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Administration and Prescription of Opioids in Emergency Departments: A Retrospective Study

Casey L. McNeil, M.D., Ph.D.[1], Alma Habib, M.D.[2], Hayrettin Okut, Ph.D.[3], Stephanie Hassouneh, MS-2[4], Elizabeth Ablah, Ph.D., MPH[4], Sheryl Beard, M.D.[5]
[1]Smoky Hill Family Practice Residency, Salina, KS
[2]University of Minnesota, Department of Medicine, Minneapolis, MN
University of Kansas School of Medicine-Wichita, Wichita, KS
[3]Office of Research
[4]Department of Population Health
[5]Ascension Medical Group, Wichita, KS

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ABSTRACT

Introduction. Opioid overdose caused 47,600 deaths in 2017 in the United States. Emergency departments (EDs) are one source of opioids that could be abused or diverted for non-medical use. Bills to reduce opioid use in EDs have been passed in multiple states; however, Kansas does not have a bill regulating opioid administration. This study sought to identify characteristics that influence opioid administration and prescription at EDs in Wichita, Kansas.

Methods. This was a retrospective chart review analyzing patient encounters from EDs of three hospitals in Wichita, Kansas during May 2018. Information collected from charts included demographic and insurance information, as well as pain evaluation, diagnosis, disposition, provider education, and provider documentation of efforts to limit opioid abuse.

Results. Of the 1,444 encounters included in the analysis, providers administered opioids in the ED during 17.4% of visits and prescribed opioids for outpatient treatment for 10.6% of ED patient encounters. Subjective pain rating and provider credentials were associated significantly with opioid prescription.

Conclusion. The prevalence of opioid administration and prescription in participating emergency departments is roughly equivalent to current best-practice data from hospitals utilizing strong opioid-reduction protocols. ***Kans J Med 2021;14:1-4***

INTRODUCTION

In the U.S., opioid overdose was a cause of 42,249 deaths in 2016 (13.3 deaths per 100,000) and contributed to 67.8% of all drug overdose deaths in 2017.[1,2] The rate of drug overdose resulting in death in Kansas in 2016 was 11.8 per 100,000 (333 total drug overdose deaths).[2] In 2010, 31% of emergency department (ED) visits nationally resulted in an opioid prescription.[3] With more than one-third of visits involving opioids, EDs often are evaluated for opioid prescription abuse. However, little research has been conducted on the opioid administration of Kansas EDs.

The number of opioid prescriptions from an ED varies greatly, even for a single medical indication. For example, states varied from 40% to 2.8% of patients being prescribed an opioid medication from the ED for ankle sprains among opioid-naive patients treated from 2011 to 2015.[4] In Kansas, 35.7% of ankle sprain patients received an opioid prescription from an ED.

Guidelines for acute pain, including the Alternatives To Opioids protocol (ALTO)[5] and the U.S. Centers for Disease Control and Prevention's Chronic Pain Guidelines (CDC-CPG)[6] are available to guide opioid medication decisions. The ALTO protocol can be used to guide administration and prescription of analgesics for indications that include headache/migraine, musculoskeletal pain, renal colic, abdominal pain, bone fracture, and joint dislocation. The protocol encourages the use of analgesics, such as acetaminophen, ibuprofen, and ketorolac, prior to opioid administration.[5] The CDC-CPG guides the provider into setting goals for pain control, discussing appropriate risks and benefits with the patients, and setting criteria for minimizing long-term opioid use,[6] but defers to the American College of Emergency Physician's (ACEP) 2012 clinical policy guideline for opioid management of chronic pain in the ED. The ACEP recommends against prescribing opioids for acute exacerbation of chronic pain in the ED [Level C recommendation].[7]

Adopting opioid prescribing guidelines has reduced opioid prescribing rates drastically in some locations.[8] For example, a study performed in both a community and an academic medical center tested the implementation of a prescribing guideline that resulted in a decline of opioid prescriptions from 52.7% to 29.8% of patient visits. Even in a hospital with less frequent opioid prescribing practices, adopting guidelines has reduced opioid administration in the ED from 22.5% to 17.7%.[9] In 2017, 17 states had bills including opioid prescription guidelines;[10] however, Kansas was not one of those states. As of 2020, Kansas did not have a bill regarding opioid prescription. Additionally, Kansas had little published research on opioid prescription practices. The purpose of this study was to identify what patient and provider characteristics were associated with opioid administration and prescription in EDs in Wichita, Kansas.

METHODS

Procedures. This study was approved by the Human Subjects Committee at the University of Kansas School of Medicine-Wichita and the Institutional Review Board of hospitals participating in this study. ED medical records were collected for the month of May 2018 from three hospitals in Wichita, Kansas: a large, urban, Level 1 trauma and tertiary referral center, a large community hospital, and a suburban community hospital.

More than 8,000 charts from all ED visits to each of the hospitals were abstracted and de-identified. Data abstraction was initiated with 246 charts completed (in chronological order from two of three hospitals). Upon further evaluation, the study team decided to reduce the total number of charts reviewed to preserve time and effort. The remaining charts were randomized, and a total of 1,500 charts (500 per hospital) fitting inclusion criteria were selected for data abstraction, including the initial 246 charts.

Participants. All patients presenting to these EDs were eligible for study selection. Inclusion criteria included patients aged 13 years or older (patients known to be at greatest risk for abusing opioids).[3,11] Exclusion criteria included trauma and hospice patients and those with an active diagnosis of cancer, as determined by ICD-10 codes.

Instrument. Demographic and insurance information was abstracted from hospital-collected data in the electronic health record (EHR). Subjective pain measurements, using a numerical scale from 0 - 10 with faces,[12] were garnered from nurse-recorded vital signs, with the maximum reported pain recorded during each encounter. All other information, including diagnoses, medications, disposition, and provider credentials were obtained from emergency providers' (physicians and/or mid-levels) clinical notes. Visits in which the patient was prescribed an opioid pain medication for outpatient therapy were evaluated for documentation of efforts to minimize opioid use. Such efforts could include documentation that the patient was asked screening questions regarding drug abuse, following guidelines of the ALTO protocol[5] or CDC-CPG[6], attempting use of non-opioid analgesia prior to opioid administration, and/or prescribing a small number of short-acting opioids.

Statistical Analysis. Of the 1,500 EMRs of patient encounters selected for this study, 56 encounters were excluded. This resulted in 1,444 records that were included in the analysis. All statistical analyses were performed in SAS software (Version 9.4, SAS Institute, Inc., Cary, NC). Summary statistics were generated and a multiple multinomial logistic regression model with generalized logit link function was utilized to analyze the effects of predictor variables (all of which were treated as discrete variables) against two response variables: 1) opioid administered in the ED (yes/no), and 2) opioid prescribed for outpatient therapy (yes/no/not applicable). Upon identifying significant predictor variables, odds-ratio estimates of each predictor variable level were estimated against a reference predictor variable level. In the case of insurance status, each predictor variable level was utilized as a reference level in a sub-model to investigate differences between all possible insurance status effects. Additionally, the frequency of opioid administration in our chronologic 246 charts were compared against the randomly selected remainder of charts to investigate their potential difference. Finally, demographics and pain variables were analyzed to elucidate possible differences in the makeup of populations, utilizing each hospital, as they varied among the hospitals.

RESULTS

Most patients (71.6%, n = 1,034) self-reported being Caucasian, and 57.6% (n = 831) of patients were female (Table 1). The most frequent age range of patients in the ED were those in their 30s, constituting 18.7% of all ED visits. More than one-third (35.9%, n = 519) of patients utilized private insurance, 25.0% (n = 361) used Medicare, 18.4% (n = 265) used Medicaid, and 0.7% (n = 299) of patients were uninsured.

Nearly half (45.6%, n = 658) of patients reported 'severe' (7 - 10) pain, and a report of "10/10" was the single most reported pain value (15.3%, n = 220). Seventeen percent (17.4%, n = 243) of patients were administered an opioid analgesic while in the ED. The frequency of opioid administrations among the first 246 EMRs abstracted was not significantly different than the randomized 1,198 EMRs (p = 0.933). Among those patients who were administered an opioid analgesic, 45.3% (n = 110) were given a non-opioid medication trial prior to opioid administration.

Table 1. Patient demographics.

	Frequency	Percent
Self-Reported Race and Ethnicity		
Caucasian	1,034	71.6%
African American	205	14.2%
Hispanic	154	10.6%
Other/Not reported	52	3.6%
Gender		
Female	831	57.6%
Male	613	42.5%
Age (years)		
13-19	132	9.1%
20-29	238	16.5%
30-39	270	18.7%
40-49	226	15.7%
50-59	197	13.6%
60-69	165	11.4%
70-79	103	7.1%
80-89	86	6.0%
90 or older	27	1.9%
Insurance Status		
Private insurance	519	35.9%
Medicare	361	25.0%
Uninsured	299	20.7%
Medicaid	265	18.4%

Opioids were prescribed for 12.8% (n = 153) of ED discharges. Hydrocodone was the opioid medication most prescribed, resulting in 56.8% of all opioid prescriptions (n = 88; Figure 1). Oxycodone was the second most frequent, representing 29.7% of opioid prescriptions (n = 46). The mean number of opioid tablets prescribed was 13.3. Most (84.8%, n = 128) opioid prescriptions were for fewer than 20 tablets, and one prescription was written for more than 24 tablets.

Multinomial logistic regression identified two variables that were associated with opioid administration in the ED: the patient's subjective pain rating ($p < 0.0001$) and the credentials of the prescriber ($p < 0.0241$). Patients reporting a pain rating of 3 or 5 of 10 (not 4 of 10) were more likely to have opioids administered in the ED than those rating no pain ($p < 0.0076$ for all individual ratings). Medical doctors were more likely to administer opioids in the ED than nurse practitioners (NPs; $p < 0.0055$).

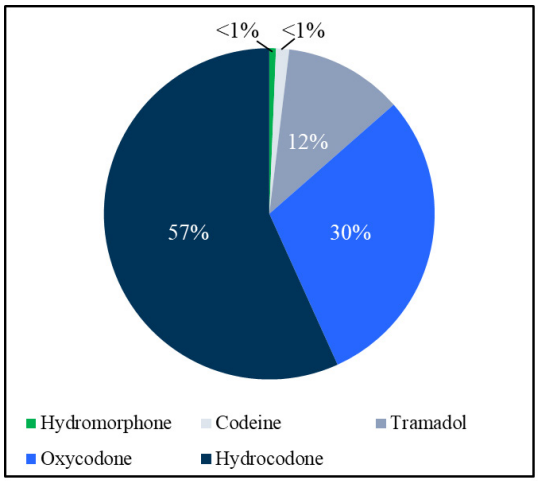

Figure 1. Percentage of outpatient opioid medications prescribed.

Four variables were associated with opioid prescriptions upon discharge: the patient's subjective pain rating ($p < 0.0005$), prescriber credentials ($p < 0.0001$), hospital ($p < 0.0001$), and insurance status ($p < 0.0040$). Patients with a pain rating of 5 of 10 were more likely to be prescribed opioids than those rating no pain ($p < 0.05$ for all ratings).

Both MDs (OR = 0.421, 95% CI: 0.311-0.570) and DOs (OR = 0.459, 95% CI: 0.317-0.663) were less likely to prescribe opioids than NPs ($p < 0.0001$). Physician assistants (PAs) were 1.605 (95% CI: 1.063-2.422) times more likely to prescribe opioids than NPs ($p < 0.0244$; Figure 2).

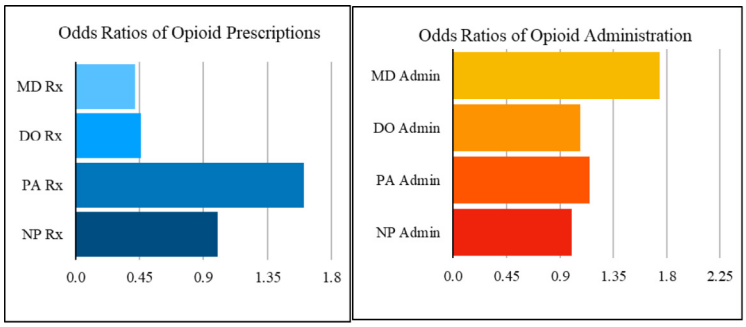

Figure 2. Odds ratios of likelihood of various ED healthcare professionals prescribing or administering opioids.

Patients presenting to one ED (hospital 3) were 3.423 (95% CI: 2.481-4.725) times more likely to be prescribed an opioid than the least frequent prescribing ED. The lowest frequency prescribing ED (hospital 1) was not significantly different than hospital 2. The hospitals varied significantly among multiple demographic variables, including age, race, gender, insurance status, and subjective pain ($p < 0.01$ in all cases). Of note, hospital 3 (highest opioid prescribing) had the highest proportion of Caucasian patients and privately insured patients, the lowest proportion of uninsured patients, and the lowest overall subjective pain ratings ($p < 0.0010$). Hospital 3 also had the fewest ED visits over the study month, with 1,010 ED visits; hospital 2 had 3,167 ED visits, and hospital 1 had 4,053 ED visits.

Medicare recipients were 0.537 (95% CI: 0.338-0.852) times less likely than Medicaid beneficiaries ($p < 0.0083$), 0.57 (95% CI: 0.362-0.898) times less likely than uninsured patients ($p < 0.0153$), and 0.48 (95% CI: 0.321-0.712) times less likely than those with private insurance ($p<0.0003$) to receive an opioid prescription for outpatient therapy.

DISCUSSION

The patient demographics of this sample were similar to the population demographics of the 2010 Census.[13] This patient population was likely representative of the community, though the current study had slightly more uninsured and women patients than the population of Wichita, KS in the 2010 U.S. Census.

In the current study, an opioid was administered during 17.4% of patient encounters in the ED. This value is consistent with a study of an academic medical center after the establishment of the ALTO protocol, in which 17.7% of visits resulted in opioid administration.[9]

Moreover, opioids were prescribed for 12.8% of ED discharges. This frequency of opioid prescribing was substantially lower than a study from 2013 through 2015, in which 24.3% of ED discharges resulted in an opioid prescription nationally.[14] In light of these comparisons, prescribers from the current study prescribed opioids less than might be expected for community hospitals in a state which lacks strong state regulations for opioid prescribing in the ED.

Increased patient-reported pain was associated with opioid administration and prescription. Though effective pain control can be achieved with opioid medications, it was noteworthy that non-opioid pain medications were trialed in 48.9% of patients who eventually received an opioid. This was especially significant considering a study of a large, academic medical center ED following the ALTO protocol resulted in non-opioid medications being utilized for 19.3% of visits.[9]

The prescriber's credentials were associated with opioid administration and prescribing in an incongruent way. MD physicians (but not DO physicians) were more likely to administer opioid medication than NPs. However, MD and DO providers were both associated with fewer visits resulting in an opioid prescription than NPs, and PAs were more likely to prescribe opioids than any other group. Since patient encounters, not providers themselves, were the focus of this study, this incongruency in administration may be attributed to the limited number of providers included in this study. Additionally, other unmeasured factors could differ between and amongst physicians and mid-level practitioners, reflecting these inconsistencies. Yang et al.[14] suggested that among medical indications, mid-level practitioners and physicians differed significantly in the frequency of opioid prescriptions (e.g., physicians were more likely to prescribe opioids for abdominal pain, whereas mid-level prescribers were more likely to prescribe opioids for dental pain).

As one of the hospitals included in this study prescribed more opioids than the other two, it is useful to consider what factors may contribute to this difference. The hospital with the highest proportion of patients receiving an opioid prescription in this study had the smallest ED census during the study month, with less than one-third of the ED visits of either of the other hospitals. Furthermore, it was the smallest and only suburban hospital in this study; the other two were urban. Demographically, the highest prescribing hospital

patient population had a greater proportion of Caucasian patients and those with private insurance, but slightly lower subjective pain scores than other patient populations. Given that the same staffing company provides physicians and mid-levels for all the hospitals studied, prescribers were not necessarily unique to any one study location. This finding may indicate that, even among a stable set of providers, hospital location, demographic factors, or ED census may affect opioid prescribing rates.

Insurance status was a significant predictor of opioid prescriptions. Medicare beneficiaries were less likely to be prescribed opioids than Medicaid recipients, the uninsured, and privately insured patients. This finding may be attributed to the advanced ages of Medicare beneficiaries, as it is recommended that opioid medication is limited for use in geriatric populations who are at risk for falls or fractures.[15] Another possible explanation to this outcome could be that Medicaid recipients and the uninsured population are visiting the ED at a more advanced stage in their disease conditions. This population is also more susceptible to injury due to their living and working conditions.

Limitations. There are a few limitations to our study that may interfere with its generalizability. The study was completed over a limited period of time. It was conducted during the month of May, a month during which our population may have participated in more outdoor activities, leading to more minor injuries and ED visits. In addition, the study was completed in one city setting and included a 71.6% majority Caucasian population. Furthermore, only three EDs were included in our study, in a city that has additional hospitals and freestanding ED facilities.

Our study aimed to abstract data based on each individual ED visit and did not take into consideration repeated visits of the same patients. This procedure could have led to one or more patients being included in our study multiple times and may have overestimated the prevalence of opioid use in the hospital if opioids were utilized for these patients on more than one visit. Additionally, since the extension diagnoses of each patient were not accounted for, the differences between ongoing chronic pain management and acute pain management could not be determined. This means that our results could be altered by providers filling opioid prescriptions that a patient entered the ED on. Further studies need to consider diagnoses and previous medications to elucidate further the relationship between opioid administration and EDs.

CONCLUSIONS

In this study, opioids were used commonly in a variety of ED settings. In the hospitals examined, almost half of the patients reported severe pain during their ED encounter. Providers attempted to treat patients initially with non-opioid medications in 48.9% of cases. Efforts should be taken to highlight pertinent guidelines and put more definite criteria for administering and prescribing opioid medications for this population.

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Demographics and Incident Location of Traumatic Injuries at a Single Level I Trauma Center

David Watson, MS-4[1], Blair Benton, MS-4[1], Elizabeth Ablah, Ph.D., MPH[2], Kelly Lightwine, MPH[3], Ronda Lusk, RN[3], Hayrettin Okut, Ph.D.[2], Thuy Bui, MPH[4], James M. Haan, M.D.[1,3]

University of Kansas School of Medicine-Wichita, Wichita, KS

[1]Department of Surgery

[2]Department of Population Health

[3]Ascension Via Christi Hospital on St. Francis, Department of Trauma Services, Wichita, KS

[4]University of Kansas School of Medicine-Wichita, Wichita, KS Department of Pediatrics

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ABSTRACT

Introduction. Traumatic injuries are preventable and understanding determinants of injury, such as socio-economic and environmental factors, is vital. This study evaluated traumatic injuries and identified areas of high trauma incidence.

Methods. A retrospective review was conducted of all patients 14 years or older who were admitted with a traumatic injury to a Level I trauma center between 2016 and 2017. Descriptive analyses were presented and maps of high injury areas were generated.

Results. The most frequent mechanisms of injury were falls (58.3%), motor vehicle crashes (22.3%), and motorcycle crashes (5.7%). Fall patients were more likely to be female (59.6%) and were the oldest age group (72.1 ± 17.2) compared to motor vehicle and motorcycle crash patients. Severe head (22.1%, $p = 0.007$) and extremity (35.7%, $p = 0.001$) injuries were most frequent among fall patients, however, more motorcycle crash patients required mechanical ventilation (16.1%, $p < 0.001$) and experienced the longest intensive care unit length of stay (5.3 ± 6.8 days, $p < 0.001$) and mechanical ventilation days (6.6 ± 8.5, $p < 0.036$). Motorcycle crash patients also had the greatest number of deaths (7.5%, $p < 0.001$). The generated maps of all traumas suggested that most injuries occur near our hospital and are located in several of the most population-dense zip codes.

Conclusion. Patient demographics, injury severity, and hospital outcomes varied by mechanisms of injury. Traumatic injuries occurred near our hospital and were located in several of the most population-dense zip codes. Injury prevention efforts should target high incident areas. ***Kans J Med 2021;14:5-11***

INTRODUCTION

Traumatic injuries play a significant role in healthcare. In 2015, 27.6 million people in the U.S. were treated in emergency departments for injuries, and 2.8 million were hospitalized.[1] Unintentional injuries are the fourth leading cause of death in the U.S., with fall and motor vehicle crash injuries accounting for the most significant number of deaths.[1,2] Numerous studies have demonstrated that the incidence of traumatic injuries is influenced by a combination of demographic, socioeconomic, and environmental factors.[3-16] Understanding how these factors are associated with the incidents of traumatic injuries is essential for trauma prevention efforts.[6,8]

In 2011, the American Association for the Surgery of Trauma Prevention Committee released a publication addressing three resources for injury prevention and research.[5] These resources included the National Trauma Data Bank (NTDB), geographic information systems (GIS), and teaching injury prevention. The NTDB provides an aggregate of U.S. trauma information which can be used to identify the incidence and frequency of mortality and provide injury characteristics on a national level.[2]

Geographic information systems take trauma information one step further by adding geospatial maps of traumatic injuries.[3] With the use of GIS specific neighborhood characteristics and socio-economic factors that might increase or decrease an individual's risk of sustaining a traumatic injury can be explored further.[3] Several previous studies highlighted the effectiveness of GIS analysis in trauma research and demonstrated that there are spatial patterns of injuries.[3-6] As an example, Newgard and associates noted that injury location is not random and that major traumas tend to cluster in census tracts with distinct population characteristics, such as higher rates of unemployment and lower education levels.[4] Another study using GIS to describe motor vehicle crashes (MVC), indicated that environmental factors, such as inadequate traffic engineering and lighting, can lead to increased MVCs.[12]

The purpose of this study was to describe the demographics of our trauma population, identify the frequency of types of injuries, and establish where these injuries occur.

METHODS

Kansas is a predominantly rural state and is served by three American College of Surgeons Committee on Trauma (ACS COT)-verified Level 1 trauma centers. Two of these centers, Wesley Medical Center and Ascension Via Christi St. Francis, located in Sedgwick County, are within 2.3 miles of one another. The dividing line for patient trauma destination is determined by Interstate 135 (I-135), which runs north-south through the city (Figure 1). Those injured East of I-135 go to Wesley Medical Center and those injured West of I-135 go to Ascension Via Christi St. Francis. Among traumas that occur outside of the county line, patient trauma destination is either determined by the responding Emergency Medical Unit or the transferring facility.

A retrospective chart review was conducted of all patients aged 14 years or older who presented with a traumatic injury to Ascension Via Christi St. Francis from January 1, 2016 and December 31, 2017. Patients were excluded if the incident occurred outside of Kansas, there was no documentation of mechanism of injury or incident location, the injury involved a firearm, or the injury was intentionally self-inflicted.

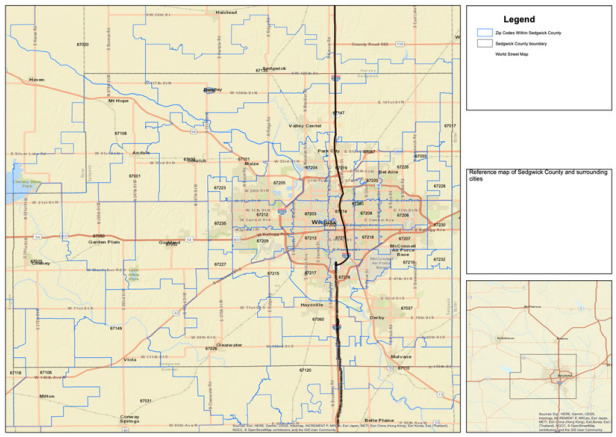

Figure 1. Sedgwick County reference map indicating I-135 dividing line for trauma patient destination.

Data were retrieved from the trauma registry and patient medical records. Abstracted patient data included demographics (age, gender, race/ethnicity, type of insurance), mechanism of injury and injury details, injury location (street address and zip code), injury severity (Injury Severity Score [ISS], Glasgow Coma Scale [GCS], Abbreviated Injury Score [AIS], use of personal protection or restrains), blood alcohol level (BAC), drug test results, hospital parameters (surgical procedures, intensive care unit [ICU] admission and length of stay, mechanical ventilation use and duration of use, hospital length of stay), hospital disposition destination, and mortality.

Descriptive analyses were presented as frequencies with percentages for categorical variables and means with standard deviations for continuous variables. Before comparative analysis was performed, patients were grouped by the top three mechanisms of injury which included falls, motor vehicle crash (MVC), and motorcycle crash (MCC). Pearson's chi-square, likelihood ratio chi-square, and Fisher's exact tests were used to test the significant association between two nominal or categorical variables in contingency tables. Shapiro-Wilk variables also were used.

For non-normal distributions with appropriate transformation operations, the rank transform approach to nonparametric methods was used as a combination of PROC RANK and PROC GLM. Least-squares means (to estimate the marginal means over a balanced population) were used for pairwise comparisons of groups by Tukey test using Kramer adjustment.

Kernel Density Estimation (KDE) was used to create maps of injury location. KDE is a nonparametric technique for estimating the probability density function of a random variable. Using ArcGIS Desktop version 10.4.1 (ESRI, Redlands, CA), KDE was used to estimate risk zones by calculating the density of trauma injury locations around individual output raster cells as a function of the frequency and proximity of known trauma injury locations.[17] The final output is displayed as a smoothly tapered raster image. The value of the smoothly tapered surface is highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the search radius distance from the point. The following equation was used to determine the search radius: $\text{SearchRadius} = 0.9 \times \min(SD, \sqrt{(1/ln^2)} \times D_m) \times n^{-0.2}$.

All statistical tests were two-sided, and analyses were considered significant when the resultant was at $p \leq 0.05$. Descriptive statistics for nominal, categorical, and continuous variables were conducted by using PROC FREQ and PROC UNIVARIATE in SAS version 9.4 (SAS Int. Inc., Carry, NC). This study was approved by the Institutional Review Board at Via Christi Hospitals Wichita, Inc. and the Human Subjects Committee at the University of Kansas School of Medicine-Wichita.

RESULTS

Of 4,176 patients admitted for a traumatic injury during the study period, a total of 1,112 were excluded. Exclusions were due to missing incident location (20.7%, n = 864), involvement of a firearm (3.2%, n = 134), intentional self-inflicted injury (2.0%, n = 82), incident location outside of Kansas (0.7%, n = 30), or unknown mechanism of injury (0.1%, n = 2). The final sample consisted of 3,064 patients, most of whom were male (52.6%, n = 1,612) and Caucasian (86.0%, n = 2,634) with an average age of 60.3 ± 22.7 years. The three most frequent mechanisms of injury were falls (58.3%, n = 1,786), motor vehicle crashes (MVC; 22.3%, n = 684), and motorcycle crashes (MCC; 5.7%, n = 174; Table 1).

Significant differences were noted between the three-main mechanisms of injury regarding gender, age, race, and insurance status (Table 1). Patients who sustained a fall were more likely to be female (59.6%, n = 1,064), while males accounted for most MVC (62.1%, n = 425), and MCC (87.4%, n = 152, $p < 0.001$) patients. Fall patients accounted for the oldest group (72.1 ± 17.2) and most MVC (45.6%, n = 312) and MCC (52.3%, n = 91, $p < 0.001$) patients were between the ages of 19-44 years. Compared to the other mechanisms of injury, fall patients had the highest number of patients with Medicare/ Medicaid (78.6%, n = 1,403, $p < 0.001$).

Comparisons of injury severity and hospital outcomes based on mechanism of injury are presented in Table 2. Severe head (22.1%, n = 394, $p = 0.007$) and extremity (35.7%, n = 638, $p = 0.001$) injuries were most frequent among fall patients, however, more motorcycle crash patients had an ISS > 15 (24.1%, n = 42, $p < 0.001$). Motorcycle crash patients also were more likely to require mechanical ventilation (16.1%, n = 28, $p < 0.001$) and experienced the longest ICU length of stay (5.3 ± 6.8 days, $p < 0.001$) and mechanical ventilation days (6.6 ± 8.5, $p < 0.036$) as compared to fall and MVC patients. Fall injury patients were most likely to be discharged to a nursing home (46.4%, n = 828, $p < 0.001$) and motorcycle crash patients experienced the highest rate of mortality (7.5%, n = 13, $p < 0.001$).

Injury details are broken down further for the three-main mechanisms of injury (Table 3). Patients who fell were most likely to do so while standing, sitting, or lying (76.3%, n = 1,362). Those admitted due to MVC were most likely the driver (68.3%, n = 467), and were restrained during the crash (59.1%, n = 385). Among MCC patients, 67.8% (n = 118) did not use protective equipment. Fourteen percent of MVC (n = 100) and 19.5% of MCC (n = 34) patients had BAC above the legal limit (≥ 0.08).

Table 1. Demographics for patients with a traumatic injury by mechanism of injury.

Parameter*	Total	Fall	Motor Vehicle Crash	Motorcycle Crash	p value
Number of Patients	3,064 (100%)	1,786 (58.3%)	684 (22.3%)	174 (5.7%)	
Gender					< 0.001
Male	1,612 (52.6%)	722 (40.4%)	425 (62.1%)	152 (87.4%)	
Female	1,452 (47.4%)	1,064 (59.6%)	259 (37.9%)	22 (12.6%)	
Age (years)	60.3 ± 22.7	72.1 ± 17.2	44.3 ± 20.2	41.3 ± 14.6	< 0.001
Age groups					< 0.001
14-18	103 (3.4%)	16 (0.9%)	59 (8.6%)	6 (3.4%)	
19-44	735 (24.0%)	137 (7.7%)	312 (45.6%)	91 (52.3%)	
45-54	330 (10.8%)	121 (6.8%)	81 (11.8%)	45 (25.9%)	
55-64	406 (13.3%)	214 (12.0%)	109 (15.9%)	23 (13.2%)	
65-74	413 (13.5%)	308 (17.2%)	67 (9.8%)	7 (4.0%)	
≥ 75	1077 (35.2%)	990 (55.4%)	56 (8.2%)	2 (1.1%)	
Race/ethnicity					< 0.001
Caucasian	2,634 (86.0%)	1,632 (91.4%)	524 (76.6%)	148 (85.1%)	
African American	174 (5.7%)	57 (3.2%)	66 (9.6%)	13 (7.5%)	
Hispanic/ Latino	189 (6.2%)	68 (3.8%)	70 (10.2%)	8 (4.6%)	
Asian American	36 (1.1%)	14 (0.8%)	18 (2.6%)	1 (0.6%)	
Other	31 (1.0%)	15 (0.8%)	6 (0.9%)	4 (2.3%)	
Insurance					< 0.001
Private	1,328 (43.3%)	330 (18.5%)	575 (84.1%)	154 (88.5%)	
Medicare/Medicaid	1,634 (53.3%)	1,403 (78.6%)	95 (13.9%)	15 (8.6%)	
Other	102 (3.3%)	53 (2.9%)	14 (2.1%)	5 (2.9)	

*Values presented as n (%) or mean ± standard deviation.

Table 2. Injury severity and hospital outcomes for patients with a traumatic injury by mechanism of injury.

Parameter*	Fall	Motor Vehicle Crash	Motorcycle Crash	p value
Number of Patients	1,786 (58.3%)	684 (22.3%)	174 (5.7%)	
Injury severity score > 15	183 (10.2%)	130 (19.0%)	42 (24.1%)	< 0.001
Head AIS ≥ 3	394 (22.1%)	91 (13.3%)	28 (16.1%)	0.007
Chest AIS ≥ 3	96 (5.4%)	102 (14.9%)	34 (19.5%)	0.054
Abdominal AIS ≥ 3	32 (1.8%)	34 (5.0%)	9 (5.2%)	0.454
Extremity AIS ≥ 3	638 (35.7%)	57 (8.3%)	30 (17.2%)	0.001
ICU admission	744 (41.7%)	250 (36.5%)	69 (39.7%)	0.068
ICU days	3.5 ± 3.7	5.0 ± 6.6	5.3 ± 6.8	< 0.001
Mechanical ventilation	100 (5.6%)	85 (12.4%)	28 (16.1%)	< 0.001
Ventilator days	3.8 ± 4.4	5.8 ± 7.8	6.6 ± 8.5	0.036
Surgery	788 (44.2%)	166 (24.3%)	63 (36.2%)	< 0.001
Hospital length of stay	4.4 ± 4.7	4.0 ± 6.3	4.8 ± 9.4	0.092
Disposition				< 0.001
Home	619 (34.7%)	464 (67.8%)	115 (76.9%)	
Nursing home	828 (46.4%)	49 (7.2%)	9 (5.2%)	
Rehabilitation	194 (10.8%)	67 (9.8%)	19 (10.9%)	
Hospice	30 (1.7%)	2 (0.3%)	0 (0.0%)	
Mortality	76 (4.4%)	35 (5.1%)	13 (7.5%)	

*Values presented as n (%) or mean ± standard deviation.

Table 3. Injury details for patients with a traumatic injury.

Parameter	Number (%)
Fall	
Standing, sitting, lying	1,362 (76.3%)
Stairs	182 (10.2%)
Height	83 (4.6%)
Ladder	78 (4.4%)
Motor Vehicle Crash	
Driver	467 (68.3%)
Passenger	134 (19.6%)
Pedestrian or pedal cyclist	83 (12.1%)
Restraint, Yes	385 (59.1%)
Restraint, No	266 (40.9%)
Blood alcohol above legal limit (≥ 0.08)	100 (14.6%)
Motorcycle crash	
Protective equipment, No	118 (67.8%)
Protective equipment, Yes	56 (32.2%)
Blood alcohol above legal limit (≥ 0.08)	34 (19.5%)

Most traumatic injuries were located slightly southwest of the hospital and included zip codes 67202, 67203, 67213, and 67211 (Figure 2). Figures 3, 4, and 5 represent the distribution of incident locations by each of the top three mechanisms of injury. Most fall injuries occurred west of the hospital in zip codes 67202, 67203, and 67213 (Figure 3). Both MVC and MCC were predominantly located in zip code 67202 (Figures 4 and 5, respectively). The highest number of outlying high-density injury locations occurred among MCCs. Although patient socioeconomic factors were not collected, Figure 6 displays residents within our study area living below the federal poverty line (FPL) by zip code.[18]

DISCUSSION

This was the first study to combine trauma registry data and incident location information to describe our study population. Study findings demonstrated that falls, motor vehicle crashes, and motorcycles crashes accounted for the highest frequency of traumatic injuries in our area. These trends were similar to national trends reported by the U.S. Department of Health and Human Services and the National Trauma Data Bank.[2]

Falls accounted for most of injuries and were most frequent among those 75 years or older. Those who suffered a fall injury also were more likely to be discharged to a nursing home or skilled nursing facility more frequently than any other mechanism of injury. A previous study found that among elderly fall injury patients who lived at home or independently before hospital admission, 37.3% were discharged to a nursing home or skilled nursing facility, suggesting that fall injuries can be harmful and debilitating for those 65 years or older.[19]

An overwhelming majority of patients who fell did so while standing, sitting, or lying. This finding suggested that daily tasks such as getting out of bed or standing up in the bathtub may be factors in fall injuries. Although fall injuries were less frequently severe than MVC and MCC injuries, these cases were most likely to have a severe extremity or head injury. Surgical intervention was required most frequently among fall injuries, further suggesting that these injuries are a significant source of morbidity among our trauma patients.

Motor vehicle crashes were the second most frequent mechanism of injury in the study and occurred most frequently among those aged 19 to 44 years. Road traffic injuries, including those by motor vehicle crashes, were a leading cause of mortality among those aged 15 to 49 years, further highlighting the need for more research and interventions into this issue.[20] In Kansas, 14 years of age is the youngest age a person can obtain a learner's driving permit and legally start driving.[21] A driver's education course is required for those aged 14 to 16 years but is not required for those 17 and older. Therefore, the lack of driving experience and a driver's education course could play a role in the high frequency of motor vehicle crash injuries among the younger trauma population.

In the current study, restraints were used in less than two-thirds of motor vehicle crash injuries, despite there being a state law requiring the use of seatbelts. Additionally, concerning is that more than one out of ten patients injured by a motor vehicle crash were identified as legally impaired by alcohol. Previous studies have demonstrated that lack of restraint use and impairment by alcohol are associated with worse outcomes, such as high frequency of severe injuries and mortality, in motor vehicle crashes.[22-25]

Motorcycle crash injuries occurred less frequently than both fall and motor vehicle crash injuries but accounted for the highest frequency of severe injuries and the second-highest frequency of surgical intervention. Potential contributing factors to the higher incidence of severe injury and mortality among our motorcycle crash population included lack of protective equipment use and alcohol impairment, as other studies have suggested that these are associated with worse patient outcomes.[24,26-28]

The generated maps of all traumatic for the current study suggested that most injuries occurred near our hospital and were located in several of the most population-dense zip codes.[29] These findings were similar to what other studies have demonstrated.[10,14-16] Injury locations in our study area also corresponded to locations popular for dining, shopping, and nightlife. These areas also have a large number of alcohol-serving establishments. Walker and associates noted that traumatic injury hotspots also had a high concentration of alcohol-serving establishments.[10]

The high injury areas for each mechanism of injury were different, although the areas had some overlap. For instance, both MVC and MCC were located near the hospital and seemed to occur along or near a major highway (U.S. 54). These findings were similar to Dezman et al.[14] who studied MVC in Baltimore, Maryland. They noted that crash sites were predominately in the high-density center of the city and followed main access roads and avenues. However, among our population, MCCs were centered north and south of U.S. 54, while more MVCs occurred west along U.S. 54. In addition, more MCCs appeared to

occur at interactions in surrounding areas, and one hotspot of MCC corresponded to a local motocross track (near zip code 67101). Fall injuries were more spread-out compared to MVC and MCC, however, these injuries still had a high number located central to our hospital.

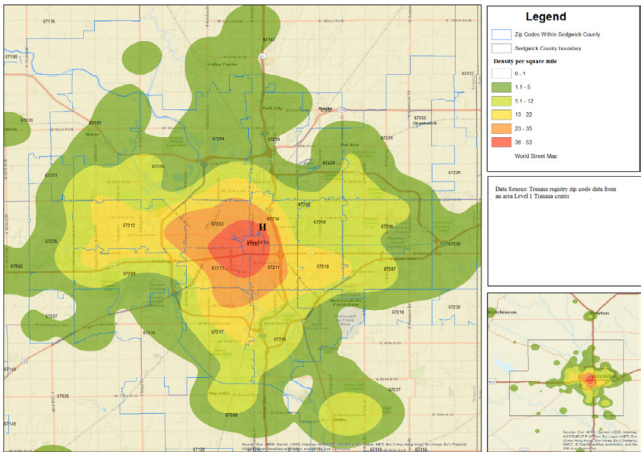

Figure 2. Geographic distribution of traumatic injuries by incident zip code between January 2016 and December 2017.

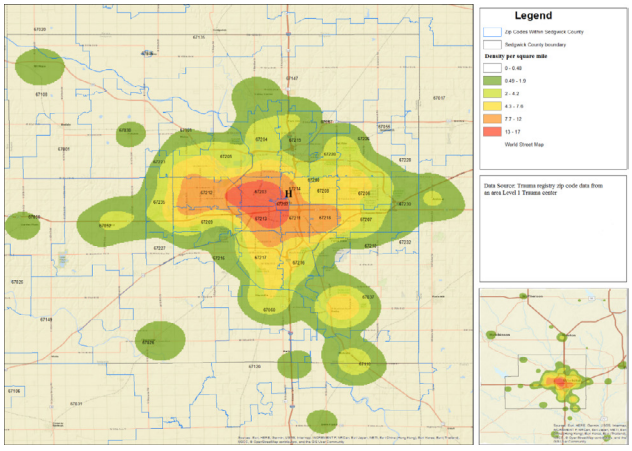

Figure 3. Geographic distribution of fall-related injuries by incident zip code between January 2016 and December 2017.

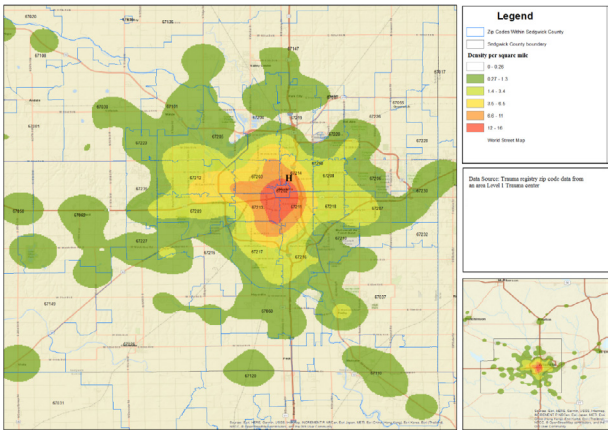

Figure 4. Geographic distribution of motor vehicle crash-related injuries by incident zip code between January 2016 and December 2017.

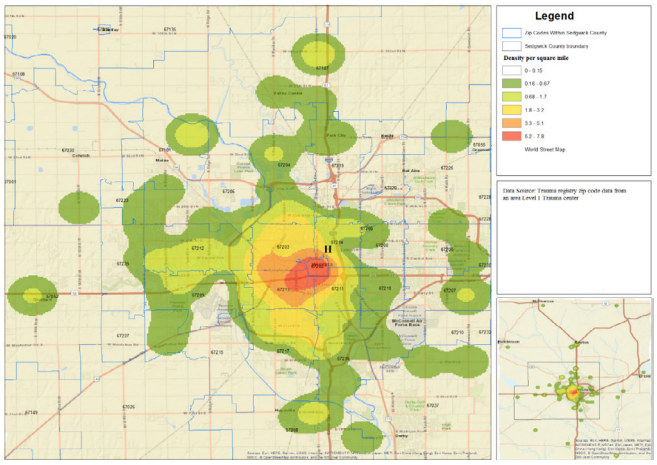

Figure 5. Geographic distribution of motorcycle crash-related injuries by incident zip code between January 2016 and December 2017.

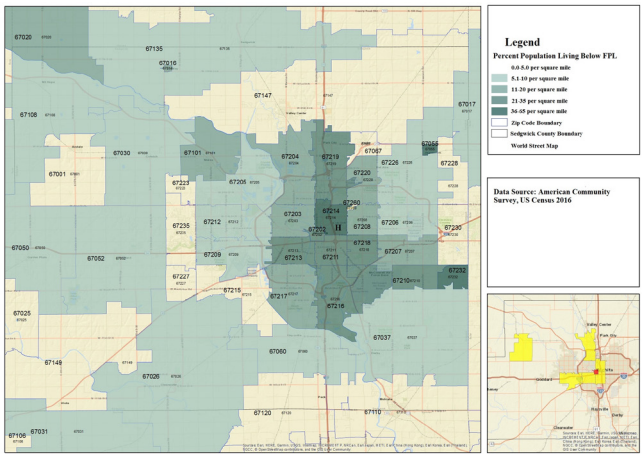

Figure 6. Residents within our study area living below the federal poverty line (FPL) by zip code.

Implications. Traumatic injuries are frequently preventable, yet remain a leading cause of death in the U.S. To reduce traumatic injuries and promote safety, injury prevention strategies should be implemented at the population level. States with more injury prevention policies in place have lower rates of death from injury.[30] GIS can be used to identify high incidence and high-risk areas for traumatic injuries.[5] Once these areas have been identified, guided interventions can be developed and tailored to specific characteristics of the area, such as lowering speeds of streets in areas of high pediatric pedestrian injuries.[31] The use of geospatial analysis to guide injury prevention strategies is a clear benefit to communities that are trying to reduce traumatic injuries and should become a staple of any injury prevention initiative.[4-6]

Through the mapping of fall injuries, it is possible to identify areas more densely populated with people over the age of 65, specifically outside of nursing homes, with the goal of targeting community gathering spots to implement educational interventions regarding fall risks and hazards. Since our finding suggested that falls occur most often during daily activities providing information on common household fall risks and techniques on how to limit these risks should be included in any fall prevention effort directed at our patients. With the use of our GIS maps, these prevention programs can be targeted to the high incident locations.

Among our MVC and MCC patients, lack of seatbelt use and driving under the influence (DUI) were common. With our generated maps for MVC and MCC locations, police can increase traffic enforcement, such as enforcement of seatbelt laws and DUI checkpoints, in these high injury locations. Unfortunately, due to the nature of our study we were unable to investigate any environmental factors that may play a role in the high number of MVC and MCC locations displayed in our maps.

Future Research. Future studies can use this information to aid in the development of targeted injury prevention strategies. Another avenue for future research involves comparing socioeconomic factors within the area and identifying trends among traumatic injuries. The use of GIS could highlight these areas further and identify their spatial relation to socioeconomic trends within the area. In addition, future studies may involve a more detailed investigation at the neighborhood level to establish risk factors of significant injuries for our hospital population catchment areas. This may include investigating the influence of the built environment, neighborhood demographics, and risk-taking behaviors.

Limitations. There are limitations to our study. First, not all trauma injuries in our area were represented in the study findings due to including only one of two local Level 1 trauma centers and by not including those who died at the scene. Second, the lack of data in patient charts made looking at patient socioeconomic factors impossible. Census data were used to characterize zip codes according to the federal poverty level. However, these data did not reflect the study population necessarily as trauma injuries did not always occur in or near a patient's home; this was likely to be seen with motor vehicle and motorcycle crashes. Additionally, more detailed information regarding incident locations such as the characteristic of the built environment and environmental factors were not available due to the retrospective nature of the study.

CONCLUSIONS

Falls, motor vehicle crashes, and motorcycle crashes were the most common mechanisms of injury among the study population. Although the mechanisms of injury differed in frequency, morbidity, and mortality, they each represented a significant hazard to the community. The use of GIS aided in the identification of the areas of highest incidence, showing that the most traumatic injury cases per square mile were concentrated in certain regions. With these findings, it is possible to implement injury reduction strategies aimed at areas of high injury prevalence, with the goal of reducing preventable trauma injuries.

ACKNOWLEDGMENTS

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Keywords: wounds and injury, trauma centers, incidence, geographic information systems, geographic mapping

KANSAS JOURNAL of MEDICINE

Multiple Subcutaneous Gouty Tophi Even with Appropriate Medical Treatment: Case Report and Review of Literature

Troy D. Erickson, D.O., FAAOS[1], Binara Assylbekova, M.D.[2], Alexander C.M. Chong, MSAE, MSME[3,4]
[1]Sanford Thief River Falls Clinic, Thief River Falls, MN
[2]Sanford Broadway Medical Center, Fargo, ND
[3]Sanford Health Department of Graduate Medical Education, Fargo, ND
[4]University of North Dakota, School of Medicine & Health Sciences, Grand Forks, ND

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INTRODUCTION

Gout is one of the most common and complex causes of arthritis that can affect anyone.[1,2] It is one of the most ancient medical conditions known going back to references in Egypt in 2640 BC and Hippocrates writing about it in 400 BC.[3-5] Gout occurs when there are deposits of urate monosodium crystals in the synovial fluid and other tissues causing the inflammation and intense pain of a gout attack. Urate monosodium crystals usually are associated with long-term hyperuricemia that is triggered by several genetic factors as well as environmental factors such as the overconsumption of rich purine diets, alcohol, obesity, obesity-related disease, kidney disease, and certain medications.[1,6-13] Risk factors for older patients include low-dose aspirin, alcohol abuse, decreased renal function, and prolonged use of diuretics.[14,15]

Advanced gout, also known as gouty tophi, are large, visible (masses) made up of urate crystals.[5,16,17] The tophus is a cardinal sign and usually develops after 5-10 years of chronic undertreated gout with the olecranon bursa being one of the most affected areas.[5,16,17] Formation is caused by elevated serum uric acid levels due to neglected and poorly controlled gout.[18,19]

Gouty tophi can develop anywhere. It can develop in periarticular soft tissues, sub-articular regions around bones, tendon sheaths, bursas, articular cartilage, and synovial tissues around flexor tendons.[17,20] Gouty tophi have been identified in vocal cords, myocardium, heart valves, eyes, spinal cord, pancreatic tail, breast, penis, with a propensity to affect the helix of the ear.[17,21,22] However, patients with multiple gouty tophi rarely are encountered because hyperuricemia can be treated effectively. The differential diagnosis of gouty tophi is broad, even though gout can be diagnosed clinically by elevated serum uric acid level; however, the concentration of serum uric acid may be within the normal limits and yet gouty tophi still can be developed.[23-25]

This case was a patient who developed multiple gouty tophi over an extended period of time with increasing size of the masses while on medical treatment for his gout. The one mass of unique interest developed over the superficial anterior tibia just distal to the tibial tubercle and not in the patellar tendon, which is uncommon.

CASE REPORT

A 65-year-old obese male (height: 177.8 cm; weight: 123.3 kg; BMI: 39.0 kg/m^2) had advanced cardiac disease, and atrial fibrillation. He was on anticoagulation and presented to his primary care physician with intermittent pain and a mass on the left olecranon region of greater than 20 years. He was a non-smoker and drank no alcohol. His serum uric acid level was 8.3 mg/dL.

The patient was referred to an orthopedic clinic due to the mass. Physical examination revealed a prominent soft tissue mass that measured 30 cm x 12 cm x 4 cm, with a small laceration over the left dorsal proximal forearm, distal to the olecranon. The patient had no pain with active range of motion, but the lesion was painful with direct pressure over the subcutaneous mass. He complained of a soft tissue growth on his left elbow/forearm that had been enlarging slowly over the previous 2 - 3 years. He previously had undergone nonsurgical treatment that included needle aspiration of fluid from the soft tissue growth about 10 years previously with no significant relief of the symptoms, at that time the patient was diagnosed with an olecranon bursa. No record of the fluid being sent for microbiological exam was noted. He denied recent trauma to the area but a small laceration was noted. He was not on any medications for gout but was on many medications for his heart disease and hypertension to include loop diuretics and anticoagulants.

Plain radiographs (Figure 1) of the left elbow showed mild spur formation with a soft tissue mass. Computed tomography (CT) revealed a cystic accumulation with some calcific heterogenicity around the margins of the cystic tissue. CT was performed instead of using magnetic resonance imaging (MRI) because the patient had a pacemaker that prevented him from having a scan. From the radiographic images, he was diagnosed with an olecranon bursitis on his left elbow.

