorough neurological examination must be a part of the physical exam for any patient presenting with unilateral erythema, edema, and increased foot temperature that has high risk factors for peripheral neuropathy. This examination could prevent any hidden inflammatory process, like Charcot neuroarthropathy, from going undiagnosed. A protocol for primary care and emergency room physicians provides a comprehensive guideline on foot screening, especially for acute Charcot neuroarthropathy.

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Keywords: Charcot, neuroarthropathy, diabetic foot, diabetic neuropathy

KANSAS JOURNAL of MEDICINE

Hereditary Diffuse Gastric Cancer: More than What Meets the Endoscopic Eye

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A 39-year-old female underwent esophagogastroduodenoscopy (EGD) after she was found to have hereditary diffuse gastric cancer (HDGC). Seven of patient's family members were diagnosed with gastric adenocarcinoma between 20 - 40 years of age. Genetic testing revealed CDH-1 mutation. Endoscopic findings revealed normal esophagus, gastroesophageal junction, and stomach (Figure 1). A total of 30 biopsies (six each from antrum, distal stomach, transition zone, proximal stomach, and fundus) were obtained per Cambridge protocol.[1] One of 30 biopsies demonstrated a focus of intramucosal adenocarcinoma in the fundus (Figure 2). The patient underwent a total gastrectomy with esophagojejunostomy. The gross specimen that was morphologically normal showed a total of 19 foci (Figure 3; rectangles) of poorly differentiated intramucosal adenocarcinoma ranging from 0.5 - 2.5 mm (Figures 4 and 5); 11 foci in the fundus and 8 foci in the body. The final stage was 1A (T1a, N0, M0) diffuse signet-ring carcinoma.

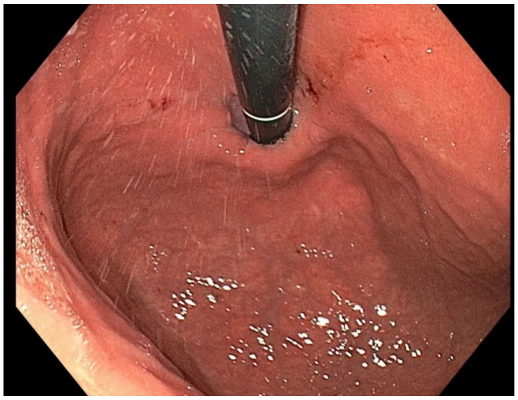

Figure 1. A retroflexed view of normal appearing stomach. Grossly no abnormalities were detected, hence random biopsies were obtained.

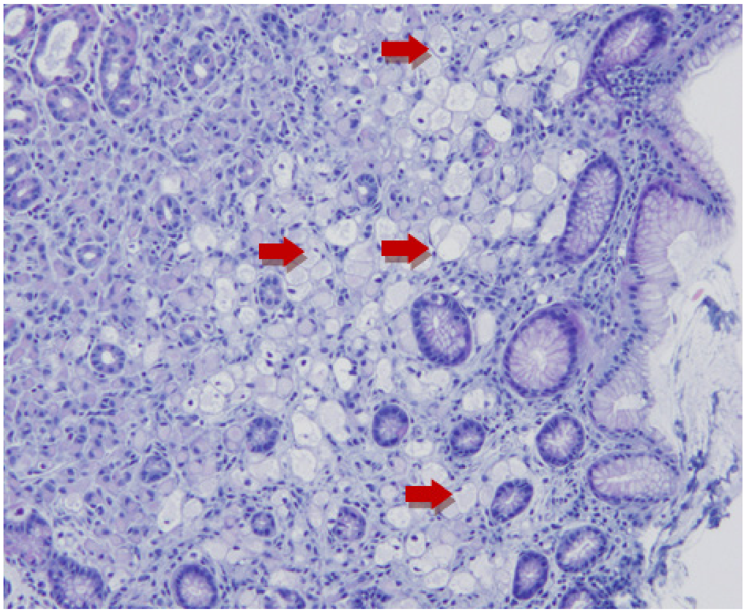

Figure 2. H&E stain on specimen obtained from biopsy during EGD exhibiting infiltrating adenocarcinoma poorly differentiated with mucinous and signet ring cell features (red arrows).