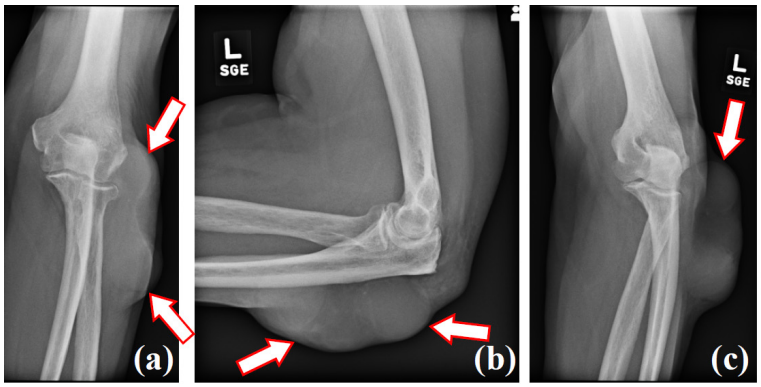

Figure 1. Radiographs of the mass on the patient's left elbow: (a) Anteroposterior view, (b) Lateral view, (c) Oblique view.

Surgical resection of the mass was performed due to the pain when the patient would lean on it and the fact that there was a small laceration distal to the mass that would not heal. Operative report showed the mass was superficial to the fascia and periosteum with the size measured at 15 cm x 7 cm x 4.5 cm. It was fixed in formalin and the histopathology (Figure 2) revealed a gouty tophus with the presence of morphologic features and polarization characteristics (inflammation, fibrosis, and hemorrhage associated with abundant crystalline material).

Post-operatively, the patient developed a complex wound infection (skin loss and necrosis of the wound) ultimately undergoing multiple irrigations, debridements, and skin grafting procedures. With the patient's multiple medical comorbidities including the need for anticoagulants, wound healing was prolonged. Four-months post-operatively, the patient's elbow showed no evidence of infection; the wound appeared clean and had healed. The patient had almost full range of motion at the time. His serum uric acid level was 6.9 mg/dL while being treated with allopurinol.

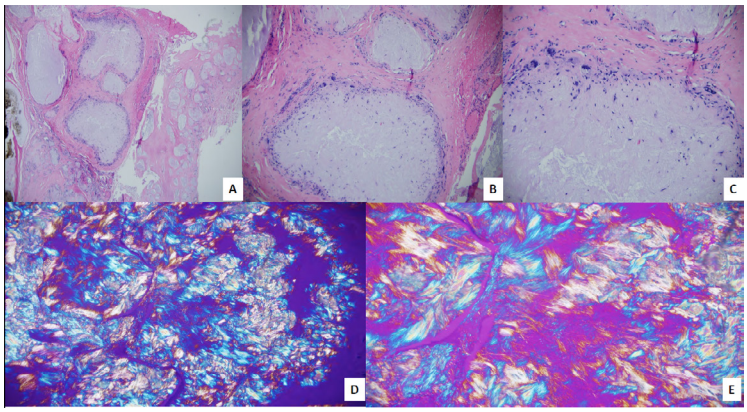

Figure 2. The histological examination of the mass on the left elbow. (A, B, C) Magnification view of eosinophilic amorphous material surrounded by histiocytic and chronic inflammation (x4, x10, and x20 power view). (D, E) Magnification view under polarizer showing needle shaped negatively birefringent crystals (10x and 20x power view).

Two and half years after the left elbow surgeries, the patient presented to the orthopedic clinic with two large soft tissue masses. One about the anterior aspect of the left tibia at approximately the junction of the proximal and mid-third of the tibia, and another one on the posterior aspect of the right elbow that had developed since his previous surgeries. The patient had no significant pain at either location unless he leaned on either of the two areas. Exam of the left knee showed a soft tissue mass that measured approximately 6 cm x 6 cm over the front of the left tibia, medial and distal to the patellar tendon and tibial tubercle, and the right elbow soft tissue mass measuring about 8 cm across with no redness or breakdown of the skin.

Plain radiographs of the right elbow showed a large soft tissue mass (Figures 3A - 3C). The left knee plain radiographs revealed medial compartmental narrowing and a large soft tissue prominence over the proximal tibia (Figures 3D - 3E).

The patient's health history had worsened, and it was significant for congestive heart failure, diabetes, atrial fibrillation, pacemaker/defibrillator, previous myocardial infarction, hypertension, chronic warfarin and clopidogrel use, hyperlipidemia, sleep apnea, varicosities, and gout. Due to his multiple co-morbidities and previous complications with surgery, the patient elected for non-surgical treatment even after discussion with the orthopedic surgeon who recommended excision of the masses before they broke down.

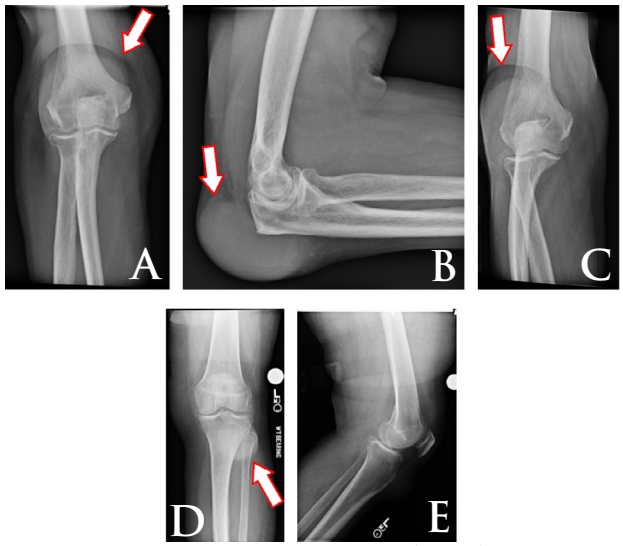

Figure 3. Radiographs of the mass on the patient. (A, B, C) right elbow and (D, E) left knee.

The patient accidentally bumped the mass over his anterior left tibia approximately 12 months after his last orthopedic office visit. His primary care provider had been trying to treat this conservatively without success. Due to the patient being on warfarin and clopidogrel, the mass had been oozing and bleeding since that time, wound care was not working, and the mass continued to drain. Approximately 2.5 months later, the patient presented to another orthopedic surgeon with a large bleeding mass over the anterior left tibia. His serum uric acid level was 4.2 mg/dL which was below the defined serum urate level for hyperuricemia (> 6.8 mg/dL).[26-28] Physical exam revealed a large skin lesion on the left anterior tibial region of the knee that had a black eschar formation that would bleed intermittently (Figure 4). Plain radiographs showed moderate osteoarthritis involving the medial compartment with meniscal calcifications and a soft tissue mass about the anterior tibial region (Figure 5). Discussion with the patient centered on mass excision with irrigation and debridement due to concern for infection and the fact that it had not healed with 2.5 months of conservative treatment.

Figure 4. Lateral and anterior views of the left tibial mass.

Figure 5. Radiographs of the mass on the patient's left knee.

Surgical resection of the mass was performed. Due to the extended timeline to seek orthopedic care, the mass had compromised the skin leading to poor tissue for coverage. The mass was superficial, extending along the anterior-medial aspect of the proximal tibia just distal to the tibial tubercle. It measured 7 cm x 7 cm x 5 cm (Figure 6). The mass was sent in saline, and the histopathology revealed a gouty tophus with associated and marked necrosis, hematoma and suppurative inflammation, and no growth of organisms (Figure 7).

Figure 6. Resected mass from the left knee.

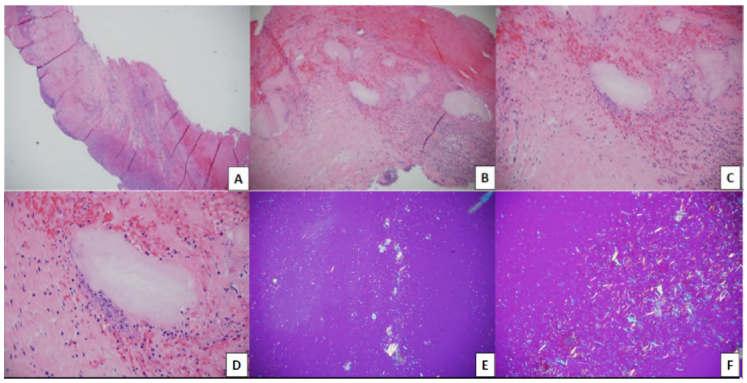

Figure 7. The histological examination of the mass on the left knee. (A) Proximal anterior tibia mass specimen showing surface skin ulceration. (B, C, D) Acutely and chronically inflamed fibrous tissue with nodular accumulation of amorphous pale pink material (x2, x4 and x10 power views). (E, F) Touch preparations from fresh tissue show needle shaped negatively birefringent crystals.

The patient had difficulties healing the incision site and underwent wound care with a wound vac, and other modalities with no further operative intervention. Three months post-operatively, the patient's wound showed no evidence of infection and the wound appeared clean with abundant healing granulation tissue (Figure 8). Due to the patient's poor health conditions, his right elbow mass excision surgery has not been completed.

Figure 8. Three months follow up on the left knee.

DISCUSSION

The clinical course of this case provided two interesting findings. The first finding was the symptomatic gouty tophi appeared as a superficial mass along the anterior tibia which is not common. The second finding was that the patient developed multiple gouty tophi over multiple extremities over a couple of years even with appropriate medical treatment to lower his uric acid levels.

It is rare to have gouty tophi formation since hyperuricemia can be treated effectively and the patient was on allopurinol that had lowered his uric acid levels. Hyperuricemia is defined as a serum urate level of approximately 6.8 mg/dL or higher.[26-28] In this case, the patient's uric acid levels dropped to 4.2 mg/dL which is below the defined level. Even with the medical treatment, the tophi continued to grow in size. This may have been related to his other comorbidities and medications that he was on which included loop diuretics. Loop diuretics (furosemide and bumetanide), thiazide diuretics (chlorthalidone and indapamide), and cyclosporine increase the risk of gout.[29-32] Of note, serum uric acid levels in chronic tophaceous gout may not be conclusive of hyperuricemia in patients with diabetes. Therefore, his uric levels may have been falsely lower than noted leading the physician to believe that they were normal or at lower levels than they truly were.[33] The patient also had changed his diet in hopes of modifying his risks for gout recurrence following his providers' recommendations.

Surgical intervention of gouty tophi rarely is needed due to medical management. Surgery is indicated if the tophi are painful, shows impending skin necrosis, infection, ulcerating wound, tendon impairment, mechanical impairment, nerve compression, and joint destruction.[34-36] Surgery can be challenging because of wound complications.[37,38] Ochoa et al.[39] suggested that inflammatory changes of the lobular subcutaneous tissue can be triggered and perpetuated by the arterial blood supply disruption caused by the monosodium urate crystals thus rending tissue vulnerable to deposits. They also believed that some microtrauma of the walls of terminal blood vessels as well as communication loss between the vessels and the dermis occurred, making the tissue vulnerable.

Gouty tophi may appear at intra- or extra-articular locations.[40-45] It can be in the subcutaneous tissue. It mostly affects peripheral joints, but can involve the extensor tendons of the knee. Bone erosions at the sites of tophi formation are common, but superficial gouty tophi appearing along the anterior tibia is rare when it does not extend from the interarticular knee joint or from the tendon. Usually, these gouty tophi do not cause the patient any pain unless they become acutely inflamed, but they can cause problems when trying to kneel on them.

What is the reason for the higher complication rates? Is it related to waiting too long and having to deal with the aftermath of an open wound and poor skin coverage? Would it be better to remove the tophi earlier in the disease process when they have not eroded through the skin? Gouty tophi and its pathophysiology potentially can lead to the poor healing but waiting until the mass is so large is another problem.

Skin under tension and thinned out due to the size is a problem no matter the etiology of the mass.

On a final note, it is important to consider how the pathological specimen is sent to the pathologist. The correct fixative is important and the specimens should be submitted in alcohol fixative because the monosodium urate crystals in gout dissolve away in formalin and are lost from hematoxylin and eosin (H&E) stained sections.[46,47] Physicians also should consider having cultures done on the specimen as well as a crystal analysis.

CONCLUSION

This report represented a unique case of how gouty tophi can develop at multiple joint locations over a short time period even with appropriate medical treatment, and how one of these tophi developed in the superficial tissues of the anterior tibia outside of any joint or tendon. Although gouty tophi are not life threatening, it has a significant impact on the quality of life. Intervening sooner medically may be a benefit for the patient with the hope that patient compliance with therapeutics may have an important impact on prognosis and avert surgical intervention. Nevertheless, lab values may misrepresent true uric acid levels. Gouty tophi may need to be removed sooner if therapeutics have not changed the progression and earlier involvement with the surgeon is warranted.

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Keywords: gout, gouty arthritis, tibia, elbow, surgical margins

KANSAS JOURNAL of MEDICINE

Tramadol's Potential as a Gateway to Opioid Use Disorder

Michael Choi[1], Griffin Bins[1], Jaya Sri Konakanchi, MBBS[1], Roopa Sethi, M.D.[1,2]
[1]University of Kansas School of Medicine, Kansas City, KS
[2]Department of Psychiatry and Behavioral Sciences

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INTRODUCTION

Tramadol was introduced into the U.S. market in 1995 as a non-scheduled drug.[1] It was made a schedule IV drug in 2014.[2] According to the Drug Enforcement Agency (DEA), schedule IV drugs have "low potential for abuse and low risk of dependence".[2] There are very few studies from the U.S. about tramadol abuse with literature from Egypt and its abuse potential being recognized more in the Middle East. This case report highlighted the potential of tramadol abuse and its significance as a gateway drug to developing opioid use disorder.[3-5]

We report a patient who was exposed to long-term use of tramadol for cervical disc protrusion and later developed opioid use disorder (OUD). We suspect exposure to tramadol set the patient on a course to seek other opiates, perpetuating opioid abuse. While tramadol (Schedule IV) is believed to have a lower abuse potential compared to other opiates (Schedule II), providers should be aware of the abuse potential that this drug holds.

CASE REPORT

A 30-year-old female presented with an 8-year history of OUD and a history of degenerative disc disease. At 16 years old, the opioid naïve patient had a bulging disc of the cervical spine for which she was prescribed 50 mg tramadol four times a day. After completion of treatment with tramadol for a year, the patient did not experience cravings or withdrawal symptoms. She subsequently used ibuprofen for mild cervical and thoracic back pain.

At 22 years of age, the patient developed worsening cervical pain and was prescribed 50 mg of tramadol, four times a day. After about four and half months of this regimen, she reported tolerance and increased cravings requiring medication more frequently than prescribed. While she remained on this prescribed regimen for two years, she also began buying tramadol from the streets. After several months, the patient's increased tolerance to tramadol caused her to seek out oxycodone from the streets with variable doses. She was able to stop the use of opiates but was unable to quit tramadol abuse.

While struggling to find sellers, the patient attempted to quit tramadol and had unsuccessful efforts in cutting down. While trying to taper, she developed withdrawal symptoms including opioid hyperalgesia causing full-body pain with worsening of her cervical spine pain, nausea, vomiting, diarrhea, restlessness, insomnia, and anxiety. The patient attempted to quit without assisted withdrawal five to six times and developed unrelenting withdrawal symptoms. She also reported significant mood changes and thoughts of suicide, with no plan, during these periods of withdrawal. She later started methadone through an opioid treatment program for unrelenting withdrawal symptoms and relapses on tramadol. She developed excessive sedation, nausea, and vomiting due to methadone. As she developed intolerability to medication, she quit to follow-up with a relapse on tramadol.

The patient was seen later in an addiction clinic, initiated on buprenorphine-naloxone therapy and maintained at eight 2 mg doses twice a day with no relapses. At that time, the patient reported no cravings, no withdrawal symptoms, no extraneous opiate use, and appeared to be tolerating the treatment well.

DISCUSSION

Tramadol is a centrally acting analgesic that works on mu opioid and monoamine receptors.[6] The drug is both a weak opioid agonist and a weak inhibitor of the reuptake of norepinephrine and serotonin. Tramadol is administered as a racemic mixture, where each enantiomer has its own active metabolite, (+)-O-desmethyltramadol or (-)-O-desmethyltramadol thought to be responsible for mu-agonist properties.[1] Tramadol's antagonistic properties on the 5-HT2C receptor could contribute to the drug's effects on depressive and obsessive-compulsive symptoms in patients with pain.[6] The half-life for tramadol is about 5.5 hours with extensive first-pass metabolism in the liver and primary excretion (90%) through the kidneys. The drug can be administered intravenously, intramuscularly, or orally.

The recommended dose for tramadol ranges from 50-100 mg every six hours, orally or parenterally, for mild to moderate pain.[1] Guidelines for tramadol use in pediatric populations vary between countries. In the U.S., tramadol is not recommended for those less than 16 years old.[6] Our case report showed a 16-year-old who was first introduced to tramadol without any complication. However, no conclusions could be made on whether her exposure to tramadol at a young age may have predisposed her to tramadol abuse later. In some populations, it also has been used to relieve distress related to depression and anxiety.[7] Tramadol generally is well tolerated with common adverse effects of nausea, vomiting, dizziness, drowsiness, sweating, and dry mouth. Unlike other opioids, tramadol reports lower adverse effects on respiratory or cardiovascular parameters at clinical doses in adults or children.[6] With these findings, tramadol (schedule IV) has been thought to be a safer alternative, regarding abuse and adverse effects, compared to other opiates (schedule II).

Tramadol was introduced in the U.S. market in 1995 as a non-scheduled drug for treatment of moderate to moderately severe pain.[1] The MedWatch program of the Food and Drug Administration (FDA) received 766 case reports of tramadol abuse and 482 cases of withdrawal associated with tramadol since the drug entered the market in 1995 through 2004.[8] However, the FDA had no recommendations to change the scheduling of tramadol at this point. Tramadol eventually was classified as a schedule IV controlled substance in 2014. Schedule IV drugs, according to the DEA, are drugs with a low potential for abuse and low risk of dependence. Tramadol also has been reported to have a low potential for abuse or dependence with reports of 0.7 to 1.5 cases of abuse per 100,000 individuals.[6] Anecdotally in clinical practice, many physicians believe tramadol to be safer. However, tramadol's low potential for abuse or dependence may be overestimated. Furthermore,

tramadol exposure in opioid-addicted communities likely is concealed by access to more potent opioids.[8]

This case revealed an opioid naïve individual who became dependent on tramadol after being prescribed for a medical condition. Her long-term exposure to this schedule IV opiate, without careful monitoring, eventually brought her to find other opiates with more abuse potential. More research should be performed to determine the risks of opiate addiction due to tramadol in naïve individuals and whether more careful monitoring and control of this substance should be undertaken.

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Keywords: tramadol, opioid-related disorders, case report

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Volunteering Saved my Life! A Case of Anomalous Right Coronary Artery Take Off

Grace Nassim, M.D., MPH[1], Patrick Ters, M.D.[1,2], Freidy Eid, M.D.[1,3]
[1]University of Kansas School of Medicine-Wichita, Wichita, KS Department of Internal Medicine
[2]Cardiovascular Consultants of Kansas, Wichita, KS
[3]Cardiovascular Care, P.A., Wichita, KS

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INTRODUCTION

Anomalous right coronary artery from the left sinus is a rare and potentially serious congenital variant that can present with chest pain, and sudden cardiac death.[1] About 80% of coronary artery abnormalities seen during catheterization are benign incidental findings.[2] However, ectopic coronary origin from the pulmonary artery or opposite aortic sinus, single coronary artery, and large coronary fistulae are serious anomalies resulting in angina pectoris, myocardial infarction, heart failure, arrhythmias, and even sudden cardiac death.[1,2] We present a case of an asymptomatic middle-aged male with an abnormal electrocardiogram (EKG) rhythm strip while volunteering at an EMS course and was found to have an anomalous right coronary artery originating from the left aortic coronary sinus.

CASE REPORT

A 54-year-old white male with no significant past medical history, presented to his primary care physician with an abnormal electrocardiogram monitor strip. The patient worked as an emergency medical technician and during a first aid course, he volunteered for an EKG monitor placement and noticed repolarization abnormalities (i.e., T wave inversions). A 12-lead EKG at the primary care physician's office was normal (Figure 1).

Upon further investigation, the patient stated a positive family history of coronary artery disease in his father, but at an older age. He reported tiredness and exertional dyspnea. Physical examination was unremarkable. He was referred for an exercise nuclear stress test which revealed a large area of reversible ischemia within the right coronary artery distribution.

Then, a coronary angiogram was done and showed an anomalous Right Coronary Artery (RCA) originating from the left coronary sinus of Valsalva (Figure 2). There was no evidence of any obstructive atherosclerotic coronary artery disease. A computed tomography scan was subsequently obtained, confirming this diagnosis with a large proximal right coronary artery, with an intramural course between the pulmonary artery and aorta. The patient was referred for a surgical intervention. A vein graft was bypassed to a 1.5 mm patent ductus arteriosus, which had flows of 110 cc per minute. The patient tolerated the procedure well. He was started and discharged on aspirin, statin, and beta-blocker.

Figure 1. Normal electrocardiogram at the primary care office.

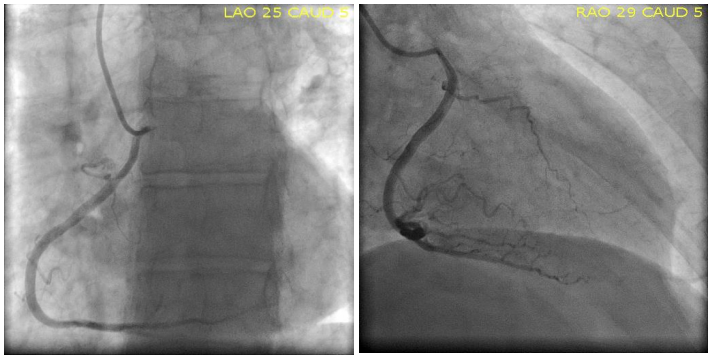

Figure 2. Coronary angiography revealed the anomalous right coronary artery from the left sinus of Valsalva.

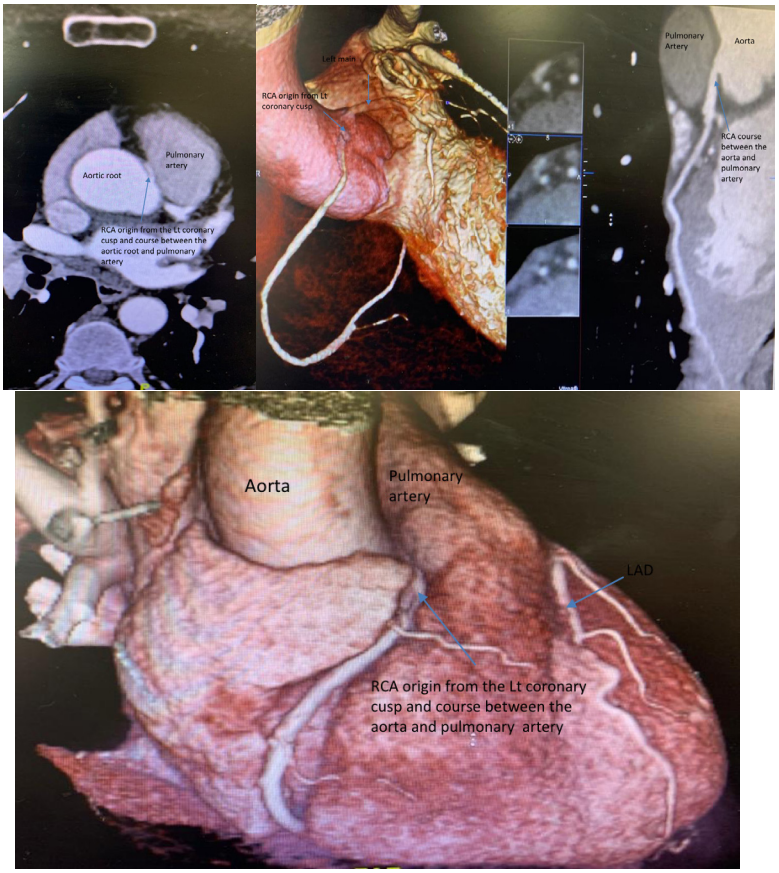

Figure 3. Cardiac coronary CAT scan showed the aberrant course of the right coronary artery with intramural course. LAD: left anterior descending artery; RCA: right coronary artery.

DISCUSSION

The incidence of anomalous origin of the RCA arising from the left coronary cusp that courses between the great vessels varies between 0.026% and 0.250%.[3] The initial presenting symptom may be sudden cardiac death, because the high inter-arterial course of the anomalous RCA between the pulmonary artery and aorta is at risk for being compressed during exertion. Therefore, making a timely correct diagnosis with the subsequent appropriate surgical procedure can improve outcomes significantly.

We reported a case report of a surgically repaired anomalous right coronary artery in a patient presenting with an abnormal EKG monitor strip. This is the first known case to reveal another presenting chief complaint for an underlying anomalous right coronary artery. It is crucial to document such presentations among physicians for early recognition and treatment.

EKG repolarization abnormalities on rhythm strips are usually due to underlying bundle branch block, hypertrophy or non-specific. Dynamic repolarization abnormalities or persistent changes in multiple configurations/axis, in the presence of a normal QRS configuration and duration, should raise suspicion for ischemia. Stress testing does not always show ischemic changes in patients with coronary anomalies. Thus, when the symptoms are typical or when there is a high suspicion for coronary anomalies (typical exertional symptoms in young patients), one should consider anatomical imaging with cardiac computed tomography or magnetic resonance imaging. Cardiac computed tomography especially is suited to identify the origin and course of coronary arteries, and their relationship to other major vessels and structures. It is superior and more detailed than coronary angiography and definitely more diagnostic than stress testing.

Anomalous coronary arteries are the second most common cause of sudden death in young athletes.[4] Our patient was fortunate to have this discovered with minimal symptoms and before any bad outcome occurred. Screening for cardiac disease in college sports participants is still a subject of debate with opposing strategies between the American and European guidelines.[5] A clinician index of suspicion, good history, and physical exam are still the main initial strategy and the driver of further evaluation.

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The State of Obesity in Kansas: A Community Based Approach to Chronic Care Management

Morgan P. Bretches[1],
Tiffany E. Schwasinger-Schmidt, M.D., Ph.D.[2]
[1]Wichita State University, Wichita, KS
[2]University of Kansas School of Medicine-Wichita, Wichita, KS
Department of Internal Medicine

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INTRODUCTION

Based on the current prevalence of obesity and projected growth rates, approximately 50% of all adults ages 18 and older in the United States will be obese within the next 10 years.[1] The state of Kansas is projected to have greater obesity rates than the national average during this timeframe at 55.6% of the population. Current estimates rank Kansas 12th in the nation for obesity prevalence, with 34.4% of adults ages 18 and older who are obese, and 39th in the nation for childhood obesity with 12.5% of the population ages 0 - 17 with obesity.[2-4] The increasing prevalence of obesity is associated with a variety of factors including: socioeconomic status, ethnic and racial disparities, genetics, geographic location, age, disability status, pregnancy, associated comorbid medical conditions, access to food, cultural beliefs, and health behaviors.[5-20]

Socioeconomic factors including income level, education, ethnicity, race, unemployment, and geographic location have a significant influence on the development of obesity (Figure 1).[1,5-10] Obesity prevalence is correlated negatively with income level, with increased rates of obesity noted in low income populations. Individuals with limited financial means often live in food deserts and gravitate toward convenient food sources that are highly processed, low in nutrient density, and high in caloric content with a long shelf life. Within the city of Wichita, there are 44 square miles of food deserts where individuals live more than 1 mile from a grocery store.[12] With limited access to food, individuals within these neighborhoods increasingly utilize convenience stores that are located within walking distance. A study conducted by the Health and Wellness Coalition of Wichita in 2013 showed that convenience stores make up 40% of the retailers within Wichita, but only 44% offer fresh fruits and 9% offer fresh vegetables.[12] The cost associated with fresh produce at these locations can be up to four times the cost of fresh produce purchased from grocery stores.

Individuals without a college degree are more likely to be obese due to limited education regarding food selection and healthy lifestyle habits.[5,8] Within the post-secondary education systems, students often receive information related to healthy behaviors including daily exercise recommendations, nutrition education, and the negative effects of obesity on overall health and wellness. With limited access to education regarding nutrition, individuals tend to select cheaper food that is promoted as being "nutritious" like fruit juices and canned fruits and vegetables, rather than fresh produce.

Geographic location has been correlated with obesity.[7-10] Within urban communities, there is increased access to exercise facilities and recreational activities and spaces, which can be restricted in resource limited rural areas. Additionally, access to fast food tends to be more prevalent within urban communities leading to increased consumption of food with high caloric density and limited nutrients. Obesity rates within the state vary by region, with the southeast portion of the state having obesity rates as high as 40.4% of the population, which is in direct contrast to the Kansas City metropolitan area at 31.7%.[9,10]

Furthermore, similar disparities exist within ethnic and racial groups in Kansas with both Hispanic and African-American populations having a higher prevalence of obesity than non-Hispanic White populations.[4] This disparity in obesity rates have been linked to cultural differences surrounding food. Additional individualized patient demographics further contribute to the development and increased prevalence of obesity.[11,13] As an individual ages, their risk of obesity increases due to changes in metabolism that promote fat deposition, food insecurity, and changes in activity levels that result in fewer calories burned compared to intake of nutrients.[11] Two-thirds of obesity begins after adolescence, and in Kansas, the prevalence increases from 21.8% (ages 18 - 25) to 36.3% (ages 26 - 44) to 40.1% (ages 45 - 64).[4] Moreover, gender has a role in the risk of obesity development with women in Kansas having a higher prevalence of obesity compared to men.

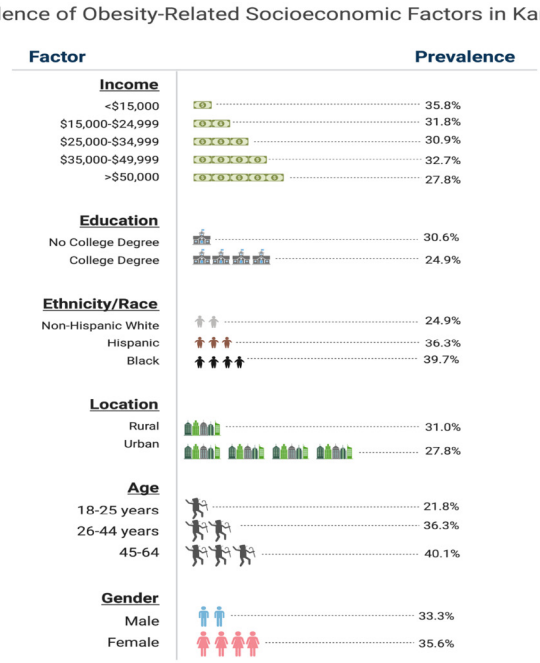

Figure 1. The impact of socioeconomic factors on the development of obesity rates within the state of Kansas. Rates reflect self-reported survey data and likely underestimate the true prevalence and the effect of demographics on the development of this disease. [Figure created with BioRender.com.]

Despite the increasing prevalence of obesity within the state of Kansas, accurate data are limited due to the majority of data consisting of self-reports of height and weight through the Behavioral Risk Factor Surveillance System (BRFSS).[1] Adjustments for self-reporting bias in body mass index (BMI) specifically have been conducted through adjustments in BMI distributions (BMI quartile, gender, and time period to control for time trends and the variation within demographic subgroups), thus allowing for comparison for the BRFSS data with the National Health and Nutrition Examination Survey (NHANES) data. NHANES data reported substantially higher obesity prevalence rates than BRFSS due to the fact that BRFSS uses self-reported data. For example, the national prevalence for adult obesity is 42.4%, per NHANES, and the national average reported from BRFSS is 30.82%.[2] Given the discrepancy of prevalence rates and methods of collection between NHANES and BRFSS, it can be assumed that NHANES has more accurate data, although BRFSS had a larger data set allowing for BRFSS and NHANES to be adjusted to each other.[1] Following adjustment of the data to minimize self-reported bias, it was evident that the prevalence of this disease is higher than originally predicted and is continuing to grow at an alarming rate.

Obesity has an effect on all organ systems in the body and can result in the development of numerous co-morbid medical conditions (Figure 2).[2,8,14-20] Within Kansas, the incidence of obesity is increased in patients diagnosed with depression compared to patients without depression. This finding can be attributed to alterations in personal body image, social stigma, and variations in neurochemistry and biological responses to stress.[8,21-23] Diabetes rates in Kansas are elevated significantly in patients with obesity compared to those without obesity. In 2010, there were 239,691 reported cases of diabetes mellitus, and by using these data, it can be projected that 367,777 total cases of diabetes mellitus will occur within the state by 2030, which is an increase of approximately 50%.[4,8] Hypertension and coronary artery disease followed a similar trend with 44.3% of obese patients experiencing high blood pressure and 38.7% with a diagnosis of coronary artery disease.[8] Without intervention, the number of new cases of heart disease will reach 769,578 cases by 2030 resulting in significant morbidity and mortality with increased healthcare resource utilization within the state.[4]

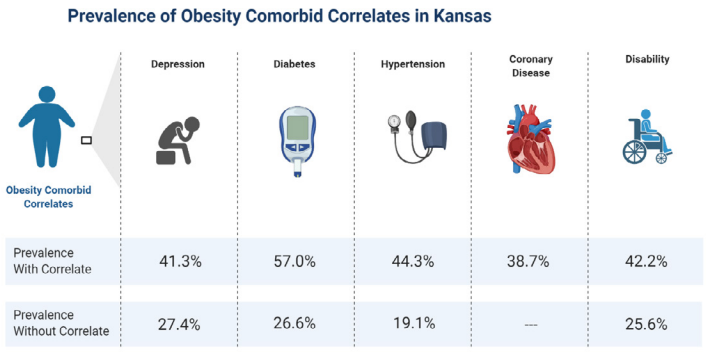

Figure 2. Prevalence of obesity related comorbid conditions in Kansas. Prevalence is based on self-reported data from BRFSS. Accurate data for prevalence of coronary disease without obesity in Kansas was unable to be obtained due to the high correlation between obesity and coronary disease. [Figure created with BioRender.com.]

Disability status due to medical conditions was also a large predictor of obesity.[8,10] Kansas followed this national trend with 42.2% of individuals on disability being obese, compared to 25.6% without a disability. Furthermore, arthritis also has an increased prevalence in obese patients with 39.8% experiencing joint inflammation.[8] Reasons for disabilities could include limitations due to multiple chronic medical conditions or limitations in activities of daily living secondary to excess weight gain.

Dietary intake and access to food can be a contributing factor to the development of obesity.[24-26] Promotion of healthy behaviors of Kansans are limited, with a significant portion of individuals in the state not meeting the recommended daily activity levels, at 45.3%.[8] Furthermore, 37.5% of all Kansans do not eat at least one serving of fruits or vegetables each day.[27] Access to healthy foods can be challenging both within urban and rural communities.[28-29] Within urban communities, food deserts are prevalent. Community-based efforts to address food insecurity including farmer's markets and community gardens placed within food deserts promote healthy eating and access to nutritious food that is beneficial on a population-based level. Increasing access to food can serve as an economic stimulus in that money spent within the community benefits the overall community.

Primary care providers are positioned to address the obesity epidemic, due to the widespread prevalence of the disease and the trusting therapeutic relationship that often is established between physicians and their patients. However, most physicians do not have adequate training in nutrition counseling and lack resources to support the implementation of a comprehensive obesity care program that incorporates evidence-based guidance on dietary modification, mechanisms for behavioral changes, and guidelines for physical activity.[30-32] Additionally, there are numerous barriers in providing obesity counseling to patients, including stigma associated with the disease, implicit provider bias, cost of services, personnel to deliver an effective behavioral modification program, limited payor coverage, lack of consistency of care, time constraints, demand for increased physician relative value units for performance, and a paucity of clear guidelines to document an encounter for reimbursement.[21,22,33,34]

A recent study investigating medical licensing examinations found that concepts deemed important for obesity prevention and treatment were not featured on certification exams for primary care providers.[35] Results from the study showed that 289 (38%) of the 802 multiple-choice questions from all three licensing exams were relevant to obesity, with a large focus on diagnosing and treating comorbid conditions versus the disease itself. Due to the substantial increase in obesity rates within recent years, it is crucial for the medical licensing examinations and medical education curricula to assess medical student and physician knowledge of obesity prevention and treatment options adequately and effectively.

Implicit bias within healthcare has been identified to be as prevalent in the general population and has been shown to affect diagnosis and treatment of disease.[33] Combating implicit bias within healthcare requires individual recognition, which can be obtained from taking implicit bias tests. Medical curricula across the country have started to implement implicit bias training in which students become more aware of their own biases and develop tools to inhibit bias in healthcare.

The cost of services associated with obesity care has continued to increase with an estimated $3,508 per obese patient in 2010.[34] The economic impact of obesity consists of both direct and indirect costs including obesity-related prevention initiatives, diagnostic testing, treatment for obesity and related co-morbid conditions, and reductions in productivity and days of lost work due to medical treatment and disability.[36] Current estimated healthcare costs associated with obesity are 209 billion dollars per year, a figure that represents 20% of all healthcare spending in the United States.[37] Lost productivity due to obesity-related conditions are estimated to cost $3.38 - 6.38 billion annually.[36]

Obesity Impact on Health

Obesity has significant systemic effects on the overall health of the population and was associated with a 20% increase in morbidity and mortality.[38,39] Estimates of all-cause mortality associated with obesity were around 18%, with women having higher mortality rates than men.[40] Obesity has a disproportionate effect on the cardiovascular system through the development of atherosclerosis, coronary artery disease, cerebrovascular accidents, hypertension, dilated cardiomyopathy, and renal disease development and progression via blood pressure dysregulation.[41-45]

The development of insulin resistance and resultant type II diabetes mellitus is another leading cause of morbidity and mortality secondary to obesity.[46] Within Kansas, the prevalence of diabetes is approximately 12%, and is the 7th leading cause of death.[4,47,48] Additional complications associated with diabetes include the development of diabetic neuropathy, diabetic retinopathy, the development and progression of renal disease, and increased lower extremity amputations.[48] Complications from diabetes has become the leading cause of kidney failure in the United States and at least 229,000 people are on dialysis or have a kidney transplant due to diabetes. Diabetes is the leading cause of blindness in the United States, and contributed to 10,000 new cases of blindness each year. Lastly, diabetes is the underlying cause for approximately 60% of non-traumatic lower extremity amputations.

A strong association exists between obesity and underlying systemic inflammation that has been linked to an increased risk of the development of various cancers, which are the second leading cause of death in the United States and Kansas.[42,43,48,49] Obesity-related malignancies include breast cancer (in postmenopausal women), colorectal cancer, renal cell carcinoma, endometrial cancer, thyroid cancer, pancreatic cancer, multiple myeloma, hepatic malignancies including hepatocellular carcinoma, ovarian cancer, and esophageal adenocarcinoma.[50] Within the United States, approximately 40% of all cancer diagnoses were made in overweight or obese individuals. Following the gender discrepancy of obesity, cancers related to obesity also had higher prevalence among females, at 55%.

Obesity negatively impacts quality of life through development of osteoarthritis resulting in an 4.2% reduction in productivity.[51] Additionally, progression of the disease adds burden to the healthcare system through increased joint replacement surgeries and limited mobility.[51-53] Specifically, within Kansas, the total number of arthritis cases in 2010 was 555,211 individuals with 38% of Kansans with arthritis who were obese.[4]

Challenges in the Treatment of Obesity

Provider-Level Challenges. Due to the increased prevalence of obesity in the United States and Kansas, the majority of obesity treatment occurs in primary care offices across the country.[1-4] Significant challenges that physicians face in the treatment of obesity include a paucity of nutrition education among healthcare professionals, reduced access to registered dietitians, challenges in interprofessional care collaboration, medication-induced weight gain, patient disability status, local community health policies, and access to evidence-based methods in addressing behavioral change.[14,16-18,32,35,54-62]

One of the most significant challenges in the treatment of obesity is the paucity of nutrition education among healthcare professionals.[35,54] Medical students and physicians who were surveyed at a Midwestern medical school felt unprepared to offer nutrition counseling to patients, and reported little-to-no observed nutrition counseling during clinical experiences.[54] Additionally, nurses are well positioned to provide nutrition education to patients due to their unique intermediary interactions between both the patients and the physician.[58] However, despite this relationship, nurses often feel unprepared to counsel patients on nutrition. All healthcare professionals could address this barrier through enhanced nutrition-based continuing education regarding simple food label interpretation (i.e., if you cannot understand the first five ingredients on the label, you should not eat it), eating closer to nature with more fruits and vegetables, shopping on the periphery of the grocery store (limiting consumption of highly processed foods located in the middle of the store), and/or limiting portion sizes by eating off the salad plate instead of the dinner plate, which has doubled in size over the past 15 years. All of the previously mentioned opportunities are simple and cost-effective methods to address the barriers in nutrition education.

Furthermore, providers can review or provide educational resources that are available online. The Obesity Society provides key recommendations focusing on the multi-facets of obesity such as pregnancy, adequate weight management tips for children and adults, and medication-induced obesity.[62-63] Additionally, the American Heart Association (AHA) has information for both the patient-level and the provider-level regarding several topics including diet, exercise, and weight management tips with a large focus and key recommendations of how obesity affects cardiovascular disease.[64] The U.S. Centers for Disease Control and Prevention has current literature on obesity prevalence, guidelines for treatment, as infographics that provide patients with visual references regarding the effects of obesity.[65]

Interprofessional collaborations between registered dietitians and physicians would aid in the quality of care that patients receive and improve health outcomes.[56] Similar to the growing physician shortages, registered dietitians are facing shortages both in the United States and in Kansas, with 89,300 total registered dietitians in the United States and 943 providers located in Kansas.[59] Limited access to these professionals is noted especially in rural communities across the state. Given the benefit of dieticians to the multidisciplinary healthcare team, it is crucial to incorporate these professionals remotely via telemedicine or through grant-based funding to bring increased resources to rural communities.

Medications used in the treatment of chronic medical conditions can result in increased weight gain.[17-18] For example, insulin use in patients with type II diabetes mellitus can result in weight gain, which further increases cardiovascular morbidity and mortality in an already high risk population.[17] Additionally, antipsychotics used for the treatment of mental health conditions promote weight gain.[18] An average weight gain of 3.22 kilograms was found in patients who use antipsychotics short-term, and 5.30 kilograms on average in patients with long-term use of the medications. Due to this risk of side effects associated with medication use, healthcare professionals should monitor the patient's weight throughout the course of treatment and adjust treatment as indicated if the patient has significant weight gain on the medications.

Additionally, behavioral change is a crucial component to addressing the obesity epidemic.[60-62] Physicians should recommend and assist with behavioral therapies to include: setting initial goals, self-monitoring, controlling or modifying the stimuli that activates eating, eating style, behavioral contracting and reinforcement, nutrition education and meal planning, increasing physical activity, social support, cognitive restructuring, and problem solving. These elements consist of a comprehensive lifestyle change that can aid patients to succeed in addressing weight loss. Examples of how physicians can aid in the critical elements of behavioral therapy are assisting with a realistic and healthy weight loss schedules, encouraging food diaries, providing healthy stimulus suggestions, suggesting to slow patients' eating styles, promoting regular weight checks and documentation of weight changes, suggesting behavioral rewards that are not linked to food, providing nutritional education or referral to a registered dietician, promoting physical activity prescriptions, and referring to support groups to maintain a social support system. The efficacy of behavioral therapy has proven benefits when there is a comprehensive plan established.

Patient-Level Challenges. In a recent study, approximately 62% of food within the United States was found to be hyper-palatable and contains a high percentage of fats, sugars, carbohydrates, and sodium.[26] These hyper-palatable foods have been linked to reward circuits in the brain, so that when these foods are consumed, individuals receive an infusion of dopamine resulting in a reward based stimulus. Additionally, foods that are labeled as lower in fat and/or calorie content often have other measures of hyper-palatability further contributing to this epidemic. Food labels often are deceiving and the general population has difficulty interpreting both the front-of-the-package and back-of-the-package labeling.[66] Food labels largely are regulated by the U.S. Food and Drug Administration (FDA).[67] The FDA assures that labeling of foods provides consumers with statement of identity, the product's net weight, manufacturer's address, nutrition facts, and ingredients lists. Additionally, the labels must follow certain rules to include serving size, macronutrients, and vitamins and minerals. However, for the average person, these labels are confusing and require basic knowledge of nutritional needs and correct interpretation of the serving size, which often proves to be challenging for many people, as demonstrated by Figure 3.

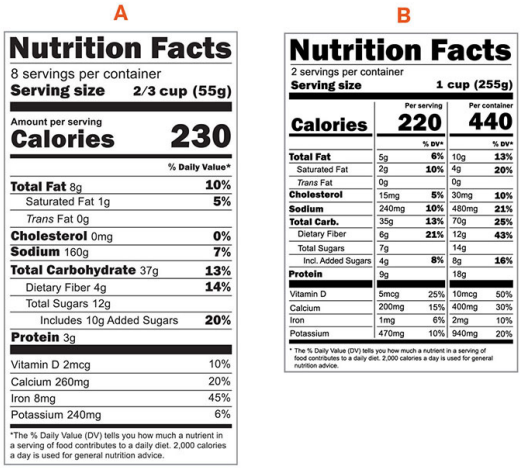

Figure 3. Examples of current food labels and how the information is presented. (A) Per serving-based label. (B) Per serving and per container-based label. Obtained from: https://www.nia.nih.gov/health/reading-food-labels.

Simple labeling, such as a "stop light" color-coded system, has shown merit by identifying the high, medium, and low nutrient content in food.[65] Mislabeling results in "hidden calories" that increase the intake of nutrient poor foods leading to increased fat deposition in the body. The relabeling of food to include simple and easy to understand methods, such as the "stop light" coded system, would create a simple, effective method to promote healthy eating (Figure 4).

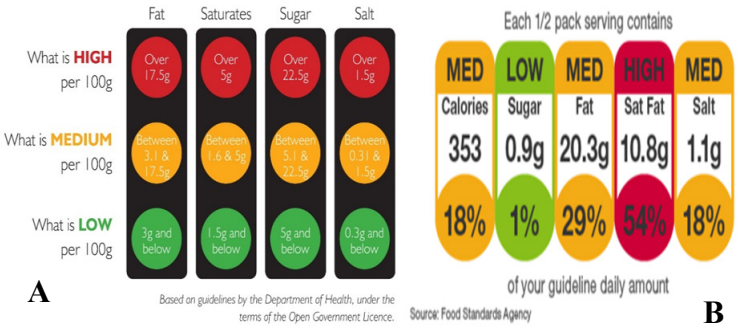

Figure 4. (A) Examples of food labels coded with the stop light system (https://www.chss.org.uk/supportus/hps/foodlabels/). (B) A sample food label with the stop light labeling (https://www.foodnavigator.com/Article/2014/04/28/From-traffic-light-to-colour-coded-labelling).

Stop light food labels have been proven to be effective in a recent study.[68] The study reported that when a hospital cafeteria adopted the stop light labeling method, hospital employees consumed reduced calories and more nutritious foods, which was sustained for two years after first adopting the method. Moreover, stop light food labels are becoming more popular, given the benefits and readability. However, despite the benefits, adopting this method of food labeling requires additional research on effectiveness in large populations and federal funding to ensure compliance.

Additional barriers to the treatment of obesity include societal norms and individual health behaviors, such as the social acceptance of obesity, known as the "obesogenic culture".[69-71] Individuals who were overweight or obese rated their weight as "about right", suggesting a normalization of obesity among the population.[69] The normalization of overweight and obese individuals can pose severe health consequences at the population level due to the increased risk for co-morbid disease development. Cultural beliefs and historical events also impacted obesity development.[19] When the history of our nation is examined, increased weight was viewed as a sign of wealth indicating increased access to food. In some cultures, increased weight was perceived historically as a desirable trait, especially in women, as it was viewed as a marker of increased fertility and baseline reserves. However, in contrast, current cultural beliefs have shifted to the opposite end of the spectrum, favoring thin individuals across all age groups examined.[70] Additionally, overweight individuals were rated more negatively than their thin counterparts, creating harmful long-term consequences.

The current societal views regarding weight gain and obesity center on negative social stigmas that can harm an individual's confidence and hinder motivation for behavioral change.[71] Moreover, the negative stigmatization associated with obesity in recent years has contributed to negative health outcomes through increased mental illness, which creates a confounding burden. Overcoming these challenges can be achieved by providers promoting a positive, reassuring, and supportive role to patients with frequent check-ins and enhanced patient activation in their own care. Ways to overcome cultural barriers and societal stigmas include gaining a deeper understanding of the patient's culture and finding ways to highlight health promotion with regards to cultural beliefs that align health promotion within the community. This can be achieved through the use of community health workers, which are individuals within the target community who can partner with providers to promote health through the use of cultural norms and beliefs.[57] These individuals can aid in care coordination, social support, resource linking, health assessments, coaching, and medication adherence promotion. Community health workers enhance access to care which improves patient outcomes and the overall health within the community.

The health behaviors in the United States have been changing steadily with the increasing use of technology, and the negative effects of "screen-time" on obesity development is a significant contributor to the growing epidemic.[72,73] In an age of technology, combatting the effects of "screen-time" can be overcome by simple measures including walking while responding to emails or text messages (as long as the participant is aware of their surroundings and is not completing this task in a high risk situation, including walking across a street), the use of standing or exercise desks, Nintendo Switch™ and Wii™ games that incorporate movement with entertainment for short periods of time, and streaming workout videos on the numerous online platforms.

Lastly, a significant challenge in the treatment of obesity focuses on the barriers within the community regarding access to food and safe spaces to exercise.[48] Both local and national health policies affect the prevalence of obesity within a community and can create a challenge for patients and providers.[48,55] For example, within Kansas, surveyed legislators ranked obesity as the second highest priority for the state, only after increasing employment rates; yet few initiatives have been passed on a state level to promote health and reduce the prevalence of obesity.[56] Individual counties have made significant advancements in chronic care management despite the paucity of state-wide initiatives. After Sedgwick County completed the local food assessment in 2015, it found that if policies supported farmers to provide 5% of fruits and vegetables to grocery stores in Sedgwick County, it would lead to an overall local economic benefit of $54.6 million.[48] These data stimulated the formation of a local Food Policy Committee to focus on enhancing the food supply, by creating neighborhood gardens and promoting local farmer markets. Furthermore, local churches and community organizations can promote health and wellness by advocating exercise and nutritional foods, contributing to overall population health within the local community.

Urban and Rural Community Resources

There are a variety of available resources for both urban and rural communities including social media platforms, mobile applications, smart watches, active commuting, community exercise centers, breastfeeding initiatives, and farmers markets; all of which can help to fight the obesity epidemic throughout Kansas communities.[6,74-79] Social media platforms, mobile applications, and smart watches each have possibilities in aiding in weight loss and healthy eating. Specifically, social media platforms are a way to follow healthy eating recipes and allow providers to connect patients with health-based information that aligns with their own values. Examples of healthy lifestyle influencers are Fit Men Cook, Kayla Itsines, Massy Arias, and Dwayne "The Rock" Johnson. However, patients should be advised of the pros and cons that exist with social media platforms.[74] While social media can create inspiration, it also can create unrealistic expectations, which psychologically could be damaging to patients. Additionally, social media can propagate false information so only reputable sources should be encouraged through patient education of healthy behaviors and the use of reliable resources.

Mobile applications and smart watches additionally promote weight loss and healthy eating in an environment that is accessed easily by all patients in all settings. There are a variety of mobile applications designed to track daily food intake and caloric content, as well as recording physical activity levels and calories burned.[77] Examples include Ideal Weight, MyFitnessPal, Noom, and Nike Run Club. Ideal Weight tracks participant's daily weight and BMI by their "Weight Wheel," which provides graphs to help the participant understand how their recent dietary choices affects their weight. MyFitnessPal relies on an established food database and pairs it with a barcode scanner to track the participant's nutrient intake, calorie content, and offers insights to how one can make healthier choices. Noom is unique in that it relies on psychology to create a custom approach to develop healthier habits. Noom also tracks the participant's weight, blood pressure, blood sugar, exercise, and food intake. Lastly, the Nike Run Club application provides encouragement throughout the participant's walk or run by connecting to Facebook and as friends "like" the post, a cheer comes through the participants' headphones. Mobile applications offer the ease and convenience needed for

individuals with busy lives, and many of the nutrition trackers simplify the ability to monitor energy intake and expenditures.

Smart watches allow an opportunity to interface across devices and provide reminders for physical activity and water consumption, aiding in healthy behaviors and patient activation with health outcomes. Other technology-based obesity-reduction strategies include smart scales, which can connect to all the patient's devices and track/graph the patient's weight loss progress.

Technology-based initiatives, when combined with healthcare system approaches, can have a significant positive impact on weight-reduction and healthy behavior modifications.[75,76,78] Individuals with technology-based initiatives in addition to the aid of healthcare services, noted at least a five percent reduction in weight in six months.[75] Additionally, a meta-analysis noted at least one kilogram of weight loss among those using mobile applications compared to others without mobile technology initiatives.[76] Another benefit to mobile applications is both patients and providers report being satisfied with the application for weight loss.[78] Furthermore, the effectiveness of the mobile applications has been noted in obesity. The mobile applications showed weight reduction and sustained weight loss when obese patients added them to their treatment plan in primary and secondary care.[79] With the numbers increasing as users embrace their platforms, mobile applications prove to be a valuable tool that providers can encourage patients to use to promote overall health and improved clinical outcomes.

Another resource for physicians in urban and rural communities is the promotion of active commuting and local community exercise and recreation centers. Active commuting, which could be biking or walking to work and shopping, is an easy way to promote health. In fact, communities with active commuting noted an overall reduction of 0.51 kg/m^2 to BMI over time within the community at large.[6] Recreation centers, like the Greater Wichita YMCA, have a variety of classes that focus on nutrition counseling, cooking, and personal and group fitness.[79] Other community organizations can promote walking and running by local distance walks/runs, which often support local charities.[48]

Breastfeeding promotion has the ability to relieve childhood obesity by offering a safeguarding factor against disease development.[80] Breastfeeding can influence immunological, developmental, neural, endocrine, and psychological systems of a child that are believed to contribute to a reduced incidence of childhood obesity. Within Kansas, the rates for breastfeeding decrease from 3 months of age to 6 months of age by 58.2% to 38.5%, respectively.[81] These data suggested that continued education by providers and support for nursing mothers in the workplace can promote long-term breastfeeding and the public health benefits associated with it. Physicians and providers can encourage breastfeeding and provide/promote maternal classes in the community. Additionally, physicians can advocate for more access to private areas to pump and for daycares at the mother's workplaces to promote maternal breastfeeding, which can lead to improved clinical outcomes for both the mother and child.

One of the most important aspects of chronic disease management and prevention is community outreach and education. Healthcare providers have a unique role in that they provide both engagement and education on chronic care management and preventive care. Raising awareness about obesity and the health outcomes associated with the epidemic can occur across diverse settings. Engagement and education can take place at health clinics, hospitals, medical schools, the health department, and community organizations. Physicians working interprofessionally with health champions in the community can promote culturally appropriate and individualized care plans that result in enhanced engagement, education, and health outcomes on a population level. Additionally, healthcare providers can get involved with local schools to reinforce healthy behaviors early to empower families at home and prevent future generations of obese patients. Engagement and education by healthcare providers also should include advocacy within local, state, and federal governments in a continued effort to create policies to enforce positive health outcomes.

CONCLUSIONS

Given the increasing prevalence of obesity, a heightened awareness of this epidemic is needed from healthcare providers. The negative systemic effects of obesity on the population, both nationally and locally, continue to impact the overall health of Americans significantly. Providers can address and engage obese populations in diverse ways to align with the individual's beliefs, culture, and personal goals. Utilization of local and national resources can provide a team-based interprofessional approach, which is an essential component of chronic disease management. By eliminating barriers to better health outcomes and working together as a team, healthcare providers across Kansas can contribute positively to the overall health of individuals within our state.

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Comparative Prevalence of Incidentally Detected Lung Malignancies on CTAC for MPI

Joseph Lee, MBBS, FRACP, Jia Wen Chong, B Med Sci, MBBS
The University of Queensland, Brisbane, Queensland, Australia

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Dear Editor:

We read with interest the study published by Tung and Heyns.[1] It echoes the sentiments we espoused in our findings.[2] We, too, support thorough investigation of incidental findings on computed tomography for attenuation correction (CTAC) during myocardial perfusion imaging (MPI). In particular, we share concerns about lung malignancies discovered by this avenue.

Interestingly, there were considerable similarities as well as significant differences in the respective patient cohorts. The age group was comparable. In both groups, there was a range of histologic types represented. On the other hand, we noted that the series of patients studied by Tung and Heyns[1] was entirely male. Most surprisingly was the occurrence rate of malignancies being discovered incidentally on MPI. The frequency of malignancy of chest in the patients who underwent MPI in this series was 0.73% (8/1,098 patients). By contrast, we identified 10 primary thoracic cancers amongst 3,122 patients. This equates to 0.32%. This is less than half the frequency suggested by Tung and Heyns.

We wonder if the CTAC settings (in terms of voltage, current, collimator, rotation time and pitch) were comparable. Other factors which determine spatial resolution on CT scan include field of view, pixel size, focal spot size, magnification, patient motion, kernel, slice thickness, detector size.[3] We are at a loss to explain the difference in detection rates otherwise. Perhaps the authors can give suggestions on why our respective cohorts, and prevalences, differed so significantly.

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Reply to Dr. Lee and Dr. Chong

Robert T. Tung, M.D., Johannes Heyns, M.D.
U.S. Department of Veterans Affairs, Eastern Kansas HealthCare System, Topeka, KS

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Delaney et al.[1] reported 10/3,122 (0.32%) frequency of detecting chest malignancy by CTAC during MPI because of significant incidental findings (IF) compared to 8/1,098 (0.73%) patients in our patients.[2] However, our recent report included not only 6/1,098 (0.55%) cases of chest malignancies detected initially because of IF on CTAC,[3] it also included an additional two cases of malignancy detected during one-year follow-up among those patients who were found to have significant IFs that required further follow-up. Thus, the comparable prevalence of detecting chest malignancy in our respective series was 0.32% vs. 0.55%. We are uncertain for the reason(s) for higher prevalence of malignancy in our study but a few factors might be considered:

1) The SPECT/CT MPI cameras used in our study were Siemens' Symbia Intevo Excel[3], installed in 2016, a newer version of Symbia T6 camera used in their study.

2) In our study, both sets of CT at rest and after stress were reviewed to reduce or minimize the effects of respiratory motion artifact; it is unclear to us if these also were performed in their study.

3) They correctly pointed out that most of our patients were of male gender; this was due to the fact that our patient population included only veterans, who were predominantly male. They are particularly at risk as current or past smoking is more common among the veterans.[4] According to recent US Centers for Disease Control and Prevention report, about 29.2% US veterans used tobacco products during 2010-2015 which was similar to that reported in 1997.[5] The higher incidence of malignancy in our studies could be due to these differences in the patient population studied.[2,3]

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Demographics and Incident Location of Gunshot Wounds at a Single Level I Trauma Center

Blair Benton, MS-4[1], David Watson, MS-4[1], Elizabeth Ablah, Ph.D., MPH[2], Kelly Lightwine, MPH[3], Ronda Lusk, RN[3], Hayrettin Okut, Ph.D.[2], Thuy Bui, MPH[4], James M. Haan, M.D.[1,3]

University of Kansas School of Medicine-Wichita, Wichita, KS

[1]Department of Surgery

[2]Department of Population Health

[3]Ascension Via Christi Hospital on St. Francis, Department of Trauma Services, Wichita, KS

[4]University of Kansas School of Medicine-Wichita, Department of Pediatrics, Wichita, KS

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ABSTRACT

Introduction. Kansas has seen a steady increase in the rate of firearm deaths and injuries. Little is known surrounding the demographic and geospatial factors of these firearm-related traumas. The purpose of this study was to describe the overall incidence of firearm-related traumas, identify high injury locations, and examine any racial/ethnic disparities that may exist.

Methods. A retrospective review was conducted of all patients 14 years or older who were admitted with a gunshot wound (GSW) to a Level I trauma center between 2016 and 2017.

Results. Forty-nine percent of patients were Caucasian, 26.5% African American, and 19.6% Hispanic/Latino. Hispanic/Latino patients were the youngest (25.8 ± 8.8 years) and Caucasians were the oldest (34.3 ± 14.1 years, p = 0.002). Compared to Caucasian patients, African American (42.0%) and Hispanic/Latino (54.1%) patients were more likely to be admitted to the intensive care unit (ICU; p = 0.034) and experienced longer ICU lengths of stay (2.5 ± 6.3 and 2.4 ± 4.7 days, p = 0.031, respectively). African American patients (96.0%) experienced more assaults, while Caucasians were more likely to receive gunshot wounds accidentally (26.9%, p = 0.001). More African American (86.0%) and Hispanic/Latino (89.2%) patients were injured with a handgun and Caucasians sustained the highest percentage of shotgun/rifle related injuries (16.1%, p = 0.012). Most GSWs occurred in zip codes 67202, 67203, 67213, 67211, and 67214. Geographical maps indicated that GSWs occur in neighborhoods with low-income and high minority residents and in the downtown and nightclub areas of the city.

Conclusions. Most GSW victims were older Caucasian males. Racial differences were noted and injury locations concentrated in certain locations. ***Kans J Med 2021;14:31-37***

INTRODUCTION

Firearm-related traumas are a leading cause of morbidity and mortality in the United States (U.S.).[1,2] Each year in the U.S., there are approximately 67,000 nonfatal and 32,000 fatal firearm-related injuries.[2] Among U.S. adults aged 17 to 25 years, firearm-related injuries accounted for 80% of homicides and 45% of suicides.[3] Annually, the U.S. hospital cost for treating GSWs is close to $3 billion.[4] In 2016, Kansas had 383 firearm-related deaths, with a mortality rate of 13.4 per 100,000.[5] This was slightly higher than the national average of 11.8 per 100,000.[6]

Firearm ownership has been associated with an increased risk of firearm-related injury and mortality.[7-9] Also, several studies have noted a relationship between state firearm laws and the frequency of firearm-related homicides.[3,9-11] States with a higher number of firearm laws had 6.6 fewer firearm-related deaths per 100,000 per year than states with fewer firearm laws.[9] States with "Stand Your Ground" laws and states with "Right to Carry" laws, like Kansas, have been shown to have an increased incidence of firearm mortality.[3,10]

Racial disparities in firearm violence exist.[4,12-17] Young African American males are represented disproportionally among GSW victims.[12-17] In 2012, firearm violence was the leading cause of death among African American males 15 to 34 years of age.[1] Compared to Caucasian and Hispanic/Latino males, African American males have higher firearm-related homicide rates.[12] The Riddell et al. study of state firearm homicide and suicides in Black and White non-Hispanic men found that African American males had 27 more firearm-related homicides per 100,000 per year than Caucasian males.[12] On the other hand, older Caucasian males are at a higher risk for firearm-related suicides when compared to other race/ethnic groups.

National trends indicated firearm-related deaths vary by state and were more common in Southern states.[1,2,12] Additional studies also suggested that injury locations are not random but occur in areas with specific demographic and socioeconomic characteristics.[15-21] Differences between urban and rural firearm deaths also have been established.[22-23] Since the beginning of 2015, Kansas has seen a steady increase in the rate of firearm-related traumas.[24] Little is known surrounding the demographic and geospatial factors of these injuries. The purpose of this study was to describe the overall incidence of firearm-related traumas, identify injury location, and examine any racial/ethnic disparities that may exist.

METHODS

Kansas is a predominantly rural state and is served by three American College of Surgeons Committee on Trauma (ACS COT)-verified Level 1 trauma centers. Two of these centers, Wesley Medical Center and Ascension Via Christi St. Francis, are located within Sedgwick County and are 2.3 miles apart. The dividing line for patient trauma destination is determined by Interstate 135 (I-135), which runs north-south through the city (Figure 1). Injuries east of I-135 go to Wesley Medical Center and injuries west of I-135 go to Ascension Via Christi St. Francis. Among traumas that occur outside of the county line, patient trauma destination is determined either by the responding Emergency Medical Services (EMS) or the transferring facility. However, there is some overlap of injuries due to trauma patients arriving by private vehicle and transfers from non-trauma center.

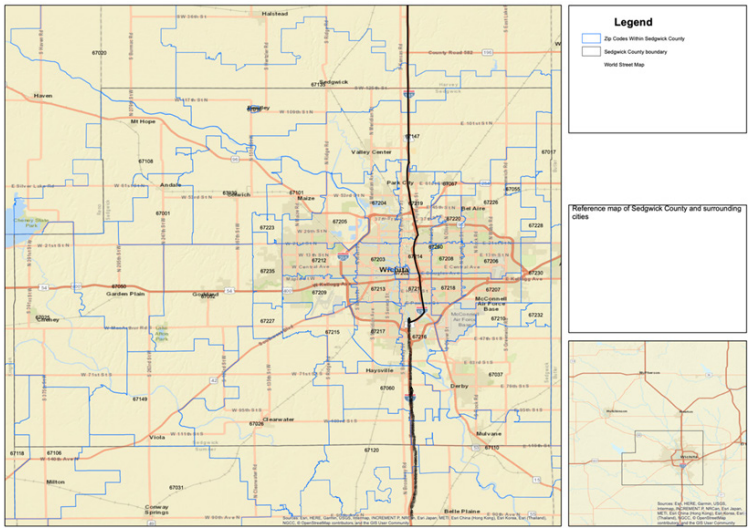

Figure 1. Sedgwick County reference map indicating I-135 dividing line for trauma patient destination.

A retrospective chart review was conducted of all patients 14 years or older who were admitted with a gunshot wound to Ascension Via Christi St. Francis from January 1, 2016 through December 31, 2017. Patients were excluded if the injury occurred outside of Kansas or if the GSW was self-inflicted. Injuries documented as "self-inflicted" include patients who intentional harmed themselves, such as suicides and attempted suicides. This information is based on information collected at the scene of the injury and provided to hospital staff by first responders or from EMS reports.

Patient identification and data retrieval were performed using the trauma registry and electronic patient medical records. Abstracted patient data included demographics (race/ethnicity, age, gender, insurance status), injury details (mechanism of injury, Injury Severity Score [ISS], abbreviated injury severity scores [AIS], injury location [street address and zip code]), hospital parameters (intensive care unit [ICU] admission and length of stay, mechanical ventilation use and length of use, hospital length of stay), discharge destination, and mortality. The type of gun used (handgun, shotgun/rifle, unspecified) and intent surrounding the injury (assault, accidental, legal intervention, unspecified) also were abstracted from the trauma registry and patient chart.

Patient race and ethnicity are provided to the trauma department by the patient. If a patient was reported as being biracial or having two ethnicities, they were characterized by the first race/ethnicity listed in the registry. The intention surrounding the GSW was documented in the trauma registry based on information provided by EMS or the patient. If no intention was given, the injury was marked as unspecified. When a patient sustained multiple GSWs involving different body regions, they were reported as having two or more AIS.

Descriptive analyses were presented as frequencies with percentages for categorical variables and means with standard deviations for continuous variables. Before performing comparative analysis, patients were grouped by the three most predominant race/ethnicity categories (Caucasians, African American, Hispanic/Latino). Independent sample t-tests were used to explore mean differences between continuous variables, while Chi-square tests were used to assess the distributions of categorical variables.

Kernel Density Estimation (KDE) was used to create maps of GSW injury locations. KDE is a non-parametric technique for estimating the probability density function of a random variable. Using ArcGIS Desktop version 10.4.1 (ESRI, Redlands, CA), KDE was used to estimate risk zones by calculating the density of GSW injury locations around individual output raster cells as a function of the frequency and proximity of known trauma injury locations.[23]

The final output is displayed as a smoothly tapered raster image. The value of the smoothly tapered surface is highest at the location of the point and diminishes with increasing distance from the point, reaching zero at the search radius distance from the point. The following equation was used to determine the search radius: Search Radius = $0.9(SD,\sqrt{(1/ln 2)} \times D_m) \times n^{-0.2}$.

To demonstrate the socioeconomic characteristic among the population in our study area, additional maps were created using zip-code barriers and the U.S. Census Bureau 2016 American Community Survey.[24] These maps display the percentage of residents living below the Federal Poverty Level (FPL), and the percent of non-Hispanic Black, and Hispanic/Latino residents in our study area.[24]

All statistical tests were two-sided, and analyses were considered significant when the result was $p \leq 0.05$. Descriptive statistics for nominal, categorical, and continuous variables were conducted by using PROC FREQ and PROC UNIVARIATE in SAS version 9.4 (SAS Int. Inc., Carry, NC). This study was approved by the Institutional Review Board at Via Christi Hospitals Wichita, Inc. and the Human Subjects Committee at the University of Kansas School of Medicine-Wichita.

RESULTS

Of the 217 patients admitted with a gunshot wound, 26 were excluded due to being intentionally self-inflicted, and two were excluded due to incident location being outside of Kansas. Among the 189 patients included, most were male (89.4%, n = 169) with an average age of 30.9 ± 12.9 years (Table 1). Broken down by race/ethnicity, 49.2% (n = 93) were Caucasians, 26.5% (n = 50) African American, and 19.6% (n = 37) Hispanic/Latino. Self-pay/charity (52.4%, n = 99) was the most common payment method followed by Medicare/Medicaid (24.9%, n = 47). A comparison of patients by race/ethnicity revealed no differences except for age. Hispanic/Latino patients comprised the youngest patients (25.8 ± 8.8 years) and Caucasians were the oldest group (34.3 ± 14.1 years, p = 0.002).

Patient injury severity and hospital outcomes are presented in Table 2. Twenty-three percent (n = 44) of all patients had an ISS > 15 with most of these injuries either being an extremity (24.9%, n = 47) or chest injury (21.7%, n = 41). Although less than half of all patients required ICU admission (37.6%, n = 71), 42.3% (n = 80) required a surgical procedure. Most patients were discharged home (72.5%, n = 137) and 8.5% (n = 16) died. Across all groups, African American (42.0%, n = 21) and Hispanic/Latino (54.1%, n = 20) patients were more likely to be admitted to the ICU (p = 0.034) and had longer ICU

lengths of stay (2.5 ± 6.3 and 2.4 ± 4.7 days, p = 0.031, respectively) than Caucasian patients. No other differences were noted between the groups.

Table 1. Demographics of patients presenting with gunshot wounds by race/ethnicity.

Parameter*	Total	Caucasian	African American	Hispanic/Latino	p value
Number of patients	189 (100%)	93 (49.2%)	50 (26.5%)	37 (19.6%)	
Gender					0.834
Male	169 (89.4%)	83 (89.3%)	44 (88.0%)	34 (91.9%)	
Female	20 (10.6%)	10 (10.8%)	6 (12.0%)	3 (8.1%)	
Average age	30.0 ± 12.9	34.3 ± 14.1	29.4 ± 12.0	25.8 ± 8.8	0.002
Age groups					0.130
14 - 19	37 (19.6%)	13 (14.0%)	11 (22.0%)	9 (24.3%)	
20 - 24	40 (21.2%)	13 (14.0%)	12 (24.0%)	13 (35.1%)	
25 - 29	29 (15.3%)	16 (17.2%)	6 (12.0%)	7 (18.9%)	
30 - 34	28 (14.8%)	16 (17.2%)	6 (12.0%)	4 (10.8%)	
35 - 39	15 (7.9%)	8 (8.6%)	6 (12.0%)	1 (2.7%)	
40+	40 (21.2%)	27 (29.0%)	9 (18.0%)	3 (8.1%)	
Insurance					0.274
Self-pay/charity	99 (52.4%)	48 (51.6%)	24 (48.0%)	20 (54.1%)	
Medicare/Medicaid	47 (24.9%)	19 (20.4%)	18 (36.0%)	8 (21.6%)	
Commercial	26 (13.8%)	15 (16.1%)	6 (12.0%)	5 (13.5%)	
Workers compensation	10 (5.3%)	8 (8.6%)	1 (2.0%)	1 (2.7%)	
Other	7 (3.7%)	3 (3.2%)	1 (2.0%)	3 (8.1%)	

Table 2. Injury severity and hospital outcomes of patients presenting with gunshot wounds by race/ethnicity.

Parameter*	Total	Caucasian	African American	Hispanic/Latino	p value
Number of patients	189 (100%)	93 (49.2%)	50 (26.5%)	37 (19.6%)	
Injury Severity Score > 15	44 (23.3%)	19 (20.4%)	13 (26.0%)	11 (29.7%)	0.493
Abbreviated Injury Severity Score ≥ 3					
Head	9 (4.8%)	3 (3.2%)	5 (10.0%)	1 (2.7%)	0.230
Chest	41 (21.7%)	18 (19.4%)	10 (20.0%)	11 (29.7%)	0.335
Abdominal	22 (11.6%)	8 (8.6%)	6 (12.0%)	6 (16.2%)	0.337
Extremity	47 (24.9%)	20 (21.5%)	11 (22.0%)	12 (32.4%)	0.889
Two or more AIS scores	46 (24.3%)	17 (18.3%)	15 (30.0%)	11 (29.7%)	0.188
ICU admit	71 (37.6%)	28 (30.1%)	21 (42.0%)	20 (54.1%)	0.034
ICU length of stay (days)	1.9 ± 4.9	1.6 ± 4.3	2.5 ± 6.3	2.4 ± 4.7	0.031
Mechanical ventilation	39 (20.6%)	16 (17.2%)	11 (22.0%)	10 (27.0%)	0.446
Mechanical ventilation (days)	1.1 ± 3.9	0.8 ± 2.9	1.6 ± 5.6	1.4 ± 3.9	0.262
Surgery	80 (42.3%)	38 (40.9%)	21 (42.0%)	17 (45.9%)	0.960
Hospital length of stay (days)	4.5 ± 7.6	4.2 ± 6.5	5.1 ± 10.5	5.0 ± 6.5	
Disposition					0.225
Home/home with care	137 (72.5%)	66 (71.0%)	36 (72.0%)	26 (70.3%)	
Left AMA/Jail	16 (8.5%)	9 (9.7%)	5 (10.0%)	2 (5.4%)	
Rehabilitation	13 (6.9%)	6 (6.5%)	2 (4.0%)	5 (13.5%)	
Skilled nursing	7 (3.7%)	6 (6.5%)	1 (2.0%)	0 (0.0%)	
Mortality	16 (8.5%)	6 (6.5%)	6 (12.0%)	4 (10.8%)	0.484

*Values presented as n (%) or mean ± standard deviation.

Differences were noted between race/ethnic groups concerning the intent and type of gun used (Table 3). Among African American patients, 96.0% (n = 48) were reported as assault-related GSWs, while Caucasians sustained the most reported accidental GSWs (26.9%, n = 25, p = 0.001). Handguns were the most commonly used weapon of choice among all races, however, more African American (86.0%, n = 43) and Hispanic/Latino (89.2%, n = 33) patients were injured with a handgun than Caucasians (72.0%, n = 67, p = 0.012). Compared with the other race/ethnic groups, Caucasians experienced the highest percentage of shotgun/rifle injuries (16.1%, n = 15). No differences were noted regarding race and positive alcohol and drug tests.

Figure 2 displays the map of GSW locations for only those patients with a known incident location (70.4%, n = 133). Colors corresponded to density of cases per square mile, with red representing the highest and white the lowest. GSW incidents were concentrated in the downtown area of the study city and located southwest of the hospital. Most GSWs occurred in zip codes 67202, 67203, 67213, 67211, and 67214.

Additional maps using U.S. Census demographic data display the neighborhood characteristics for our study area population (Figures 3, 4, and 5). Figure 3 displays the percentage of area residents living below the federal poverty level (FPL). The percentage of non-Hispanic Black residents and the percentage of Hispanic/Latino residents are displayed in Figures 4 and 5, respectively. Zip code 67214 had one of the highest percentages of residents below the FPL and had a higher percentage of non-Hispanic Black, and Hispanic/Latino residents. This same zip code also corresponds to one of the highest incidents of GSWs among our trauma patients.

DISCUSSION

National and single-site GSW studies noted that the distribution of gunshot wounds is not equal regarding age, gender, and race/ethnicity.[4,12-17] Most of these studies demonstrated that GSWs occur predominately among males, African Americans, and among those less than 30 years of age.[4,12-17] Our study findings were similar in that most of our patients were male and were predominately 35 years of age and under. However, our findings were not consistent when considering race. In our study, most GSW victims were Caucasian and not African American as other studies indicated.[4,12-17]

One possibility for this discrepancy in study findings could be related to study location and difference between rural vs. an urban landscape, as our hospital serves both rural and urban populations.[22,23] In addition, in our study, Hispanic/Latinos represent 13% of the surrounding population and African Americans 11%.[24] Compared to other studies, our percentage of resident African Americans was lower.[13,16,17] For example, a GSW study conducted at a Tennessee Level 1 trauma center noted their city population of African Americans at 27.9% for Nashville Davidson County and 16.9% for Tennessee residents.[13]

Racial differences were noted among our GSW trauma patients. In the current study, African Americans were younger than Caucasian patients, which was in agreement with previous findings.[12-17] However, Hispanic/Latinos GSW victims were the youngest age group overall. The current study also suggested racial differences in clinical outcomes, despite injury severity being similar. For instance, Hispanic/Latinos and African Americans were more likely to be admitted to the ICU and had longer ICU lengths of stay than Caucasian patients. Similar results were found by Zebib and colleagues which suggested that Hispanic/Latino and African American patients were more likely to be admitted to the ICU and experienced longer ICU lengths of stay than Caucasian patients.[17] In their study, African American patients also experienced a significantly higher number of multiple gunshot wounds compared to White patients (42% vs. 35.2%, p = 0.019), which could be one of the reasons for the longer ICU length of stay. In our study, both African American and Hispanic patients also experienced a higher number of multiple gunshot wounds, however, our results were not statistically significant.

Table 3. Gunshot wound details of patients presenting with gunshot wounds by race/ethnicity.

Parameter*	Total	Caucasian	African American	Hispanic/Latino	p value
Number of patients	189 (100%)	93 (49.2%)	50 (26.5%)	37 (19.6%)	
Intent					0.001
Assault	150 (79.4%)	66 (70.9%)	48 (96.0%)	28 (75.7%)	
Accidental	32 (16.9%)	25 (26.9%)	1 (2.0%)	5 (13.5%)	
Legal intervention	4 (2.1%)	1 (1.1%)	0 (0.0%)	3 (8.1%)	
Unspecified	3 (1.6%)	1 (1.1%)	1 (2.0%)	1 (2.7%)	
Type of gun					0.012
Handgun	148 (78.3%)	67 (72.0%)	43 (86.0%)	33 (89.2%)	
Unspecified	23 (12.2%)	11 (11.8%)	6 (12.0%)	2 (5.4%)	
Shotgun/rifle	18 (9.5%)	15 (16.1%)	1 (2.0%)	2 (5.4%)	
Alcohol test, yes	148 (78.3%)	74 (79.6%)	40 (80.0%)	27 (73.0%)	0.851
Blood alcohol above legal limit (≥ 0.08), yes	30 (15.9%)	13 (14.0%)	8 (16.0%)	7 (18.9%)	0.926
Drug test, yes	7 (3.7%)	3 (3.2%)	1 (2.0%)	2 (5.4%)	0.542
Drug test positive, yes	6 (3.2%)	3 (3.2%)	1 (2.0%)	1 (2.7%)	0.583

*Values presented as n (%) or mean ± standard deviation.

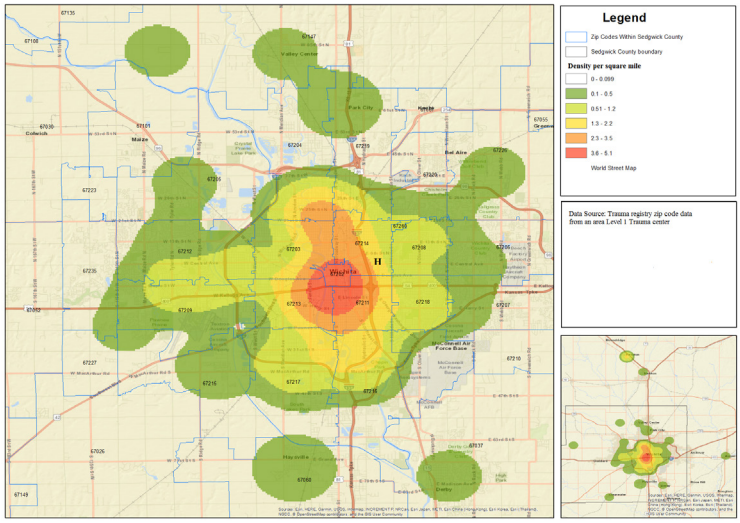

Figure 2. Geographic distribution of gunshot wounds by incident zip code between January 2016 and December 2017.

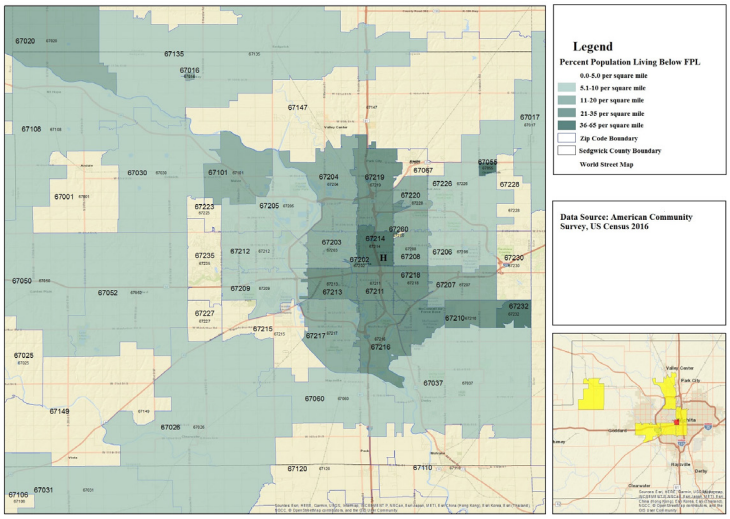

Figure 3. Residents within our study area living below the federal poverty line (FPL) displayed by zip code.

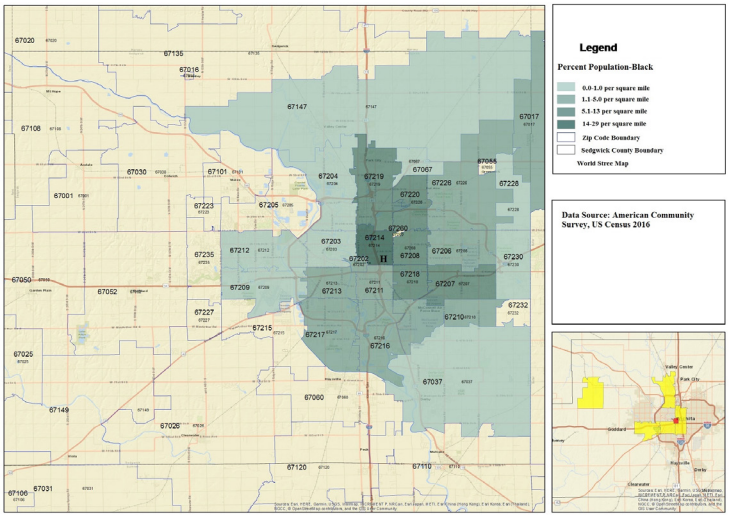

Figure 4. Non-Hispanic Black residents within our study area displayed by zip code.

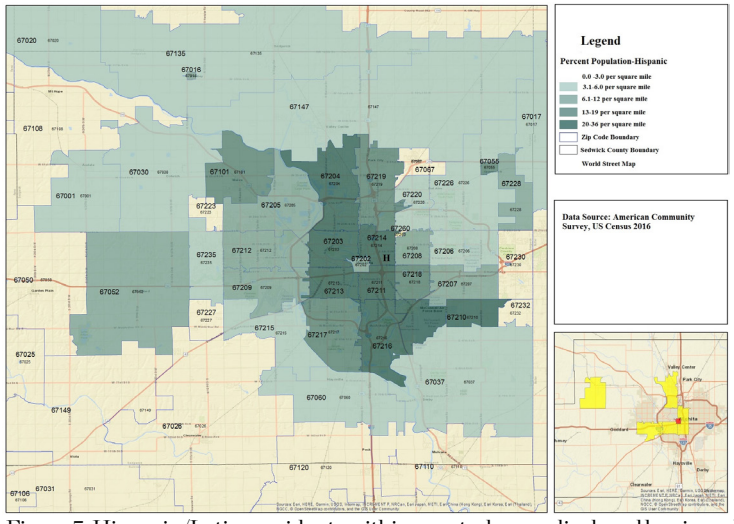

Figure 5. Hispanic/Latino residents within our study area displayed by zip code.

Consistent with other findings, the current study found African American patients were the most likely to report assaults-related GSWs, while Caucasian patients accounted for the most accidental injuries.[4,13,15,23] Moore's study of emergency room GSW visits in middle Tennessee found that 65.9% of African Americans were injured due to assault (vs. 42.5% non-Black, $p < 0.001$), and 40.2% of non-Black patients were injured unintentionally (vs. 28.2% Black, $p < 0.001$).[13] Similarly, police data on firearm violence in Philadelphia suggested that the relative risk of firearm assaults was 15.8 times higher (95% CI = 10.7, 23.2) among Black residents when compared to White residents.[15]

The study from Geutschow et al.[23] provided a similar look at gun-related injuries at a Midwest Level 1 trauma center. In this study, patient demographics were similar to ours in that most patients were Caucasian (74%). Additional findings suggested that the majority of their GSWs were assault related (83%) and involved a handgun (48%). With regard to circumstance surrounding the GSW, Geutschow and colleagues found similar results to ours in that Caucasians accounted for the most (84%) unintentional injuries and that African Americans accounted for most assault-related GSW (46%).[23] The most interesting finding was that 26% of unintentional injuries were related to hunting activities and 71% of hunting injuries involved a shotgun.

Violent injury locations have been shown to vary and concentrate in specific locations defined by certain features of the built environment or socioeconomic characteristics.[15-21] Walker et al.[21] demonstrated that violent trauma hotspots were most prevalent in a nightclub district with a high number of alcohol-serving establishments. Our study had consistent findings with Walker et al.[21] in that the zip codes with the most concentrated GSW incidents included the downtown and nightclub areas of the city. We were unable to perform block-level analysis with our software to determine if the incidents occurring in these locations involved individuals living nearby.

Another study, using the home addresses of the GSW victims, noted GSW incidence rates were higher in census tracts with more Black residents ($p < 0.001$), percent single-family homes ($p < 0.001$), and median age ($p < 0.001$).[17] We found similar results, using incident location, with most GSWs occurring in zip codes that correspond to areas with a higher percentage of residents living below the FPL and a higher percentage of non-Hispanic Black and Hispanic/Latino residents. Due to

unknown home addresses of some patients in the study, it was unclear whether the shootings in our study that occurred in a specific zip code involved the individuals that lived there or people from outside the zip code. Several studies have, however, demonstrated that violent injuries occur close to a victim's place of residence.[16,17,19]

Further research is needed to address why, despite excluding self-inflicted GSWs, older Caucasian males comprised most of our GSW study population. Determining what causes high incidents of GSW in certain zip codes also needs to be addressed. A full community approach among law enforcement, local charities, and community advocates would be beneficial. Efforts to collaborate with both Level I trauma centers also are needed to establish the trends of the GSW population better. Gun violence and injury prevention programs must evaluate their target audiences, potentially increasing focus on older Caucasian males and zip codes with higher incidents of GSW.

This study was subject to several limitations. First, the number of GSWs that occurred in Sedgwick County during our study period were underrepresented in the findings since shooting victims who died at the scene and those who were transferred to the other local trauma center were excluded. In addition, our results included patients that were only in the trauma registry. Patients that sustained GSWs distal to the wrist or ankle were not included in the registry, thus resulting in an underestimation of the GSWs during the study period. Second, an issue existed due to missing data in the registry and patients' charts. We were unable to give more detailed information regarding the circumstance of the injury, such as a hunting accident or that the shooting occurred during a crime. Information regarding the patient such as whether they had a concealed carry license, if they had a gun in the home, or if they took a gun safety course was also not available. Relying on self-reported data from the patient regarding injury intent was a limitation. This could have resulted in misclassification of the intent of the injury and skewing results. We would have benefited from following up with police regarding the nature of the GSWs, but due to the emergent nature of traumatic injuries, this was not done. Lastly, using aggregated population data, such as Census data, to describe individuals was a limitation. We cannot say with certainty that residents living in areas with a high concentration of shootings were the ones doing the shooting or if individuals from outside the neighborhoods were involved.

CONCLUSIONS

It is well established that the distribution of gunshot wounds is not equal regarding age, gender, and race/ethnicity. Newer studies, using GIS, have demonstrated that where gunshot wounds occur may not be random. The purpose of the current study was to describe the overall incidence of firearm-related traumas and examine any racial/ethnic disparities at a Midwest Level 1 trauma center. Study findings were consistent with national gun-violence trends concerning patient age and gender. However, the results suggested that among our study population most gunshot wounds were sustained by older Caucasian males. Additional findings demonstrated that GSWs were concentrated in the downtown area of the study city and corresponded with areas of lower socioeconomic status and higher percentage of minority residents.

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Keywords: gunshot wounds, racial factors, geographic information systems, geographic mapping

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Basic Life Support Awareness and Knowledge in High School Students

Rishit Chilappa[1,2], Michael J. Waxman, M.D., MBA[2,3]
[1]Blue Valley North High School, Overland Park, KS
[2]University of Kansas School of Medicine, Department of Family Medicine, Kansas City, KS

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ABSTRACT

Introduction. Cardiovascular disease is the leading cause of death in the United States. When cardiovascular disease results in cardiac arrest, the ability to perform basic life support (BLS) can change the outcome from death to survival. There is no definitive statistical data on high schoolers' awareness of basic life support (BLS).

Methods. A survey-based research study was conducted to find high schoolers' awareness of BLS. A total of 105 students, primarily from Kansas City suburbs, took a survey with questions ranging from their views on whether BLS courses should be integrated into the high school curriculum to the steps they would take when a person collapses on the ground. Results were analyzed to determine the students' knowledge of different aspects of BLS and their interest in taking a BLS course in school.

Results. Over 70% of the students would take a BLS course should it be offered in a high school class. Most students answered questions regarding BLS steps correctly but lacked critical knowledge on an automated external defibrillator (AED).

Conclusions. Although over 70% of the students were aware of the basics of BLS, most students lacked knowledge on the critical aspects of BLS, such as the use of an AED. Most students recognize the importance of BLS in the high school curriculum and would acquire the skills in a high school class. Introducing a BLS course in the high school curriculum would improve the students' knowledge and contribute to improved survival rates of victims of out-of-hospital cardiac arrest. ***Kans J Med 2021;14:38-41***

INTRODUCTION

Resuscitation and CPR are as old as medicine itself, dating back to the 1500s. After evolving for several centuries, they now encompass the various components of basic life support (BLS) known today.

In the United States, approximately 155,000 victims of cardiac arrest per year are treated outside the hospital, but only 8% survive.[1] Thus, current survival rates are low. BLS is the emergency care that can be given by anyone, from health care providers to the lay public, to victims of cardiac arrest.[2] In such instances, having knowledge of BLS is critical for the victim's survival. People who have a cardiac arrest are dead at that moment in time and will remain dead unless normal heart rhythm is restored. Their normal heart rhythm must be restored within a short enough period of time to prevent neurological damage. Quality chest compressions and administering an electrical shock to restore the normal heart rhythm are the core to resuscitation. BLS is the care that encompasses this resuscitative effort. Expanding BLS awareness is the first and most critical step in increasing the number of certified bystanders.

It is imperative to start early and educate high schoolers on the practices of BLS. Since cardiac arrest can occur anywhere and in the company of anyone, it makes sense that the more people who are competent in BLS, the higher likelihood it will be administered quickly, properly and potentially could improve outcomes. Given their numbers and city-wide distribution, the high school student population seems an ideal population to be trained.

To date, there have not been studies conducted to test high school students in the United States on their knowledge of BLS and automated external defibrillator (AED). There was a study that tested BLS awareness among female students in Riyadh, Saudi Arabia and found a low level of awareness and enthusiasm to learn.[3] Two studies tested BLS and cardiopulmonary resuscitation (CPR) knowledge retention among high school students and found high retention of BLS skills.[4,5]

In this survey-based research study, 105 high school students answered questions testing their knowledge and interest in BLS practices. Responses were analyzed to determine baseline knowledge and interest among high school students and conclude whether incorporating BLS courses as part of the high school curriculum would be meaningful and effective.

METHODS

Institutional Review Board approval was not necessary for this study since it was anonymous and survey-based, and it did not involve the testing of FDA-regulated products. Subjects were not identifiable by their responses.

Since this study population was a completely random selection of students, the participants were not specifically selected based on their previous knowledge of BLS or relation to the medical field. Thus, their knowledge of BLS was no more likely because of who they were.

Study Design. A survey-based research study was conducted; all students who took the survey were in high school (grades 9 through 12 for the 2019 - 2020 school year). The survey had 12 questions, including three questions regarding age, grade, and type of high school (public or private) attended for 2019 - 2020 school year. Data were collected over a period of one month, from July 4 to August 4, 2020. Participants took the survey, answering questions on the definition of BLS, whether their school has a BLS course, whether they were interested in taking a BLS course, and the steps to ensure proper BLS skills are provided. The survey was given on a Google Form, with all questions being multiple choice and required, except for one question asking if students would take a BLS course in school. Students only answered this question if they said 'yes' to the question asking if implementing a BLS course is important in high school.

Participants. Any high school student from the 2019 - 2020 school year was eligible to take this survey on an anonymous basis.

Setting. Participants had the chance to take this survey through social media and text message. The majority of the participants came from Kansas, but there were several students from Missouri, Colorado, and Texas. A link for the survey on Google Forms was sent out on four

high schoolers' Snapchat stories and text messaging (texting was used only to contact specific individuals).

Outcomes. The results were analyzed in three areas: the students' view on the importance of BLS in high school, whether they would take a BLS course in high school, their knowledge on the proper use of AED, if they knew where their school's AED is located, and their knowledge on the steps of BLS.

Sample Size. With approximately 500 students viewing the link to the survey on social media, 20% of those students took the survey. Throughout the one-month period in which the survey was open, a total of 105 students took the survey. All 105 students were high schoolers for the 2019 - 2020 school year, and their ages ranged from 14 years to 19 years.

RESULTS

Participants. The 105 respondents were in grades 9 through 12 during the 2019 - 2020 school year, and their ages ranged from 14 to 19 years. Forty-two students (40%) were in 11th grade, 30 students were in 12th grade (28.6%), 17 students (16.2%) were in 9th grade, and 16 students (15.2%) were in 10th grade. The age with the greatest number of students was 17 years with 41 students (39%), followed by 18 years with 21 students (20%), 16 years with 20 students (19%), 15 years with 18 students (17.1%), 14 years with 4 students (3.8%), and 19 years with 1 student (1%). The majority of the students attended a public school for the 2019 - 2020 school year; 99 students (94.3%) attended a public school, 5 students (4.8%) attended a private school, and 1 student attended a school that is neither private nor public.

Analysis. The students' knowledge was tested in three areas. The first determined the students' views on whether implementing a BLS program in the high school curriculum was important and whether they would be interested in taking the course. Ninety students (85.7%) believed it is important to implement a BLS certification program in high school. Out of 100 students, 73 students (73%) would take a BLS course to become certified if they had the opportunity. This question was optional, so not all students chose to answer it.

The students' knowledge was tested on the purpose and use of an AED while providing BLS. Most students did not know the purpose of an AED (Figure 1). Sixty-six students (62.9%) thought an AED's purpose was to shock the heart when there was no rhythm at all, while only 29 students (27.6%) knew that its purpose was to shock the heart when there was an abnormal rhythm that needed to be stopped (the correct purpose). Additionally, 77 students (73.3%) did not know where their school's AED is located. Finally, the students were asked a series of questions regarding the steps of proper BLS. Most students (65 students or 61.9%) knew to assess the scene and make sure it is safe when they first arrived on the scene of someone who had collapsed on the ground (Figure 2). Eighty-seven students (82.9%) knew that the next step was to call for help, check for pulse, and begin chest compressions if there was no pulse when the victim is unresponsive and not breathing (Figure 3).

Answers were mixed for the third step: what the student would do when the AED arrives. Only 44 students (41.9%) knew to place the AED on the victim immediately to see if he or she needed to be defibrillated (Figure 4). The majority of the students (102 students or 97.1%) knew to wait with the victim until the emergency medical technician arrives after proper BLS is given and the victim has a pulse and is able to breathe (Figure 5). Table 1 includes for a condensed list of correct and incorrect answers for each question.

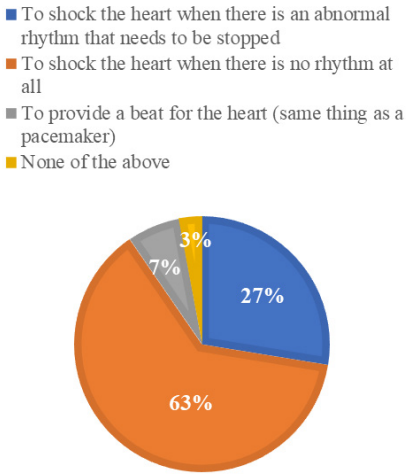

Figure 1. Responses to "What is the purpose of an AED (automated external defibrillator)?".

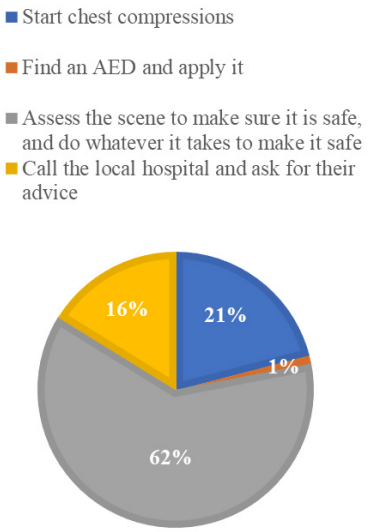

Figure 2. Responses to "When you first arrive on the scene of someone who has collapsed on the ground, what would you do first?".

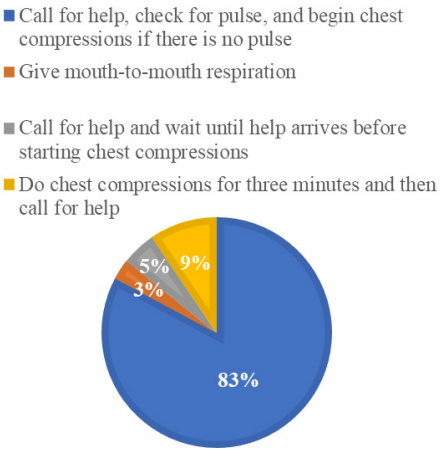

Figure 3. Responses to "If the person is unresponsive and not breathing, what would you do next?".

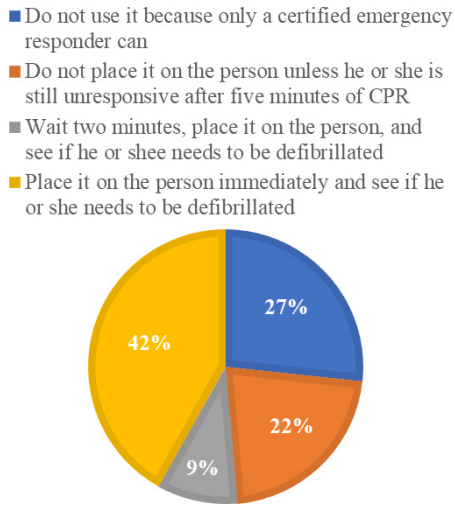

Figure 4. Responses to "Once the AED arrives, what would you do next?".

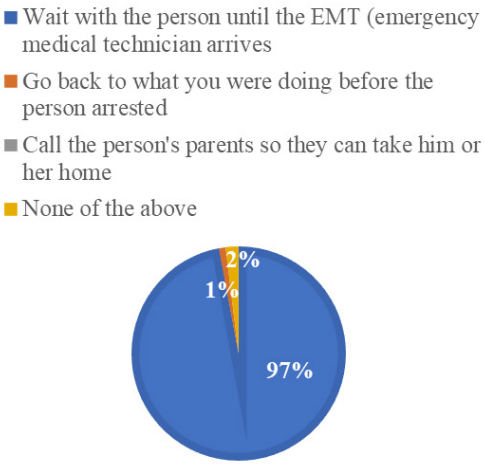

Figure 5. Responses to "After you perform BLS, the person has a pulse and is finally able to breathe. What would you do next?".