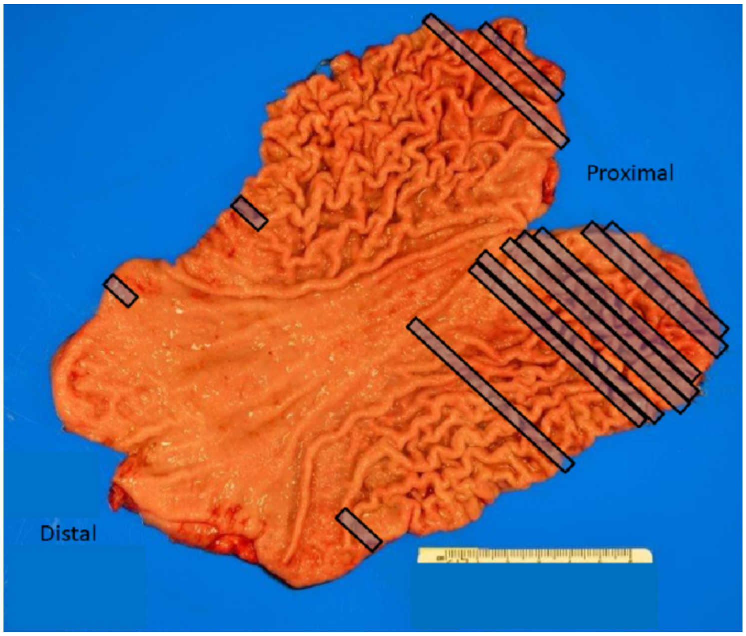

Figure 3. Gross specimen of the surgically resected stomach with rectangles highlighting the regions that had a positive foci of adenocarcinoma. (Note the longer rectangles indicated that more than 1 focus was discovered, however, they were difficult to pinpoint on the gross specimen.)

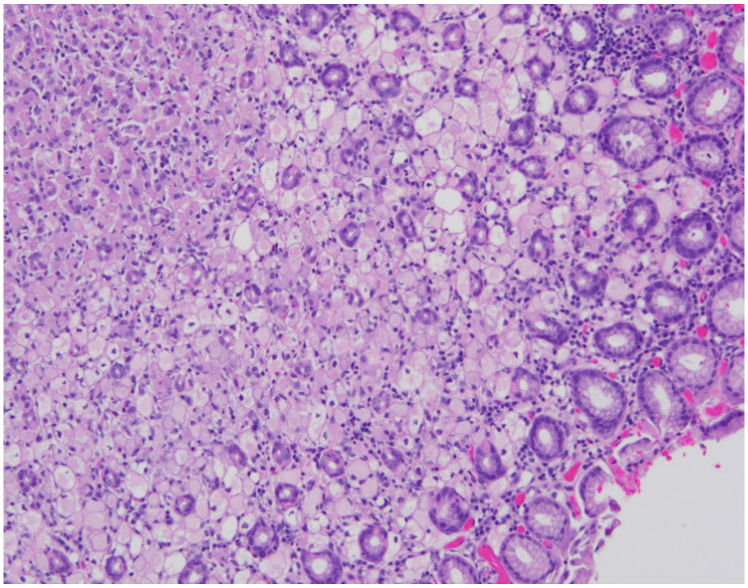

Figure 4. H&E stain of surgically resected specimen demonstrating adenocarcinoma.

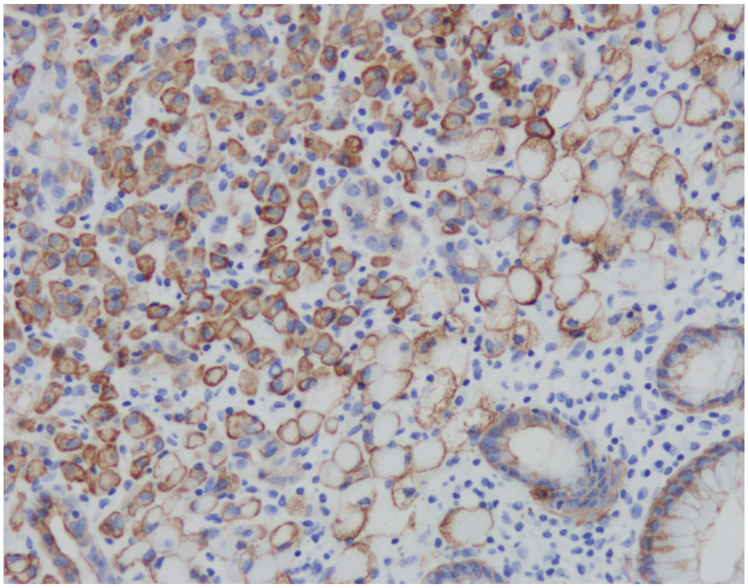

Figure 5. Pancytokeratin stain of surgically resected stomach showing adenocarcinoma.

DISCUSSION

Hereditary diffuse gastric cancer is associated with mutation in CDH-1 gene that encodes for tumorsuppressor protein E-cadherin.[2] The cumulative risk of gastric cancer with known mutation in CDH-1 is reported to be 70% (95% CI 59 - 80%) and 56% (95% CI 44 - 69%) for men and women respectively.[3] The average age of onset for stomach cancer with this mutation is 38 years (range 14 - 69 years) compared to general population which is usually between 60 - 80 years.[4,5] The incidence of lobulated breast cancer in women is 42 % harboring this mutation.[5] Endoscopic surveillance can be low yield if the tumor is microscopic and is not sampled with random biopsies during EGD. In our patient, endoscopic biopsies missed 94% (18/19) of the foci of intramucosal cancer. This case highlighted limitations of gastric biopsies in surveillance of gastric cancer in HDGC. Clinicians should strongly consider total gastrectomy in patients with HDGC because endoscopic surveillance has a high miss rate. If endoscopic surveillance is pursued, the Cambridge protocol with at least 30 biopsies should be followed and patient should be educated about the hazards of delaying surgical resection.

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