Table 1. Percentages of correct and incorrect answers.

Question	% Correct	% Incorrect
What is BLS (Basic Life Support)?	74.3	25.7
What is the purpose of an AED (automated external defibrillator)?	27.6	72.4
When you first arrive on the scene of someone who has collapsed on the ground, what would you do first?	61.9	38.1
If the person is unresponsive and not breathing, what would you do next?	82.9	17.1
Once the AED arrives, what would you do next?	41.9	58.1
After you perform BLS, the person has a pulse and is finally able to breathe. What would you do next?	97.1	2.9

Data Analysis. All data were collected on Google Forms. Answer choices for each question of the study were reported as percentages.

DISCUSSION

Results from this study revealed there was interest in taking a BLS course in school among high school students. Knowledge on the purpose and use of AED was low. Knowledge on the steps of BLS can be improved with a certification course in high school.

Interest among students is necessary to establish a course in high school. Findings showed that out of 100 students (this question was optional, so 100 out of 105 students answered it), 73 students were interested in taking a BLS course in high school; moreover, out of 105 students, 90 students (85.7%) realized the importance of implementing such a course in the curriculum.

Pulseless ventricular tachycardia and ventricular fibrillation are major causes of cardiac arrest leading to sudden death.[6] Timely defibrillation leads to improved survival. Availability and knowledge of AED usage are critical for administration of timely defibrillation. In this study, knowledge of AED was inadequate. Over 60% of the students did not know the purpose of an AED, and only 41.9% of the 105 students knew that the AED should be placed on the victim immediately while they perform BLS. Two previous studies have shown that students have a very high knowledge retention rate after they learn BLS,[4,5] so their current knowledge of AED can be improved.

Although the majority of the students knew the steps of BLS (ranging from what one would do when he or she first arrives on the scene of someone who has collapsed on the ground to the final step of waiting with the victim until emergency personnel arrived), the goal should be that every student knows this information. This can be achieved by implementing a BLS course as part of the curriculum.

Lay bystanders play a crucial role in increasing the survival rate of victims of out-of-hospital cardiac arrest. Performing proper CPR (the part of BLS in which chest compressions are provided) on victims before emergency personnel arrive was associated with a higher survival rate than when no CPR is performed.[7] However, it is necessary to educate and certify people at a younger age, preferably high school. High school is a time when students develop skills necessary for their future,[8] and BLS certification is a life skill.

Our study has shown that there is great interest among high schoolers, and this is the most important factor to consider when incorporating a certification course into the curriculum. High interest assures schools and districts that students actually would take the course to become certified. The majority of the participants in this study had an inadequate knowledge on the use of AED. Implementing a BLS course in the high school curriculum should improve knowledge on the proper use of AED, and students will be armed with the lifelong skills to save victims of out-of-hospital cardiac arrest.[4]

Further studies should use a larger and more geographically diverse sample size and implement a trial course on BLS and heart health in high schools. This would allow a more comprehensive analysis of BLS awareness among high school age students to further the development of an effective high school course.

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Keywords: automated external defibrillator, basic cardiac life support, cardiopulmonary resuscitation, out-of-hospital cardiac arrest

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Workplace Stress and Productivity: A Cross-Sectional Study

Tina Bui, M.D.[1], Rosey Zackula, M.A.[2], Katelyn Dugan, MS-3[3], Elizabeth Ablah, Ph.D., MPH[3]
[1]University of Oklahoma at Tulsa, Tulsa, OK
University of Kansas School of Medicine-Wichita, Wichita, KS
[2]Office of Research
[3]Department of Population Health

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ABSTRACT

Introduction. The primary purpose of this study was to evaluate the association between workplace stress and productivity among employees from worksites participating in a WorkWell KS Well-Being workshop and assess any differences by sex and race.

Methods. A multi-site, cross-sectional study was conducted to survey employees across four worksites participating in a WorkWell KS Well Being workshop to assess levels of stress and productivity. Stress was measured by the Perceived Stress Scale (PSS) and productivity was measured by the Health and Work Questionnaire (HWQ). Pearson correlations were conducted to measure the association between stress and productivity scores. T-tests evaluated differences in scores by sex and race.

Results. Of the 186 participants who completed the survey, most reported being white (94%), female (85%), married (80%), and having a college degree (74%). A significant inverse relationship was observed between the scores for PSS and HWQ, $r = -0.35$, $p < 0.001$; as stress increased, productivity appeared to decrease. Another notable inverse relationship was PSS with Work Satisfaction subscale, $r = -0.61$, $p < 0.001$. One difference was observed by sex; males scored significantly higher on the HWQ Supervisor Relations subscale compared with females, 8.4 (SD 2.1) vs. 6.9 (SD 2.7), respectively, $p = 0.005$.

Conclusions. Scores from PSS and the HWQ appeared to be inversely correlated; higher stress scores were associated significantly with lower productivity scores. This negative association was observed for all HWQ subscales, but was especially strong for work satisfaction. This study also suggested that males may have better supervisor relations compared with females, although no differences between sexes were observed by perceived levels of stress.

Kans J Med 2021;14:42-45

INTRODUCTION

Psychological well-being, which is influenced by stressors in the workplace, has been identified as the biggest predictor of self-assessed employee productivity.[1] The relationship between stress and productivity suggests that greater stress correlates with less employee productivity.[1,2] However, few studies have examined productivity at a worksite in relation to stress.

Previous research focused on burnout, job satisfaction, or psychosocial factors and their association with productivity;[3-7] all highlight the importance of examining overall stress on productivity. Other studies focused on self-perceived stress and employer-evaluated job performance instead of self-assessed productivity.[8] However, most studies examining this relationship have been occupation specific.[8,9] Larger studies examining this relationship were performed in other countries.[1,5,9,10]

The purpose of this study was twofold. First, the study sought to elucidate the relationship between stress and productivity in four worksites in Kansas. Second, the study sought to examine potential differences in stress and productivity by sex and race.

METHODS

Recruitment and Sampling Procedures. The target population was employees from four WorkWell KS worksites. WorkWell KS is a statewide worksite initiative in Kansas that provides leadership and resources for businesses and organizations to support worksite health. Because access to employee emails was unavailable, a URL link to an online survey was sent to the worksite contact, who was responsible for ensuring the distribution of the URL link to a cross-section of employees at the worksite. Following a WorkWell KS workshop (held in Topeka, Kansas on November 6, 2017) attendees from the four worksites were recruited to distribute a link to an online survey to their employees. Workshop attendees were members of wellness committees or were worksite representatives. Employee responses to the online survey were collected through mid-December 2017. No compensation was given for disseminating the survey link or for participating in the study. This study was approved by the University of Kansas School of Medicine-Wichita's Human Subjects Committee.

Online Survey. The online survey comprised demographic items with two instruments, the Perceived Stress Scale (PSS),[11] and the Health and Work Questionnaire (HWQ).[12] Demographic items included employee, sex, race, age, marital status, and highest level of education completed.

Perceived Stress Scale. Stress was measured by the PSS, a 10-item questionnaire designed for use in community samples. The purpose of the instrument is to assess global perceived stress during the past month. Each item is measured with a Likert-type scale (0 = Never, 1 = Almost Never, 2 = Sometimes, 3 = Fairly Often, 4 = Very Often). This scale is reversed on four positively stated questions. Scoring of the PSS is obtained by summing all responses. Results range from zero to 40, with higher PSS scores indicating elevated stress: scores of 0 - 13 are considered low stress, 14 - 26 moderate stress, and 27 - 40 are high perceived stress. The results for perceived stress were used by this study as an indication of psychological well-being.

Health and Work Questionnaire. The HWQ is a 24-item instrument that measures multidimensional worksite productivity. Productivity is assessed by asking respondents how they would describe their efficiency, overall quality of work, or overall amount of work in one week. All items are scaled with Likert-type response anchors, each ranging from 1 to 10 points. Most are positively worded items with response scales from least (scored as a 1) to most favorable

(scored as a 10). Exceptions are items 1 and 16 through 24, which are negatively worded and reversed scored. Items are divided into six sub-scales: productivity, concentration/focus, supervisor relations, non-work satisfaction, work satisfaction, and impatience/irritability. As part of the HWQ, employees assessed productivity two ways: on themselves and how their supervisor or co-workers might perceive it. Accordingly, productivity is stratified into a self-assessed sub-score and perceived other-assessed sub-score. HWQ scores are tallied and averaged for each sub-scale, with higher scores generally indicating greater productivity.

The Consent Process. Representatives who participated in the WorkWell KS workshop sent an e-mail to their employees with a request to click on the link and complete the online survey. The link opened the electronic consent, which was the opening remark, followed by the two assessment instruments and the demographic items. Consent was implied by participation in the survey. To encourage survey participation, representatives also sent employees a few e-mail reminders at their own discretion.

Statistical Analysis. The statistical analysis included descriptive statistics, measures of association, and comparisons of survey responses by sex and race. Descriptive statistics comprised response summaries; means and standard deviations were used for continuous variables, while frequency and percentages were used for categorical responses. The relationship between stress and productivity measures were assessed using Pearson correlations. Sex and race comparisons for PSS and HWQ subscales were evaluated using two-sided t-tests; alpha was set at 0.05 as the level of significance. Study participants with missing values were excluded pairwise from the analysis.

Response Rates. Four of nine worksites participated in the study, including two health departments (89 participants), one school district (76 participants), and one non-profit for the medically underserved (21 participants). A total of 188 employees opened the survey link, 186 employees answered the first question of the survey, and 174 employees completed the survey items. The 12 study participants with missing values were excluded from the pairwise analysis. The response rate, defined as those participants who completed the survey, was 58.6% (n = 174). To protect the confidentiality of respondents, data were aggregated and no other comparisons were made by location.

RESULTS

Participants who completed the survey included 174 employees from four worksites in Kansas. Of those who responded, 94% (155 out of 165) reported being white, 85% (142 of 167) reported being female, 81% (124 of 153) reported being between 30 and 59 years, and 60% (99 of 166) reported having a bachelor's degree or higher (Table 1).

With regard to measures of stress, the mean PSS was 16.4, with a standard deviation of 6.2, suggesting that employees have moderate levels of stress at these locations. This result was consistent with the HWQ question regarding "overall stress felt this week", with a mean score of 4.7 (SD 2.5; 10 is "very stressed"). Regarding measures of productivity, the mean overall HWQ was 6.3 (SD 0.7). With the exception of reverse items, as noted below, scores of 10 indicated high levels of productivity. Mean scores by scale were: 7.3 (SD 1.0) for overall productivity, with 7.5 (SD 1.3) for own assessment, and 7.5 (SD 1.2) for perceived other's assessment; 7.1 (SD 2.7) supervisor relations, 7.8 (SD 1.8) for non-work satisfaction, and 7.3 (SD 1.7) for work satisfaction. The mean scale for the reverse items scores were concentration/focus at 3.4 (SD 2.0), and impatience/irritability 3.2 (SD 1.6).

Table 1. Participant demographics.

	Missing		Total	
Characteristics	**N = 186**	**100%**	**n**	**%**
Male	19	0.10	25	15.0
Female			142	85.0
White	21	0.11	155	93.9
Minority			10	6.1
Age group	33	0.18		
20 - 29			15	9.8
30 - 39			30	19.6
40 - 49			41	26.8
50 - 59			53	34.6
60 - 69			12	7.8
70+			2	1.3
Married	17	0.09	136	80.5
Unmarried			33	19.5
Highest level of education completed	20	0.11		
High school graduate or GED			12	7.2
Some college, no degree			32	19.3
Associate degree			23	13.9
Bachelor degree			65	39.2
Graduate or professional degree			34	20.5

Correlations between the PSS and the HWQ subscales ranged from -0.61 to 0.55 (Table 2). A negative association was observed between the PSS and the overall HWQ, $r(177) = -0.35$, $p < 0.001$. While each of the positively-coded HWQ subscales was associated negatively with the PSS, the strongest correlation occurred between work satisfaction and PSS, $r(177) = -0.61$, $p < 0.001$, suggesting that as stress increases work satisfaction declines.

In evaluating differences by sex, mean scores were significantly higher for males compared with females for the HWQ Supervisor Relations subscale (8.4 (SD 2.1) versus 6.9 (SD 2.7), respectively; $p < 0.005$; Table 3). No other sex differences were observed for either instrument. Similarly, there were no significant differences by race.

Table 2. Measures of correlation within and between the PSS and HWQ.

		Productivity							
Description	**Total HWQ**	**Overall**	**Own assessment**	**Other's assessment**	**Concentration/ focus***	**Supervisor relations**	**Non-work satisfaction**	**Work satisfaction**	**Impatience/ irritability***
Overall productivity	0.76	--							
- own assessment	0.60	0.89	--						
- other's assessment	0.77	0.94	0.75	--					
Concentration/ focus*	-0.02	-0.40	-0.49	-0.37	--				
Supervisor relations	0.52	0.30	0.17	0.38	-0.25	--			
Non-work satisfaction	0.47	0.35	0.35	0.38	-0.34	0.14	--		
Work satisfaction	0.62	0.50	0.42	0.55	-0.48	0.58	0.44	--	
Impatience/ irritability*	0.06	-0.07	-0.02	-0.17	0.44	-0.31	-0.34	-0.47	--
PSS	-0.35	-0.41	-0.38	-0.45	0.55	-0.39	-0.55	-0.61	0.53

*Reverse scored item
HWQ: Health and Work Questionnaire mean score; PSS: Perceived Stress Scale mean score

Table 3. Comparing results of the PSS and the HWQ by sex.

	Male	**Female**	
	N = 25	**N = 142**	
Description	**Mean (SD)**	**Mean (SD)**	**p**
Total HWQ	6.5 (0.7)	6.3 (0.7)	0.298
Productivity	7.2 (1.3)	7.4 (0.9)	0.461
- own assessment	7.3 (1.7)	7.5 (1.2)	0.414
- other's assessment	7.3 (1.5)	7.5 (1.2)	0.483
Concentration/focus	3.7 (2.2)	3.4 (2.1)	0.446
Supervisor relationship*	8.4 (2.1)	6.9 (2.7)	0.005
Non-work satisfaction	7.8 (2.1)	7.8 (1.8)	0.954
Work satisfaction	7.6 (1.5)	7.2 (1.7)	0.348
Impatience/irritability	3.2 (1.6)	3.2 (1.6)	0.934
PSS	15.8 (6.4)	16.7 (6.2)	0.552

*t-test, two-sided test of equality; equal variances not assumed

DISCUSSION

Findings suggested there is an inverse association between overall stress and productivity; higher PSS scores were associated with lower HWQ scores. These findings are consistent with other cross-sectional studies comparing productivity and other measures of psychological well-being.[1,8,9,10] Thus, employer efforts to decrease stress in the workplace may benefit employee productivity levels.

In addition, males scored higher for supervisor relations in the HWQ than females. This finding may suggest that males have stronger relationships with their supervisors. Indeed, there is compelling evidence to suggest the main factor affecting job satisfaction and performance is the relationship between supervisors and employees.[13] Although, this relationship may be mitigated by employee-supervisor interactions of sex, race/ethnicity, status, education, age, support systems, and other factors, none of which were evaluated in the current study.

For example, Rivera-Torres et al.[14] suggested that women with support systems, defined as co-workers and supervisors, experienced less work stress than males. Results from this study seemed to support Rivera-Torres et al.[14] in that females tended to report higher levels of stress compared with males (although not significant) and reported weaker relationships with their supervisors. In addition, Peterson[15] evaluated what employee's value at work and found that males and females differed significantly. When asked to rank work values, men valued pay/money/benefits along with results/achievement/success most, whereas women valued friends/relationships along with recognition/respect. Perhaps, more research is necessary to understand the nuances between co-worker and supervisor regarding work satisfaction and productivity.

The study contributes to the literature in the use of different metrics for psychological well-being, defined as stress. Multiple organizations within Kansas were evaluated for both productivity and stress.

To our knowledge, the PSS and HWQ have never been used together to measure the relationship between stress and productivity. Results suggested that overall productivity (HWQ) was associated with the HWQ "work satisfaction" subscale. Perceived stress also had the strongest inverse relationship with HWQ sub-scale "work satisfaction" when compared with HWQ sub-scale "productivity".

This study suggested that productivity, stress, and job satisfaction were correlated, therefore, additional research needs to include each of these variables in greater detail as the current literature has been mixed on their relationships and potential collinearity. For example, one study examining two occupations suggested psychological well-being (defined as psychological functioning) was associated with productivity, whereas job satisfaction did not.[7] In contrast, another study suggested that psychological well-being has been a bigger factor in job productivity than work satisfaction alone, but both are associated with job productivity.[9] This current study was able to examine this relationship by using the PSS and the HWQ together.

More research is needed to understand these differences by standardizing terminology. In this study, psychological well-being was defined as stress. However, other studies have defined psychological well-being as happiness or as one's psychological functioning.[7,8] This study also expanded the relationship between psychological well-being and stress. Previous research focused more on the relationship between productivity and burnout or job satisfaction.

This study had limitations such as a small sample size (in number of organizations and number of employees). The sample size assessed small organizations in the United States, whereas many other large scale studies on stress occurred over multiple large organizations in other countries.[1,10] There was limited racial diversity in the current study, as 6.1% (10 of 165) reported being non-white. The population studied was also primarily female, limiting the strength of comparisons made between sexes. Furthermore, because worksites often share computers, questionnaires may have been completed using the same IP address; thus, we were unable to prevent multiple entries from the same individual.

The current study did not detect a difference in productivity or stress by race. This differed from other research. For instance, non-whites experience greater overall stress than whites potentially attributable to poorer employment status, income, and education.[16] Non-whites experience stress secondary to racial discrimination.[17,18] In one study, when examining productivity among university faculty, non-whites reported greater stress and produced less research (productivity) compared to whites.[16] Further research needs to be conducted on productivity and stress by race and ethnicity, and associated variables, such as employment status, income, education, and occupation, need to be accounted for in analysis. Differences between other research and the current study regarding race may be attributed to the fact that only 6% of respondents who answered race reported being non-white, making racial diversity in this study limited, although representative of the population sampled.

CONCLUSIONS

This study suggested there is a negative correlation between overall stress and productivity: higher stress scores were significantly associated with lower productivity scores. This negative association was observed for all HWQ subscales, but was especially strong for work satisfaction. This study also suggested that males may have better supervisor relations compared to females, although no differences between sexes were observed by perceived levels of stress. There was no difference in productivity or stress by race. The results of this study suggested that employer efforts to decrease employee stress in the workplace may increase employee productivity.

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KANSAS JOURNAL of MEDICINE

Rapid Improvement of Pyoderma Gangrenosum Managed with IV Methylprednisolone

Malia B. Downing, M.D., Tony Nguyen, M.D., Aly Barland, M.D., Atieh Jibbe, M.D., Ting Wang, M.D.
University of Kansas Medical Center, Department of Internal Medicine, Division of Dermatology, Kansas City, KS

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INTRODUCTION

Pyoderma gangrenosum (PG) is an uncommon cutaneous ulcerative disease.[1-3] In contrast to its name, PG is neither infectious nor gangrenous. It occurs worldwide in patients of all ages, but most commonly affects women between 20 and 50 years of age. It is characterized as a neutrophilic dermatosis, though the pathogenesis of PG is not well understood. The diagnosis of pyoderma gangrenosum is one of exclusion. Of note, PG frequently is misdiagnosed as an infectious process resulting in unnecessary antibiotic or antifungal use. In general, it is managed with immunosuppressive therapy. Topical corticosteroids may be sufficient to treat mild and local disease, while systemic steroids are considered first line therapy for severe and more extensive disease. Antibiotics and/or antifungal therapy are not necessary unless PG is secondarily infected. We present a case of pyoderma gangrenosum managed with systemic corticosteroids. This case report reviewed the diagnosis and management of PG and highlighted the rapid improvement that can be achieved with systemic immunosuppressive.

CASE REPORT

A 55-year-old woman presented with a one-week history of several painful nodules on her hands and face that appeared abruptly. She reported similar lesions in the past that resolved without treatment. Her medical history was significant for rheumatoid arthritis for which she was not undergoing treatment due to cost. Physical exam revealed large, ulcerated nodules on the left fifth finger, right fourth finger, and left cheek near nostril (Figure 1). Given the negative cultures, and histopathology consistent with the diagnosis of pyoderma gangrenosum, the patient was started on intravenous methylprednisolone 1 g daily for three days, then switched to a prednisone taper of 60 mg, 40 mg, 30 mg, 20 mg, 10 mg, then 5 mg daily for two weeks on each dose. Trimethoprim/Sulfamethoxazole (Bactrim™ DS) was used three times weekly when prednisone was over 20 mg daily. Within five days, the size, depth and associated pain of the ulcers had significantly improved (Figure 2). Unfortunately, the patient was lost to follow-up.

DISCUSSION

Pyoderma gangrenosum is a neutrophilic inflammatory disease that causes cutaneous ulcerations.[3] There are different subtypes of PG based on clinical presentations. The most common subtype is ulcerative. It presents as a tender papule, pustule, vesicle, or nodule that rapidly expands and ulcerates with gun-metal gray undermined borders. Ulcers heal with characteristic thin, atrophic scars. It occurs most frequently on the pretibial lower extremities, although lesions may present on any area of the body including the mucosa and stomas. PG often is associated with pain out of proportion to exam. Pathergy has been reported in 20 - 30% of cases. Patients with PG also may exhibit systemic symptoms such as fever, arthralgia, and malaise. Other subtypes include bullous, pustular, or vegetative.

Figure 1. Ulcerated nodule of pyoderma gangrenosum on the left 5th finger.

Figure 2. Improvement of pyoderma gangrenosum after IV methylprednisolone.

The diagnosis of PG is a diagnosis of exclusion, as there are no specific clinical, histologic or laboratory findings.[4] Detailed history, complete physical exam, and skin biopsies should be performed for diagnosis and to rule out malignancy, infection, and vasculitis. Skin biopsies should be sent for both histopathologic exams and cultures including bacterial, fungal, and acid-fast bacteria. Pathology of PG should demonstrate a neutrophilic infiltrate and necrosis depending on the stage of ulceration. One recently proposed list of diagnostic criteria includes the presence of one major criterion and four out of eight minor criteria (Table 1).[5] These criteria had a sensitivity of 80% and a specificity of 95%.

Table 1. Diagnostic criteria for the diagnosis of pyoderma gangrenosum.[5]

Major criteria (required)	1. Biopsy of ulcer edge demonstrating neutrophilic infiltrate
Minor criteria (4 of 8 required)	1. Exclusion of infection 2. Pathergy 3. History of inflammatory bowel disease or inflammatory arthritis 4. History of a papule, pustule, or vesicle ulcerating within four days of appearing 5. Peripheral erythema, undermining border, and tenderness at ulceration site 6. Multiple ulcerations, at least one on an anterior lower leg 7. Cribriform or wrinkles paper scar(s) at healed ulcer sites 8. Decreased ulcer size within one month of initiating immunosuppressive medications

Approximately 50% of cases are idiopathic while the remainder of the cases were associated with underlying systemic disease, such as inflammatory bowel disease, rheumatoid arthritis, or a hematologic disorder (IgA monoclonal gammopathy, acute myelogenous leukemia, myelodysplasia).[1-3] Thus, gastrointestinal and hematologic studies are included in the recommended work-up. The most commonly associated systemic disease for PG is inflammatory bowel disease; however, only 1.5 to 5% of patients with inflammatory bowel disease will develop PG.[6]

The mainstay of the treatment of pyoderma gangrenosum is immunomodulatory therapy, although there is no definitive guideline for treatment.[7-9] For mild and local disease, topical or intralesional corticosteroids and tacrolimus can be used. For more extensive disease, systemic immunomodulators, such as systemic corticosteroids or cyclosporine, are standard treatments, but steroid-sparing agents, such as mycophenolate mofetil or azathioprine, are often necessary during the steroid taper. Oral dapsone, and TNF-alpha inhibitors are among the medications that have been used with varying degrees of success.[10] Antibiotics and/or antifungal therapy are not necessary unless PG is secondarily infected. Of note, PG is frequently misdiagnosed as an infectious process, resulting in unnecessary antibiotic or antifungal use. Tissue culture is commonly negative, but may yield growth of normal skin flora or demonstrate secondary superinfection. The role of surgery in treatment of PG is controversial due to the potential that trauma can induce or worsen PG, also known as pathergy.

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Keywords: pyoderma gangrenosum, immunosuppression, IV methylprednisolone

KANSAS JOURNAL of MEDICINE

Uncommon Association of Aortopulmonary Window in a Patient with Complex Univentricular Heart and CHARGE Syndrome

Sathish Chikkabyrappa, M.D.[1,2], Guruprasad Mahadevaiah, M.D.[3], Arpan R. Doshi, M.D.[4,5], Joan Lee, M.D.[1,2], Eyal Sagiv, M.D., Ph.D.[1,2], Sujatha Buddhe, M.D.[1,2]

[1]Seattle Children's Hospital, Division of Pediatric Cardiology, Seattle, WA

[2]University of Washington School of Medicine, Seattle, WA

[3]California Northstate University College of Medicine, Sacramento, CA

[4]Children's Cardiology Associates, Pediatrix Medical Services, Inc., Houston, TX

[5]University of Houston College of Medicine, Houston, TX

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INTRODUCTION

The univentricular heart and aortopulmonary window (APW) are rare cardiac malformations and their association is extremely rare. Worldwide incidence of congenital heart disease (CHD) is estimated at 8 per 1,000 live births.[1] APW represents 0.1 to 0.6% of all CHD.[2] The most associated malformations are aortic arch anomalies, specifically coarctation of the aorta and type A interruption of aortic arch, as well as atrial and ventricular septal defects and conotruncal anomalies.

Only a handful of case reports of APW associated with complex single ventricle lesions have been described in the literature.[3,4] To our knowledge, there is no literature on association of CHARGE syndrome (Coloboma, Heart defect, Atresia choanae, Retarded growth and development, Genital hypoplasia, Ear anomalies/deafness) with complex univentricular heart and APW. We report a case of unique combination of large APW in a complex univentricular heart of undetermined morphology with malposed great arteries in a neonate with absent thymus and CHARGE syndrome. In addition, our patient's genetic testing was positive for CHD7 mutation.

CASE REPORT

A full-term, 2.5-kg, female neonate with prenatal diagnosis of complex single ventricle was transferred from an outside institution for stage one single ventricle palliation. She was born to a 23-year-old, gravida 2, parity 2, Caucasian woman at 38 weeks of gestation. The pregnancy was complicated by pregnancy-induced hypertension and gestational diabetes. Her immediate postnatal course was uncomplicated without requiring any resuscitation. Initial oxygen saturations were in 90% range on room air without any signs of respiratory distress. Physical exam was significant for dysmorphism consistent with CHARGE syndrome (head-sparing short stature, hypertelorism, down-slanting palpebral fissure, iris coloboma, and microtia). Cardiac exam was significant for single first heart sound and nonspecific soft systolic murmur.

The transthoracic echocardiogram showed a complex univentricular heart with undetermined morphology. Both atria drained into the single ventricle via common atrioventricular (AV) valve. There was common atrium. There was malposition of great arteries with aorta anterior and rightward of the pulmonary artery with two normal semilunar valves. There was a large type III APW immediately distal to the semilunar valves, and both branch pulmonary arteries arose posteriorly from the large truncal artery. There was a left aortic arch with aberrant right subclavian artery with mildly hypoplastic distal aortic arch. There was no patent ductus arteriosus. The patient had bilateral superior vena cave and normal pulmonary venous drainage (Figures 1, 2, and 3).

Due to the complex great artery and arch anomalies, cross sectional imaging was obtained to confirm the above findings prior to surgical palliation (Figures 4 and 5). This anatomy was deemed to be non-ductal dependent cardiac lesion. Further work-up included a computed tomography (CT) scan of internal auditory canal, which revealed bilateral hypoplastic petrous ridge with dysplastic inner ears, absent semicircular canal, normal cochlear nerve, consistent with CHARGE syndrome. The cranial, abdomen and renal ultrasounds were unremarkable. Genetic testing confirmed the CHD7 mutation, supportive of CHARGE syndrome.

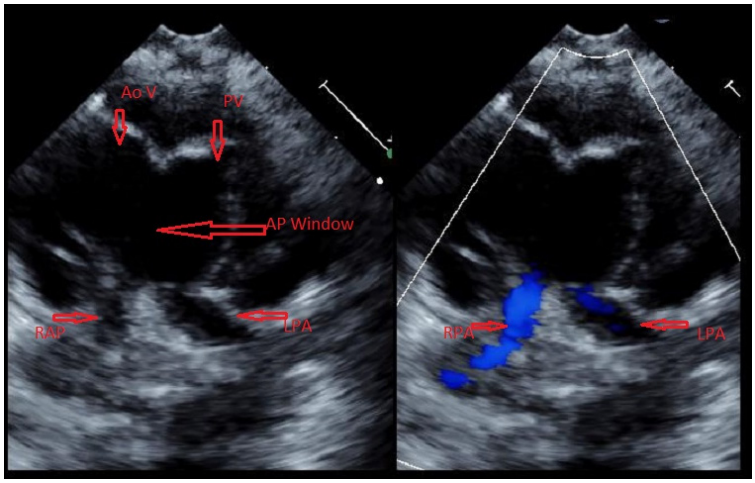

Figure 1. Parasternal short axis echocardiogram image on color comparison showing large aortopulmonary window with both branch pulmonary arteries coming off posterior portion of common trunk. (RPA-Right pulmonary artery, LPA-Left pulmonary artery, AoV-Aortic valve, PV-Pulmonary valve, AP Window-Aortopulmonary window).

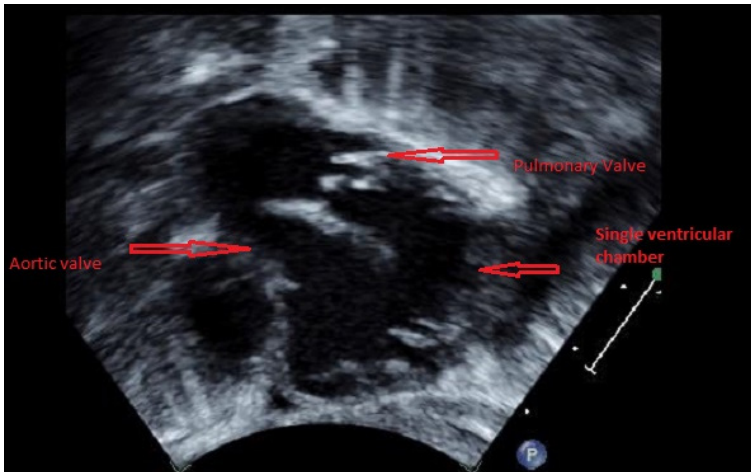

Figure 2. Subcostal 2D image depicting two semilunar valves arising side by side from a single ventricle of undetermined morphology.

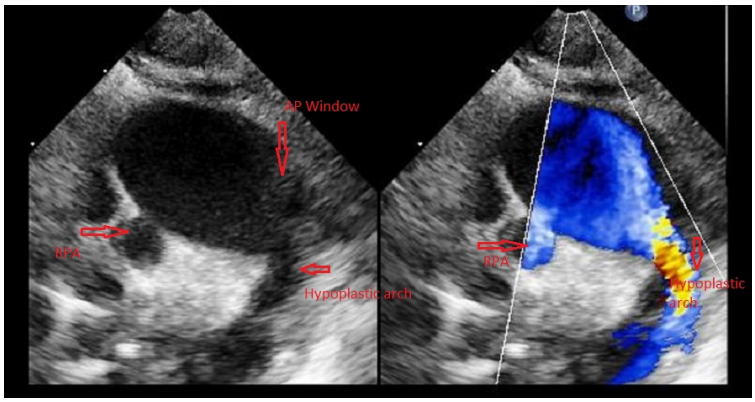

Figure 3. High parasternal transthoracic image with color comparison showing hypoplastic arch continues from the large AP window trunk and showing branch pulmonary artery from the posterior portion of trunk. (RPA-Right pulmonary artery, AP window-Aortopulmonary window).

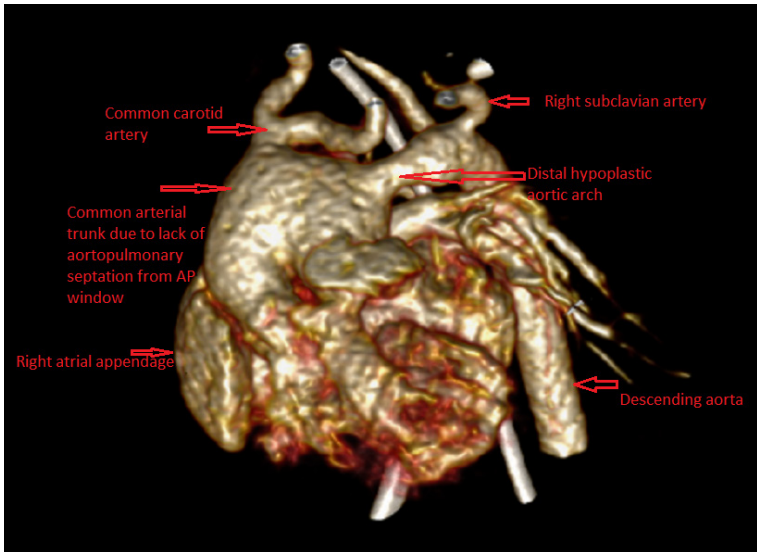

Figure 4. Reconstructed CT image anterior projection showing head and neck vessels and AP window in detail.

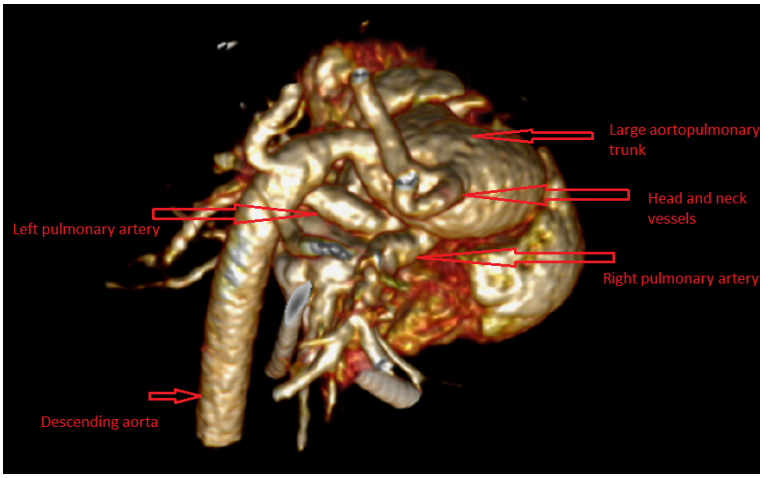

Figure 5. Reconstructed CT image posterior projection showing head and neck vessels and AP window in detail.

After extensive discussion in our combined cardiac surgery conference, she underwent aortic arch repair with APW repair, oversewing of pulmonary valve, and placement of 5 mm right ventricle to pulmonary artery conduit at six days of age. Interestingly, complete lack of thymic tissue was noted intraoperatively.

Post-operative course was complicated by hemodynamic instability, cardiac arrest, post-arrest seizure, and acute kidney injury. She underwent cardiac catheterization on day 13 post-surgery for persistent respiratory failure and hemodynamic lability, and had a stent implanted into her right pulmonary artery for stenosis. During the rest of the hospitalization, she underwent GI-tube placement for feeding, weaned off respiratory support and progressed to discharge from the hospital.

DISCUSSION

To our knowledge, this is the first case of a neonate with univentricular heart with common AV valve and an APW. There were two earlier case reports with APW in the setting of complex univentricular heart, one with tricuspid atresia and the other had double inlet ventricle with large ventricular septal defect.[3,4]

Univentricular hearts are uncommon and there is controversy about the definition, classification, and nomenclature. Van Praagh et al.[5] has described them as hearts with one ventricular chamber that receives both atrioventricular valves or a common AV valve, excluding mitral and tricuspid atresia. Anderson et al.[6] used the term "univentricular connection" in which both atria are committed to one ventricle (double inlet ventricle) or one of the AV valves is absent. The ventricle can be either right or left ventricle based on the morphologic characteristics or indeterminate. The most common type of univentricular AV connection is a double-inlet left ventricle with a hypoplastic right ventricle[7] and comprise 1% of all the congenital heart defects.[8]

Our case was a rare combination of univentricular heart (indeterminate morphology) via a common AV valve and type III APW in an infant with CHARGE syndrome. This is a form of AV septal defect. Van Praagh et al.[5,7] reported about 33% had common AV valve in their series on "common ventricle". In the same series, situs ambiguous was frequent and polysplenia was present in about 40% of cases with common AV valve type. The double outlet right ventricle was seen often, or ventriculo-arterial (VA) connections were discordant with right or left anterior aorta or normally related. Pulmonary valve stenosis or atresia is frequently found. Embryologically, the AV valves develop from endocardial cushions and the interventricular septum develops with contributions from multiple regions including muscular growth from the developing common ventricle, membranous septum from endocardial cushions and bulbar septum from the aortopulmonary septum above. The failure of aortopulmonary septation leads to aortopulmonary window. In our case, there was failure of endocardial cushions and interventricular septum formation as well as aortopulmonary septation.

AP window is a condition in which there is persistent communication between the intrapericardial walls of aorta and pulmonary trunk. Mori et al.[9] classified this condition into three types. Type I is a proximal defect between the ascending aorta and the pulmonary trunk and is located above the semilunar valves with only a slight inferior rim. Type II is absence of superior rim distally at the level of pulmonary artery

bifurcation. Type III refers to a large defect that extends from above semilunar valves to the pulmonary artery bifurcation. Richardson's classification was similar to Mori's except the Type III referred to anomalous origin of one of the branch pulmonary artery from ascending aorta, with no other aortopulmonary connection.[10] This Type III Richardson defect is no longer considered as a variant of AP window, but as a unique defect. The Society of Thoracic Surgeons Congenital Heart Surgery Database committee has accepted Mori's classification. They recognized a fourth variant, an "Intermediate" defect consisting of a smaller, central defect with a circumferential rim of tissue.[2]

Although there have been two previous reports of APW associated with single ventricle, our patient was unique in her association with CHARGE syndrome, which has not been reported. CHARGE syndrome initially was defined as a non-random association of anomalies (Coloboma, Heart defect, Atresia choanae, Retarded growth and development, Genital hypoplasia, Ear anomalies/deafness).[3,4] The cardiac anomalies are present in up to 75% of these patients. Septal defects and tetralogy of Fallot are most common cardiac defects in CHARGE syndrome.

APW usually is associated with arch anomalies and septal defects. In our patient's case, it was associated with a complex single ventricle physiology. Patients with CHARGE syndrome have additional morbidity and mortality risk related to increased obstructive sleep apnea, aspiration, and death, even without the presence of CHD.[11-13] Patients with CHARGE syndrome are also at high risk for immunological dysfunction secondary to T-cell functional abnormalities and varying degrees of thymic hypoplasia.[14] Our patient underwent first stage of single ventricle palliation, repair of APW and arch repair successfully.

CONCLUSIONS

Our case is a unique association of complex univentricular heart with common AV valve and type III APW, in the setting of CHARGE syndrome, confirmed by CHD7 mutation. It emphasized the importance of thorough evaluation in the presence of dysmorphic features.

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Dr. Sathish Chikkabyrappa and Dr. Guruprasad Mahadevaiah have equally contributed to the report.

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Keywords: CHARGE syndrome, aortopulmonary septal defect, univentricular heart, neonate, case report

KANSAS JOURNAL of MEDICINE

A Case Report of a Modern-Day Scurvy

Jared Regehr, M.D.[1,2], Mariah Kriwiel, M.D.[1,2], Emily Roth, M.D.[3], Samuel Ofei-Dodoo, Ph.D., MPA, M.A.[1,2]
University of Kansas School of Medicine-Wichita, Wichita, KS
[1]Department of Family and Community Medicine
[2]Family Medicine Residency Program at Ascension Via Christi Hospital
[3]Ascension Via Christi St. Francis Hospital, Department of Emergency Medicine, Wichita, KS

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INTRODUCTION

Scurvy is a nutritional deficiency due to lack of vitamin C that can result in serious consequences.[1] The first written description of scurvy can be traced back to as early as 1500 BC by the Egyptians, and it mostly has disappeared in developed countries due to advances in nutrition and food supplements.[2-5] Due to the rarity of scurvy, diagnosis often is delayed or missed completely, resulting in potentially serious complications and unnecessary workups.[6] Recently, however, there has been a slight increase in the diagnoses of scurvy in hematology clinics around the country. Certain factors can predispose patients to develop this ancient disease. Scurvy is seen more often among people who live alone and prepare their own food, persons with alcohol use disorder, the elderly, and indigent persons.[7] If sufficient vitamin C is not ingested through diet, the body's stores can deplete in as little as one to three months.[5] Therefore, it is essential to have a steady dietary supply of vitamin C.

Vitamin C is essential for many basic functions. Vitamin C aids in collagen synthesis and helps with wound healing and bone formation, plays a role in the synthesis of the neurotransmitter norepinephrine, and increases iron absorption in the stomach.[8-11] Vitamin C also plays a role in the metabolism of prostaglandins, which in turn aids in the management of the inflammatory response by preventing the inhibition of the innate immune response.[12-14] Furthermore, vitamin C has significant antioxidant properties, helping to protect against cellular damage.[15,16]

The most common manifestations of vitamin C deficiency often present as hematologic, skin, and immunologic dysfunction.[1] Bleeding gums, perifollicular hemorrhages, corkscrew hairs, and poor wound healing characterize some of the signs of a classic presentation of scurvy.[5] Clinically, perifollicular hemorrhages are identified by small petechiae surrounding the base of the hair follicles and corkscrew hairs are thin wiry strands that can become kinked (Figure 1). Lack of vitamin C replacement can lead to disastrous consequences including hemolysis, seizures, and death.[5] Prompt recognition and treatment is key as scurvy is an easily treatable disease. We report a case of scurvy in an 18-year-old male.

CASE REPORT

An 18-year-old male with a history of cerebral palsy, autism, and spina bifida presented to the emergency room with ankle pain and fever. The patient was nonverbal and seemed agitated at baseline, so the history was taken from the parents, who noted the young man fell three weeks prior and hurt his ankle. At the time, he was evaluated by his primary care physician and diagnosed with a mild ankle sprain. His ankle pain initially improved but swelling worsened during the past week. On the day of presentation, he developed fever, swelling in his ipsilateral knee, bleeding gums, and diffuse perifollicular hemorrhages across his lower and upper extremities bilaterally. Family history was pertinent for an unspecified bleeding disorder on his maternal side.

On general exam, he was not toxic appearing, but had a fever of 38.9°C and was tachycardic with a heart rate of 125 beats per minute. His blood pressure and oxygen saturation were within normal limits. There was mild clubbing of the nails of his lower extremities and splinter hemorrhages were present on the nails of his upper extremities bilaterally. Other pertinent aspects of the physical exam included tacky mucous membranes and evidence of dried blood on his gums. His right knee and ankle were mildly swollen and warm to the touch with pain on passive range of motion. The dermatologic exam revealed extensive perifollicular hemorrhages on the lower extremities bilaterally (Figure 1), ecchymoses were present on the plantar aspect of both feet, and the presence of petechiae on the back. Furthermore, corkscrew hairs were identified diffusely across the upper and lower extremities (Figure 1).

Figure 1. Photo shows perifollicular hemorrhages and corkscrew hairs (circled). [Reprinted with permission from Vogt KA, Lehman JS. Corkscrew hairs. Cleve Clin J Med 2015; 82(4):216. doi:10.3949/ccjm.82a.14135. Copyright © 2015 Cleveland Clinic Foundation. All rights reserved.]

Pertinent admission labs revealed a moderate iron deficiency anemia, a normal white blood cell count, and an elevated lactic acid of 3.2 mmol/L (reference range, 0.5 - 2.1 mmol/L). Pending labs at the time of admission included blood cultures, vitamin C level, vitamin D level, Factor 8, Factor 9, DIC panel, LDH, and haptoglobin. Plain films of the ankle and knee were unremarkable.

Prior to transfer to the medical floor, the patient received an IV bolus of normal saline, empiric antibiotics of vancomycin and cefepime, and he was started on high-dose vitamin C (1,000 mg daily) by the emergency room physician. This treatment regimen subsequently was continued by the admitting team. An orthopedic surgeon

was consulted to rule out a septic joint and discerned that no drainable effusion was present in either joint. The intravenous fluids, antibiotics, and daily vitamin C were continued upon admission. On hospital day two, a lower extremity venous ultrasound revealed no evidence of deep vein thrombosis. The patient did not have any further bleeding from the gums, his joint swelling was stable, and clinically he was improving. On hospital day three, the vitamin C level was < 0.01 mg/dL (reference range, 0.6 - 2.0 mg/dL) and the vitamin D level was < 3 ng/mL (reference range, 20 - 50 ng/mL). Lactic acid dehydrogenase, haptoglobin, DIC panel, Factor 8, and Factor 9 levels were normal. He continued to improve clinically and remained afebrile for more than 48 hours with no growth on blood or urine cultures, and antibiotics were discontinued. He was discharged home on oral vitamin C 250 mg daily and vitamin D 1,000 IU daily with follow-up scheduled.

DISCUSSION

This case was unique due to the combination of pathognomonic signs and the patient's atypical presenting symptoms. Certainly, the presence of bleeding gums, perifollicular hemorrhages, and corkscrew hairs increased the suspicion for vitamin C deficiency. However, the patient's fever and tachycardia were a major focus upon initial presentation. Treatment for suspected sepsis with antibiotics was initiated, but no infectious etiology for the fever was identified and antibiotics were discontinued prior to discharge. Fever and tachycardia do not appear to be a common presentation of scurvy in reported case studies.[6,7,17,18]

This case demonstrated the importance of a thorough history and physical examination. Though the fever and tachycardia were concerning, the emergency room physician's recognition of the constellation of symptoms typically associated with scurvy allowed for prompt intervention to be initiated without laboratory confirmation. This recognition and treatment were imperative for the patient's quick clinical improvement. Further, the patient's history helped pinpoint the diagnosis. The patient's nonverbal status complicated the history, but caregivers were able to provide important details. Importantly, the parents reported at baseline that the patient had a severe aversion to nearly all foods; his diet consisted almost exclusively of Pop-Tarts® which contain 0 mg of vitamin C.

Another complicating factor to this case was the ankle injury that occurred weeks prior. Symptoms had not resolved from that injury, so much of the history focused on the injury. Vitamin C is important for skin, hematologic, and immune function so it is reasonable to conclude that the deficiency may have led to longer wound healing.[8,9] Was this a coincidence that the signs of scurvy happened to manifest during his recovery from this injury? It is possible that the patient barely was getting enough vitamin C to not manifest symptoms of scurvy, but the injury increased vitamin C demand beyond that minimal level of supply and tipped him over the edge into symptomatic scurvy.

CONCLUSIONS

Scurvy is an ancient disease that has been mostly eradicated. However, as this case demonstrated, certain lifestyle factors can predispose one to be susceptible, even in the 21st century. It is imperative to approach each patient with a broad differential and let the history and physical exam guide clinical decision making. Even 21st century physicians should be alert to the risk factors, signs, and symptoms of this ancient disease.

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Keywords: nutritional deficiency, scurvy, vitamin C, cerebral palsy, autism

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Time and Financial Costs for Students Participating in the National Residency Matching Program (the Match©): 2015 to 2020

Kari M. Nilsen, Ph.D.[1], Anne Walling, MB ChB[1], Jill Grothusen, M.D.[2], Gretchen Irwin, M.D., MBA[3], Mark Meyer, M.D.[4], Greg Unruh, M.D.[5]

[1]University of Kansas School of Medicine-Wichita, Wichita, KS
Department of Family and Community Medicine

[2]University of Kansas School of Medicine-Kansas City, Kansas City, KS
Department of Family Medicine and Community Health

[3]University of Kansas School of Medicine-Wichita, Wichita, KS
Office of Graduate Medical Education
University of Kansas School of Medicine-Kansas City, KS

[4]Office of Student Affairs

[5]Office of Graduate Medical Education

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ABSTRACT

Introduction. The purpose of this study was to provide information to assist students, faculty, and staff in making critical career-determining decisions regarding the residency NRMP "Match©" process.

Methods. A 47-item survey questionnaire was developed and piloted on a regional medical school campus in 2015. The revised questionnaire was distributed each year from 2016 to 2020 to fourth-year medical students after rank lists had been submitted. The questionnaire incorporated a request for comments about the interviewing experience and suggestions to improve the process. This narrative feedback was coded using a thematic analysis.

Results. The overall response rate was 86.1% (897/1,042). Annual response rates ranged from 70.0% in 2020 to 97.0% in 2018. Respondents' average age was 27.3 (± 2.7) years and 50.0% (448/897) were male. Most applied to family medicine (164/897; 18.2%) and internal medicine (140/897; 15.6%). Eight specialties had fewer than ten applicants over the six-year period. The number of students applying to individual specialties fluctuated annually, but no specialty showed a consistent upward or downward trend over the study period.

Conclusions. This study found huge differences in numbers of applications, expenses, and days interviewing. Students crave more guidance, a more efficient system, transparent communication with programs, and less pressure during the process. Reducing escalating volumes of applications is central to improving the system. Despite efforts to inform applicants better, student behavior is unlikely to change until they feel safe in the belief that lower and more realistic numbers of applications and interviews are likely to result in securing an appropriate residency position. ***Kans J Med 2021;14:53-63***

INTRODUCTION

Concerns about the national residency matching program (NRMP subsequently referred to as "the Match©") are reported by students throughout medical school.[1] Fourth-year medical students are preoccupied with success in the Match© and report the process as their dominant source of stress.[1-3] Several authors have criticized the curricular time lost and detriment to learning from students absent on interviews or distracted by Match© concerns during coursework.[4-12] Serious concerns have been raised about expenses incurred by students, especially those most heavily burdened with debt.[13-24] In addition to students, residency programs report "drowning in applicants" and struggling with escalating financial and time demands to process applications.[16,24-49] These demands have fueled multiple calls for reform of the process.[7-11,16,17,21,26-59]

Until the Spring of 2020, the demands on students and residency programs were expected to increase due to rising numbers of Match© participants and the trend for individuals to apply to more programs.[16,25-40] The impacts of the dramatic changes to the Match© process due to the COVID-19 pandemic are difficult to predict. While applicant expenses are likely to fall due to the ban on in-person interviews, students could apply to more programs and/or consider programs across a broader geographical area, placing even greater burdens on residency programs. Those specialties that previously were associated with the highest applicant Match expenses could see a disproportionate increase in applications as they now appear more accessible to students who are disadvantaged economically and/or have high debt. All students could spend considerably more time arranging and participating in remote interviews. Applicants will continue to incur costs associated with application fees and possibly other expenses. An understanding of the previous patterns of costs and time expenditures is necessary to prepare students for the upcoming year and to provide the baseline data necessary to evaluate the impact of the proposed changes. We sought to provide updated comprehensive data on the time and financial costs incurred by University of Kansas School of Medicine (KUSM) students participating in the Match© over the past six years, including sources of funding and financial contributions from residency programs.

At least 20 studies have published cost estimates from different groups of Match© applicants (Table 1).[3,17-22,47-58] The studies have limited generalizability due to the heterogeneous groups studied and results reported. Most studied applicants to highly competitive specialties; information on primary care specialties was limited. Some studies only covered interviewing expenses, whereas others attempted to capture all costs. Few studies included any contribution to applicant expenses by programs. All studies were surveys based on participant recall and several were limited by low response rates. Results were presented in different formats and some focused on specific aspects, such as comparing costs for matched and unmatched applicants, among specialties, or between United States allopathic graduates and other groups. Data also quickly became outdated in the dynamic Match© process. The most recent comprehensive study (2016), reported average costs of about $3,500 with much higher spending for some specialties than others.[19] This was generally consistent with other studies (Table 1).

Eleven of the identified studies provided information on how students funded interviews and related expenses.[18-21,23,24,49,51,54,55,59] No single funding source dominated, but personal and/or additional student loans, savings, family gifts or loans, and credit cards consistently were reported. In several studies, students reported limiting the number of interviews due to expense, validating concerns that Match© expenses could limit career choices for students with limited resources.[16,17,19,21,24] In the six studies reporting either total estimated time or "time away from clinical duties" for interviewing, students reported around 20 days for interviewing with a range of 1 to 90 days (Table 1).[20,49,50,54,58,59]

All published studies provided "snapshot" information on different groups of students. By monitoring the entire KUSM graduating class over several years, we sought to add insights on trends in the time and costs of the Match© process for students. Our primary purpose was to provide information to assist KUSM students, and the faculty and staff who support them, in making critical career-determining decisions, but our findings could be useful to students and others in similar institutions.

METHODS

Participants. The participants were all fourth-year medical students of the University of Kansas School of Medicine (KUSM) who participated in the Match© to secure first year residency positions from 2016 to 2020, as well as a pilot completed in 2015. Every year, approximately 190 KUSM students use the Match© for nationwide application to residency programs in all specialties (Table 2).

Process. The research team consisted of faculty members involved in both medical student and graduate medical education, plus students from the third- and fourth-year classes during each survey year. The survey questionnaire was developed based on literature reviews and piloted on a regional campus in 2015.[54] The resulting 47-item questionnaire was reviewed each year and updated based on feedback from students and others, developments in the literature, and changes in the Match©. The questionnaire incorporated a request for student comments about the interviewing experience and suggestions to improve the process. The electronic questionnaire was distributed by e-mail weekly for four weeks in late February to early March, after rank lists had been submitted but before announcement of Match© results. Class leaders sent social media reminders two to three times weekly encouraging students to complete the questionnaire. As an incentive, a donation proportional to the response rate was offered to the student graduation celebration fund. This study was approved by the University of Kansas School of Medicine Institutional Review Board as Non-Human Subjects.

Statistical Analysis. Descriptive analyses provided demographic information about participants in all years (age, graduation year, gender); survey responses regarding specialty choice; number of residency program applications and interviews (offered and completed); time spent interviewing (in whole days); cost of residency interviews (in whole dollars); sources of funding (student loans, personal savings, credit cards, monetary gifts, private loans, and other sources); and any contribution to travel, lodging, and meal expenses from programs (as reported on a scale of 0 = 0% contribution and 4 = 100% contribution). Chi-square tests were used to determine any statistical differences by specialty choice, and t-tests were used to compare the average costs of interviewing by specialty choice and year. All data analyses were performed using SPSS version 26.0 (SPSS Inc., Chicago IL).

Narrative responses from two open-ended questions at the end of the survey were analyzed independently by two investigators (KN, AW) to identify themes using a thematic analysis approach, a method to identify and interpret patterns of meaning across qualitative data.[60] Thematic analysis followed an inductive process of becoming familiar with the data, generating initial codes, then identifying and refining common patterns or themes. Both investigators independently coded the narrative comments and reached consensus on an agreed coding framework. One investigator (AW) completed the remaining coding and recursively refined a thematic structure in discussion with the second investigator (KN). Patterns of commonality and divergent views were identified. The two investigators then came to a consensus on the names of the themes and identified illustrative quotations to defend each theme identified. Any differences in interpretation were resolved by discussion.

The thematic findings were reviewed by all members of the research team (comprising of students, faculty, and leaders of the graduate medical education and student affairs offices) to confirm the themes from multiple informed perspectives. The final themes were determined by consensus of the team. Formal member-checking was conducted by presenting results to students who had completed the NRMP Match© process, medical student advisors and faculty, directors and faculty of residency programs, and staff of the Office of Student Affairs. This enabled the team to determine the trustworthiness of the themes and take the appropriate perspectives into account.

RESULTS

Participants. The overall response rate was 86.1% (897/1,042). Annual response rates ranged from 70.0% in 2020 to 97.0% in 2018. Respondents' average age was 27.3 (± 2.7) years and 50.0% (448/897) were male. The largest numbers applied to family medicine (164/897; 18.2%) and internal medicine (140/897; 15.6%). Eight specialties had fewer than ten applicants over the six-year period. The number of students applying to individual specialties fluctuated year to year, but no specialty showed a consistent upward or downward trend over the study period.

Numbers of Applications and Interviews. Students applied to an average of 42.3 (± 25.7) programs (Table 3). This varied from 27.4 (± 24.0) in family medicine to 79.2 (± 46.5) in dermatology. In ten specialties, students reported averages of 50 or more applications. Specialties showed year-to-year variation in the average number of applications per student. Some specialties (e.g., family medicine, internal medicine, and pediatrics) remained stable, whereas others, such as obstetrics/gynecology and emergency medicine, showed a steady increase. Specialties with small numbers of applicants (e.g., neurology and dermatology) had large differences year to year, with

very high numbers (i.e., over 100 applications per student) in recent years. Within each specialty, individual students reported a wide range in the number of applications. The greatest range (10 to 250 programs) was in internal medicine and the smallest (60 to 75 programs) in thoracic surgery.

Table 1. Review of literature on costs and time reported by NRMP Match© applicants.

Study	Match© Year	Specialty/ Applicant Group Studied	Number of Respondents (response rate)	Mean Expense $ (range)	Average Days Interviewing (range)	Comments
Teichman JMH, Anderson KD, Dorough CR, et al.[47]	1998 - 99	Urology - national survey	230 (44%)	75% spent $1,000 - 5,000 (not provided)	-	Focuses on ethical issues in Match© process
Little DC, Yoder SM, Grikscheit TC, et al.[48]	2002 - 03	Pediatric surgery - single program	36 (80%)	$6,974 (not provided)	21[1]	Interview costs only (26% credit card)
Kerfoot BP, Asher KP, McCullough DL[20]	2005 - 06	Urology - All U.S. programs	287 (61%)	$4,000 ($2,000 - $5,000)	20 (14 - 30)	Interview cost only
Tichy AL, Peng DH, Lane AT[50]	2009 - 10	Dermatology - single program	125 (31%)	$4,500 (not provided)	21	Application and interview costs
Claiborne JR, Crantford JC, Swett KR, et al.[17]	2011 - 12	Plastic surgery - one program	127 (65%)	$6,073 (not provided)	-	Interview costs only
Guidry J, Greenberg S, Michael L[51]	2012 - 13	All Texas allopathic MS-4	274 (20.4%)	$4,783 ($127- $20,000)	-	All costs
Oladeji LO, Raley JA, Smith S, et al.[22]	2013 - 14	22 specialties - U.S. allopathic seniors	834 (4.8%)	$4,420 (not provided)	12 - 24	Interview costs only
Benson NM, Stickle TR, Raszka WV Jr[3]	2013 - 14	All MS-4 at 20 selected institutions	1,362 (47.4%)	33% spent > $4,000	-	-
Nikonow TN, Lyon TD, Jackman SV, et al.[21]	2013 - 14	Urology - 18 programs	173 (not provided)	$7,000 ($3,000 - $9,000)	-	Interview costs only
Agarwal N, Choi PA, Okonkwo DO, et al.[52]	2013 - 14	Neurological surgery - all U.S. programs	130 (64.4%)	$7,180 +/- $3,880 ($4,500 - $10,000)	-	Interview costs only
Camp CL, Sousa PL, Hanssen AD, et al.[53]	2014 - 15	Orthopedic surgery - 4 programs	408 (37%)	$5,415 ($450- $25,000)	-	Interview costs only
Fried JG[19]	2014 - 15	All U.S. allopathic MS-4	953 (not provided)	$3,423 +/- $2,853 ($80 - $25,000)	-	Interview travel & lodging only
Callaway P, Melhado T, Walling A, et al.[54]	2014 - 15	Regional campus MS-4	-	29% spent > $5,000	-	All costs
Fogel HA, Finkler ES, Wu K, et al.[55]	2014 - 15	Orthopedic surgery - single program	43 (90%)	$7,119 ($2,500 - $15,000)	-	Interview costs only
Van Dermark JT, Wald DA, Corker JR, et al.[24]	2015 - 16	Emergency Medicine (EMRA members[2])	180 (12.6%)	$4,159 (not provided)	-	Interview costs only
Fogel HA, Liskutin TE, Wu K, et al.[18]	2015 - 16	All U.S. allopathic MS-4	759 (not provided)	30% spent > $5,000	-	-
Blackshaw AM, Watson SC, Bush JS[56]	2015 - 16	Emergency Medicine - single program	66 (81%)	$8,312 (not provided)	-	-
Polacco MA, Lally J, Walls W, et al.[23]	2015 - 16	Otolaryngology - two programs	103 (35%)	$6,400 ($1,200 - $20,000)	-	-
Chang PS, Rezkalla J, Beard M[57]	2015 - 16	Single institution	40 (68.3%)	$6,596.51 (not provided)	-	Includes Sub-Internship, interview, second look costs
Susarla SM, Swanson EW, Slezak S, et al.[58]	2015 - 16	Plastic surgery - single program	48 (90.5%)	63% spent > $5,000	35% missed > 12 days	-
Walling A, Nilsen K, Callaway P, et al.[59]	2015 - 16	Single institution	163 (84%)	$3,500 ($20 - $12,000)	26 (1 - 90)	-

[1]Days away from clinical duties. Does not include vacation and other time used for interviewing.
[2]Emergency Medicine Residents Association

Table 2. Study participants by specialty: 2015 to 2020.

Specialty	2015[a]	2016	2017	2018	2019	2020	Total (%)
Anesthesiology	2	10	6	19	12	10	59 (6.6)
Dermatology	0	3	0	2	4	0	9 (1.0)
Emergency Medicine	4	7	14	11	15	9	60 (6.7)
Family Medicine	13	31	24	46	28	22	164 (18.2)
General Surgery	6	10	20	12	13	8	69 (7.7)
Internal Medicine	5	28	30	29	30	18	140 (15.6)
Medicine/Psychiatry	0	0	1	1	0	1	3 (0.3)
Medicine/Pediatrics	2	4	5	2	1	1	15 (1.7)
Medicine/Primary	0	1	0	2	2	0	5 (0.6)
Neurology	0	2	1	0	3	3	9 (1.0)
Neurosurgery	0	4	5	7	6	1	23 (2.6)
Obstetrics & Gynecology	7	9	16	9	16	9	66 (7.3)
Ophthalmology	0	2	5	2	3	3	15 (1.7)
Orthopedic Surgery	2	11	4	5	4	6	32 (3.6)
Otolaryngology	1	2	3	1	2	2	11 (1.2)
Pathology	1	3	2	3	3	2	14 (1.6)
Pediatrics	3	13	15	19	12	19	81 (9.0)
Plastic Surgery	0	0	3	0	4	3	10 (1.1)
Preventive Medicine[b]	0	1	0	0	0	0	1 (0.1)
Psychiatry	0	6	5	6	5	6	28 (3.1)
Radiation Oncology	0	1	0	0	2	0	3 (0.3)
Radiology	1	7	10	13	11	5	47 (5.2)
Rehabilitation Medicine	0	0	3	4	3	2	12 (1.3)
Thoracic Surgery[c]	0	0	2	0	0	0	2 (0.2)
Urological Surgery	1	2	1	1	2	1	8 (0.9)
Urology	0	6	2	0	1	2	11 (1.2)
Missing	0	2	0	0	0	0	2 (0.2)
Total	**48**	**163**	**177**	**194**	**182**	**133**	**897**
Response Rate	**78.6%**	**84.0%**	**92.0%**	**97.0%**	**93.3%**	**70.0%**	**86.1%**

[a]Pilot study with one campus
[b]Residency not available in State or Kansas City metro area
[c]Potential outlier as many students apply to general surgery for the first three years of residency

Table 3. Applications, completed interviews, estimated costs, interview time by specialty (combined 2016 to 2020).

Specialty	N	Applications (n)			Completed Interviews (n)			Estimated Cost ($)			Interview Time (# days)		
		M	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
Anesthesiology	59	39.9	17.8	12.0 - 90	11.7	3.2	5.0 - 18	4,083	2,793	800 - 15,000	27.7	12.8	2 - 70
Dermatology	9	79.2	46.5	11.0 - 120	9.6	3.8	6.0 - 19	7,022	6,015	500 - 20,000	34.6	24.4	12 - 90
Emergency Medicine	60	49.2	23.1	10.0 - 130	13.2	5.2	3.0 - 30	5,508	3,350	150 - 15,000	31.0	14.7	5 - 60
Family Medicine	164	27.4	24.0	3.0 - 183	10.4	4.0	2.0 - 28	2,688	2,197	20 - 11,000	26.6	15.8	2 - 120
General Surgery	69	47.3	18.1	1.0 - 102	11.0	4.0	1.0 - 22	5,826	4,350	300 -30,000	31.4	19.7	1 - 90
Internal Medicine	140	42.3	27.3	10.0 - 250	11.1	4.0	2.0 - 24	4,352	3,191	100 - 20,000	28.0	14.5	2 - 90
Medicine/Psychiatry	3	40.7	13.0	28.0 - 54	11.7	4.5	7.0 - 16	5,500	707	5,000 - 6,000	37.5	10.6	30 - 45
Medicine/Pediatrics	15	36.0	24.1	12.0 - 108	11.9	4.0	6.0 - 20	3,923	2,130	1,000 - 8,000	35.3	14.9	12 - 60
Medicine/Primary	5	48.0	35.0	25.0 - 100	10.5	3.4	6.0 - 14	4,375	5,218	1,000 - 12,000	34.8	17.3	22 - 60
Neurology	9	51.8	27.6	26.0 - 114	11.6	4.0	4.0 - 18	6,214	3,053	1,000 - 10,000	29.5	15.4	8 - 60
Neurosurgery	23	37.7	22.5	15.0 - 105	11.2	2.8	6.0 - 18	4,105	2,916	300 - 12,000	29.4	12.8	8 - 60
Obstetrics & Gynecology	66	48.8	23.6	8.0 - 105	11.0	4.2	2.0 - 21	4,465	2,791	200 - 12,000	29.3	17.2	2 - 60
Ophthalmology	15	61.0	30.5	15.0 - 95	13.3	4.4	7.0 - 24	7,371	5,123	1,000 - 10,000	36.1	14.6	13 - 60
Orthopedics	32	55.6	29.5	7.0 - 110	9.1	3.4	4.0 - 17	3,678	2,338	500 - 10,000	21.3	13.0	6 - 60
Otolaryngology	11	64.8	21.5	25.0 - 100	14.1	4.8	7.0 - 20	6,611	3,180	3,000 - 11,000	34.0	14.9	15 - 60
Pathology	14	30.5	17.0	10.0 - 71	10.8	4.5	3.0 - 20	3,767	1,838	500 - 7,557	27.2	13.7	6 - 60
Pediatrics	81	33.5	15.9	10.0 - 81	11.8	3.8	1.0 - 25	3,874	2,716	100 - 12,000	28.9	14.4	3 - 90
Plastic Surgery	10	68.8	24.0	30.0 - 102	13.6	3.6	5.0 - 18	8,250	5,277	3,000 - 20,000	34.2	13.9	10 - 60
Psychiatry	28	44.0	20.6	10.0 - 81	9.3	3.0	3.0 - 15	4,438	2,914	700 - 10,000	24.7	15.5	8 - 90
Radiation Oncology	3	68.0	16.0	52.0 - 84	16.3	3.8	12.0 - 19	9,833	4,646	4,500 - 13,000	38.3	10.4	30 - 50
Radiology	47	50.7	24.1	20.0 - 120	13.6	4.7	6.0 - 30	5,962	3,680	1,500 - 20,000	32.5	16.3	12 - 90
Rehabilitation Medicine	12	41.3	21.7	18.0 - 97	11.5	3.5	6.0 - 16	5,263	2,871	1,500 - 10,000	31.3	10.2	15 - 51
Thoracic Surgery	2	67.5	10.6	60.0 - 75	15.5	0.7	15.0 - 16	6,750	2,475	5,000 - 8,500	33.5	4.9	30 - 37
Urological Surgery	10	62.4	44.9	4.0 - 124	12.3	8.2	4.0 - 27	5,400	5,241	500 - 15,000	26.9	17.8	2 - 53
Urology	9	43.3	18.6	6.0 - 61	12.6	5.0	5.0 - 20	4,900	2,902	200 - 8,000	27.3	11.8	12 - 45
Total/Overall	**897**	**42.3**	**25.7**	**1.0 - 250**	**11.4**	**4.2**	**1.0 - 30**	**4,454**	**3,361**	**20 - 30,000**	**28.9**	**15.4**	**1 - 120**

The average number of completed interviews was 11.4 (± 4.2), ranging from 9.1 (± 3.4) in orthopedics to 16.3 (± 3.8) in radiation oncology. In contrast to the number of applications, the average number of completed interviews per student remained largely unchanged for each specialty throughout the study period. Within each specialty, individual students reported large differences in the number of completed interviews. The largest ranges were in emergency medicine (3 to 30) and family medicine (2 to 28), but the range in number of completed interviews was 20 or more in seven specialties.

Time Spent Interviewing by Specialty. Students reported an average of 28.9 (± 15.4; range 1 to 120) days for interviewing and related travel (Table 3). The greatest average time commitment was reported by applicants to radiation oncology (38.3 days, ± 10.4), whereas the smallest was for orthopedic surgery (21.3 days, ± 13.0). In 13 specialties, students reported an average of more than 30 days. Within specialties, individual students reported a wide range of time commitment to interviews. The largest range was two to 120 days in family medicine, but in 16 specialties the range in reported interview time among students was 50 days or more.

The average time increased from 25.2 (± 15.1, range 1 to 90) in 2016 to 28.9 (± 13.8, range 2 to 90) in 2020, with a peak of 31 (± 15.3, range 2 to 90) in 2019 [$t(324) = -3.4$, $p = 0.001$]. The largest increases were reported by dermatology from 2016 to 2019 (14.3 to 53.3 days; a 273% increase), and neurosurgery from 2016 to 2020 (from 17 to 51 days, a 200% increase). Several specialties showed large increases from 2016 to 2019 that were somewhat reduced in 2020. Eleven specialties reported decreased time between 2019 and 2020. Most of these one-year decreases were small, but obstetrics/gynecology decreased from 38 to 22 days (42%), and otolaryngology from 51 to 15 days (70%). Overall, seven specialties reported fewer days in 2020 than 2016: otolaryngology (29 to 15 days, 43.8%), psychiatry (26 to 18 days, 30.8%), medicine/pediatrics (42 to 30 days; 28.6%), obstetrics/gynecology (27 to 22 days; 18.5%), ophthalmology (29 to 15 days; 14.3%), and pathology (35 to 31 days; 14.3%).

Cost for Interviews. The average student-estimated interviewing expenses rose from 2016 to 2017 ($3,506 to $4,784) and from 2018 to 2019 ($4,001 to $5,423), but dropped between 2017 and 2018 ($4,784 to $4,001), and 2019 and 2020 ($5,423 to $4,529; Tables 3 and 4). Across the five years 2016 - 2020, average cost reported by all students dropped slightly from $4,784 (± $3,175, range $150 to $20,000) in 2016 to $4,529 (± $2,915, range $400 to $12,000) in 2020. This was not statistically significant [t(277) = -0.69, p = 0.49, 95% CI -$986 to -$476].

The highest average costs were reported by applicants to radiation oncology ($9,833), plastic surgery ($8,250), and preventive medicine ($8,000). The lowest costs were for family medicine ($2,688), orthopedic surgery ($3,678), and pathology ($3,767). Individuals reported a wide range of expenses within each specialty. The highest costs reported by individuals were in general surgery ($30,000), followed by dermatology, internal medicine, ophthalmology, plastic surgery, and radiology (each $20,000).

In nine of the 20 specialties with applicants in both years, average costs rose between 2016 - 2020. The largest increases were in neurosurgery ($7,750), ophthalmology ($7,158), and neurology ($6,500), but the increase only reached statistical significance for ophthalmology (Table 5). Seven of the eleven specialties reporting decreases from 2016 to 2020 had drops of more than $1,000. The largest decreases were in rehabilitation medicine ($3,217), urological surgery ($2,800), and otolaryngology ($2,667).

Funding Sources for Match© Expenses. New or additional student loans were the principal funding source for interview expenses, used by over 30% of students each year (Table 5). Credit cards increased as the principal funding source from around 17% to 27% during the study, while use of savings declined from 28.5% to 20%. In each study year, around 60% of students added to personal debt by using loans or credit cards to finance Match©-related expenses. Cost was reported as a limiting factor in interviewing 430 of 699 (61.5%) respondents, of whom 117 (16.7% of the total) reported cost as a very limiting factor.

Contributions to Travel Expenses by Residency Programs. Students reported a wide range of assistance with travel, lodging, and meals expenses by programs (Table 6). Results were inconsistent across the three years that this topic was included in the survey, especially for lodging. Programs were least likely to provide any contributions to travel costs. Radiation oncology provided the most travel assistance, but no programs in medicine/psychiatry, medicine/pediatrics, medicine/primary, ophthalmology, plastic surgery, psychiatry, thoracic surgery, and urological surgery covered any travel expenses. More than half of the students reported that all or nearly all programs contributed to the cost of meals during interviews. Neurology was reported to pay for 100% and the lowest contributions were from radiation oncology and thoracic surgery that covered 25 - 50% of applicant meals. Family medicine programs were most likely to pay or reimburse applicants for lodging with urology providing the least assistance.

Student Narrative Feedback. Three hundred and eleven students (34.6%) provided 329 narrative comments (Table 7). The largest number (79/311; 25.4%) expressed frustrations with inefficiencies and/or problems in scheduling interviews, mainly the use of multiple scheduling systems, random announcement of interview invitations, urgency to accept interviews, and difficulties in planning. Several students mentioned using interview brokers or assistants. Forty-seven students (15.1%) recommended limiting students in the number of applications, but only seven (2.5%) called for programs to limit or correlate the number of interviews with the available positions. The 49 (15.8%) comments regarding student advising focused on need for earlier, more individualized, and more specialty-specific information from residents and faculty in their specialty of interest. Excessive cost was mentioned in 37 comments (11.9%), including difficulty using student loans for Match© costs. The 27 (8.7%) comments regarding the time requirement focused on two periods, the long duration of the interviewing season and the delay between submission of rank order lists and announcement of residency Match© results. Twenty-four comments (7.7%) discussed travel-related issues including expense, difficulties of winter travel, and calls for regional coordination of interviews or greater use of video triage of applicants.

The 27 (8.7%) comments regarding communication with programs focused on two stages of the process: confusion over post-interview communication, and uncertainty about status after submitting applications, especially if an interview was not offered or offered with very little notice. The students provided 18 positive comments (5.8%) about the scheduled time provided for interviewing in the fourth-year curriculum, but 21 (6.8%) comments critical of restrictions on interviewing at other times.

DISCUSSION

This was the first study to track the Match© experiences of students from a single institution over several years. In addition to longitudinal changes in costs and time requirements, it drew attention to the large differences among classmates applying to the same specialty in number of applications, costs and time, and added insights on funding sources, program contributions to expenses, and student perspectives. The findings highlighted the need for attention to the contribution of Match© expenses to student debt, the time consumed by the process throughout the senior year, and the lack of information of program contribution to applicant cost. The high response rates, volume of comments, and active involvement of students emphasized the importance of this topic for students.

The study confirmed and updated previous reports of the substantial cost to applicants of the Match© and the wide differences across specialties. Contrary to popular belief, overall interview costs did not rise steadily over time, but large increases were reported by students applying to certain specialties. The largest component of applicant cost was the interview and related travel. Some of the cost reduction in 2020 could reflect national and local initiatives counseling students to apply to more realistic numbers of programs, as well as extensive efforts by students to exchange cost-reduction information. While the small numbers of applicants limited the interpretation of our results, students in certain specialties appeared to be spending more time and money on roughly the same number of interviews. As national travel

and accommodation costs did not vary greatly over the study period, this suggested they travelled farther and/or spent more time on each interview. An additional factor could be expensive "last minute" travel if interviews were offered at short notice (e.g., cancellation slots).

Table 4. Increase in costs by specialty between 2016 and 2020.

	2016				2020				Cost Difference				
Specialty	***N***	***M***	***SD***	**Range**	***N***	***M***	***SD***	**Range**	**Difference**	***t***	**df**	***p***	**95% CI**
Anesthesiology	6	$3,783	$3,577	$800 - $10,000	8	$4,088	$2,175	$1,750 - $8,000	$305	0.2	12	0.85	-$3,042 to $3,652
Emergency Medicine	13	$5,604	$3,461	$150 - $13,200	9	$5,056	$2,391	$1,500 - $10,000	-$548	-0.4	20	0.69	-$3,332 to $2,236
Family Medicine	23	$2,708	$1,740	$200 - $6,000	20	$2,350	$1,919	$400 - $7,000	-$358	-0.6	41	0.52	-$1485 to $769
General Surgery	17	$6,421	$3,384	$2,000 - $13,000	6	$6,250	$2,444	$3,000 - $10,000	-$171	0.1	21	0.91	-$3,317 to $ 2,975
Internal Medicine	28	$5,379	$4,078	$800 - $20,000	17	$3,994	$2,492	$500 - $10,000	-$1,385	-1.3	43	0.21	-$3,360 to $829
Medicine/ Pediatrics	5	$4,000	$2,449	$1,000 - $7,000	1	$3,500	---	---	-$500	---			
Neurology	1	$1,000	---	---	2	$7,500	$3,536	$5,000 - $10,000	$6,500	---			
Neurosurgery	4	$4,250	$2,062	$2,000 - $6,000	1	$12,000	---	---	$7,750	---			
Obstetrics & Gynecology	13	$3,777	$2,574	$500 - $7,500	7	$5,214	$2,233	$2,000 - $8,000	$1,437	1.2	18	0.23	-$991 to $3,865
Ophthalmology	4	$3,175	$2,030	$1,200 - $6,000	3	$10,333	$1,528	$9,000 - $12,000	$7,158	5.1	5	0.004	$3,534 to $10,782
Orthopedics	4	$3,625	$1,887	$1,500 - $6,000	6	$5,333	$3,869	$1,500 - $10,000	$1,708	0.8	8	0.44	-$3,159 to $6,575
Otolaryngology	3	$6,167	$4,193	$3,500 - $11,000	2	$3,500	$707	$3,000 - $4,000	-$2,667	-0.8	3	0.46	-$12,683 to $7,349
Pathology	2	$4,000	---	---	2	$5,279	$3,222	$3,000 - $7,557	$1,279	0.6	2	0.63	-$8,524 to $11,082
Pediatrics	14	$4,987	$3,141	$400 - $10,000	17	$3,609	$2,489	$700 - $8,500	-$1,378	-1.4	29	0.18	-$3,444 to $689
Plastic Surgery	3	$4,167	$764	$3,500 - $5,000	3	$8,333	$2,887	$5,000 - $10,000	$4,167	2.4	4	0.07	-$621 to $8,953
Psychiatry	5	$5,900	$2,793	$2,500 - $10,000	5	$4,200	$4,006	$700 - $9,000	-$1,700	0.78	8	0.46	-$6,736 to $3,336
Radiology	8	$5,750	$2,726	$3,500 - $12,000	4	$4,375	$1,797	$3,000 - $7,000	-$1,375	0.9	10	0.39	-$4,764 to $2,014
Rehabilitation Medicine	3	$6,667	$3,055	$4,000 - $10,000	2	$3,450	$1,061	$2,700 - $4,200	-$3,217	-1.4	3	0.26	-$10,679 to $4,244
Urological Surgery	1	$9,800	---	---	1	$7,000	---	---	-$2,800	---			
Urology	1	$6,000	---	---	2	$8,000	---	---	$2,000	---			
Total/Overall	**160**	**$4,784**	**$3,175**	**$150 - $20,000**	**119**	**$4,529**	**$2,915**	**$400 - $12,000**	**-$255**	**-0.69**	**277**	**0.49**	**-$986 to $476**

Table 5. Funding sources for interview expenses.[1]

	Year											
	2015		**2016**		**2017**		**2018**		**2019**		**2020**	
	n (%)		n (%)		n (%)		n (%)		n (%)		n (%)	
Student Loans	32	(37.6)	102	(35.1)	123	(37.7)	128	(33.0)	117	(32.6)	76	(30.3)
Savings	24	(28.2)	71	(24.4)	65	(19.9)	89	(22.9)	80	(22.3)	64	(25.5)
Credit Cards	14	(16.5)	69	(23.7)	73	(22.4)	89	(22.9)	94	(26.2)	64	(25.5)
Gift	12	(14.1)	37	(12.7)	45	(13.8)	58	(14.9)	51	(14.2)	31	(12.4)
Private Loans	2	(2.4)	9	(3.1)	16	(4.9)	12	(3.1)	8	(2.2)	9	(3.6)
Other[2]	1	(1.2)	3	(1.0)	4	(1.2)	12	(3.1)	9	(2.5)	7	(2.8)
Total	**85**		**291**		**326**		**388**		**359**		**251**	

[1]All funding sources identified by students.
[2]Airline/credit card points and other unidentified income used.

Table 6. Student-reported contributions to travel expenses by residency programs.*

Type of Expense	Percent of Programs Paying	Number (%) of Students Reporting Payments							
		2017		2018		2019		2020	
Travel	0%	139	(84.2)	130	(67.7)	156	(89.1)	107	(86.3)
	25%	14	(8.5)	56	(29.2)	11	(6.3)	7	(5.6)
	50%	7	(4.2)	1	(0.5)	0	(0.0)	4	(3.2)
	75%	4	(2.4)	5	(2.6)	7	(4.0)	4	(3.2)
	100%	1	(0.6)	0	(0.0)	1	(0.6)	2	(1.6)
Total		**165**		**192**		**175**		**124**	
Lodging	0%	34	(20.6)	23	(12.0)	55	(31.4)	34	(27.4)
	25%	55	(33.3)	54	(28.1)	53	(30.3)	37	(29.8)
	50%	23	(13.9)	21	(10.9)	0	(0.0)	14	(11.3)
	75%	33	(20.0)	61	(31.8)	51	(29.1)	24	(19.4)
	100%	20	(12.1)	34	(17.7)	17	(9.7)	15	(12.1)
Total		**165**		**193**		**176**		**124**	
Meals	0%	12	(7.3)	9	(4.7)	22	(12.6)	17	(13.8)
	25%	18	(10.9)	17	(8.9)	8	(4.6)	14	(11.4)
	50%	12	(7.3)	16	(8.3)	0	(0.0)	8	(6.5)
	75%	30	(18.2)	33	(17.2)	49	(28.0)	19	(15.4)
	100%	93	(56.4)	117	(60.9)	97	(55.4)	65	(52.8)
Total		**165**		**192**		**176**		**123**	

*All funding sources identified by students. Question added in 2017.

Table 7. Student narrative feedback.

Major Theme	Illustrative Quotations (Selected from 329 total comments)
Inefficiencies/frustrations with scheduling system (79)	• Using multiple scheduling programs is ludicrous, the most stressful part of the whole process.
	• Impossible to predict where or when slots will be available. Offers come in randomly.
	• Glued to your computer/phone for two to three months to respond quickly to interviews.
	• Had to use an interview broker.
	• At multiple interviews there were cancellations and the spots didn't get filled.
	• The process was a nightmare to be honest.
Improve information and assistance on process (49)	• Need more counseling on appropriate number of applications.
	• Felt unprepared in October without mock interviews.
	• Needs explained by specialty as experiences are so different.
Limit number of applications per student (47)	• There should be a max number of applications allowed per specialty.
	• Give students a max of 25 - 30 applications.
	• Limit the number of applications. I applied to programs I wasn't interested in to reach a total number.
	• I wish there was a limit in the number of programs we can apply to and a limit in the number of programs we can interview at.
Excessive cost (37)	• The cost is WAY too high.
	• Take away ridiculous fees.
	• Too much money for student with lot of debt.
	• Increase MS-4 cost of attendance to allow for greater financial aid awards.
	• Money was the biggest limiting factor. I had to take out extra loans and was constantly stressing out about how to pay for things.
	• Applications should be free. It is criminal to charge $26 for each additional application which costs nothing to send digitally.
Excessive time demands (27)	• Time period greater than people realize.
	• Interviews were so spread out. I needed more than two months to interview.
	• Decrease time from rank list due and Match© day to allow more time for SOAP or to relocate.
	• Tell us where we Match© earlier. The algorithm takes literally seconds.

Table 7. Student narrative feedback. *continued.*

Major Theme	Illustrative Quotations (Selected from 329 total comments)
Communication problems with programs (27)	• Multiple programs that I never heard from- even a wait list or rejection.
	• It feels very dishonest and secretive due to expressed or unexpressed interest.
	• Clarify post-interview communications.
	• Enforce post-interview communication regulations.
	• Increase transparency from programs regarding their selection criteria.
Travel difficulties (24)	• It was a huge hassle flying across the country multiple times.
	• Winter travel is expensive and disrupted by weather and holidays.
	• Difficult to schedule interviews by location. Regional programs could coordinate.
	• Should have online or video interviews first with optional visit.
Limits on time out of courses for interviews (21)	• Administration needs to be more relaxed about students taking time off to interview.
	• Limiting to two days per rotation is ridiculous.
	• Interviewing should take priority over possibly missing a few days of a rotation.
	• Forcing students to break the rules and hope you don't get caught.
Support for two month scheduled interview time (18)	• At least two months needed. We had great opportunities compared to other students.
	• Having two months [off for interviews] was extremely helpful.
	• Keep the interview months- it gives our students a huge advantage.

Previous suggestions to curtail Match© costs for students have focused almost exclusively on rationalizing the number of programs to which each student applies. Our data showed that increasing the number of applications did not result in more interviews, confirming the Association of American Medical Colleges report that "shotgun" applications are inefficient and costly for students and place huge burdens on residency programs to triage large numbers of applicants.[61] Nevertheless, narratives confirmed that students are prepared to do "whatever it takes" regardless of data or advice.[47] The high stakes incentivize students to over-apply, leading to pressures on programs to identify the most appropriate applicants, and setting up a "vicious circle" of ever-escalating time and cost demands on both applicants and residency programs. With greater uncertainty in 2021 and the removal of distance barriers, students could increase the number of applications, further increasing demands on residency programs. The removal of travel expenses could result in especially large increases in applications to those specialties that previously had the highest costs.

This was the first study to compare interviewing time by specialty. The reported average interviewing time rose significantly between 2016 and 2019 from 25 days to 31 days, then declined to 28 days in 2020, which was not a significant difference from either 2016 or 2019. The highest reported times of nearly 40 days (otolaryngology and radiation oncology) were almost double those for the lowest specialties. The low times for some highly competitive programs, such as orthopedics and neurosurgery, could reflect local availability of positions, students receiving few interview invitations, or programs clustering interviews by time and/or location. Within all specialties, individual students reported a wide range of time spent interviewing, again supporting the need for individualized expert advising. Our students were allocated eight weeks in the fourth year for interviewing. Obtaining permission for additional time was regarded as a major challenge that regularly was circumvented and could inhibit reporting of high interviewing times. Despite the regulations, individuals reported up to 120 days. The true interviewing times could be much longer.

Match©-related activities are the priority of the fourth-year medical student, far out-weighing any course or curricular requirements. Importantly, our study did not capture time invested in away rotations, learning about the Match© process, preparing and submitting applications, and negotiating interviews. The period when interview offers were made was particularly time-demanding and stressful. During this period, usually early in the senior year, students are distracted from other responsibilities and hypervigilant for interview offers that require immediate action. The negative impact of the entire Match© process on medical education, especially in the fourth year, merits greater attention.

The move to video interviewing paradoxically could increase time requirements, especially at the beginning of the fourth year and possibly earlier, not just during the "interview season" of September to January. Potential time savings from the removal of travel and in-person interviews may be negated by the time required to arrange and prepare for interviews and possibly participate in more than one interview per program.

The study findings emphasized the need for intensive assistance for students in making decisions about numbers of applications and selection of interviews. Individualized, specialty-based assistance appeared especially necessary for those highly competitive specialties with few applicants per year, but even in the most popular specialties, the wide range in numbers of applications and costs indicated a need for assistance in navigating the Match© process more efficiently.

Limitations. Our study had several limitations, most notably limited generalizability to other institutions, especially non-state medical schools outside the region. Student responses could be inaccurate or biased by faulty recall. Such bias was likely to be minimal due to the high student investment in the project, response rates, narrative comments, and consistency of results over time. In data analysis, each student was allocated only to his/her top-ranked specialty. Small numbers in individual specialties and year-to-year variation limited attributing statistical significance to some trends and we did not address situations where students applied to more than one specialty or potential differences by gender, regional campus, or other variables. Class rank, Step 1 scores, or other measures of student "competitiveness" also were not considered.

CONCLUSIONS

Our study draws attention to the huge difference in numbers of applications, expenses, and days interviewing among individual students even among classmates applying to the same single specialty. The Match© is a crucial and intensely personal experience. Students crave more guidance, a more efficient system, transparent communication with programs, and less pressure on them and their families during the process. Reducing the escalating volume of applications is central to improving the system and may become even more critical with the move to remote interviewing. Despite efforts to inform applicants better, student behavior is unlikely to change until they feel safe in the belief that lower and more realistic numbers of applications and interviews are likely to result in securing an appropriate residency position. The upcoming 2020 - 2021 academic year presents a unique opportunity to document the impact of the sudden change to remote interviewing and to provide guidance on strategies to improve this crucial process. Further research and discussion are needed at both the medical school and residency program level to determine the future direction of the Match©.

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Recent Evolution in the Management of Lymph Node Metastases in Melanoma

Shelby Breit, MS-3[1], Elise Foley, MS-3[1],
Elizabeth Ablah, Ph.D., MPH[2], Hayrettin Okut, Ph.D.[2,3],
Joshua Mammen, M.D., Ph.D., FACS[4]
[1]University of Kansas School of Medicine-Salina, Salina, KS
University of Kansas School of Medicine-Wichita, Wichita, KS
[2]Department of Population Health
[3]Office of Research
[4]University of Kansas School of Medicine-Kansas City,
Department of Surgery, Kansas City, KS

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ABSTRACT

Introduction. Based upon two large randomized international clinical trials (German Dermatologic Cooperative Oncology Group (DeCOG-SLT) and Multicenter Selective Lymphadenectomy Trial II (MSLT-II)) published in 2016 and 2017, respectively, active surveillance has been demonstrated to have equivalent survival outcomes to completion lymphadenectomy (CLND) for a subset of patients who have microscopic lymph node disease. In this study, the changes in national practice patterns were examined regarding the utilization of CLND after positive sentinel lymph node biopsy (SLNB).

Methods. Using the National Cancer Database, CLND utilization was examined in SLN-positive patients diagnosed with melanoma between 2012 and 2016. A hierarchal logistical regression model with hospital-level random intercepts was constructed to examine the factors associated with SLNB followed by observation vs. SLNB with CLND.

Results. Of the 148,982 patients identified, 43% (n = 63,358) underwent SLNB and 10.3% (n = 6,551) had a SLNB with microscopic disease. CLND was performed for 57% (n = 2,817) of these patients. Patients were more likely to undergo CLND if they were ≤ 55 years of age (OR, 1.454; $p \leq 0.0001$), ages 56 - 65 (OR, 1.127; $p = 0.026$), Charlson Deyo Score = 0 (OR, 2.088; $p = 0.043$), or were diagnosed with melanoma in 2012 (OR, 2.259, $p \leq 0.0001$).

Conclusions. The utilization of CLND among patients with microscopic nodal melanoma was significantly lower in 2016 compared to 2012. Younger age, lack of comorbidities, and primary tumor location on the trunk or head/neck were associated with higher utilization of CLND. ***Kans J Med 2021;14:64-72***

INTRODUCTION

Melanoma is a malignant tumor typically of the skin that arises from the proliferation of melanocytes.[1] The incidence of melanoma in the United States has increased from 10.51 cases per 100,000 persons in 1980 to 25.83 cases per 100,000 persons in 2016,[2] and is predicted to rise in the United States and worldwide for the foreseeable future.[1,3,4] In 2019, there were approximately 96,000 new cases and an estimated 7,300 deaths due to melanoma in the United States.[5]

Melanoma has the propensity to spread via the lymphatic system, and the status of the sentinel lymph node (SLN) is amongst the most important prognostic factors for patients.[6,7] Early regional lymph node evaluation with sentinel lymph node biopsy (SLNB) has been standard of care since the early 1990s, with putative benefits including decreased lymph node basin relapse and improved disease-free survival with less morbidity than full lymphadenectomy.[8-10] Following a positive SLNB, completion lymph node dissection (CLND) had been the standard recommendation in an effort to remove other lymph nodes with metastases and to control disease.[7,10,11]

CLND can be associated with high morbidity, with the occurrence of complications ranging from 11 - 73%.[9,12-15] Consequently, there have been several studies that have sought to determine if it is safe to avoid CLND for patients following a positive SLNB, including two large randomized control trials (RCTs): the German Dermatologic Cooperative Oncology Group (DeCOG-SLT) and the Multicenter Selective Lymphadenectomy Trial II (MSLT-II).[9,16] The results of these two RCTs comparing CLND with observation demonstrated no difference in overall survival at three years, suggesting that CLND did not provide additional benefit among patients diagnosed with nodal metastasis.[9,17] Both trials were limited by relatively short follow-up, and the favorable histologic characteristics of the patients enrolled.

A study evaluating the usage of CLND among patients diagnosed with melanoma from 2004 to 2005 reported that 50% of patients with a positive SLNB underwent a CLND,[18] suggesting that clinicians were foregoing CLND for some patients. However, few studies have examined the practice patterns and trends in the performance of CLND among patients after a positive SLNB, with respect to frequency and patient factors. Our study objectives were to: 1) examine the national trends and practice patterns regarding the utilization of CLND among patients after a positive SLNB, and 2) identify which patient and tumor characteristics were associated with undergoing a CLND and those associated with observation after a positive SLNB.

METHODS

Participants. A cross-sectional study was conducted using the National Cancer Database (NCDB) to include patients 18 years or older who were diagnosed with melanoma between 2012 and 2016, as classified by the World Health Organization's International Classification of Disease for Oncology (ICD-O), 3rd edition.[19] Patients with metastatic disease, clinically positive lymph nodes, and carcinoma in situ were excluded.

Instrument. This study was considered "Not Human Subjects" by the Human Subjects Committee at the University of Kansas School of Medicine-Wichita. The NCDB, established in 1988, is a joint program of the American College of Surgeons Commission on Cancer (CoC) and the American Cancer Society (ACS) that collects data on approximately 70% of all cancer diagnoses annually.[20] Cases were abstracted from the 2016 NCDB Adult Participant Use Data File, the most recent year of available data. The NCDB Participant Use Data File contains de-identified, Health Insurance Portability, and Accountability Act (HIPPA)-compliant data and are available to investigators affiliated with CoC-accredited programs.

Clinically relevant factors included gender, age (≤ 55 years, 56 - 65 years, 66 - 75 years, > 75 years), race (white, non-white), insurance status (private, not insured, Medicaid, Medicare, other government insurance), quartile of median household income (< $38,000, $38,000 - $47,999, $48,000 - $62,999, and ≥ 63,000), the number of comorbid conditions based on the Charlson-Deyo Score (0, 1, 2, and ≥ 3), year of melanoma diagnosis (2012 - 2016), Breslow thickness (< 1.00 mm, 1.01 - 2.00 mm, 2.01 - 4.00 mm, ≥ 4.01 mm), the presence or absence of tumor ulceration, and the primary location of the tumor (head, trunk, upper extremity, and lower extremity).

Surgical Procedure and Nodal Evaluation. The Facility Oncology Registry Data Standards (FORDS) were used to define regional lymph node evaluation and the surgical procedure(s) performed.[21] Before January 1, 2012, the variable, "Scope of Regional LN Surgery", had been used. However, the coding instructions for this variable led to the inability to distinguish SLNB alone or SLNB + CLND, leading to concerns of the under-reporting of procedures performed. A joint committee comprised of the Commission on Cancer (CoC), National Cancer Institute's Surveillance Epidemiology and End Results (SEER), and North American Association of Central Cancer Registries (NAACCR) created a new variable, "Scope of Regional LN Surgery 2012",[22] that created the distinction between type of surgeries performed. "Scope of Regional LN Surgery 2012", which was used in the current study, was coded as SLNB alone or SLNB with CLND. Cases were abstracted by Certified Tumor Registrants using NAACCR-approved software.[21] Breslow thickness, primary site, and presence or absence of ulceration were evaluated using the Collaborative Stage Data Collection System.[21]

Statistical Analysis. Data were analyzed using SAS version 9.4 (SAS Int. Inc., Carry, NC). Frequencies and percentages were reported for all categorical data. A hierarchal logistic regression model with hospital-level random intercepts that accounted for the clustering of patients within hospitals was constructed to examine the factors associated with SLNB followed by observation vs. SLNB with CLND. Maximum Likelihood Estimation Based on Adaptive Gauss-Hermite quadrature rule was used for model parameter estimates and Hannan-Quinn information criterion (HQIC) was conducted to decide the model that better fit the outcome variables. Odds ratios were generated with 95% confidence intervals (CI). All statistical tests at $p \leq 0.05$ were considered significant.

RESULTS

A total of 265,127 patients were diagnosed with melanoma between January 1, 2012, and December 31, 2016. After excluding patients with distant metastatic disease, clinically positive lymph nodes, and carcinoma in situ or unknown American Joint Committee on Cancer (AJCC) staging, the final cohort contained 148,982 patients from 1,343 CoC-accredited facilities.

Of these patients, 42.5% (n = 63,358) underwent a SLNB (Table 1). Among patients who underwent a SLNB, 10.3% (n = 6,551) also had at least one lymph node with metastatic disease. Among those with a positive SLNB, 60% (n = 3,928) were male, and their mean age was 59 (SD = 15) years. Fifty-four percent (n = 3,517) of those with a positive SLNB were privately insured, 37% (n = 2,395) had Medicare, and 3% percent (n = 185) were uninsured. For 37% (n = 2,448) of patients, the trunk was the location of the primary site, making it the most common location in those with a positive SLNB. The head region comprised 14% (n = 949) of primary site cases.

Forty-three percent (n = 2,817) of patients with a positive SLNB had no further surgery, whereas 57% (n = 3,737) of patients with a positive SLNB underwent CLND. Among those who underwent CLND, 61% (n = 2,265) were male, and their mean age was 56 (SD = 15) years. Among those who underwent observation after positive SLNB, 59% (n = 1,663) were male, and their mean age was 62 (SD = 16) years. Fifty-nine percent (n = 2,186) of patients who underwent CLND were privately insured, whereas 48% (n = 1,331) of those who underwent observation after a positive SLNB were privately insured. Twenty-six percent (n = 966) of patients who underwent CLND had a Breslow thickness of ≥ 4.01 mm, whereas 31% (n = 875) of patients who underwent observation after positive SLNB had a Breslow thickness of 2.01 - 4.00 mm. In the unadjusted analysis, patient sex, age, insurance status, median household income, education, year of diagnosis, Breslow thickness, ulceration, and location were significantly different between individuals forgoing CLND after a positive SLNB and patients receiving a CLND after a positive SLNB (all p values < 0.05). Additional patient and tumor characteristics are detailed in Tables 1 and 2.

Use of Completion Lymph Node Dissection. Of the 148,982 patients identified, 42.5% underwent a SLNB (63,358), and 43% (n = 6,551) of those had a metastatic lymph node on final pathology (Figure 1). Overall, CLND was performed in 57% of cases (n = 3,734), but this frequency decreased over time. In 2012, 63% (n = 716) of patients underwent CLND after positive SLNB, decreasing to 48% (n = 719; $p \leq 0.0001$) of patients undergoing CLND after positive SLNB in 2016.

Logistic regression analysis was employed to assess the impact of several predictor variables on the likelihood that a patient would or would not undergo CLND after a positive SLNB (Table 3). Patients were significantly more likely to undergo CLND if they were younger than or equal to 55 years of age (OR =1.454; $p \leq 0.0001$), between the ages of 56 - 65 (OR = 1.127; p = 0.026) or had a Charlson-Deyo Score of 0 (OR = 2.088; p = 0.043). Regarding location, patients were significantly more likely to undergo CLND if the primary tumor was located in the head region (OR =1.238; p = 0.0002) or on the trunk region (OR =1.71; p = 0.0002). Patients were more likely to undergo CLND if they were diagnosed with melanoma in 2012 (OR =1.172; $p \leq 0.0001$). Patients were more likely to undergo CLND if they had private insurance (OR = 1.172; p =0.026). There was no statistical difference between those individuals who had Medicaid and Medicare.

Table 1. Characteristics of 63,358 patients with melanoma who underwent SLNB.

	All Patients Receiving a SLNB[a] (n = 63,358) n[b],%	All Patients Receiving a SLNB with a Metastatic Lymph Node on SLNB (n = 6,551) n[b],%	Observation After Positive SLNB (no CLND) (n = 2,817) n[b],%	CLND After Positive SLNB (n = 3,734) n[b],%	p value*
Gender					
Male	36,870 (58.2%)	3,928 (60.0%)	1,663 (59.0%)	2,265 (60.7%)	<0.001
Female	26,488 (41.2%)	2,623 (40.0%)	1,154 (41.0%)	1,469 (39.3%)	<0.001
Age					
Median, y (IQR)	60.6	58.7	61.6	56.4	<0.001
<55 y	21,798 (34.4%)	2,625 (40.1%)	940 (33.4%)	1,685 (45.1%)	
56 - 65 y	15,837 (23.3%)	1,558 (23.8%)	641 (22.7%)	917 (24.6%)	
66 - 75 y	14,763 (23.3%)	1,349 (20.6%)	616 (22.0%)	733 (19.6%)	
>75 y	10,960 (17.3%)	1,019 (15.5%)	620 (22.0%)	399 (10.7%)	
Race					0.289
White	62,115 (98.7%)	6,387 (98.0%)	2,746 (98.0%)	3,641 (98.0%)	
Non-White	801 (1.3%)	130 (2.0%)	56 (2.0%)	74 (2.0%)	
Insurance Status					<0.001
Not-insured	1,281 (2.0%)	185 (2.8%)	67 (2.4%)	118 (3.2%)	
Private	33,842 (54.0%)	3,517 (54.2%)	1,331 (47.7%)	2,186 (59.1%)	
Medicaid	1,903 (3.0%)	312 (4.8%)	121 (4.3%)	191 (5.2%)	
Medicare	24,906 (39.7%)	2,395 (36.9%)	1,235 (44.3%)	1,160 (31.4%	
Other Government	807 (1.3%)	77 (1.2%)	36 (1.3%)	41 (1.1%)	
Median Household Income					
>$63,000	25,830 (40.1%)	2,374 (36.3%)	1,067 (38.0%)	1,307 (35.0%)	<0.001
$48,000 - $62,000	17,992 (28.5%)	1,963 (30.0%)	814 (28.9%)	1,149 (30.8%)	<0.001
$38,000 - $47,999	12,940 (20.5%)	1,456 (22.2%)	600 (21.3%)	856 (23.0%)	<0.001
<$38,000	6,488 (10.3%)	750 (11.5%)	333 (11.8%)	417 (11.2%)	0.001
Education (% without a HS diploma)					
<7%	21,204 (33.5%)	1,994 (30.5%)	876 (31.1%)	1,118 (30.0%)	<0.001
7% - 12.9%	22,764 (33.4%)	2,433 (37.2%)	1,015 (36.1%)	1,418 (38.0%)	<0.001
13% - 20.9%	13,457 (21.3%)	1,417 (22.5%)	614 (21.2%)	857 (23.0%)	<0.001
>21%	5,858 (9.3%)	647 (4.9%)	310 (11.0%)	337 (9.0%)	0.004
Charlson-Deyo Score					
0	53,136 (83.9%)	5,362 (81.8%)	2,250 (79.9%)	3,112 (83.3%)	<0.001
1	8,027 (12.7%)	913 (13.9%)	415 (14.7%)	498 (13.3%)	0.001
2	1,573 (2.5%)	185 (2.8%)	102 (3.6%)	83 (2.2%)	0.112
>3	622 (0.9%)	91 (1.4%)	50 (1.8%)	41 (1.1%)	0.239
Year of Diagnosis					
2012	11,316 (17.7%)	1,133 (17.3%)	417 (14.8%)%	716 (19.2%)	0.001
2013	12,048 (19.0%)	1,224 (18.7%)	498 (17.7%)	726 (19.4%)	<0.001
2014	12,902 (20.4%)	1,330 (20.3%)	545 (19.3%)	785 (21.0%)	<0.001
2015	13,437 (21.2%)	1,363 (20.8%)	575 (20.4%)	788 (21.1%)	<0.001
2016	13,655 (21.5%)	1,501 (22.9%)	782 (27.8%)	719 (19.3%)	<0.001

Table 1. Characteristics of 63,358 patients with melanoma who underwent SLNB. *continued.*

	All Patients Receiving a SLNB[a] (n = 63,358) n[b],%	All Patients Receiving a SLNB with a Metastatic Lymph Node on SLNB (n = 6,551) n[b],%	Observation After Positive SLNB (no CLND) (n = 2,817) n[b],%	CLND After Positive SLNB (n = 3,734) n[b],%	p value*
Tumor Characteristic					
Breslow Thickness					<0.001
Median, mm (IQR)	2.02	3.12	3.05	3.17	
<1.00mm	21,621 (34.4%)	850 (13.1%)	382 (13.7%)	468 (12.6%)	
1.01 - 2.00mm	22,283 (35.5%)	1,956 (30.1%)	854 (30.6%)	1,102 (29.7%)	
2.01 - 4.00mm	11,841 (18.9%)	2,044 (31,5%)	875 (31.4%)	1,169 (31.5%)	
>4.01mm	7,039 (11.2%)	1,645 (25.3%)	679 (24.3%)	966 (26.1%)	
Ulceration					
Present	14,946 (24.0%)	2,750 (42.4%)	1,167 (41.8%)	1,583 (42.8%)	<0.001
Absent	47,456 (76.0%))	3,742 (57.6%)	1,624 (58.2%)	2,118 (57.2%)	<0.001
Location					<0.001
Head/Ear/Lip/Neck	12,148 (19.2%)	949 (14.4%)	378 (13.4%)	571 (15.3%)	
Trunk	20,077 (31.7%)	2,448 (37.4%)	921 (32.7%)	1527 (40.1%)	
Upper Extremity	18,347 (29.0%)	1,452 (22.2%)	613 (21.8%)	839 (22.5%)	
Lower Extremity	12,786 (20.1%)	1,702 (26.0%)	905 (32.1%)	797 (21.3%)	

[a]Missing data for race (n = 442), insurance status (n = 619), median household income (n = 588), education (n = 75), Breslow Thickness (n = 574), Ulceration (n = 956)
[b]Percentages do not add up to 100% due to missing data
*p values were estimated with program-level cluster-adjusted chi square tests of association for comparisons between positive SLNB without CLND and positive SLNB with CLND

Table 2. Factors associated with CLND (compared with observation).

Predictor	p value	Odds Ratio
Sex		
Male	(Ref)	(Ref)
Female	0.993	1.00
Age		
>75	(Ref)	(Ref)
<55	<.001	0.687
56 - 65	0.023	0.886
66 - 74	0.137	0.919
Race		
White	(Ref)	(Ref)
Non-White	0.507	0.939
Insurance Status		
Other Government	(Ref)	(Ref)
Not-insured	0.837	0.972
Private	0.02	0.853
Medicaid	0.5756	0.938
Medicare	0.500	1.060
Median Household Income		
>$63,000	(Ref)	(Ref)
<$38,000	0.235	0.919
$38,000 - $47,999	0.410	0.959
$48,000 - $62,000	0.868	0.992

Table 2. Factors associated with CLND (compared with observation). *continued.*

Predictor	p value	Odds Ratio
Education (% without a HS diploma)		
<7%	(Ref)	(Ref)
>21%	<0.001	1.301
13% - 20.9%	0.415	0.958
7% - 12.9%	0.005	0.881
Charleson Deyo Score		
3	(Ref)	(Ref)
0	0.043	0.859
1	0.086	0.862
2	0.246	1.164
Year of Diagnosis		
2016	(Ref)	(Ref)
2012	<.001	0.794
2013	0.123	0.92
2014	0.119	0.922
2015	0.863	1.01
Breslow Thickness		
>4.01 mm	(Ref)	(Ref)
<1.00mm	0.017	1.153
1.01 - 2.00mm	0.388	1.04
2.01 - 4.00mm	0.672	0.982
Ulceration		
Present	(Ref)	(Ref)
Absent	0.081	1.052
Primary Site		
Lower Extremity	(Ref)	(Ref)
Head/Ear/Lip/Neck	<0.001	0.807
Trunk	<0.001	0.853
Upper Extremity	0.081	0.919

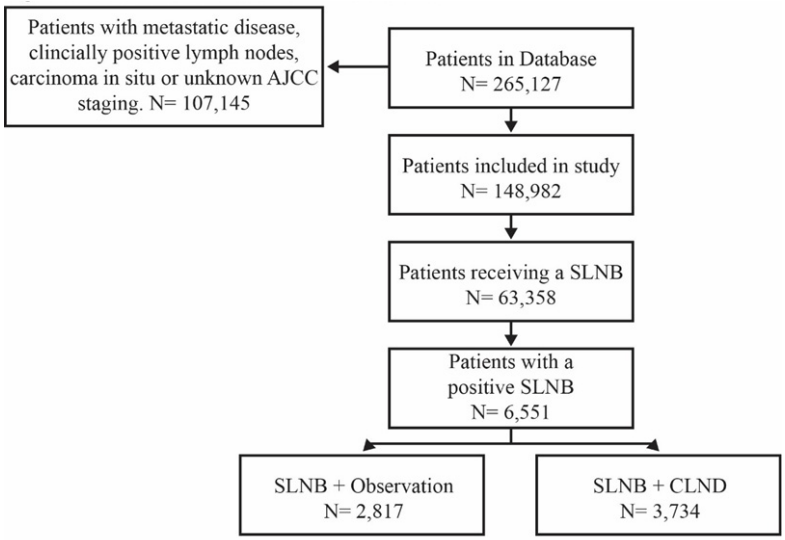

Figure 1. Flowchart of inclusion and exclusion criteria.

Table 3. Factors associated with undergoing CLND.

Predictor	β	Wald χ^2	p	Odds Ratio
Sex				
Male	(Ref)	(Ref)	(Ref)	(Ref)
Female	0.001	0.002	0.968	1.001
Age				
> 75	(Ref)	(Ref)	(Ref)	(Ref)
≤ 55	0.374	43.16	< 0.0001	1.454
56 - 65	0.119	4.974	0.026	1.127
66 - 74	0.085	2.227	0.136	1.089
Race				
White	(Ref)	(Ref)	(Ref)	(Ref)
Non-White	0.061	0.462	0.519	1.063
Insurance Status				
Other Government	(Ref)	(Ref)	(Ref)	(Ref)
Not-insured	0.284	0.041	0.839	1.03
Private	0.159	4.939	0.026	1.172
Medicaid	0.067	0.339	0.561	1.067
Medicare	-.0.060	0.480	0.488	0.941
Median Household Income				
≥ $63,000	(Ref)	(Ref)	(Ref)	(Ref)
< $38,000	0.085	1.401	0.236	1.088
$38,000 - $47,999	0.042	0.683	0.408	1.043
$48,000 - $62,000	0.007	0.026	0.872	1.008
Education (% without a HS diploma)				
< 7%	(Ref)	(Ref)	(Ref)	(Ref)
> 21%	-0.264	12.306	0.0005	0.768
13% - 20.9%	0.042	0.065	0.419	1.043
7% - 12.9%	0.127	7.834	0.005	1.136
Charleson Deyo Score				
3	(Ref)	(Ref)	(Ref)	(Ref)
0	0.152	4.067	0.043	1.164
1	0.149	2.971	0.084	1.161
2	-0.152	1.352	0.244	0.859
Year of Diagnosis				
2016	(Ref)	(Ref)	(Ref)	(Ref)
2012	0.231	16.685	< 0.0001	1.259
2013	0.082	2.312	0.128	1.086
2014	0.082	2.426	0.119	1.085
2015	-0.008	0.002	0.867	0.991
Breslow Thickness				
≥ 4.01 mm	(Ref)	(Ref)	(Ref)	(Ref)
< 1.00 mm	-0.142	5.682	0.017	0.867
1.01 - 2.00 mm	-0.039	0.744	0.388	0.962
2.01 - 4.00 mm	0.018	0.179	1.019	0.982

Table 3. Factors associated with undergoing CLND. *continued.*

Predictor	β	Wald χ^2	p	Odds Ratio
Ulceration				
Present	(Ref)	(Ref)	(Ref)	(Ref)
Absent	-0.051	2.966	0.085	0.951
Primary Site				
Lower Extremity	(Ref)	(Ref)	(Ref)	(Ref)
Head/Ear/Lip/Neck	0.213	13.712	0.0002	1.238
Trunk	0.157	14.035	0.0002	1.71
Upper Extremity	0.085	3.058	0.080	1.088

DISCUSSION

CLND has been the standard of care for clinically node-negative patients with SLN positive melanoma since the early 1990s.[10] However, there has been a growing trend in favor of omitting CLND for melanoma patients with a positive SLNB. Given that more than 80% of sentinel lymph node-positive patients have disease limited to the sentinel node, SLNB is thought to have both diagnostic and therapeutic value, potentially eliminating the need for a further, more extensive surgery.[9,10,23,24]

The first objective of this study was to examine the national trends and practice patterns regarding the utilization of CLND in patients after a positive SLNB. From 2012 to 2016, 57% of patients underwent a CLND following a positive SLNB. Patient age (≤ 55 years of age, and between 55 and 65 years of age), tumor location (head/neck region and trunk), year of diagnosis (2012), and total number of comorbidities (Charlson-Deyo Score = 0) were significantly associated with patients electing to undergo a CLND after a positive SLNB.

Two landmark clinical trials, DeCOG-SLT and MSLT-II, were conducted to determine what, if any, therapeutic role CLND had in the treatment of melanoma patients with lymph node metastases.[25] These trials demonstrated that CLND provided no melanoma-specific survival advantage compared to observation following a positive SLNB, suggesting that SLNB in concordance with observation may be sufficient for a subset of patients.[9,17,26] As evidence grows that continues to support observation in lieu of CLND, our study sought to examine practice patterns with respect to CLND after SLNB before the results of the two clinical trials were published or disseminated. Our results showed that there was a significant decline in the usage of CLND from 2012 to 2016, and those who were diagnosed in 2012 were significantly more likely to undergo CLND than observation following a positive SLNB, consistent with another study by Hewitt et al.[27] These similarities may be attributed to the possibility that surgeons and patients already were aware or at least anticipated the impending results of DeCOG-SLT and MSLT-II trials, with surgeons adopting a more selective approach to CLND based on established predictors of non-sentinel lymph node involvement, such as sentinel lymph node tumor burden, number of sentinel lymph nodes removed, and primary tumor thickness.[28]

SLN tumor burden is a well-established predictor of non-SLN metastasis, and patients with non-SLN metastasis have an increased risk of mortality compared to patients with disease confined only to the SLNs.[27,29-33] Therefore, the patients with non-SLN metastasis are the ones that potentially could benefit the most from CLND. Several models exist to predict non-SLN positivity, but there is no consensus on an optimal model that could be applied in clinical practice.[10,25,28,34-36] Therefore, the fact that the DeCOG-SLT and MSLT-II trials enrolled patients with a very low tumor burden (≤ 1 mm) brings into question the ability to generalize those with a higher tumor burden.[9,17]

The NCDB does not provide data to evaluate CLND utilization among patients with low SLN disease burden. The are two variables used to assess regional lymph node disease burden. Those variables are regional lymph nodes examined and regional lymph nodes positive. However, these two variables are cumulative. The variables report the total number of regional lymph nodes from all procedures that removed regional lymph nodes.[21] Therefore, it is not possible to differentiate between the number of positive lymph nodes from a SLNB from a patient that received both a SLNB and CLND. A new variable that allows for the reporting of the total number of positive lymph nodes after SLNB, and the total number of positive lymph nodes after CLND would be valuable. Additionally, the size of the metastatic deposit should be reported in cancer registries, as this will be an essential factor driving clinical decision-making. With these additions, further evaluation of the impact of SLNB disease burden on CLND utilization will be possible.

The second objective of our study was to examine factors associated with undergoing CLND versus electing observation after a positive SLNB. Our research found that patients were more likely to undergo a CLND if they were younger (< 65 years), had a primary tumor on the trunk or head/neck, had no comorbidities, or underwent primary resection in 2012. Previous studies have identified multiple factors associated with undergoing CLND including age, tumor location, and Breslow thickness.[37-39] One study suggested that patients were more likely to forgo a CLND if they were older (> 55 years), had multiple comorbidities, had a lower extremity primary tumor location, or underwent primary resection in 2015.[27] Another study found a lower likelihood of undergoing CLND in patients with a positive SLNB if the patients were older (> 75 years), had a primary tumor location

on the lower extremity and Breslow thickness ≤ 1.00 mm.[18] CLND is avoided in older patients due to the high postoperative risks.[37] The finding that patients were more likely to undergo CLND if the primary tumor was on the trunk or head/neck likely reflects the high complication rate following inguinal node dissection and a tendency to avoid those dissections. Inguinal node dissections are associated with more extended hospital stays, increased wound infection, and delayed wound healing.[15] Finally, though we described the alternative to surgery to be observation, we did not have documentation of the observation strategy implemented for each patient. In fact, the alternative to surgery may have been, for at least some patients, no further evaluation of the concerning lymph node basin.

In the future, it will be essential to continue to monitor the change in national practice patterns concerning the utilization of CLND, in particular, that patients with minimal tumor burden are offered the choice of nodal observation via ultrasound (active surveillance) versus CLND. Additionally, the utilization of CLND should be monitored in patients with more significant tumor burden who are considered a "high risk" subgroup.[40]

CONCLUSIONS

The utilization of CLND among patients with microscopic nodal melanoma was significantly lower in 2016 compared to 2012. Younger age, lack of comorbidities, and primary tumor location on the trunk or head/neck were associated with higher utilization of CLND.

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Keywords: melanoma, lymph node, lymphadenectomy, sentinel lymph node biopsy, neoplasm

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Evaluation of an Initial Specimen Diversion Device (ISDD) on Rates of Blood Culture Contamination in the Emergency Department

Blake A. Buzard, Pharm.D., Patrick Evans, Pharm.D., BCPS, Todd Schroeder, Pharm.D., BCPS (AQ-ID)
Ascension Via Christi St. Francis Hospital, Wichita, KS

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ABSTRACT

Introduction. Blood cultures are the gold standard for identifying bloodstream infections. The Clinical and Laboratory Standards Institute recommends a blood culture contamination rate of less than 3%. Contamination can lead to misdiagnosis, increased length of stay and hospital costs, unnecessary testing, and antibiotic use. These reasons led to the development of initial specimen diversion devices (ISDD). The purpose of this study was to evaluate the impact of an initial specimen diversion device on rates of blood culture contamination in the emergency department.

Methods. This was a retrospective, multi-site study including patients who had blood cultures drawn in an emergency department. February 2018 to April 2018, when an ISDD was not utilized, was compared with June 2019 to August 2019, when an ISDD was being used. The primary outcome was total blood culture contamination. Secondary outcomes were total hospital cost, hospital and intensive care unit length of stay, vancomycin duration of use, vancomycin serum concentrations obtained, and repeat blood cultures obtained.

Results. A statistically significant difference was found in blood culture contamination rates in the pre-ISDD group vs. the ISDD group (7.47% vs. 2.59%, $p < 0.001$). None of the secondary endpoints showed a statistically significant difference.

Conclusions. Implementation of an ISDD reduced blood culture contamination. When implementing the ISDD to a healthcare system, compliance is important and will affect contamination rates dramatically. ***Kans J Med 2021;14:73-76***

INTRODUCTION

Blood cultures are the gold standard for identifying bloodstream infections. However, blood cultures commonly become contaminated with environmental or skin-residing organisms.[1,2] Contaminated cultures can lead to misdiagnosis, increased length of stay (LOS) and hospital costs, and unnecessary testing and antibiotic use.[1-3] National contamination rate recommendations are set at less than 3% by the Clinical and Laboratory Standards Institute (CLSI).[4] However, institutions across the U.S. have varying and often higher contamination rates ranging from 2 - 10%.[4] Ascension Via Christi Hospitals, Inc (AVC) ministries includes three separate hospitals: St. Francis, St. Joseph, and St. Teresa. St. Francis is considerably larger and is a Level 1 trauma center with access to multiple specialties. St. Joseph and St. Teresa are smaller tertiary hospitals with less resources and support including phlebotomy access. Across all AVC ministries, average contamination rates are about 6% in blood draws occurring in the emergency department (ED).

There are many organisms that can lead to contaminated blood cultures, but among the most common are coagulase-negative staphylococci, *Corynebacterium* species, *Bacillus* species other than *Bacillus anthracis*, *Propionibacterium acnes*, *Micrococcus* species, viridans group streptococci, and *Clostridium* perfringens.[1,2,3,5] All of these pathogens can represent true bacteremia when found in a blood culture. Obtaining accurate blood cultures will prevent potential errors in diagnosing, unwarranted lab tests, antibiotic usage, and lower total costs hospital wide. Blood culture contaminants increase total hospital costs from $4,500 - 13,000 per contaminant.[2,4,6,7] For the current study, the median of the existing data of $8,750 per contaminant was used. Of note, several of the existing financial outcome studies were older, with one of them being from over a decade ago.[6] The median number utilized may not reflect the inflation or increased hospital costs that have occurred during that time span. It also did not reflect the change in price for the actual device.

There are many practices that decrease the number of blood culture contaminants, which include pulling from independent venipuncture sites, use of alcohol or chlorhexidine swabs prior to puncture, and use of highly-trained phlebotomists.[3] Gander et al.[6] evaluated the advantage of utilizing phlebotomists for all blood culture draws in the ED versus regular nursing draws. The study showed a decrease of contamination from 7.1% to 3.1% using phlebotomists. However, this is above the national benchmark of less than 3% contamination.

AVC ministries use a variety of practices when sepsis is suspected. AVC utilizes rapid diagnostic tests to identify gram positive organisms, especially *Staphylococcus* and *Streptococcus* species, within a matter of hours. If sepsis is suspected, patients go through standard practices regarding fluid requirements and antibiotics within one hour in accordance with guidelines. Alcohol swabs are used in the emergency departments for venipuncture sites, as opposed to chlorhexidine or povidone-iodine swabs. AVC contamination rates have varied when looking specifically at phlebotomist drawn labs, but the range varies from 1 - 4% month to month. Consistently, phlebotomy drawn blood cultures have contamination rates that are closer to or are under the national goal of less 3%. Phlebotomy is not used within any of the AVC ministry emergency departments; thus, this study population did not capture any benefit from phlebotomy use.

There are other factors that affect contamination rates as well, including skill level of the staff and educational interventions. In ED environments, it can be challenging to monitor technique and re-educate when needed.[1] To combat these challenges, two initial specimen diversion devices (ISDD) were produced. Steripath™ is a device that mechanically diverts and sequesters 1.5 - 2 mL of blood, which commonly is considered the volume that most likely contains skin-residing organisms. It allows for a separate, sterile blood flow pathway to be collected in a closed vein-to-vial path. This was the device piloted during the study. Kurin™ sequesters the first small amount of blood, but this volume is closer to 0.1 - 0.2 mL of blood.[8] This device also does not use

a separate, sterile pathway as opposed to the Steripath™ device. The use of ISDD's can lower contamination rates by 80% of the baseline contaminant rate and to a total contamination rate to less than 1%.[1,4,9]

AVC chose to implement a three-month pilot use of Steripath™ for blood cultures drawn in the ED. The three-month time period was compared to another three months from the year prior.

With a decrease of contaminated blood culture rates by 80%, AVC would be below the national recommended rate of less than 3%. For this study, an initial specimen diversion device was evaluated to determine its effectiveness in lowering the contamination rates of blood cultures drawn in the ED.

METHODS

This study was approved by the institutional review board as a retrospective chart review conducted at Ascension Via Christi Hospitals, Inc., that included patients in the emergency department who had a blood culture collected. The time frame in which an ISDD was used for collection was June 1, 2019 to August 31, 2019. This time frame was compared to February 1, 2018 to April 31, 2018 in which an ISDD was not used. Historically, there were ongoing issues with higher contamination rates despite implementing different practice changes. The two time frames were chosen specifically as it was confirmed the same practices were used to gather blood cultures and no other practice changes were ongoing during the separate time periods. There was little nursing turnover within the emergency department during this time period, with the majority of the same nurses included within both time periods. Patients were identified from the electronic health record (EHR) if a blood culture was taken in the ED during those two time periods. Patients who met inclusion criteria were divided into their respective groups and analyzed for the primary and secondary endpoints (Table 1). The primary endpoint was total blood culture contamination rate. The secondary endpoints analyzed were total hospital cost, hospital length of stay, intensive care unit (ICU) length of stay, vancomycin duration of use, vancomycin serum concentrations obtained, and repeated blood cultures obtained. The cost for the device used in the analysis was $15 per device.

Table 1. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Age ≥ 18 years of age	Age < 18 years of age
Blood culture obtained in the ED	

Outcomes. The primary endpoint was total blood culture contamination rate. The secondary endpoints analyzed were total hospital cost, hospital length of stay, ICU length of stay, vancomycin duration of use, vancomycin serum concentrations obtained, and repeated blood cultures obtained. The ISDD group had a primary endpoint analysis in both an intent-to-treat manner and per protocol manner. The per protocol examination excluded all contaminants from the ISDD group in which the ISDD was confirmed not to be used. For the secondary endpoints, hospital length of stay and ICU length of stay were not included if the stay was greater than seven days. The time frame was established to avoid including patients in the hospital staying for longer periods due to reasons other than a blood culture contaminant. Repeated blood cultures taken greater than seven days from the original blood cultures also were excluded from the study. The time frame was established to avoid capturing repeated blood cultures obtained for reasons other than repeating a blood culture after a contaminant.

Statistical Analysis. To detect an 80% reduction in the two groups with an $\alpha < 0.05$ and a power of 0.80, 235 subjects were needed in each arm. Blood culture contamination and repeat blood cultures were analyzed with a chi-squared test. Hospital length of stay was analyzed with the t-test. All other secondary outcomes were analyzed with Wilcoxon Rank sum to account for non-normalized distribution.

RESULTS

The study included a total of 3,331 patients. After review of patient's age, it was confirmed that no patients needed to be excluded due to age. A total of 1,713 patients were included in the pre-ISDD results group and 1,618 patients were included in the ISDD group. Baseline characteristics (except confirming age ≥ 18 years old) were not obtained as it was predicted to not change the results.

Study Outcome. The primary outcome blood culture contamination rate was 7.47% in the pre-ISDD group vs. 2.59% in the ISDD group ($p < 0.001$). The per protocol contamination rate was 0.86%. The total hospital cost was $1,120,000 in the pre-ISDD group vs. $383,690 in the ISDD group, providing a difference of $736,310. The per protocol hospital cost analysis was $138,690, which provided a difference of $981,310. The hospital length of stay ($p = 0.7$), ICU length of stay ($p = 0.3$), and vancomycin duration of therapy ($p = 0.19$) were not statistically significant (Figure 1). Vancomycin serum levels obtained were 0.085 vs. 0.075 ($p = 0.58$). Repeat blood cultures were 33 vs. 31 in the two groups, respectively ($p = 0.8$).

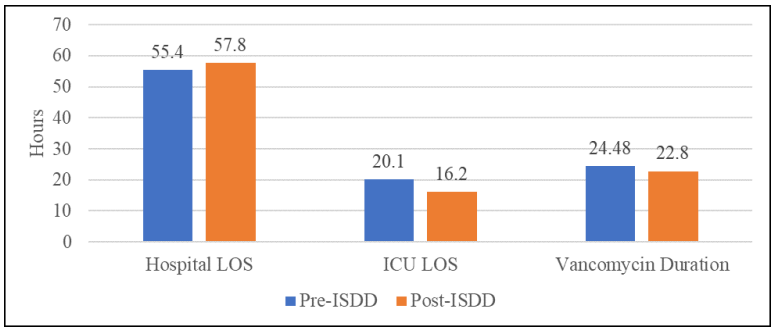

Figure 1. Length of stay and duration of therapy results.

DISCUSSION

Current recommendations for blood culture contamination are rates less than 3% set by the CLSI. The baseline AVC ED contamination rate was 6%. Our study demonstrated a statistically significant reduction in blood culture contamination rates by implementing an ISDD. Both post-ISDD groups met the national goal of less than 3%. There was not an 80% reduction in blood culture contamination in the intent-to-treat analysis (65% reduction); however, there was over an 80% reduction in the per protocol analysis (88% reduction). The primary endpoint showed an ISDD, when used appropriately, significantly reduced contamination rates. The difference between the intent-to-treat and per protocol analysis showed the real-life application of using an ISDD

compared to the true benefit of the device. When the device was being used properly, contamination rates were less than 1%.

Like all novel instruments, compliance can be an issue. Over half of the contaminants in the ISDD group were contributed to nurses not utilizing the ISDD. When it could not be determined if the device was used, it was recorded in the per protocol analysis, meaning the true benefit of the device was likely not captured adequately. Educational instructions for proper ISDD use were provided prior to implementing the device and re-education was done with each nurse when a blood culture contaminant was confirmed throughout the study period. Although re-education was occurring, some nurses simply chose not to use the device. There were no reports of the ISDD being hard to use; however, there were reports that when the ED was busy, nurses went with what they were comfortable with. This reality was known prior to the study which is why a per protocol and intent-to-treat analysis were performed to capture the real world effect. However, due to the retrospective nature of this study, the compliance was a major limitation of this study.

The hospital cost analysis showed money potentially saved by using an ISDD. When looking at the per protocol results, almost $1 million could be saved with consideration to microbiology, antibiotic usage, length of stay, and labor costs. Geisler et al.[2] showed an average cost accruing to more than $6,000 dollars per contaminant with the most influential factors being LOS, daily hospital costs, and antibiotic usage. Many factors influencing the increased costs were avoidable factors. The largest factor was extended length of stay.[2] This study's estimated cost analysis was unable to find consistency with previous literature regarding cost savings. This study was unable to capture differences within the secondary endpoints, however, there was a significant difference in contamination rates. Based on previously published literature, that difference should have resulted in cost savings.[3,4,6,7] To date, the use of a studied ISDD is the single most effective intervention for reducing costs related to blood culture contamination.[2]

AVC utilizes rapid diagnostic testing on all blood cultures which allows confirmation of a positive blood culture quicker and time to confirm a contaminant. In the previous studies, rapid diagnostic testing was not used, therefore, they had longer waiting periods for confirmation. This could be a potential answer for the reason as to why this study was unable to detect significant differences in our secondary endpoints and could lead to the conclusion that an ISDD might provide greater benefit in hospitals that do not utilize rapid diagnostic technology for their blood culture analysis.

One of the major limitations of this study was the secondary outcomes analysis took place from the intent-to-treat analysis only. This study could not capture if the ISDD was used with every blood culture obtained. AVC did not require documentation for device use every time a blood culture was drawn. This prevented knowing the true benefit of the device in the secondary outcomes. Future studies should look specifically at secondary outcomes when the ISDD use was confirmed vs. a time period when an ISDD was not used. A recommendation, if implementing an ISDD in a facility, would be to require documentation of whether the device was used.

Another data point not captured within this study was the actual organisms being isolated due to the retrospective nature of this study. This information could provide valuable clinical information when comparing the two study arms, especially if there are profound differences in the organisms being identified. Future studies should include this information, as it potentially could capture trends that clinicians should be aware of going forward.

Nursing turnover between the two study periods could have provided a limitation. Although there was little turnover, there were some nurses included in only one of the time periods. This could change our results as the benefit could have been captured from the nursing staff expertise as opposed to the device itself.

When implementing an ISDD, this study stressed the importance of compliance with the device. Although we were unable to show any statistically significant effect on our secondary outcomes, it was limited by our inability to confirm compliance with the device. As shown through the primary outcome, contamination rates were improved when the ISDD usage was confirmed. ISDD implementation will have the biggest benefit when there is near 100% compliance.

CONCLUSIONS

This study showed that utilizing an ISDD significantly reduced blood culture contamination. The study also showed that when implementing the ISDD to a healthcare system, compliance is important and will affect contamination rates dramatically. AVC ministries final decision was to continue using the ISDD due to the proven benefit in reducing blood culture contamination. Although it was shown that barriers of compliance can reduce the benefit of an ISDD, with continuing re-education and increased compliance, contamination rates were expected to decline.

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Keywords: blood culture, emergency department, infection control, infections

KANSAS JOURNAL of MEDICINE

A Retrospective Review of Morbidity and Mortality Associated with Acute Benzodiazepine Withdrawal at a Midwestern Academic Medical Center

Stephen L. Thornton, M.D.[1,2], Jeffrey Whitacre, M.D.[1], Nicholas Pallo, M.D.[1], Nathan Roberts, M.D.[1], Lisa Oller, R.Ph.[2]

[1]The University of Kansas Health System, Department of Emergency Medicine, Kansas City, KS

[2]Kansas Poison Control Center at the University of Kansas Health System, Kansas City, KS

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ABSTRACT

Introduction. There is concern that acute benzodiazepine (BZD) withdrawal may result in morbidity and mortality. However, there is a paucity of medical literature regarding clinical characteristics and outcomes of acute BZD withdrawal. We sought to characterize acute BZD withdrawal and its associated clinical outcomes and treatment at a midwestern academic medical center.

Methods. This was a retrospective study. The medical records of the University of Kansas Hospital, a tertiary academic medical center, were queried for patients with a diagnosis of BZD withdrawal, drug withdrawal, sedative-hypnotic withdrawal, or withdrawal-NOS from January 1, 2009 to January 1, 2016. Data collected included age, sex, month/year of encounter, initial vital signs, type of drug withdrawal (alcohol, opioid, BZD, or other), type of BZD withdrawing from, disposition, duration of hospitalization, seizures, endotracheal intubation, mortality, and pharmacological treatment.

Results. Eighty-two cases were identified. Cases per year increased over the study period. Thirty-one (38%) cases involved concurrent drug withdrawal with opioids most common (n = 25). Alprazolam (n = 32) was the most common BZD implicated in BZD withdrawal. Thirty-nine cases (47%) were admitted including seven to the ICU. Seizures were reported in 8 (10%) cases. Endotracheal intubation occurred in three (3.6%). Sixty-seven patients (81%) were treated with a BZD, with lorazepam (n = 42) most used. There were no deaths. Upon discharge, 40 (49%) patients received a prescription for a benzodiazepine.

Conclusions. Cases of acute BZD withdrawal increased over the study period but were associated with only occasional morbidity and no mortality. Further multi-center studies are warranted to characterize the incidence and characteristics of acute BZD withdrawal better.

Kans J Med 2021;14:77-79

INTRODUCTION

Benzodiazepines (BZD) are a class of medications widely used to treat conditions such as anxiety, insomnia, and seizures. In 1960, chlordiazepoxide (Librium) was the first BZD approved by the U.S. Food and Drug Administration and subsequently multiple others, such as lorazepam, diazepam, and midazolam, were introduced.[1] While the initial mechanism of action of BZDs was unknown, their lack of respiratory depression rapidly saw them replace barbiturates and other sedatives. Further driving the popularity of BZD use was the initial belief that they were less habit forming than other forms of sedatives. It was not until 1975 that BZD's effects on the gamma-aminobutyric acid receptor were elucidated and by then they had become among the most widely prescribed medications.[2]

Even today, BZDs remain among the most widely prescribed medications. In 2013, it was found that approximately 5.6% of the adult population was filling a regular prescription for BZD.[3] Over 25 million adults in the United States reported prescription use of a benzodiazepine between 2015 and 2016.[4] Among the most frequent users were patients in the 65 - 80 age range and women.[5] With this increasing prevalence of use, the misuse and abuse of BZDs has become a major concern. Some studies estimated over 5 million adults in the U.S. misuse BZDs.[4] The high prevalence of concomitant BZD and opioid misuse only amplified these concerns.[6]

The widespread use and misuse of BZDs raises the potential for development of acute BZD withdrawal. Acute BZD withdrawal is thought to manifest similar to alcohol withdrawal including symptoms such as hypertension, tachycardia, tachypnea, tremors, anxiety, agoraphobia, insomnia, altered mental status, seizures, delirium, and hallucinations.[7] However, compared to acute alcohol withdrawal, acute BZD withdrawal is described poorly in the medical literature. As with acute alcohol withdrawal, seizures were described to occur in acute BZD withdrawal.[8] Status epilepticus has been suggested as a consequence of acute BZD withdrawal.[9] While rare cases of significant morbidity and mortality have been reported, there is a paucity of medical literature detailing clinical characteristics and outcomes of acute BZD withdrawal. The goal of this study was to characterize acute BZD withdrawal and its associated clinical outcomes and treatment by retrospectively reviewing cases at an academic medical center.

METHODS

This was an IRB-approved retrospective review of The University of Kansas Hospital electronic medical record (EMR) from January 1, 2009 to January 1, 2016. The University of Kansas Hospital is a 700-bed quaternary care academic medical center. The EMR was searched for all cases that contained ICD codes for BZD withdrawal, drug withdrawal, sedative-hypnotic withdrawal, or withdrawal-NOS. Data examined included age, sex, month/year of encounter, initial vital signs, type of drug withdrawal (alcohol, opioid, BZD or other), type of BZD, disposition, duration of hospital stay, presence of seizures, need for endotracheal intubation, mortality, and pharmacological treatment. Five reviewers were utilized to collect the above data. To ensure reliability between reviewers, 16 cases were selected at random and a kappa score was calculated. Means were compared using two-sample t-test and proportions with Chi-squared test.

RESULTS

The search identified a total of 356 encounters matching the search parameters. Two-hundred seventy-four cases (77%) were determined to not involve BZP withdrawal and were excluded. Of the cases excluded, opioid withdrawal was most common cause of withdrawal identified (n=200). Eighty-two (23%) encounters were determined to involve

BZP withdrawal. Figure 1 demonstrates the number of these cases per year. Kappa scoring was 0.90 when comparing the randomly selected 16 cases.

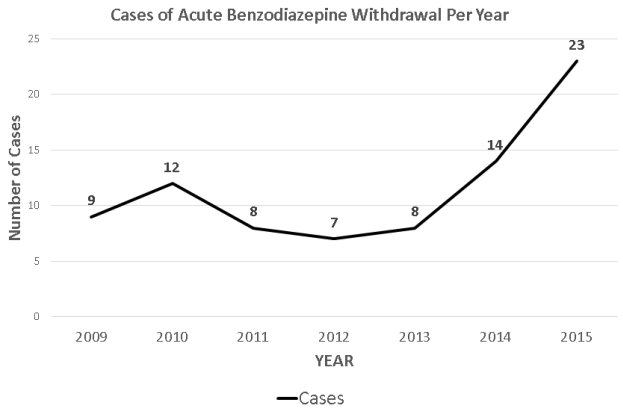

Figure 1. Cases of acute benzodiazepine withdrawal per year.

Of the 82 acute BZD withdrawal cases, 31 (38%) involved concurrent withdrawal from another drug. The majority of these cases involved opioid withdrawal (n = 25). Ethanol withdrawal was present in the other six cases.

Table 1 compares the demographics and clinical characteristics of the BZD only and the BZD plus another drug withdrawal groups. The only statistically significant difference between the two groups was a higher percentage of the BZD plus another drug withdrawal cases were women. Alprazolam was the most common BZD from which patients were withdrawing (n = 32). Thirty-nine patients (47%) in this study were admitted to the hospital. Of the patients admitted to the hospital, seven (18%) were admitted to an intensive care unit (ICU). Among those admitted to the ICU, five (16%) were withdrawing from BZD plus another drug and just two (4%) were withdrawing from BZDs only. In total, seizures occurred in eight cases (10%). Three cases required intubation. Sixty-seven cases (81%) were treated with a BZD, lorazepam being the most common (n = 42). The other cases treated pharmacologically involved phenobarbital (two cases) and propofol (two cases). Dexmedetomidine was used for withdrawal treatment in just one case. Ketamine was not used. Flumazenil was not used. No deaths occurred in either group. Upon discharge, thirty-nine patients (49%) received a prescription for BZD with the most common agent prescribed being clonazepam (n = 19).

DISCUSSION

BZDs remain a commonly prescribed medication for the treatment of many medical conditions including panic attacks, acute anxiety, insomnia, and post-traumatic stress disorder. BZD use is increasing with an annual increase of 2.5% from 1996 - 2013.[10] Not surprisingly, several BZDs (alprazolam and diazepam) are among the most frequently involved substances in drug overdose deaths.[11]

While morbidity and mortality from the use of BZDs continue to be widely reported in the medical literature, contemporary reports detailing complications related to acute BZD withdrawal are limited. Our study demonstrated a temporal increase in the number of cases of acute BZD withdrawal, though significant morbidity and mortality were lacking. Seizures in particular are a feared complication of acute BZD withdrawal, and some literature describes them as being "common".[8]

Our study demonstrated a low incidence of recorded seizures. Similarly, while status epilepticus after acute BZD withdrawal had been described, none of our cases required treatment for status epilepticus.[12] It is not clear why seizures were so rare in our population. It may be the higher incidence of seizures in acute benzodiazepine withdrawal reported in the medical literature suffers from reporting bias and the true incidence is lower. Further studies are warranted to determine the true incidence of seizures from acute benzodiazepine withdrawal. Importantly, no deaths were seen in our study.

Table 1. Demographics and clinical characteristics of the BZD withdrawal only and the BZD withdrawal plus another drug withdrawal groups.

	BZD withdrawal only (n = 51)	95% CI	BZD withdrawal plus another drug withdrawal (n = 31)	95% CI
Age [SD]	47.4 [14.1]	43.5-52.1	45.5 [14.7]	40.3 - 50.7
Female	51.0% (n = 26; 51%)	36.6%, 65.2%	74.2% (n = 23)	55.4% - 88.1%
Initial heart rate [SD]	98 [18]	93.1 - 103	96 [21]	88.6 - 103
Initial systolic blood pressure [SD]	140 [26]	133 - 147	136 [27]	127 - 146
Initial temperature °C [SD]	36.8 [0.5]	36.7 - 36.9	36.7 [0.7]	36.5 - 36.9
Admitted to hospital floor	41.2% (n = 21)	27.6% - 55.8%	35.5% (n = 11)	19.2% - 54.6%
Admitted to ICU	3.9% (n = 2)	0.48% - 13.5%	16.1% (n = 5)	5.4% - 33.7%
Duration of hospital stay (days) [SD]	6.1 [5.2]	4.67 - 7.53	8.3 [9.3]	5.03 - 11.6
Case with seizures reported	11.8% (n = 6)	4.4% - 23.9%	6.4% (n = 2)	0.79% - 21.4%
Most common BZD implicated in withdrawal	Alprazolam 45.1% (n = 23)	31.1% - 59.7%	Alprazolam 29.0% (n = 9)	14.2% - 48.0%
Treated with a BZD in hospital	82.3% (n = 42)	69.1% - 91.6%	77.4% (n = 24)	58.9% - 90.4%
Most common BZD administered in hospital	Lorazepam 49.0% (n = 25)	34.7% - 63.4%	Lorazepam 54.8% (n = 17)	36.0% - 72.7%

Many of our identified cases of acute BZD withdrawal included a concurrent withdrawal from another agent. The most common drug withdrawal in conjunction with BZD withdrawal was opioids. This was consistent with the known trend of combined abuse of these substances.[13] While there was no statistically significant difference identified between the two groups, there was a trend towards the group of multi-substance withdrawal patients requiring more intensive care.

Alprazolam was the BZD most frequently associated with acute withdrawal. This was consistent with alprazolam being one of the most commonly prescribed BZDs and having a relatively short half-life.[14,15]

The treatment of acute BZD withdrawal is described poorly with some sources recommending a ten-week taper of the same abused agent versus transitioning to a longer half-life agent (i.e., diazepam) for the initial taper and transitioning back to an agent with a shorter half-life.[9,16] In our study, less than half of patients were discharged with a BZD prescription. For those that were, clonazepam, an intermediate acting benzodiazepine, was the most commonly prescribed BZD. We did not collect post-discharge data and cannot comment on the utility of clonazepam or any other agent.

This study had several limitations. It was a single center study and findings may not reflect the experience of other institutions. The sample size was small which may have resulted in failure to identify key characteristics. It was a retrospective study and pertinent data points may not have been recorded. Our search method was reliant on the patient being diagnosed with one of the withdrawal diagnoses. It was possible cases of acute BZD withdrawal were not diagnosed correctly. This limitation was exacerbated by the lack of a gold standard definition or scoring system to diagnose acute BZD withdrawal. Finally, the time frame of the data was limited to seven years due to the lack of an EMR prior to 2009.

In this study, acute BZD withdrawal at a midwestern academic medical center increased over the study period but was associated with only rare morbidity and no mortality. Future multi-center studies are warranted to characterize the prevalence and clinical significance of acute BZD withdrawal.

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Keywords: benzodiazepine, drug withdrawal symptoms, alprazolam, seizures, opioids

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An Unusual Case of Acute Kidney Injury

Farah A. Mansour, M.D., Boutros N. El Haddad, M.D., Roy A. Raad, M.D., Najat I. Joubran, M.D., Rami Chemali, M.D.
Balamand University, St. George Hospital University Medical Center, Beirut, Lebanon

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INTRODUCTION

Bladder catheter insertion is among the most common and routine urological procedures done not only for diagnostic but also for therapeutic purposes.[1] In the majority of cases, it is considered a safe procedure with no major complications. Inadvertent placement of the bladder catheter into the ureter is rare with around 25 case reports published in the English literature.[1-5] It results in various complications such as ureteric obstruction leading to hydronephrosis, acute kidney injury, ureteric injury, and even rupture.[1]

CASE REPORT

A 77-year-old Middle Eastern gentleman with a past medical history of hypertension, nephrolithiasis, and benign prostatic hyperplasia status post transurethral resection of the prostate presented with seven days history of left flank pain, fever, and chills. Initial investigations showed a creatinine of 1.36 mg/dl (nl = 0.4 -1 mg/dl), C-reactive protein 11.6 mg/dl (nl =0-0.5 mg/dl), and white blood cell (WBC) count 8.8 mm^3 (nl = 4-10 x 103 /mm^3), urinalysis showed trace protein, leukocyte esterase > 80/mm^3, red blood cells > 150 /hpf, and numerous WBCs. Urine and blood cultures were taken.

A non-contrast computed tomography scan of the abdomen and pelvis showed a 9.5 x 14 x 25 mm calculus in the left renal pelvis in addition to left moderate hydronephrosis. The scan also noted mild left perinephric and proximal periureteric fat stranding with other multiple non-obstructing left renal calculi. The right kidney was normal in size with no evidence of hydronephrosis, mass, or calculi. The patient was diagnosed with obstructive pyelonephritis and he was started on ceftriaxone.

Ureteral pig tail stent insertion by cystouretheroscopy was not successful because the left ureteral orifice could not be identified. Percutaneous nephrolithotomy was performed and anterograde ureteral stent was inserted under general anesthesia. A 16 Fr urethral balloon catheter was placed before the start of the procedure. Postoperatively, lab results showed worsening kidney function with an increase in the serum creatinine from 1.36 to 2.9 mg/dl on post-operative day one and 4.7 mg/dl on post-operative day 2.

A repeat non-contrast computed tomography (CT) scan of his abdomen and pelvis was performed showing the tip of the indwelling Foley catheter located within the right vesicoureteric junction, with new mild dilatation of the right ureter and right hydronephrosis, highly suggestive of obstruction of the distal ureter due to obstruction by the indwelling Foley catheter (Figure 1, 2A). The CT scan showed the resolution of the left hydronephrosis. Subsequently, the indwelling Foley catheter was removed, and a repeat CT scan after 48 hours showed the resolution of the new right hydronephrosis (Figure 2B). Renal function improved with a decrease in creatinine level to baseline. The patient was discharged home after getting a full course of antibiotics.

Figure 1. Coronal non-enhanced CT scan of the abdomen and pelvis shows Foley catheter terminating within the right ureterovesical junction and right hydronephrosis with associated right perinephric fat stranding.

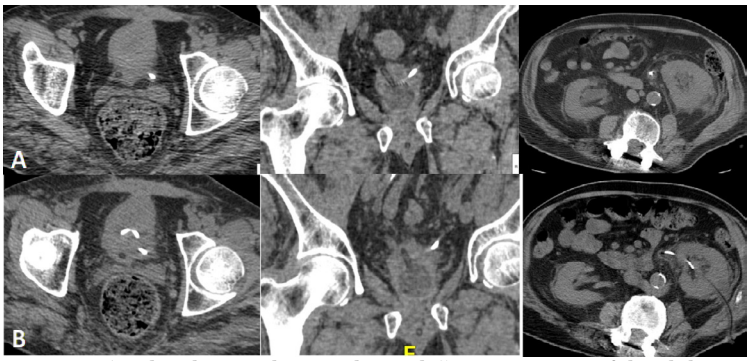

Figure 2. Axial and coronal non-enhanced CT scan images of the abdomen and pelvis demonstrates: (A) the Foley catheter terminating within the right ureterovesical junction and right hydronephrosis with associated right perinephric fat stranding; (B) non-enhanced CT scan images of the abdomen and pelvis obtained 2 days after retraction and adjustment of the position of the Foley catheter, now within the urinary bladder showing resolution of the right hydronephrosis associated right perinephric fat stranding. Note the presence of a left ureteral stent.

DISCUSSION

Insertion of a Foley catheter, despite being considered to be a safe procedure, can be associated with some complications that range from minor (bleeding, infection, or malfunction) to serious (perforation, obstruction, or hydronephrosis).[6] Misplacement of Foley catheter into the ureter is rare with around 25 cases reported in the English literature.[1-5] Insertion of Foley tip or inflation of catheter balloon in the ureter may cause deleterious side effects such as ureteral obstruction, hydronephrosis, pyelonephritis, severe ureteral injury, and even rupture in severe cases.[1]

Catheterization of an empty bladder and chronic catheter use increase the risk of inadvertent insertion secondary to bladder contraction due to ensuing change in the anatomy between the bladder neck and ureteral orifice.[1,7] Other reported risk factors include frequent catheterization, neurogenic bladder, spinal cord injury, and vesicoureteric reflux.[1,8] Females are at higher risk due to shorter urethra with a

female to male ratio of 3:1.[1,6]

Patients can be asymptomatic but usually complain of flank pain, abdominal pain, or fever.[1] For patients with impaired sensation, a catheter leak, or inability to inflate the balloon would be a clue for misplaced catheter. Incidental finding on imaging or during surgery also has been reported.[9]

The diagnosis usually is made by imaging studies including ultrasound, CT scan, intravenous urography, retrograde pyelography, or catheterography.[1] Diagnosis also can be done by cystoscopy which could be therapeutic. Because of it is low incidence, it not recommended to perform routine diagnostic studies after Foley catheter insertion.

Contrary to most of patients described in the literature who had risk factors, our patient did not have any. This highlighted the fact that this complication should be considered even in the absence of known risk factors.

To prevent inadvertent placement, over insertion of the bladder catheter into the lumen should be avoided. After balloon inflation with no resistance, the catheter should be pulled back gently until the catheter balloon rests on the bladder neck.[10] Other suggested measures include using short tip catheters and placement under ultrasound guidance.[1,10]

Misplaced Foley catheter into the ureter without ureteral injury can be managed simply by conservative measures such as removing or replacing it.[1] However, more pronounced ureteral injury might require nephrostomy tubes placement, stent placement, and even surgical repair in severe cases.[3]

Our patient did not complain of any symptoms. Misplaced Foley catheter was noted on CT scan of the abdomen and pelvis which was done as a diagnostic procedure for elevated creatinine and oliguria. He did not require any invasive or surgical procedure as the misplaced catheter was removed directly upon diagnosis with no complications.

CONCLUSIONS

Aberrant placement of urinary catheter into the ureter is a rare complication of bladder catheter insertion. Although uncommon, such complication increases morbidity and may lead to long term sequela. Care should be taken to avoid such a complication. Caretakers should keep a high index of suspicion in case of worsening kidney function, oliguria, or flank or abdominal pain that follow bladder catheter insertion and treatment should be initiated promptly in case of aberrant placement.

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Ziprasidone Associated Neuroleptic Malignant Syndrome

Jeffrey D. Bell, M.D.[1], Chancen Hall, D.O.[2], Justin Sandall, D.O.[2]
[1]Beaver Medical Group, Redland, CA
[2]University of Kansas School of Medicine-Wichita, Wichita, KS
Department of Anesthesiology

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INTRODUCTION

Neuroleptic malignant syndrome (NMS) is a severe and potentially lethal disorder due to an adverse reaction to dopamine receptor antagonism or the rapid withdrawal of dopaminergic medications.[1] While incidence is estimated to be 0.02%[1] generally and 0.2%[2] among neuroleptic users, NMS continues to be an unpredictable and potentially life-threatening condition of which case reports continue to be a main source of information for clinicians.[3]

Despite the advent of second-generation antipsychotics (SGA), NMS continues to be a rare yet severe adverse reaction to neuroleptics.[4] It is seen most often with abrupt cessation, decrease, or increase in dopaminergic dose.[5] A recent systematic literature review conducted by Murri et al.[5] found only 186 individual cases meeting their criteria for SGA-NMS, only six of which were caused by ziprasidone. Our patient met the Diagnostic and Statistical Manual of Mental Disorders, Revised Fifth Edition,[6] (DSM-V) diagnostic criteria for NMS as she presented with hyperthermia, profuse diaphoresis, generalized muscle rigidity, elevated creatinine phosphokinase, delirium, and autonomic instability. All were associated with exposure to a dopamine receptor antagonist, in this case, ziprasidone. While most patients fully recover and mortality rates have been decreasing due to early recognition and treatment, fatality rates are estimated between 5 - 10%.[1-3] This case demonstrated how NMS can present as a mimic of sepsis or serotonin syndrome.

CASE REPORT

A 60-year-old female nursing home patient with bipolar affective disorder, hypertension, hypothyroidism, and paraplegia demonstrated increasing confusion requiring admission to a senior behavioral facility. Over a period of approximately a week and a half, she became unable to communicate and developed tachycardia, tachypnea, flushing, diaphoresis, and fevers greater than 38°C. She was transferred to the Neurologic Critical Care Unit (NCCU) for further evaluation and treatment for possible sepsis.

Upon arrival to the NCCU, she was encephalopathic, tachypneic, tachycardic, and hypoxemic. She had generalized rigidity, although not lead pipe, of the trunk and extremities and 2+/4 hyperreflexia without clonus which was difficult to evaluate with her baseline lower extremity paraplegia. Initial laboratory analysis revealed leukocytosis, acute kidney injury, elevated serum creatinine phosphokinase of 444 U/L, procalcitonin elevated at 0.27 ng/mL, and C-reactive protein levels which were within normal limits. While her initial blood pressure was normal, she had pronounced fluctuations with episodes of hypotension and hypertension.

Given these initial findings, the differential diagnosis included sepsis, NMS, serotonin syndrome (SS), non-convulsive status epilepticus, or other central nervous system (CNS) pathology. Blood, urine, and sputum cultures were obtained, and she was considered for a lumbar puncture to evaluate for meningitis. In addition, medical records were obtained from the outside facility and showed she had been receiving increasing doses of ziprasidone along with haloperidol, lithium, duloxetine, oxybutynin, and baclofen.

Once this information was received and in consultation with our neurology and psychiatry colleagues, the patient was treated for a presumptive diagnosis of NMS with IV bromocriptine 10 mg every six hours and a one-time dose of IV dantrolene 2.5 mg/kg, discontinuation of possible causative agents, a cooling blanket and antipyretics, and IV fluids.

SS, which presents with dysautonomia and hyperreflexia in the setting of serotonergic medications, was considered for this patient, but the escalating doses of ziprasidone were the most influential factor compared to her unaltered use of duloxetine and lithium. Also, our cautious decision to administer bromocriptine was an SS challenge as bromocriptine likely would have exacerbated her condition if it had been serotonin related.[7] The neurology consultant further recommended scheduling dantrolene at 2.5 mg every six hours. Electroencephalography showed generalized slowing consistent with encephalopathy, but no seizure activity and magnetic resonance imaging of the brain with and without contrast showed no acute finding.

By hospital day three, the patient was afebrile with improved leukocytosis without antibiotics thus no lumbar puncture was performed. By day four, autonomic dysregulation had resolved with cessation of labile blood pressures. Supplemental oxygen requirements ceased, and she became more awake and less rigid in the extremities. However, she was unable to participate in a meaningful interview with psychiatry and dantrolene was increased to 100 mg TID due to persistent rigidity. The following day she remained stable and was transferred out of the NCCU.

DISCUSSION

NMS is thought to be due primarily to neuroleptic blockade at the dopamine receptor resulting in reduced CNS dopaminergic tone and dysregulation of autonomic nervous system activity.[5] Nonneuroleptic agents with antidopaminergic activity also have been associated with NMS such as metoclopramide, promethazine, tetrabenazine, droperidol, diatrizoate, and amoxapine.[1] However, dopaminergic activity did not explain the pathogenic mechanism of NMS completely, because it also was induced by withdrawal of antipsychotics or by SGAs that have reduced action at dopamine receptors. There is increasing investigation into other receptors (i.e., serotonergic, adrenergic, and cholinergic) that may play an important role.[5] There is also at least one case report of NMS-like syndrome due to baclofen withdrawal.[8] Our patient's medication regimen gives credence to this theory as she not only had a recent increase in her ziprasidone to a maximum dose, but also was on haloperidol as needed for agitation, a typical antipsychotic, lithium,

which has anti-dopaminergic activity[9], duloxetine, a serotonin reuptake inhibitor, and oxybutynin, which has anticholinergic activity. Furthermore, she improved clinically with the cessation of all these medications along with continuing baclofen.

The treatment of NMS is individualized and based on the clinical presentation.[1] The first and most common step is cessation of the suspected offending agents. However, if the syndrome occurs after abrupt withdrawal of a dopaminergic medication, then the medication must be reinstituted. The second step involves supportive care typically consisting of aggressive hydration especially in cases of rhabdomyolysis, treatment of hyperthermia, and correction of metabolic abnormalities.

NMS patients are at increased risk for renal failure, disseminated intravascular coagulation (DIC) secondary to rhabdomyolysis, deep venous thrombosis, and pulmonary embolism from dehydration and immobilization, as well as aspiration pneumonia due to difficulty swallowing combined with altered mental status.[1] Other medical complications include cardiopulmonary failure, seizures, arrhythmias, myocardial infarction, and sepsis. As such, many cases require intensive care monitoring and support.

In severe cases, such as ours, patients often are treated with empiric bromocriptine mesylate and dantrolene sodium.[10] Bromocriptine mesylate is a dopamine agonist used to reverse the hypodopaminergic state and is administered orally or via a nasogastric tube starting with 2.5 mg two to three times daily and increasing the dose by 2.5 mg every 25 hours until a response or until reaching a maximum dose of 45 mg/d.[1] Bromocriptine generally is continued for at least 10 days in NMS related to oral antipsychotics and two to three weeks for depot neuroleptics.

Dantrolene sodium is a muscle relaxant that works by inhibiting calcium release from the sarcoplasmic reticulum and is administered intravenously starting with a loading dose of 1 - 2.5 mg/kg followed by 1 mg/kg every six hours up to a maximum dose of 10 mg/kg/day.[1] Regular monitoring of liver function is recommended with dantrolene due to its risk for hepatotoxicity. However, while often noted to aid some patients, Reulbach et al.[11] showed that there was no evidence supporting the use of dantrolene as a treatment of NMS. This reiterated the need to understand the etiology of NMS to find a better treatment.

CONCLUSIONS

Second generation antipsychotics are the most commonly prescribed antipsychotics, but our knowledge of SGA-NMS continues to be limited due its sporadic and rare nature.[1] As such, case reports continue to be a main source of information for clinicians.[3] Many of the signs of NMS are non-specific and qualify the patients for the systemic inflammatory response syndrome (SIRS). Our patient was transferred from an outside behavioral health facility due to worsening encephalopathy and SIRS thought to be secondary to sepsis. It was only after arrival to the NCCU and a thorough physical exam and review of outside records that NMS became the primary etiology in the differential diagnosis. NMS is a rarely described phenomenon, particularly with newer agents such as ziprasidone.

To our knowledge, this is one of only a few case reports of NMS presenting as a sepsis mimic.[3] Our case highlighted the need for increased study into the potential role of multiple receptors in NMS as well as the need for a high index of suspicion for those patients who present with SIRS, encephalopathy, and rigidity while on psychotropic medications.

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Urgent and Massive Investment in US Public Health Infrastructure Will Help to Stop the Spread of SARS-CoV-2 Virus and Deaths from COVID-19

Talkad S. Raghuveer, M.D.[1], Dennis Kriesel, B.A., MPA[2]
[1]University of Kansas School of Medicine-Wichita, Wichita, KS Department of Pediatrics
[2]Kansas Association of Local Health Departments, Topeka, KS

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The COVID-19 pandemic is surging in the U.S. with more than 27 million cases and 446,000 deaths.[1] COVID-19 is a leading cause of death in the U.S.[2] The pandemic has exposed significant weaknesses of the U.S. public health system, which has long suffered from inadequate funding and other resources needed to address public health emergencies like the COVID-19 pandemic. Per capita expenditures among local health departments (LHDs) decreased 30% between 2008 and 2019.[3] In 2018, 23% of LHDs reported job losses due to layoffs or attrition. In 2019, nearly 65% of LHDs received no extra funding and 81% reported funding cuts for preparedness and response.[4]

Most states (30) have a decentralized public health system, with local governance. The majority (61%) of LHDs serve less than 50,000 people and 35% have less than 10 full time staff.[3] Mitigation strategies, such as mask mandates, the capacity to conduct case investigation effectively, and contact tracing vary among LHDs and across states. Both large and small LHDs have been overwhelmed, but the impact has been greater among small, rural health departments. Nationally, only 28% of local health departments have epidemiologists or statisticians on staff. In addition, the combination of unsustainable workloads, pushback on mitigation strategies, threats, and political pressures has led to a high turnover of staff. Since April, more than 100 public health leaders across the U.S. have retired, quit, or been fired.[5]

What is happening at the local level?

Kansas can provide an example for what is happening at the local level, and this could be true in other states as well. The LHDs in the state of Kansas are strained by the volume of case investigations and contact tracing, particularly given the rapidly rising COVID-19 caseload (> 284,000 positive cases, > 8,840 hospitalizations, and > 4,300 deaths).[6] A recent survey of LHDs in Kansas showed that the LHD staff are devoting all their time to stop the spread of SARS-CoV-2, many working over weekends.[7] Despite an increase in COVID-19 cases, the number of staff involved in contact tracing has not increased, especially in smaller LHDs, and funding has not increased in many LHDs. In addition, LHD staff reported a sense of being overwhelmed. Since the start of the pandemic, there also has been a loss of 16% of the local health administrators and 20% of local health officers.

The Kansas Department of Health and Environment (KDHE) has pools of both case investigators and contact tracers, but the increasing volume of case counts has put a strain on both state and local health department capabilities. On average, a case investigator can complete 10 - 15 cases per day. With a surge in COVID-19 positive cases, it is no longer possible to complete a case investigation in the state of Kansas within 24 hours of a positive test result.

KDHE is gearing up to train LHDs on its Salesforce (https://www.salesforce.com/) tool. This is a software system to augment the traditional telephone call approach to case investigation and contact tracing. The system integrates into the Epitrax software system,[8] where all the cases are entered for the state of Kansas, and it could alleviate some of the time constraints. But the volume of cases has impacted the speed of the Epitrax and direct data entry. In addition, the Kansas Legislature passed HB 2016 in June 2020 (www.kslegislature.org/li_2020s/b2020s/ measures/hb2016/), a compromise legislation designed to do multiple COVID-19 related activities, but it also limited the powers of the Governor and allowed the legislature to have more direct control over the pandemic response. It also enabled county commissioners to review, amend, and revoke local health officer orders.

What is way forward to help local health departments?

The SARS-CoV-2 virus does not limit itself to county or state borders. On March 13, 2020, the COVID-19 pandemic was declared a national emergency.[9] This allowed the federal government to deliver funds and other resources to state and local governments but has not stopped the surge of COVID-19. The countries that successfully have controlled the spread of SARS-CoV-2, such as South Korea and Taiwan, have central agencies that have resources to ramp up contact tracing and effectively quarantine contacts. The U.S. response, in comparison, largely has been the responsibility of LHDs and state health departments. The U.S. public health agencies need resources to implement a more coordinated pandemic response. For example, the National Disaster Medical System and the U.S. Public Health Service plan to establish a Ready Reserve Corps which could be expanded to provide LHDs with case investigators, contact tracers, and other staff.[10] One of the alternative options would be to create a federal agency (the Federal Pandemic Response Agency) with enough resources to coordinate the public health measures. This agency could be part of the U.S. Department of Health and Human Services, working with the White House Pandemic team and CDC COVID-19 response team, to produce current, scientific national guidelines. In addition, the agency could have enough resources to help LHDs with more funding, staffing, and training for the duration of the pandemic.

What else can be done to help with efforts of LHDs' directly or indirectly?

Research. There is a need for research to understand the spread of the virus in various communities. The LHDs have data of positive cases and clusters, however, there has not been much research of this dataset as the LHD staff are overstretched with little or no collaboration with academic researchers. As Americans spend more time indoors, there is an urgent need for updated recommendations from the American Society of Heating and Air Conditioning Engineers (ASHRAE) regarding air handling (e.g., number of air exchanges, upper room germicidal UV fixtures).[11] In addition, national guidelines are needed to decide when to deploy (and when to stand down) the state National Guard resources (the National Guard has been mobilized in some states for

short durations). In addition, it is important to research the needs of LHDs to improve their efforts to contain the spread of SARS-CoV-2.

Improved Messaging. Lack of trust in guidelines to control the virus persists among segments of society. There are cognitive bias and errors in processing the public health guidelines.[12] To improve trust and overcome the cognitive errors, there is an urgent need to improve messaging with the help of professionals (e.g., professional advertising agencies, social media, use of "influencers" on social media, U.S. Postal Service mail, use of famous personalities such as sports and film stars). In addition, misinformation on social media needs attention.[13] Mask mandates and other public health efforts have been met with hesitancy without effective messaging.

SARS-CoV-2 Testing and Availability of Masks/Hand Sanitizers in the Community. The results of testing for SARS-CoV-2 takes more than three days[7] in many LHDs and this needs to be addressed urgently to stop the spread of the virus effectively. LHDs may need resources to provide masks and hand sanitizers to the community at large, as it may not be enough to mandate masks unless masks are easily available.

COVID-19 Vaccines. Health care workers and residents of long-term care are receiving COVID-19 vaccines. LHDs will need increased staffing/resources to administer vaccine to the community in the near future. However, despite the availability of vaccines, it is important to continue public health measures. Hesitancy and resistance to COVID-19 vaccine are possible and effective messaging may help overcome it.[13] Genetic variants of the spike protein of SARS-CoV-2 virus are emerging, and whether the current vaccines will be helpful against these variants is not known.[14] This worrisome development emphasizes the need for greater public health measures to prevent the spread of the SARS-CoV-2 virus and the spread of the variants of the virus.

The state of Kansas has received 552,775 doses of the COVID-19 vaccines. As of February 11, 2021, 331,022 people in Kansas have received the vaccine (248,977 first dose and 82,045 second dose).[6] There is hope that all the states in the U.S. will receive significantly increased distribution of COVID-19 vaccines soon. If such an increase of vaccine doses comes about, it may be time to vaccinate as many people as possible, as soon as possible, to achieve herd immunity.

If we assume that nearly 1.4 million Kansans are eligible and sign up for the vaccine, the number of people who need to vaccinated daily needs to increase significantly. For example, nearly 7,700 people need to be vaccinated daily (seven days a week) for six months (double that number if we need to vaccinate everyone in three months), to receive at least one dose of the available vaccine. If one nurse or pharmacist is able to give vaccine to an average of 60 people, there is a need for nearly 125 to 150 such health care persons available to complete this task. There is, in addition, a need to store these vaccines properly. This massive vaccination campaign will need significant planning, coordination, and conveying information regarding ongoing efforts to the public in real time. This effort may need the involvement of the state health department, all the county health departments, all the hospital systems in the state of Kansas, and all the pharmacies in the state to work together.

CONCLUSIONS

The COVID-19 pandemic is an immense human tragedy. The effects of the pandemic have been particularly harsh in the U.S., with COVID-19 deaths close to exceeding 500,000. The pandemic has affected all aspects of life in the U.S. It is estimated that the cost of the pandemic may exceed $16 trillion.[15] It may be more difficult to estimate the harm to the community at large (closure of small businesses, job losses, evictions, school closures, and mental health).

To stop this pandemic, LHDs are urgently in need of significantly more resources that includes increased access to rapid and reliable tests, increased staff for rapid case investigations, contact tracing, resources for effective quarantine, and increased staffing/equipment for vaccinating the community. There is an urgent need for massive investment in public health in the U.S. to control not just the current pandemic but future pandemics.

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2019 Annual Report of the Kansas Poison Control Center at The University of Kansas Health System

Elizabeth Silver, Pharm.D., Lisa K. Oller, Pharm.D., Kathy White, R.N., Doyle M. Coons, R.N., Stephen L. Thornton, M.D.
University of Kansas Health System, Kansas City, KS
Kansas Poison Control Center

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ABSTRACT

Introduction. This is the 2019 Annual Report of the Kansas Poison Control Center (KSPCC) at The University of Kansas Health System. The KSPCC is one of 55 certified poison control centers in the United States and serves the state of Kansas 24-hours a day, 365 days a year with certified specialists in poison information and clinical and medical toxicologists. The KSPCC receives calls from the public, law enforcement, health care professionals, and public health agencies. All calls to the KSPCC are recorded electronically in the Toxicall® data management system and uploaded in near real-time to the National Poison Data System (NPDS) which is the data repository for all poison control centers in the United States.

Methods. All encounters reported to the KSPCC from January 1, 2019 through December 31, 2019 were analyzed. Data recorded for each exposure includes caller location, age, weight, gender, exposure substance, nature of exposure, route of exposure, interventions, medical outcome, disposition, and location of care. Encounters were classified as human exposure, animal exposure, confirmed non-exposure, or information call (no exposure reported).

Results. The KSPCC logged 20,589 total encounters in 2019, including 19,406 human exposure cases. The KSPCC received calls from every county in Kansas. A slim majority of human exposure cases (50.5%, n = 9,790) were female. Approximately 61% (n = 11,876) of human exposures involved a child (defined as 19 years of age or less). Most encounters occurred at a residence (91.6%, n = 17,780) and most cases (64.9%, n = 12,599) originated from a residence. The majority of human exposures (85.5%, n = 16,589) were acute cases (exposures occurring over 8 hours or less). Ingestion was the most common route of exposure documented (85.3%, n = 16,548). The most commonly reported substance in pediatric (children ≤ 5) encounters was cosmetics/personal care products (n = 959) followed closely by household cleaning products (n = 943). For adult encounters, analgesics (n = 1,296) and sedative/hypnotics/antipsychotics (n = 1,084) were the most frequently involved substances. Unintentional exposures were the most common reason for exposures (75.4%, n = 14,634). Most encounters (65.9%, n = 12,780) were managed in a non-healthcare facility (i.e., a residence). Among human exposures, 14,591 involved exposures to pharmaceutical agents while 9,439 involved exposure to non-pharmaceuticals. Medical outcomes were 26.4% (n = 5,116) no effect, 18.8% (n = 3,652) minor effect, 9.3% (n = 1,813) moderate effect, and 3.1% (n = 603) major effects. There were 14 deaths in 2019 reported to the KSPCC. Cases from healthcare facilities and cases with moderate or major medical outcomes increased in 2019 compared to 2018. The number of deaths reported to the KSPCC increased in 2019 to 14 from 7 in 2018.

Conclusions. The results of the 2019 Kansas Poison Control Center's annual report demonstrated that cases were received from the entire state of Kansas totaling over 19,400 human exposures per year. While pediatric exposures remained the most common encounter, there continued a trend of increasing number of cases from healthcare facilities and for cases with serious outcomes. The experience of the KSPCC is comparable to national data. This report supported the continued value of the KSPCC to both public and acute health care in the state of Kansas.
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INTRODUCTION

This is the 2019 Annual Report of Kansas Poison Control Center at The University of Kansas Health System (KSPCC). The KSPCC is a 24-hour 365 day/year health care information resource serving the state of Kansas. It was founded in 1982 and is one of the 55 poison control centers certified by the American Association of Poison Control Centers (AAPCC) in the United States. The KSPCC is staffed by 10 certified specialists in poison information who are either critical care trained nurses or Doctors of Pharmacy. There is 24-hour back-up provided by five board-certified clinical and medical toxicologists.

The KSPCC receives calls from the public, law enforcement, health care professionals, and public health agencies. Encounters may involve an exposed animal or human (Exposure Call) or a request for information with no known exposure (Information Call). The KSPCC follows all cases to make management recommendations, monitor case progress, and document medical outcome. This information is recorded electronically in the Toxicall® data management system and uploaded in near real-time to the National Poison Data System (NPDS).

NPDS is the data warehouse for all the nation's poison control centers.[1] The average time to upload data for all poison centers is 7.72 [6.90, 12.00] (median [25%, 75%]) minutes creating a near real-time national exposure database and surveillance system. The KSPCC has the ability to share NPDS real time surveillance with state and local health departments and other regulatory agencies. The analysis and summary of all encounters reported to the KSPCC from January 1, 2019 to December 31, 2019 is reported below.

METHODS

All KSPCC encounters recorded electronically in the Toxicall® data management system from January 1, 2019 to December 31, 2019 were analyzed. Cases were first classified as either an exposure or suspected exposure (human exposure, animal exposure, non-exposure confirmed cases) or a request for information with no reported exposure (information call). Extracted data included caller location, age, weight, gender, exposure substance, number of follow-up calls, nature of exposure (i.e., unintentional, recreational, or intentional), exposure scenario, route of exposure (oral, dermal, parenteral), interventions, medical outcome (no effect, minor, moderate, severe, or death), disposition (admitted to noncritical care unit, admitted to critical care

unit, admitted to psychiatry unit, lost to follow-up, or treated and released) and location of care (non-health care facility or health care facility). For this analysis, a pediatric case was defined as any patient 19 years of age or less. This was consistent with NPDS methodology. Similarly, NPDS descriptions of the medical outcomes of cases were used: minor - minimally bothersome symptoms, moderate - more pronounced symptoms, usually requiring treatment, and major - life threatening signs and symptoms. Data were analyzed using Microsoft Excel (Microsoft Corp, Redmond, WA).

RESULTS

The KSPCC logged 20,589 total calls in 2019. This was a decrease of 483 calls (2.3%) compared to 2018. Among the calls in 2019 were 19,406 human exposure cases, 62 non-exposure confirmed cases, 125 animal exposure cases, and 996 information calls. For information calls, drug information (n = 327) was most common reason for calling. Table 1 describes the encounter types.

The KSPCC made 33,724 follow-up calls in 2019. Follow-up calls were done in 58.2% of human exposure cases. One follow-up call was made in 23.7% of human exposure cases and multiple follow-up calls (range 2 - 48) were made in 34.5% of cases. For human exposure cases which required a follow-up call, an average of three follow-up calls were performed per case. This was a 7% increase in the number of follow-up calls performed compared to 2018.

The KSPCC received calls from all 105 counties and every hospital in Kansas. The county with the largest number of calls was Sedgwick County with 3,115. In addition, calls were received from all 50 states, and the District of Columbia.

Table 1. Encounter type.

	Number	%
Exposure		
Human exposure	19,406	99.36
Animal exposure	125	0.64
Subtotal	**19,531**	**94.86**
Non-exposure confirmed cases		
Human non-exposure	62	100.00
Subtotal	**62**	**0.30**
Information call		
Drug information	327	32.83
Drug identification	81	8.13
Environmental information	71	7.13
Medical information	24	2.41
Occupational information	1	0.10
Poison information	94	9.44
Prevention/safety/education	9	0.90
Teratogenicity information	2	0.20
Other information	43	4.32
Substance abuse	8	0.80
Administrative	22	2.21
Caller referred	314	31.53
Subtotal	**996**	**4.84**
Total	**20,589**	**100.00**

Overall, a slim majority of human exposure cases (50.5%, n = 9,790) were female. In children younger than 13 years of age a majority were male, but this gender distribution was reversed in teenagers and adults. In fact, in the age group involving children 13-19 years of age, 61.3% of cases were female. Approximately 61.2% (n = 11,876) of human exposures involved a child (defined as age 19 years or less).

Table 2 illustrates distribution of human exposures by age and gender. Patients one year of age were the most common age group involved in encounters reported to the KSPCC. For adults, the age group of 20 - 29 years old was most encountered. Seventy exposures occurred in pregnant women (0.4% of all human exposures). Of these exposures, 28.6% occurred in the first trimester, 35.7% occurred in the second trimester, and 34.2% occurred in the third trimester. Most exposures in pregnant women (68.6%) were unintentional exposures with 30% resulting from intentional exposures. There was one reported death to KSPCC in a pregnant woman in 2019.

For human exposures, 64.9% (n = 12,599) of calls originated from a residence (own or other), while 91.6% (n = 17,780) of these exposures occurred at a residence (own or other). Calls from a health care facility accounted for 25.8% (n = 5,168) of human exposure encounters. Table 3 further details the origin of human exposure cases and the site of the exposure. The majority of human exposures, 85.5 % (n = 16,589) were acute cases defined as exposures occurring over 8 hours or less. Chronic exposures defined as exposures occurring over > 8 hours accounted for 2.3% (453) of all human exposures. Acute on chronic exposures defined as single exposure that was preceded by a chronic exposure over > 8 hours totaled 2,258 (11.6%). Ingestion was the most common route of exposure (85.3%, n = 16,548) documented in all cases (Table 4).

The most commonly reported substance in those less than six years of age was cosmetics/personal care products (n = 959), followed closely by household cleaning products (n = 943). Table 5 lists the substances most frequently involved in exposures for those ≤ 5 years old. For adult cases (> 19 years of age), analgesics (n = 1,296) and sedative/hypnotics/antipsychotics (n = 1,084) were the most frequently involved substances as seen in Table 6. Among all encounters, analgesics (n = 2,805, 11.6%) were the most frequently encountered substance category. Table 7 (available online only at "journals.ku.edu/kjm") is a summary log for all exposures categorized by category and sub-category of substance.

In 2019, there was a total of 331 plant exposures reported to the KSPCC. The single most common plant exposure encountered was to pokeweed (Phytolacca Americana; n = 28). Table 8 lists the top 5 most encountered plants.

Table 2. Distribution of human exposures by age and gender.

	Male		Female		Unknown gender		Total		Cumulative total	
Age (yrs)	N	% of age group total	N	% of age group total	N	% of age group total	N	% of total exposure	N	%
< 1 year	525	55.09	426	44.70	2	0.21	953	4.91	953	4.91
1 year	1,479	53.51	1,282	46.38	3	0.11	2,764	14.24	3,717	19.15
2 years	1,463	54.94	1,199	45.02	1	0.04	2,663	13.72	6,380	32.88
3 years	742	58.94	517	41.06	0	0.00	1,259	6.49	7,639	39.36
4 years	385	58.07	277	41.78	1	0.15	663	3.42	8,302	42.78
5 years	202	55.04	145	39.51	20	5.45	367	1.89	8,669	44.67
Unknown ≤ 5 years	0	0.00	0	0.00	1	100.00	1	0.01	8,670	44.68
Child 6 - 12 years	637	49.30	540	41.80	115	8.90	1,292	6.66	9,962	51.33
Teen 13 - 19 years	736	38.57	1,169	61.27	3	0.16	1,908	9.83	11,870	61.17
Unknown child	3	50.00	2	33.33	1	16.67	6	0.03	11,876	61.20
Subtotal	**6,172**	**51.97**	**5,557**	**46.79**	**147**	**1.24**	**11,876**	**61.20**	**11,876**	**61.20**
20 - 29 years	893	45.72	1,058	54.17	2	0.10	1,953	10.06	13,829	71.26
30 - 39 years	791	47.56	872	52.44	0	0.00	1,663	8.57	15,492	79.83
40 - 49 years	450	40.14	670	59.77	1	0.09	1,121	5.78	16,613	85.61
50 - 59 years	420	40.15	624	59.66	2	0.19	1,046	5.39	17,659	91.00
60 - 69 years	307	40.66	447	59.21	1	0.13	755	3.89	18,414	94.89
70 - 79 years	240	43.32	314	56.68	0	0.00	554	2.85	18,968	97.74
80 - 89 years	102	38.49	163	61.51	0	0.00	265	1.37	19,233	99.11
≥ 90 years	26	40.00	39	60.00	0	0.00	65	0.33	19,298	99.44
Unknown adult	42	45.65	44	47.83	6	6.52	92	0.47	19,390	99.92
Subtotal	**3,271**	**43.53**	**4,231**	**56.31**	**12**	**0.16**	**7,514**	**38.72**	**19,390**	**99.92**
Unknown age	5	31.25	2	12.50	9	56.25	16	0.08	19,406	100.00
Total	**9,448**	**48.69**	**9,790**	**50.45**	**168**	**0.87**	**19,406**	**100.00**	**19,406**	**100.00**

Table 3. Origin of call and site of exposure for human exposure cases.

Site	Origin of call		Site of exposure	
	N	%	N	%
Residence				
Own	12,257	63.16	17,170	88.48
Other	342	1.76	610	3.14
Workplace	282	1.45	476	2.45
Health care facility	5,195	26.77	111	0.57
School	37	0.19	468	2.41
Restaurant/food service	1	0.01	49	0.25
Public area	70	0.36	173	0.89
Other	1,208	6.22	223	1.15
Unknown	14	0.07	126	0.65

Table 4. Route of human exposures.*

	Human exposures		
Route	**N**	**% of All Routes**	**% of All Cases**
Ingestion	16,548	79.97	85.27
Dermal	1,583	7.65	8.16
Inhalation/Nasal	1,231	5.95	6.34
Ocular	754	3.64	3.89
Bite/Sting	184	0.89	0.95
Parenteral	172	0.83	0.89
Unknown	164	0.79	0.85
Aspiration (with ingestion)	23	0.11	0.12
Otic	14	0.07	0.07
Other	13	0.06	0.07
Vaginal	5	0.02	0.03
Rectal	2	0.01	0.01
Total Number of Routes	**20,693**	**100.00**	**106.63**

*Some cases may have multiple routes of exposure documented.

Table 5. Substance categories most frequently involved in exposures for age ≤ 5 years old.

Substance category	Previous year rank	All substance	%	Single substance exposures	%
Cosmetics/personal care products	1	959	10.48	929	11.12
Cleaning substances (household)	2	943	10.31	903	10.81
Analgesics	3	827	9.04	747	8.94
Foreign bodies/toys/miscellaneous	4	533	5.83	517	6.19
Antihistamines	5	503	5.50	463	5.54
Dietary supplements/herbals/homeopathic	6	496	5.42	464	5.55
Topical preparations	8	382	4.17	377	4.51
Vitamins	7	378	4.13	326	3.90
Pesticides	9	349	3.81	327	3.91
Gastrointestinal preparations	10	217	2.37	181	2.17
Cardiovascular drugs	12	216	2.36	121	1.45
Plants	15	199	2.17	193	2.31
Hormones and hormone antagonists	16	197	2.15	123	1.47
Electrolytes and minerals	17	185	2.02	168	2.01
Essential oils	13	176	1.92	165	1.97

Table 6. Substance categories most frequently involved in exposures of adults (> 19 years).

Substance category	All substances	%	Single substance exposures	%
Analgesics	1,296	11.83	551	9.72
Sedative/hypnotics/antipsychotics	1,084	9.89	337	5.94
Antidepressants	945	8.63	325	5.73
Cardiovascular drugs	757	6.91	244	4.30
Alcohols	601	5.49	67	1.18
Antihistamines	476	4.34	209	3.69
Cleaning substances (household)	444	4.05	356	6.28
Pesticides	434	3.96	334	5.89
Anticonvulsants	410	3.74	118	2.08

Table 6. Substance categories most frequently involved in exposures of adults (> 19 years). *continued.*

Substance category	All substances	%	Single substance exposures	%
Hormones and hormone antagonists	342	3.12	186	3.28
Stimulants and street drugs	335	3.06	149	2.63
Fumes/gases/vapors	295	2.69	268	4.73
Chemicals	294	2.68	254	4.48
Muscle relaxants	236	2.15	90	1.59
Cold and cough preparations	228	2.08	106	1.87

Table 8. Top 5 most frequent plant exposures.

Botanical name or category	N
Oxalates (species unspecified)	38
Plants: non-toxic	33
Phytolacca Americana (L.) (botanic name)	28
Cherry (species unspecified, wild & domesticated)	22
Plants-general-unknown	11
Spathiphyllum species (botanic name)	10
Poison ivy/oak	9
Philodendron (species unspecified)	7
Total of all plant calls	**331**

Unintentional exposures were the most common reason for exposures (75.4%, n = 14,634) while intentional exposures accounted for 21.3% (n = 4,127) of exposures. Table 9 lists reasons for human exposures. Most unintentional exposures, 58.8% (n = 8,609) occurred in the ≤ 5-years-old age group. In patients less than 13 years of age, 97.8% (n = 9,745) of ingestions were unintentional. However, in the age 13 to 19-years-old group, intentional exposure was most common (67.2%, n = 1,283). In total, suspected suicide attempts accounted for 16.5% (n = 3,201) of human encounters. When a therapeutic error was the reason for exposure, a double dose was the most common scenario, 32.2% (n = 756).

Most encounters (65.9%, n = 12,780) were managed in a non-health care facility (i.e., a residence). Of the 6,368 encounters managed at a health care facility, 45% (n = 2,863) were admitted. Table 10 lists the management site of all human encounters.

Among human exposures, 14,591 involved exposures to pharmaceutical agents while 9,439 involved exposure to non-pharmaceuticals. Because an encounter could include numerous pharmaceutical agents and non-pharmaceutical agents, this total was greater than the total number of encounters. However, 86% (n = 16,683) of all human exposures were exposed to only a single substance. Among these single substance exposures, the reason for exposure was intentional in 25.6% (n = 2,160) of pharmaceutical-only cases compared to 3.8% (n = 316) of non-pharmaceutical single substance exposures.

When medical outcomes were analyzed, 26.4% (n = 5,116) of human exposures had no effect, 18.8% (n = 3,652) had minor effect, 9.3% (n = 1,813) had moderate effect, and 3.1% (n = 603) had major effects. Moderate effects were more common in the 13 to 19-year-old group while major effects were more common in those over 20 years of age. Moderate and major effects were most common in those with intentional encounters. More serious outcomes were related to single-substance pharmaceutical exposures, accounting for 35.7% (n = 5) of the fatalities. Table 11 lists all medical outcomes by age and Table 12 lists outcomes by reason for exposure.

Use of decontamination and specific therapies, including antidotal therapy, is detailed in Tables 13a and 13b (tables available online only at "journals.ku.edu/kjm"). There were 14 deaths in 2019 reported to the KSPCC. All deaths involved patients 20 years of age or older, and 11 of the deaths involved intentional exposures. Table 14 details the 14 reported deaths (available online only at "journals.ku.edu/kjm").

Table 15 compares key statistics from 2015 to 2019. Overall case volumes have declined since 2016, however, the percentage of calls from healthcare facilities, and cases with moderate or major outcomes have increased steadily from 2015 to 2019. The number of deaths doubled from 2018 to 2019.

DISCUSSION

The ongoing importance of the KSPCC is reflected in trends that have seen rates of poisonings and overdoses increase at an alarming rate over the last decade. According to the Annual Surveillance Report of Drug-Related Risks and Outcomes, drug poisoning-related hospitalizations in the United States have increased 26% in over the last two years that data are available.[1,2] The National Center for Health Statistics noted over 67,000 overdose related deaths in 2018.[3]

Table 9. Reasons for human exposure cases.

Unintentional	Exposures	% of Total
Unintentional - general	9,242	47.6
Unintentional - therapeutic error	2,342	12.1
Unintentional - misuse	1,705	8.8
Unintentional - environmental	630	3.2
Unintentional - occupational	379	2.0
Unintentional - bite/sting	184	0.9
Unintentional - food poisoning	124	0.6
Unintentional - unknown	28	0.1
Subtotal	**14,634**	**75.4**
Intentional		
Intentional - suspected suicide	3,201	16.5
Intentional - misuse	474	2.4
Intentional - abuse	375	1.9
Intentional - unknown	77	0.4
Subtotal	**4,127**	**21.3**
Adverse Reaction		
Adverse reaction - drug	301	1.6
Adverse reaction - food	70	0.4
Adverse reaction - other	61	0.3
Subtotal	**432**	**2.2**
Unknown		
Unknown reason	121	0.6
Subtotal	**121**	**0.6**
Other		
Other - malicious	73	0.4
Other - withdrawal	14	0.1
Other - contamination/tampering	5	0.0
Subtotal	**92**	**0.5**
Total	**19,406**	**100.0**

Table 10. Management site of human exposures.

Site of management	N	%
Managed in healthcare facility		
Treated/evaluated and released	3,241	16.7
Admitted to critical care unit	1,421	7.3
Admitted to noncritical care unit	836	4.3
Admitted to psychiatric facility	606	3.1
Patient lost to follow-up/left AMA	264	1.4
Subtotal (managed in healthcare facility)	**6,368**	**32.8**
Managed on site, non-healthcare facility	12,780	65.9
Other	30	0.2
Refused referral	217	1.1
Unknown	11	0.1
Total	**19,406**	**100.0**

Similarly, the KSPCC consistently has seen an increase in the number of cases from healthcare facilities and cases with moderate or major medical outcomes. Over the last five years, calls from healthcare facilities have increased by 22% while moderate/major outcomes increased by 43%. Cases from healthcare facilities account for more than 25% of the cases reported to the KSPCC.[4-6] While the number of deaths doubled from 7 in 2018 to 14 in 2019, this more closely reflects previous years' exposure-related fatalities with 15 and 16 deaths documented in 2016 and 2017, respectively.[4,5]

The 2019 Kansas Poison Control Center at The University of Kansas Health System's statistics continued to mirror those seen nationally by the other 54 accredited poison control centers nationwide. In 2018, 2,530,238 encounters were logged by poison control, including 2,099,751 human exposures.[7] Overall encounters showed a 2.96% (n = 77,175) decline from 2017 to 2018, though healthcare facility human exposure cases decreased by only 0.261% from 2017. More serious outcomes (moderate, major, or death) continued to increase. Nationwide, the five substance classes most frequently involved in adult exposures were analgesics, sedative/hypnotics/antipsychotics, antidepressants, cardiovascular drugs, and cleaning substances (household), while the top five most common exposures in children age five years or less were cosmetics/personal care products, household cleaning substances, analgesics, foreign bodies/toys/miscellaneous, and topical preparations. There were 3,111 exposure-related fatalities reported nationwide in 2018.

Several important limitations must be noted when interpreting poison center data. Reporting exposures to the KSPCC is voluntary and the KSPCC is not contacted regarding all poisonings in the state of Kansas. Furthermore, in most cases, there is no objective confirmation of exposure.

CONCLUSIONS

The 2019 KSPCC annual report demonstrated that the center received over 20,000 total calls, including more than 19,000 human exposures. While pediatric exposures remain the most common, there continues to be an increasing trend in the number of calls from healthcare facilities and for cases with serious outcomes. In this regard, the experience of the KSPCC is similar to national data. This report supported the continued value of the KSPCC to both public and acute healthcare in the state of Kansas.

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Table 11. Medical outcome of human exposure cases by patient age.

	≤ 5 years		6 - 12 years		13 - 19 years		≥ 20 years		Unknown child		Unknown adult		Unknown age		Total	
Outcome	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
No effect	2,931	33.81	402	31.11	435	22.80	1,331	17.93	1	16.67	11	11.96	5	31.3	5,116	26.36
Minor effect	957	11.04	239	18.50	589	30.87	1,854	24.98	0	0.00	13	14.13	0	0.0	3,652	18.82
Moderate effect	85	0.98	42	3.25	396	20.75	1,285	17.31	0	0.00	4	4.35	1	6.3	1,813	9.34
Major effect	18	0.21	7	0.54	97	5.08	479	6.45	0	0.00	2	2.17	0	0.0	603	3.11
Death	0	0.00	0	0.00	0	0.00	14	0.19	0	0.00	0	0.00	0	0.0	14	0.07
No follow-up, nontoxic	310	3.58	30	2.32	10	0.52	20	0.27	1	16.67	2	2.17	0	0.0	373	1.92
No follow-up, minimal toxicity	4,019	46.36	518	40.09	283	14.83	1,717	23.13	2	33.33	31	33.70	3	18.8	6,573	33.87
No follow-up, potentially toxic	220	2.54	31	2.40	64	3.35	355	4.78	2	33.33	28	30.43	7	43.8	707	3.64
Unrelated effect	130	1.50	23	1.78	34	1.78	367	4.94	0	0.00	1	1.09	0	0.0	555	2.86
Death, indirect report	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.0	0	0.00
Total	**8,670**	**100.00**	**1,292**	**100.00**	**1,908**	**100.00**	**7,422**	**100.00**	**6**	**100.00**	**92**	**100.00**	**16**	**100.00**	**19,406**	**100.00**

Table 12. Medical outcome by reason for exposure in human exposures.

	Unintentional		Intentional		Other		Adverse reaction		Unknown		Total	
Outcome	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Death	3	0.02	11	0.27	0	0.00	0	0.00	0	0.00	14	0.07
Death, indirect report	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Major effect	75	0.51	489	11.85	0	0.00	13	3.01	26	21.49	603	3.11
Minor effect	2,392	16.35	1,105	26.77	18	19.57	119	27.55	18	14.88	3,652	18.82
Moderate effect	483	3.30	1,253	30.36	9	9.78	41	9.49	27	22.31	1,813	9.34
No effect	4,191	28.64	871	21.10	9	9.78	31	7.18	14	11.57	5,116	26.36
No follow-up, nontoxic	364	2.49	5	0.12	1	1.09	2	0.46	1	0.83	373	1.92
No follow-up, minimal toxicity	6,288	42.97	153	3.71	19	20.65	106	24.54	7	5.79	6,573	33.87
No follow-up, potentially toxic	461	3.15	180	4.36	18	19.57	35	8.10	13	10.74	707	3.64
Unrelated effect	377	2.58	60	1.45	18	19.57	85	19.68	15	12.40	555	2.86
Total	**14,634**	**100.00**	**4,127**	**100.00**	**92**	**100.00**	**432**	**100.00**	**121**	**100.00**	**19,406**	**100.00**

Table 15. 2015 to 2019 comparison of select statistics.

	2015	2016	2017	2018	2019
Total cases	20,109	21,965	21,431	21,072	20,589
Calls from healthcare facility	4,267	4,514	4,892	5,224	5,195
Moderate or major outcomes	1,688	1,971	2,170	2,340	2,416
Deaths	13	15	16	7	14

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Is Rural Kansas Prepared? An Assessment of Resources Related to the COVID-19 Pandemic

Hannah Berland, B.A.[1], Dorothy Hughes, Ph.D.[2]
[1]University of Kansas School of Medicine-Salina, Salina, KS
[2]University of Kansas School of Medicine, Kansas City, KS
Department of Population Health

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ABSTRACT

Introduction. This cross-sectional study investigated rural Kansas healthcare resources relevant to COVID-19 at the county level in the context of population characteristics.

Methods. The federal Area Health Resource File was used to assess system capacity and critical care-related resources and COVID-19-related risk factors at the county level. Data were described with summary statistics, cross-tabulations, and bivariate tests to discern differences across county rurality categories (2013 Rural-Urban Continuum Codes).

Results. Kansas has 105 counties. Metropolitan counties had an average of 1.5 physicians (M.D. or D.O., any specialty) per 1,000 people, while rural counties had 0.8. A total of 63.5% of rural counties had no anesthesia providers and 100.0% of rural counties had no pulmonary disease physicians. While 96 counties have at least one hospital, nearly 90% rural counties had no intensive care unit (ICU) services. The percent of the population estimated to be over 65 was higher among rural counties (24.2%) than metropolitan counties (19.3%). On average, rural counties had nearly twice as many deaths per 1,000 people by cardiovascular disease and more chronic obstructive pulmonary disease deaths than metropolitan and nonmetropolitan/urban adjacent counties.

Conclusions. Kansas faced limited ICU capabilities and physician workforce shortages in rural counties, both in primary care and specialties such as anesthesia and pulmonology. In addition, nonmetropolitan/urban adjacent and rural population age structures and mortality rates potentially demonstrated an increased risk to overwhelm local healthcare systems. This may have serious implications for rural health, particularly in the context of the COVID-19 pandemic.

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INTRODUCTION

With the evolution of coronavirus disease 2019 (COVID-19) into a worldwide pandemic, national concern originally focused on urban areas of the United States. Researchers tracking COVID-19 thought rural America was so isolated that the virus might not reach it. However, a Kaiser Family Foundation study found that in a two-week period between April 13 and 27, rural counties saw a 125% increase in coronavirus cases, on average, and a 169% increase in deaths.[1] Meanwhile, urban counties saw a 68% increase in cases and a 113% increase in deaths. Then, between June 1 and 18, 2020, 18 of the top 25 COVID-19 hot spots were in rural counties.[2,3] This trend was sustained in Kansas. The Kansas Department of Health and Environment (KDHE) reported an 86% increase in new cases between July 1 and July 31, 2020, and said it expected a spike in rural cases in mid-August while urban cases would be on the decline.[4] Rural America is home to 60 million people, and it is a real possibility that it may become one of the hardest-hit areas.[3]

There are serious implications for mortality due to COVID-19 in rural Kansas, and it is important to understand the resources the state has available to fight this pandemic. To that end, a population-based study was conducted to evaluate three areas: (1) healthcare system capacity, (2) critical care-related resources, and (3) COVID-19-related risk factors at the population level. We aimed to fill a gap in knowledge around rural Kansas pandemic preparedness and better understand whether these areas may be overwhelmed by a surge in COVID-19 cases.

Rural America faces serious challenges due to reduced hospital capacity and large proportions of its population falling into high-risk categories. According to the U.S. Centers for Disease Control and Prevention (CDC), those at risk for severe illness from COVID-19 are patients over the age of 65 and patients of any age with severe underlying medical conditions such as heart disease, severe obesity, and diabetes.[5] A report published by the U.S. Census Bureau in 2019 stated 17.5% of the rural population was 65 years or older compared to 13.8% in urban areas.[6] Additionally, obesity and other chronic diseases occur at higher rates among adults in rural versus urban populations in the U.S.[7,8] This study examined such population factors to provide insight into why rural areas may face a high incidence of severe COVID-19 illness and, therefore, may have their healthcare infrastructure overwhelmed.

Nationally, only 1% of the country's intensive care unit (ICU) beds are located in rural communities, significantly out of proportion with the potential need that about 17 - 20% of the population lives in rural areas, depending on the measure of rurality used.[9,10] In addition, if larger hospitals become overwhelmed, patient transfers to these centers may not be possible. This is already happening in some areas of Kansas. Physicians in rural Kansas are facing a situation of having to call eight to ten hospitals in the region to find an open ICU bed.[11] Of the rural patients who are able to be transferred, two-thirds are in need of intensive care.[12]

If coronavirus cases continue to escalate in rural communities, there is the potential for critical care resources, already in short supply, to reach levels unsustainable for the care of rural populations. The characteristics of rural Kansas populations and the nature of their healthcare infrastructure form a perfect storm and yield the very real possibility of a rural surge in COVID-19 cases. It is imperative that we better understand Kansas's available critical care resources, capacity, and risk factors.

METHODS

Data Source. A cross-sectional, retrospective study was conducted to assess critical care-related resources and healthcare system capacity in rural Kansas. The federal Area Health Resource File (AHRF) 2018-2019 release was used.[13] The AHRF is a county-level, national database maintained by the U.S. Health Resources and Services Administration.

It contains data from all 3,230 counties in the U.S. and more than 6,000 variables for current and historic measures of healthcare resources and population characteristics. It is updated annually and includes multiple years of data for many variables; however, due to lags in data collection, not all years were available for all variables in the 2018 - 2019 release. The most recent year available across all our variables of interest was 2017.

Fourteen variables of interest were selected. A full list of variables and detailed descriptions are located in the Appendix (Appendix is online only at journal.ku.edu/kjm). The 2013 Rural-Urban Continuum Codes (RUCCs) was used to describe rurality.[14] RUCC is a scheme used by the U.S. Department of Agriculture that distinguishes counties by their population size and adjacency to a metro area; 2013 is the most recent year these classifications were updated. RUCC uses a scale of 1 - 9, with the lowest values representing the most metropolitan counties. Based on prior literature, the nine RUCCs were grouped into three categories (referred to as "rurality categories") with the following labels: metropolitan (RUCC 1 - 3), nonmetropolitan/urban adjacent (4 - 6), and rural (7 - 9).[15-20]

Variables related to rural health networks were included. In Kansas, critical access hospitals (CAHs) are organized into state-designated rural health networks (Figure 1).[21] These networks are similar to regions and consist of one or more CAHs and a supporting hospital with higher-acuity care capabilities. Each network has a comprehensive plan regarding patient referrals and emergency and non-emergency transfers. There are ten counties that contain larger hospitals designated as supporting assigned CAHs. Four counties contain CAHs that are supported by out of state hospitals. There are 23 counties that do not contain either a supporting hospital or a CAH. These networks are included in our analyses to understand not only individual county resources but also collective resources within established patient transfer patterns.

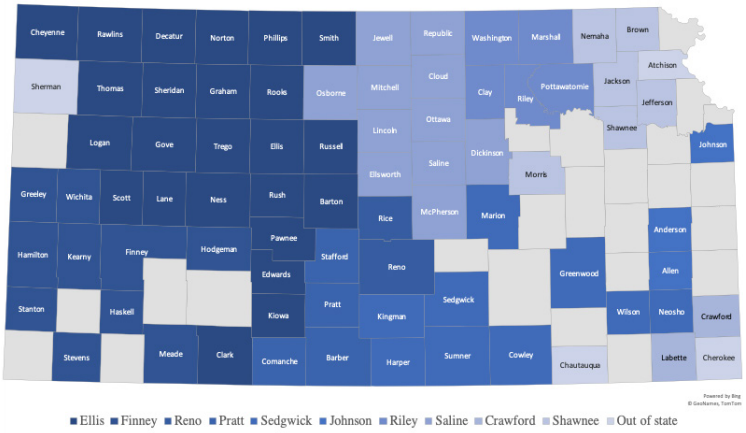

Figure 1. Kansas Rural Health Networks.
*Gray counties are those without a CAH.

Based on reports of the impact of COVID-19 to date, three categories were established to organize the data, each relating to a different aspect of COVID-19 preparedness: (1) healthcare system capacity, (2) critical care-related resources, and (3) COVID-19-related risk factors at the population level.[22]

The variables in the first category, healthcare system capacity, were: total number of hospitals, total number of CAHs, total active M.D. and D.O. phsycians, and active M.D.s and D.O.s per 1,000 people. The variables chosen to describe critical care-related resources (the second category of variables) in Kansas were: total primary care physicians, primary care physicians per 1,000 people, total anesthesia providers (M.D., D.O., and Certified Registered Nurse Anesthetists (CRNA)), total pulmonary disease M.D.s, total ICU beds, and ICU beds per 1,000 people. The providers were selected based on evidence of those most involved in the care of critically ill COVID-19 patients, specifically those needed in intensive care units.[23] While the data were variable, reports have shown 4.9 - 14.2% of COVID-19 hospitalized patients require ICU admission, making providers with pulmonary and critical care training important.[24,25] There were no data available in the AHRF database on pulmonary physicians with a degree other than an M.D. To recognize the contributions nursing staff provide to COVID-19 patients, a future analysis dedicated specifically to this critical workforce is recommended at a later time.

To understand ICU beds beyond the raw number and number per 1,000 people, they were examined in the context of the Kansas rural health networks, which reflect established patient transfer patterns. Two binary indicator variables were created (0/1) to identify counties as a "CAH county" or a "supporting county." A supporting county was any county that contained a hospital that received transfers from CAH counties. A categorical variable was created to establish groups of counties based on what supporting hospital their CAH fed into. See Appendix for detailed information on variable use and construction (Appendix is online only at journal.ku.edu/kjm).

The variables chosen to describe population-level COVID-19 risk factors (the third category of variables) were: percentage of the population eligible for Medicare, percent active physicians (M.D. and D.O.) over age 55, percent active physicians over age 65, and three-year mortality average per 1,000 people for cardiovascular disease, influenza and pneumonia, and chronic obstructive pulmonary disease (COPD). The variables for physician age demonstrated the proportions of the physician workforce who were, themselves, at higher risk for severe COVID-19 illness or death if they contracted the virus. The three-year disease mortality rates per 1,000 people were used as proxies for disease burden because individuals with chronic conditions are at higher risk for severe illness and death if infected with COVID-19.[5]

Data Analysis. Variables were analyzed descriptively to understand the range of resources, capacity, and risk across the state by rurality category. Using RUCC classifications, Kansas counties were grouped into three categories, referred to as rurality categories: rural (RUCC 7 - 9), nonmetropolitan/urban adjacent (4 - 6), and metropolitan (1 - 3). Summary statistics were calculated for each variable. These included frequencies and percentages for categorical variables and measures of central tendency for continuous variables. The AHRF is a 'population' dataset, representing all applicable data points used in each test, and is not a sample. While other published studies that have used the AHRF have used t-tests for continuous variables,[26,27] we concluded that the best bivariate test to determine meaningful differences in resources,

capacity, and risk by rurality category (rural, nonmetropolitan/urban adjacent, and metropolitan) were two-tailed z-tests using standard deviations. Analyses were conducted using Stata/SE 15.

RESULTS

The AHRF database included 3,230 counties, which were narrowed to the 105 counties in Kansas. There were 63 (60.0%) counties designated as rural, 23 (21.9%) nonmetropolitan/urban adjacent counties, and 19 (18.1%) metropolitan counties. As noted above, variables of interest were grouped by relevance to healthcare system capacity, critical care-related resources, or population-level COVID-19 risk factors. Variables were cross tabulated by the rurality category (rural, nonmetropolitan/urban adjacent, and metropolitan) to describe differences. Table 1 summarizes the variables statewide. Table 2 summarizes average healthcare system capacity, critical care-related resources, and population-level COVID-19-related risk factors among counties in each rurality category.

Healthcare System Capacity. There were 96 counties with at least one hospital and nine counties without a hospital. Of the nine counties without a hospital, five were rural and four were metropolitan. The average number of hospitals per metropolitan county was 2.8. Nonmetropolitan/urban adjacent and rural counties had an average of 1.3 and 1.1 hospitals per county, respectively, with 65.2% of nonmetropolitan/urban adjacent counties and 74.6% of rural counties having one hospital per county. Both the nonmetropolitan/urban adjacent and rural categories fell below the state average of 1.5. Z-tests were conducted to determine if there were meaningful differences in the average number of hospitals per county between rural and metropolitan counties ($p = 0.053$) and between rural and nonmetropolitan/urban adjacent counties ($p = 0.109$). There was no statistically significant difference in average number of hospitals according to a county's rurality category.

There were 72 counties with at least one CAH and 33 counties with no CAH. Of the counties with at least one CAH, 55 (76.4%) were rural, 12 (16.7%) were nonmetropolitan/urban adjacent, and 5 (6.9%) were metropolitan. Nonmetropolitan/urban adjacent and rural counties had an average of 0.7 and 1.0 CAHs per county, respectively. Metropolitan counties had an average of 0.3 CAHs per county, which was below the state average of 0.8. This was expected given that the CAH program was designed for rural areas. A z-test found a statistically significant difference in the average number of CAHs in rural versus metropolitan counties ($p < 0.001$) and in rural versus nonmetropolitan/urban adjacent counties ($p = 0.032$).

The state of Kansas had an average of 73.7 physicians per county, with a range of 0 to 3,259 physicians per county (Figure 2). On average, metropolitan counties had 348.4 per county, nonmetropolitan/urban adjacent 34.0, and rural 5.3, indicating a statistically significant difference in the supply of physicians per county by rurality category. The metropolitan category had the widest variation of the three rurality categories, from a low of 1 to a high of 3,259. Z-tests found a statistically significant difference between the means of rural versus nonmetropolitan/urban adjacent counties ($p < 0.001$), but no difference between rural and metropolitan counties ($p = 0.059$) since the test accounts for variation within the two groups being compared.

Table 1. Summary of variables of interest statewide.

Healthcare system capacity Kansas (n = 105)	**Mean**	**Range**
Total number of hospitals	1.5	0 - 14
Total number of CAHs	0.8	0 - 2
Total active M.D.s and D.O.s	73.7	0 - 3,259
Active M.D.s and D.O.s per 1,000 people	1.0	0 - 5.5
Critical Care-related Risk Factors	**Mean**	**Range**
Primary care physicians	21.4	0 - 725
Primary care physicians per 1,000 people	0.6	0 - 2.0
Anesthesia providers	9.8	0 - 335
Pulmonary disease M.D.s	1.0	0 - 64
Total ICU beds	4.3	0 - 97
ICU beds per 1,000 people	0.1	0 - 1.5
Population-level COVID-19 Risk Factors	**Mean**	**Range**
Percentage of population Medicare eligible	22.6%	10.3% - 34.0%
High-risk physician workforce population: age 55+	42.7%	100.0%
High-risk physician workforce population: age 65+	17.0%	100.0%
Three-year mortality from heart disease per 1,000 people	1.6	0.4 - 4.7
Three-year mortality from COPD per 1,000 people	0.7	0.2 - 0.8
Three-year mortality from influenza and pneumonia per 1,000 people	0.3	0.1 - 0.7

Metropolitan counties had an average of 1.5 physicians per 1,000 people. Nonmetropolitan/urban adjacent counties had an average of 1.2 physicians per 1,000 people, and rural counties had 0.8 physicians per 1,000 people. Only rural counties fell below the state average of 1.0. A z-test was conducted to compare the means between rural and metropolitan counties ($p = 0.043$) and between rural and nonmetropolitan/urban adjacent counties ($p = 0.10$). Rural counties had significantly smaller physician workforces compared to both other types of counties.

Critical Care-Related Resources. The variable, "primary care physicians (PCPs), non-federal," combined family medicine, general practice, general internal medicine, and pediatric physicians, according to AHRF documentation. Metropolitan counties had an average of 89.6 PCPs, nonmetropolitan/urban adjacent counties had 14.6, and rural counties had 3.4. Z-tests were conducted to determine whether there were statistically significant differences in the mean supply of rural versus metropolitan PCPs ($p = 0.042$) and rural versus nonmetropolitan/urban adjacent PCPs ($p < 0.001$). Rural counties had fewer PCPs on average than either other type of county. The primary care workforce also was examined in terms of number of PCPs per 1,000 people. In metropolitan counties, there were 0.5 PCPs per 1,000 people, in nonmetropolitan/urban adjacent 0.6, and in rural 0.6. Z-tests showed no difference between average rural and metropolitan per-1,000-person rates ($p = 0.715$) or between the average PCPs per 1,000 people in rural versus nonmetropolitan/urban adjacent counties ($p = 0.671$).

Notably, there were four counties (out of 63) in the rural category with 10 or more PCPs. All four counties had RUCCs of 7, the "least rural" of the rural category. These outliers could have skewed these results, even though the z-tests used the groups' standard deviations and should have controlled adequately for variation.

Table 2. Average healthcare system capacity, critical care-related risk factors, and population-level COVID-19 risk factors across Kansas counties in each rurality category.

	Metro (n = 19)	Nonmetro/ urban adjacent (n = 23)	Rural (n = 63)	Metro vs. rural comparison	Nonmetro vs. rural comparison
Healthcare system capacity (means/per county)					
Total number of hospitals	2.8	1.3	1.1	0.053	0.109
Total number of CAHs	0.3	0.7	1.0	< 0.001**	0.032*
Total active M.D.s and D.O.s	348.4	34.0	5.3	0.059	< 0.001**
Active M.D.s and D.O.s per 1,000 people	1.5	1.2	0.8	0.043*	0.010**
Critical care-related risk factors (means/county)					
Total primary care physicians	89.6	14.6	3.4	0.042*	< 0.001**
Primary care physicians per 1,000 people	0.5	0.6	0.6	0.715	0.671
Anesthesia providers	43.9	6.4	0.8	0.036*	< 0.001**
Pulmonary disease M.D.s	5.1	0.2	0.0	< 0.001**	0.475
Total ICU beds	15.9	5.0	0.5	0.017*	< 0.001**
ICU beds per 1,000 people	0.1	0.2	0.1	0.357	0.004**
Population-level COVID-19 risk factors (means/county)					
Percentage of population Medicare eligible	19.3%%	20.7%	24.2%	< 0.001**	0.003**
High-risk physician workforce population: age 55+					
Mean % of physicians aged 55+	39.7%	42.9%	49.3%	0.177	0.248
Proportion of counties with > 50% of physicians 55+	31.6%	30.4%	61.9%	0.016*	0.007**
High-risk physician workforce population: age 65+					
Mean % of physicians aged 65+	16.0%	16.5%	26.2%	0.123	0.056
Proportion of counties with > 50% of physicians 65+	5.3%	4.3%	28.6%	0.003**	< 0.001**
Three-year mortality from heart disease per 1,000 people	1.3	1.4	2.1	< 0.001**	0.004**
Three-year mortality from COPD per 1,000 people	0.6	0.8	0.9	< 0.001**	0.083
Three-year mortality from influenza and pneumonia per 1,000 people	0.2	0.3	0.5	0.041*	0.144

*Indicates significance at the 0.05 confidence level.
**Indicates significance at the 0.01 confidence level.

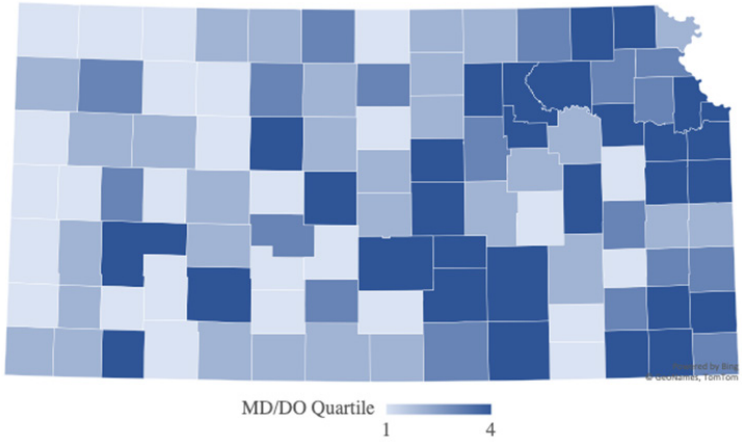

Figure 2. M.D./D.O.s per county.

Next, the supply of anesthesia providers was examined, which included M.D. and D.O. anesthesiologists as well as CRNAs. Eleven (57.9%) metropolitan counties and 17 (73.9%) nonmetropolitan/urban adjacent counties had two or more anesthesia providers. Forty (63.5%) rural counties had zero anesthesia providers. The mean number of anesthesia providers in metropolitan counties was 43.9, in nonmetropolitan/urban adjacent it was 6.4, and in rural 0.8. Both nonmetropolitan/urban adjacent and rural counties fell well below the state average of 9.8. Z-tests were used to determine whether there were statistically significant differences between the average number of anesthesia providers in rural versus metropolitan counties ($p = 0.036$) and in rural versus nonmetropolitan/urban adjacent counties ($p < 0.001$). In both cases, rural counties had significantly fewer anesthesia providers.

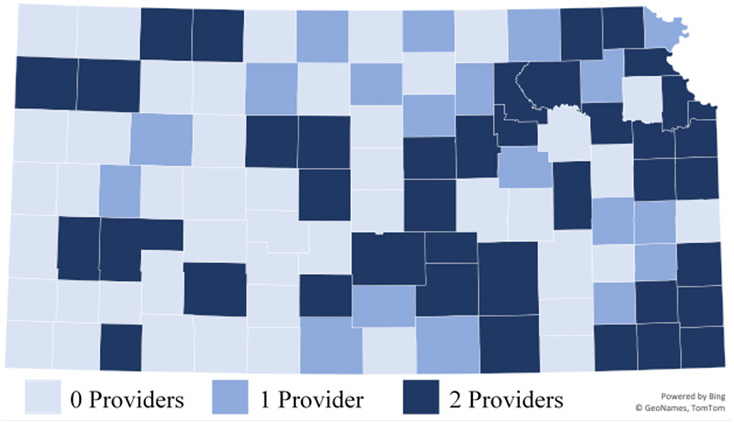

Figure 3. Anesthesia providers per county.

On average, both nonmetropolitan/urban adjacent and rural counties had fewer than the state average of 1.0 pulmonary disease M.D. (mean in nonmetropolitan/urban adjacent counties 0.2, in rural 0.0). In contrast, metropolitan counties had an average of 5.1. Z-tests were used to determine that the means in rural versus metropolitan counties were statistically significant with fewer pulmonary disease physicians than urban counties in Kansas ($p < 0.001$), but there were no differences between rural and nonmetropolitan/urban adjacent counties ($p = 0.475$).

The maximum number of ICU beds in any county was 97. There were no data available in the AHRF on surge capacity, or how far above their maximum ICU beds any hospital or county might be able to go. The majority of the state's available ICU beds were in the five most metropolitan counties (RUCC = 1), which collectively had 60% of all medical/surgical ICU beds in the state. Fifty-six (88.9%) rural and eight (34.8%) nonmetropolitan/urban adjacent counties had zero ICU beds. On average, metropolitan counties had 15.9 ICU beds, nonmetropolitan/urban adjacent had 5.0, and rural had 0.5. Although metropolitan and nonmetropolitan/urban adjacent counties were above the state average of 4.3, rural counties fell well below. Z-tests showed that the mean supply of ICU beds in rural counties was significantly different from the mean supply in metropolitan counties ($p = 0.017$), and it was different from the mean supply in nonmetropolitan/urban adjacent counties ($p < 0.001$). When analyzed in terms of ICU beds per 1,000 people, results were different. Metropolitan counties had 0.1 ICU beds per 1,000 people, nonmetropolitan/urban adjacent had 0.2, and rural had 0.1. Z-tests showed a statistically significant difference in this rate between rural and nonmetropolitan/urban adjacent counties ($p = 0.004$), but not between rural and metropolitan counties ($p = 0.357$).

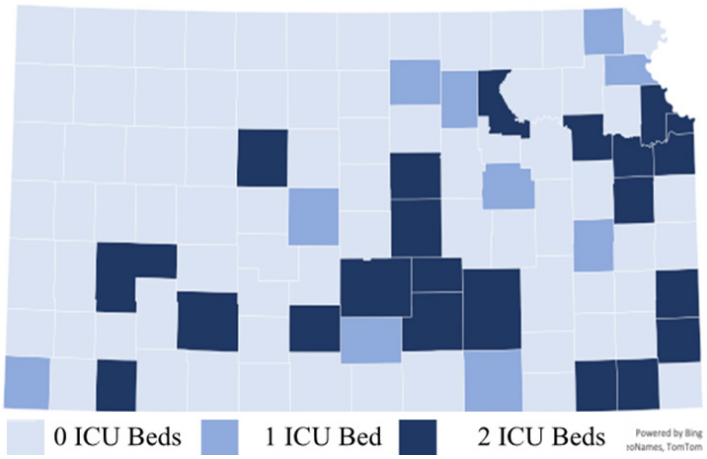

Figure 4. ICU beds by county.

The data available for ICU beds and the structure of the Kansas Rural Health Network allowed for assessing the availability of ICU beds within counties supporting CAHs. Using population estimates from 2017, the county populations in each individual network (the counties of a given supporting hospital and its supported CAHs) were summed. The number of ICU beds were calculated per 1,000 people in each individual network. There were, on average, 0.14 ICU beds per 1,000 people in each network.

Population-level COVID-19 Risk Factors. On average, 19.3% of metropolitan county populations, 20.7% of nonmetropolitan/urban adjacent county populations, and 24.2% of rural county populations were Medicare eligible. A z-test was conducted to compare these mean percentages across rurality categories. Rural and metropolitan counties were compared ($p < 0.001$), as were rural and nonmetropolitan/urban adjacent counties ($p = 0.003$), with both tests showing statistically significant differences. These findings indicated elderly individuals make up significantly greater proportions of the populations in rural counties.

Table 3. Counties supporting CAHs and corresponding populations and ICU capacity in Kansas.

Supporting county	Number of CAHs supported	Number of ICU beds in network	Population in network	ICU beds per 1,000 people	RUCC
Crawford	1	8	59,179	1.35	4
Ellis	23	12	137,367	0.87	5
Finney	9	8	64,928	1.23	5
Johnson	2	97	611,530	1.59	1
Pratt	3	6	20,130	2.98	7
Reno	1	13	72,170	1.80	4
Riley	4	8	121,268	0.66	3
Saline	10	18	143,850	1.25	5
Sedgwick	8	48	627,956	0.76	2
Shawnee	5	32	235,717	1.36	3
Out of state	4	4	45,740*	0.87	n/a

*This does not include the out of state county that supports the Kansas population.

DISCUSSION

This study investigated COVID-19-related healthcare system capacity, critical care resources, and population-based health risk factors in Kansas. Limited hospital presence in nonmetropolitan/urban adjacent and rural counties is problematic in the context of rising COVID-19 cases. Moreover, hospitals that are in nonmetropolitan/urban adjacent and rural counties tend to be CAHs, which are by nature limited in scope and acuity level.

There are approximately 69.1 primary care physicians per 100,000 people in the U.S. as of 2017.[28] According to the Organization for Economic Cooperation and Development (OECD), the U.S. average of 2.6 physicians per 1,000 is lower than the OECD average of 3.3. The Kansas average is even lower at 1.0 physician per 1,000, and the rural county level is 0.8 physicians per 1,000, highlighting the physician maldistribution in the U.S. Given that physician expertise is critical in COVID-19 prevention, monitoring, and treatment, the limited physician workforce in rural areas is alarming. While knowledge of a rural physician shortage is not new, understanding the shortage in terms of its criticality to COVID-19 or other similar, future public health threats is an important contribution to the rural health literature.

Most physicians in rural and nonmetropolitan/urban adjacent areas are primary care physicians; however, even among primary care specialties, the workforce is minimal in rural counties.[29] The primary care physicians who are practicing in rural areas are beneficial to these communities facing COVID-19, as they bring a wide skill set to the healthcare team. However, our data showed that these physicians do not exist in sufficient numbers; thus, rural Kansas is in a vulnerable position.[30,31]

Further, rural and nonmetropolitan/urban adjacent counties have serious voids in anesthesia and pulmonary medicine physicians, hindering the treatment of severe COVID-19 cases in these areas. Nearly two-thirds of rural counties had no anesthesia providers of any kind. This is of particular concern because anesthesia providers bring a unique skill set to COVID-19 patient management, including intubation for mechanical ventilation. In critically ill patients, profound acute hypoxemic respiratory failure from acute respiratory distress syndrome is the dominant clinical finding in COVID-19.[23] In a study of 5,700 hospitalized patients in New York, 1,151 (20.0%) required mechanical ventilation.[25] Our evidence of the lack of rural anesthesia providers was consistent with past findings relevant to the U.S. as a whole; a study of all U.S. counties from 2010 - 2015 found nonmetropolitan/urban adjacent counties had less than half the amount of anesthesia providers that non-nonmetropolitan/urban adjacent counties had, 7.72 versus 16.42 per 100,000 people, respectively.[32] This relationship was especially significant for anesthesiologists, who were four times more likely to work in urban counties.

Our findings showed an overall shortage of pulmonary disease physicians in Kansas. Rural and nonmetropolitan/urban adjacent counties had averages of zero, and metropolitan counties had an average of one, with only the five most metropolitan counties having two or more. This finding was consistent with previous research. A 2017 study showed that approximately 5% (2.2 million) of adults living in rural areas do not have a pulmonologist available within 50 miles.[33] It also showed that among 12,392 U.S. self-identified pulmonologists, 92.9% were located in metropolitan areas, whereas only 2.1% practiced rural areas.

Particularly alarming was the limited ICU capacity in nonmetropolitan/urban adjacent and rural areas. Our results showed that while 96 of 105 Kansas counties had at least one hospital, 88% of rural counties had no ICU services. Although evidence on hospitalization rates varies, up to 25% of those hospitalized for COVID-19 may need ICU admission, representing approximately 5 - 8% of the total infected population.[23] Overall, the results from our study aligned with other national data on hospital and ICU beds. For example, in the Society of Critical Care Medicine's most up-to-date statistics on resources, 9% of U.S. hospitals with ICU services and 1% of ICU beds were located rural areas, defined as areas with fewer than 10,000 people.[9]

These results provided important context for rural Kansas. Without intensive care services in rural counties, many hospitals will need to rely on the closest supporting hospitals during the COVID-19 crisis in rural Kansas. Kansas Rural Health Networks provide coordinated alliances of supporting hospitals assigned to critical access hospitals,[21] but the supporting hospitals cover up to 23 counties each. The ICU beds-per-1,000-people ratios were assessed to understand the potential for COVID-19 to overwhelm these supporting hospitals. Our results showed that the average ratio was 0.14 ICU beds per 1,000 people. While 0.14 is less than one ICU bed, the reason this variable was scaled to 1,000 people was because of the distribution of rural populations. Using the AHRF data, the majority of Kansas rural counties had an average population of 3,000 people, and this resource should be viewed in the context of rural counties' realities.

Older adults are affected more commonly and are more likely to have severe disease in the event of COVID-19 infection.[25,34] Age is a risk factor to be considered not only among the general populace, but also among the physician workforce. Over one-third of the physician

workforce in metropolitan and nonmetropolitan/urban adjacent counties in Kansas and nearly half in rural counties could be at greater risk for COVID-19 due to being over age 55. In rural counties, one-fifth of their physician workforce was over age 65. The fact that these proportions were not statistically different from those found in metropolitan counties meant that all counties, regardless of rurality, should be concerned about the proportions of the physician workforce that could be at a higher risk for severe illness if exposed to COVID-19. The percent of the general population estimated to be over the age 65 was higher among rural counties (24.2%) than metropolitan counties (19.3%). This difference in age structures across Kansas counties has the potential to influence the severity of COVID-19 cases and the associated mortality. It is important that these facts are viewed in terms of practical significance, not only statistical significance.

This study sought to describe the burden of chronic underlying conditions that may increase a patient's risk for severe illness from COVID-19 by rurality. In a study assessing a COVID-19 outbreak across several long-term care facilities in the state of Washington, 94.0% of 101 facility residents affected had a chronic underlying condition, with hypertension and cardiac disease being most common.[35] On average, rural counties in Kansas had more deaths per 1,000 people by cardiovascular diseases and COPD than metropolitan and nonmetropolitan/urban adjacent counties. These higher mortality rates among nonmetropolitan/urban adjacent and rural populations in conditions associated with greater risk for severe COVID-19 illness, combined with the greater proportion of elderly individuals in rural counties, were important factors that nonmetropolitan/urban adjacent and rural counties should consider. While some of the differences in raw numbers may seem small, practical significance must again be taken into account. Even small increases in disease burden can mean serious complications for rural health systems given the shortages of healthcare resources we have described.

This study had several limitations. Our study utilized 2017 data to assess capacity, preparedness, and risk factors for a pandemic that began in 2020. While these data were valid for descriptive purposes, more recent data would provide a more accurate picture of the circumstances Kansas will face in the months to come. In addition, depending on how state policymakers choose to make resource-related decisions, it may be necessary to examine resources in the context of the state medical underservice schema, rather than the federally-established RUCC system.[36] Lastly, while the AMA Physician MasterFile has been found to be a valid and frequently-used source, it does rely on physician self-reporting and this is an important factor when considering study limitations.[37,38]

The use of bivariate statistics was intended to be descriptive, as the entire population of Kansas counties was used rather than a sample. There would be value in completing a per capita analysis for all of these resources and more, and this is a suggested direction for future work. In addition, future research should include more conclusive evidence on rural disease burden and broaden the scope to include other critical COVID-19 care providers, including nursing staff. We believe this analysis should be performed again, following the same or similar protocol, after 2020 Census data are available.

CONCLUSIONS

In this study, the Kansas healthcare system capacity and critical care-related resources important to the care of COVID-19 patients were investigated at the county level in the context of population health characteristics. This study found that the quantity of total physicians, primary care physicians, and specialty physicians needed for the care of COVID-19 patients decreased dramatically in nonmetropolitan/urban adjacent areas and especially in rural areas. In addition to the physician workforce shortage challenging rural Kansas, ICU bed scarcity was also problematic. Most rural counties had no intensive care units and when analyzed at the supporting-network level, there was an average of 0.14 ICU beds per 1,000 people. Lastly, there was significant risk for inundating the healthcare system due to the increased portion of the general population over the age 65 and the higher average three-year mortality for COVID-19-associated underlying chronic conditions in rural populations. This evidence cast light on rural Kansas and the threat it faces from COVID-19 and similar crises with limited healthcare system capacity and resources.

These findings should inform rural physicians, county public health officials, as well as other health professionals on the front lines of COVID-19 preparedness and response. Our study can educate rural Kansas healthcare professionals on the level of risk for severe COVID-19 cases within their populations. This information may be useful to other majority-rural states to the extent their rural counties are resourced similarly. Future research should examine these resources in a variety of rural contexts so that rural communities can prepare for future health crises.

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Hispanic Acculturation: Associations with Family Planning Behaviors and Attitudes

Rachel Chamberlain, D.O.[1], Mary Fatehi, M.D.[1], Joshua Fogel, Ph.D.[1,2], Jacob Kulyn, M.D.[3]
[1]Nassau University Medical Center, East Meadow, NY
Department of Obstetrics and Gynecology
[2]Brooklyn College, Brooklyn, NY
Department of Business Management
[3]American University of the Caribbean, Sint Maarten

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ABSTRACT

Introduction. The purpose of this study was to investigate the association of Hispanic acculturation in the U.S. with family planning behaviors and attitudes.

Methods. Surveys of 225 Hispanic women were collected that used acculturation measures of number of years lived in the U.S. and the Short Acculturation Scale for Hispanics (SASH), along with questions about family planning behaviors, including birth control use, sterilization, and abortion.

Results. SASH-Language statistically differed ($p = 0.03$) where those with 'yes birth control' had significantly lower English acculturation ($M = 6.10$, $SD = 1.77$) than those with 'no birth control' ($M = 7.00$, $SD = 3.16$). Greater U.S. acculturation on SASH-Ethnic Social Relations was associated positively with the attitude that finances are important when considering to have children ($r = 0.18$, $p < 0.05$). Number of years lived in the U.S. was associated positively with the attitude that it is a woman's personal choice to have an elective termination of pregnancy ($r = 0.19$, $p < 0.01$).

Conclusions. Healthcare providers should consider patient acculturation level when discussing family planning topics. It is possible that a more detailed explanation concerning the reasons for family planning is necessary when discussing family planning topics with Hispanic patients who exhibit higher levels of English language acculturation.

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INTRODUCTION

Hispanics are a growing population in the U.S. where they account for 18% of the population,[1] 38% of which were not born in the U.S.[2] Hispanic women have higher rates of sexually transmitted infections than Whites.[3] Hispanic women also become pregnant at younger ages than Whites[4] and have greater elective pregnancy termination rates than Whites but less elective pregnancy termination rates than Blacks.[5]

Young-adult Hispanic women reported that adolescent pregnancy is normal and believe that birth control equates with abortion.[6] Mexican-American Hispanic women reported the reason they choose to undergo sterilization is difficulty in discussing contraception with their families and partners.[7] Hispanic women reported less conversations with their parents about how to say "no" to sex and about contraception use as compared to Black and White women.[8] Hispanics were more likely to report than White women that it is very important that their contraceptive does not contain hormones.[9]

Hispanic women with lower English language subscale acculturation scores on the Short Acculturation Scale for Hispanics (SASH) were more likely to use no birth control or cyclic hormonal contraception than long-acting reversible contraception (LARC) for pregnancy prevention as compared to those with higher acculturation levels.[10] The same study showed no difference between low and high English language acculturation groups when comparing condom use to LARC use.[10] Hispanic women with SASH language subscale lower levels of English language acculturation had lesser awareness of emergency contraception than those with higher acculturation levels.[11] Higher English language acculturation levels were associated positively with ever-use of very effective contraception among Mexican-Americans with very effective contraception defined as intrauterine device (IUD), contraceptive implants, depot medroxyprogesterone acetate injection (Depo-Provera), medroxyprogesterone acetate/estradiol cypionate (Lunelle Monthly Contraceptive Injection), contraceptive patch, and oral contraceptive pills when acculturation was measured by the Simple Language-Based Acculturation Scale for Mexican Americans.[12]

The previous acculturation research for pregnancy prevention among Hispanic women did not measure association of years lived in the U.S. with family planning behaviors of typical use birth control when engaging in sexual intercourse, having had a sterilization procedure, having a partner who has had a sterilization procedure, or having had an elective termination of pregnancy. The association of typical use of birth control and acculturation only measured language acculturation[10] and did not assess other measures of acculturation by media and ethnic social relations. Two studies[10,11] used language items from the SASH,[13] and one study used the Simple Language-based Acculturation Scale for Mexican Americans.[12] None of these studies related media and ethnic social relations acculturation topics to family planning behaviors.[10-12]

Acculturation is important to study because it has been linked to adverse neonatal outcomes. One study of Puerto Rican Hispanic women immigrants found that those with lower acculturation in the U.S. had babies with lower gestational age and lower birthweight than those with greater acculturation in the U.S.[15] Our study investigated the association of Hispanic English language acculturation, media acculturation, ethnic social relations, and years in the U.S. with the family planning behaviors of birth control, sterilization surgery, and abortion. These different measures of acculturation were correlated with a number of pregnancy prevention attitudes regarding safety of hormonal birth control, pro-choice beliefs, family size, and financial aspects related to family planning.

METHODS

A total of 222 Hispanic patients were surveyed who were seen at a women's health center in a suburban New York City public hospital that typically serves lower-middle income patients from Central America. Data were obtained during patient visits from March through May 2020. All Hispanic women were eligible to participate. All questionnaires were in Spanish. The surveys were self-administered and respondents answered them individually. Respondents provided oral informed consent. Responses were anonymous. The

study received Institutional Review Board approval.

Demographic questions asked for participant age (years), age at first pregnancy (years), whether they were born in the U.S. (no/yes), and length of residence in the U.S. (years). Participants were asked about the number of children that they want to have.

Acculturation variables consisted of number of years lived in the U.S. and the 12-item SASH which has subscales for language, media, and ethnic social relations.[13] The Language subscale consists of five items. A Likert scale was used to measure the items with a range from 1 (only Spanish) to 5 (only English). A sample item is, "In which language(s) do you usually think?". The Media subscale consists of three items. A Likert scale was used to measure the items with a range from 1 (only Spanish) to 5 (only English). A sample item is, "In general, in what language(s) are the movies, TV, and radio programs you prefer to watch and listen to?". The Ethnic Social Relations subscale consists of four items. A Likert scale was used to measure the items with a range from 1 (all Latinos/Hispanics) to 5 (all Americans). A sample item is, "Your close friends are". Each of the subscales were scored by adding items for a total score. Greater scores indicated greater acculturation. Cronbach alpha reliability ratings were: Language = 0.84, Media = 0.88, and Ethnic Social Relations = 0.73.

Participants responded to four attitude items that were measured with a Likert scale varying from 1 (strongly disagree) to 5 (strongly agree). These items were: "birth control with hormones is safe", "it is a woman's personal choice to have an elective termination of pregnancy (i.e., abortion)", "I want to have a lot of children", and "finances are important when considering to have children".

Family planning outcome variables were: 1) typically use birth control when engaging in sexual intercourse, 2) having had a sterilization surgery to prevent pregnancy or having a partner who had a sterilization surgery to prevent pregnancy, and 3) having had an elective termination of pregnancy (i.e., abortion); all measured as no/yes.

Statistical Analysis. Descriptive statistics of mean and standard deviation were used to describe the continuous variables. Frequency and percentage were used to describe the categorical variables. Pearson correlation analyses were performed for the acculturation and attitude variables. Analysis of covariance (ANCOVA) analyses comparing family planning with acculturation variables adjusted for age, age first became pregnant, and number of children they want to have. The SASH-Language subscale had a skewed distribution and was transformed logarithmically. Mean values are reported for untransformed variables for ease of understanding. Imputation of the mean of the other items from that participant was done for any SASH subscale missing one item from the subscale. All p values were two-sided with alpha at < 0.05. IBM SPSS Statistics Version 25 was used for all analyses.[16]

RESULTS

Table 1 describes the sample characteristics. Mean age for all patients was more than 32 years. Mean age of first pregnancy was almost 21 years. Mean number of children desired was more than two. Most respondents were born outside of the U.S. There were 18% of participants who had moved to the U.S. within 12 months of their first pregnancy. When determining family planning approaches, more than one-third used birth control, 9.0% had sterilization surgery, and 4.1% had an abortion. Acculturation variables consisted of a mean of 10 years living in the U.S., SASH-Language toward Spanish language use, SASH-Media toward Spanish better than English, and SASH-Ethnic Social Relations toward more Latinos than Americans. Mean for the attitude items were between neutral and disagree except for "finances are important when considering to have children" which approached agree.

Table 1. Descriptive statistics of variables from 222 participants.

Variable	M (SD) or # (%)
Mean age in years	32.1 (8.06)
Mean age first became pregnant in years	20.7 (4.72)
Mean number of children you want to have	2.4 (1.07)
Born USA (yes)	5 (2.3)
Moved to U.S. within 12 months of first pregnancy	40 (18.0)
Typically use birth control (yes)	88 (39.6)
Sterilization surgery (yes)	20 (9.0)
Abortion (yes)	9 (4.1)
Mean years for live in USA in years	10.0 (6.37)
SASH-Language [mean]	6.4 (2.50)
SASH-Media [mean]	5.4 (2.84)
SASH-Ethnic [mean]	7.4 (2.21)
Birth control with hormones is safe. [mean]	2.9 (1.00)
It is a woman's personal choice to have an elective termination of pregnancy (i.e., abortion). [mean]	2.5 (1.27)
I want to have a lot of children. [mean]	2.6 (1.08)
Finances are important when considering to have children. [mean]	3.9 (1.41)

Note: M = mean, SD = standard deviation, USA = United States of America, SASH = Short Acculturation Scale for Hispanics

Table 2 shows the correlation analyses. The acculturation variable of "live in the U.S." had small positive correlations with SASH-Language and "a woman's personal choice to have an elective termination of pregnancy (i.e., abortion)". SASH-Language had moderate positive correlations with SASH-Media and SASH-Ethnic Social Relations. SASH-Media had a moderate positive correlation with SASH-Ethnic Social Relations. SASH-Ethnic Social Relations had a small positive correlation with "finances are important when considering to have children". The attitude of "birth control with hormones are safe" had small-moderate positive correlations with "a woman's personal choice to have an abortion" and "finances are important when considering to have children". The attitude of "a woman's personal choice to have an abortion" had a small positive correlation with "finances are important when considering to have children".

Table 2. Correlation of acculturation and attitudes.

Variable	1	2	3	4	5	6	7	8
1) Live in USA	1.00							
2) SASH-Language	0.26***	1.00						
3) SASH-Media	0.11	0.59***	1.00					
4) SASH-Ethnic Social Relations	0.14	0.48***	0.53***	1.00				
5) Birth control with hormones is safe.	-0.07	0.05	0.08	0.15	1.00			
6) It is a woman's personal choice to have an elective termination of pregnancy (i.e., abortion).	0.19**	0.11	0.12	0.13	0.32***	1.00		
7) I want to have a lot of children.	-0.04	-0.05	-0.13	-0.08	0.02	-0.15	1.00	
8) Finances are important when considering to have children.	0.07	0.07	0.12	0.18*	0.34***	0.19*	-0.002	1.00

Note: USA = United States of America, SASH = Short Acculturation Scale for Hispanics.
*p<0.05, **p<0.01, ***p<0.001.

Table 3 shows the analyses for the acculturation variables and "typically use birth control when engaging in sexual intercourse". SASH-Language statistically differed where those with "yes birth control" had significantly lower mean values indicating Spanish than "no birth control". SASH-Media, SASH-Ethnic Social Relations, and live in the U.S. did not differ between the birth control groups. Table 4 shows the analyses for the acculturation variables and sterilization surgery and Table 5 shows analyses for the acculturation variables and abortion. None of the acculturation variables differed between the groups for sterilization surgery or abortion.

Table 3. Acculturation and typically use birth control.

Variable	No birth control M (SD); (n = 93)	Yes birth control M (SD); (n = 73)	p value
Live in USA (years)	10.38 (6.54)	9.20 (5.88)	0.40
SASH-Language	7.00 (3.16)	6.10 (1.77)	0.03
SASH-Media	5.80 (2.87)	5.39 (3.07)	0.34
SASH-Ethnic	7.89 (2.14)	7.63 (2.21)	0.38

Note: M = mean, SD = standard deviation, USA = United States of America, SASH = Short Acculturation Scale for Hispanics. All analysis of covariance (ANCOVA) analyses adjusted for age, age first became pregnant, and number of children they want to have. Sample size slightly varies due to omissions from participants.

Table 4. Acculturation and sterilization surgery.

Variable	No sterilization M (SD); (n = 153)	Yes sterilization M (SD); (n = 16)	p value
Live in USA (years)	9.95 (6.31)	9.28 (6.58)	0.12
SASH-Language	6.63 (2.77)	6.20 (1.47)	0.86
SASH-Media	5.54 (2.91)	6.00 (3.35)	0.43
SASH-Ethnic	7.65 (2.20)	8.07 (2.09)	0.32

Note: M = mean, SD = standard deviation, USA = United States of America, SASH = Short Acculturation Scale for Hispanics. All analysis of covariance (ANCOVA) analyses adjusted for age, age first became pregnant, and number of children want to have. Sample size slightly varies due to omissions from participants.

Table 5. Acculturation and abortion.

Variable	No abortion M (SD); (n = 159)	Yes abortion M (SD); (n = 9)	p value
Live in USA (years)	9.65 (6.37)	13.56 (3.57)	0.27
SASH-Language	6.59 (2.68)	6.25 (2.12)	0.82
SASH-Media	5.59 (2.96)	4.44 (1.81)	0.42
SASH-Ethnic	7.73 (2.16)	7.00 (2.14)	0.40

Note: M = mean, SD = standard deviation, USA = United States of America, SASH = Short Acculturation Scale for Hispanics. All analysis of covariance (ANCOVA) analyses adjusted for age, age first became pregnant, and number of children they want to have. Sample size slightly varies due to omissions from participants.

DISCUSSION

SASH-Language values for those with "yes birth control" had significantly lower mean values indicating lesser English language acculturation (i.e., a Spanish language preference) than those with "no birth control". None of the other acculturation variables of years in the U.S., SASH-Media, or SASH-Ethnic Social Relations were associated significantly with any of the family planning behaviors. Greater American acculturation on SASH-Ethnic Social Relations had a small positive correlation with the attitude that "finances are important when considering to have children". Number of years lived in the U.S. was associated positively with the attitude that "it is a woman's personal choice to have an elective termination of pregnancy".

The only statistically significant finding for language acculturation with family planning behavior was a negative association of English language acculturation with "typically use birth control when engaging in sexual intercourse". Previous research reported less-acculturated Hispanics are less likely to have ever used an IUD, contraceptive implants, Depo-Provera, Lunelle Monthly Contraceptive Injection, contraceptive patch, or oral contraceptive pills as compared to greater-acculturated Hispanics.[12] Our study differed from this pattern and showed the opposite. Public policy has focused on increased access to contraception among the underserved.[17] Our hospital provides free access to a variety of contraceptive options without financial restrictions. Our findings differed from those of past research because our health care delivery, with increased access to free contraception, has helped to remove language acculturation barriers to contraception use.

English language acculturation was not significantly associated with having sterilization surgery or having had an abortion. The acculturation variables of years in the U.S., SASH-Media, and SASH-Ethnic

Social Relations were not significantly associated with any of the family planning behaviors of birth control, sterilization surgery, or abortion. Prior research reports that Hispanics are less aware of specific contraceptive methods, such as male sterilization, as compared to Whites and Blacks.[9] Acculturation may not be a key factor for understanding Hispanic attitudes and behaviors for sterilization and abortion.

The only significant association between acculturation as measured by the SASH sub-scales and family planning attitudes was that ethnic social relations acculturation was correlated significantly and positively with "finances are important when considering to have children". Previous research in asset building among Hispanics showed that American acculturation was associated positively with the financial stability of home ownership.[18] Hispanics that were more American ethnic acculturated also may consider financial topics as important related to their family planning.

No association of language acculturation was found with the pro-choice attitude that it is a woman's personal choice to have an elective termination of pregnancy (i.e., abortion). Years in the U.S. was associated positively with this pro-choice attitude. A prior study reported that language acculturation was associated positively with increased pro-choice attitudes among Hispanics while years in the U.S. was not associated with pro-choice attitudes.[19] Social acceptability was a driving factor for making reproductive decisions.[20] The U.S. has greater reproductive autonomy than Mexico and all of Central America except Costa Rica.[20] Time living in the U.S., a country with greater reproductive autonomy than the countries of origin, may foster attitudes supporting reproductive autonomy. Differences between research findings for language acculturation may occur because of different measures of language acculturation used or differences in country of origin for study participants.

Number of years lived in the U.S. was associated positively with greater English language acculturation. However, number of years lived in the U.S. was not associated significantly with media or ethnic acculturation. Previous research indicated number of years lived in the U.S. was associated with both the language and media sub-scales of the SASH.[21] Our research was consistent with this existing research in regard to language acculturation but different in regard to media acculturation. One reason for the observed discrepancy could be due to the different study cohort. The participants in Ellison et al.[21] were both men and women, while our study looked solely at women. Another potential reason our study showed language acculturation to be the only acculturation measure significantly related to number of years lived in the U.S. was because language is required for function in society and the workplace, while media and ethnic acculturation are more related to leisure activities. Therefore, language acculturation by necessity would occur before media or ethnic acculturation. This reasoning also aligns with disparities of gender in the work force. Prior research showed that Hispanic women comprise the smallest percentage of the workforce as compared to Hispanic men.[22] As Hispanic immigrant men are more likely to be engaged in an organized workforce than women, men are more likely to exhibit language acculturation as well as media acculturation, which could account for the greater media acculturation observed in the study by Ellison et al.[21]

When comparing fertility attitudes with each other, the pro-choice attitude of woman's personal choice to have an abortion was associated positively with the attitude that birth control with hormones is safe and also was associated positively with the attitude that finances are important when considering to have children, but not with the attitude of wanting to have a lot of children. Previous research reported that pro-choice parents typically have fewer children than families with pro-life parents.[23] Our findings were consistent with this pattern.

This study had some limitations. First, our study was from a single institution in a single geographic location with a homogenous ethnic background and our observed results may not generalize to other Hispanic immigrant populations. Second, we asked, "How many children do you want to have?" which may limit the ability to discern true attitudes toward family planning. Future research may better assess this issue by asking two distinct questions; "How many children do you have?" and "How many more children would you like to have?" Also, future research could further investigate why higher English language acculturated Hispanics typically use less birth control.

CONCLUSIONS

Higher English language acculturation as measured by SASH-Language was associated with not typically using birth control when engaging in sexual intercourse. Higher acculturation measured by years lived in the U.S. was associated positively with the attitude that it is a woman's personal choice to have an abortion. Higher acculturation measured by SASH-Ethnic Social Relations was associated positively with the attitude that finances are important when considering to have children. These findings can increase health care provider's cultural competence and focus the health care visit on family planning topics needing coverage based on the patient's acculturation level. Health care providers counseling Hispanic patients who exhibit high language acculturation should recognize that contraception counseling may require a more detailed discussion for successful adherence than for Hispanic patients with less language acculturation.

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KANSAS JOURNAL of MEDICINE

Hospital Collaboration in Response to the COVID-19 Pandemic in Kansas City Metropolitan Region

Michael C. Burton, M.D.[1], Lewis Satterwhite, M.D.[1], Xiaosong Shi, M.S.[1], Angelica Allen, AOS[2], Mario Castro, M.D., MPH[1]
University of Kansas Medical Center, Kansas City, KS
[1]Division of Pulmonary Disease, Critical Care, and Sleep Medicine
[2]Department of Biostatistics and Data Science

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ABSTRACT

Introduction. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, aka COVID-19) virus has evolved into a World Health Organization-declared pandemic which has strained our regional critical care and hospital resources.

Methods. A Critical Care Task Force was established between Kansas City area intensive care units to allow for preparedness for potential surges by sharing of bed capacity both in the ICU and hospital, and ventilator capacity as well as weekly web-based meetings to share resource concerns and best practice. This Task Force also collected patient information to understand the dynamics of community impact and resource needs better. This effort allowed for compilation and dissemination of information regarding data that describe characteristics of patients with COVID-19 compared to a random sample of medical ICU patients with conditions other than COVID-19.

Demographic and therapeutic factors affecting patients admitted to medical intensive care units in the Kansas City metro area are reported from May 5, 2020 until June 2, 2020 using a retrospective case-control study examining gender, race, and therapeutic options including modes of ventilation, vasopressor requirements, renal-replacement therapy, and disposition.

Results. During data collection, patients being treated for COVID-19 in intensive care units in the Kansas City metropolitan area were more likely to be older, less likely to be white, and less likely to be immunosuppressed as compared to those being treated for non-COVID illnesses. They were more likely to require non-invasive ventilation and undergo prone positioning but were equally likely to require invasive ventilation and other organ supportive therapy.

Conclusions. Hospitalized patients being treated for COVID-19 in the Kansas City metropolitan area have similar demographics to those being reported in the U.S. including age and race. Additionally, establishing a Critical Care Task Force in response to the pandemic allowed for preparation for a potential surge, establishing capacity, and disseminating timely information to policy makers and critical care workers on the front line. ***Kans J Med 2021;14:108-110***

INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 virus (SARS-CoV-2, aka COVID-19) evolved into a World Health Organization (WHO)-declared worldwide pandemic with high incidence of respiratory disease, including acute respiratory distress syndrome (ARDS) and critical illness requiring intensive care. To date, it is not clear how many patients needed hospitalization due to lack of clarity in total numbers of cases, however, it is thought to be approximately 4.6 per 100,000 population with significant variation with age.[1] Reports suggested that intensive care unit care (ICU) admission is required in 10 - 20% of hospitalized patients, although estimates range as high as 35%, with 75% of hospitalized patients requiring supplemental oxygen and 3 - 10% requiring intubation.[2,3] Of those that were admitted to the ICU, 19 - 91% required invasive mechanical ventilation.

Initial reports from China revealed a case fatality rate of 5%.[4] However, other research has suggested critical disease involving respiratory failure, pneumonia, shock, and multiorgan failure in 5% of cases, with mortality in the 2% to 5% range. Also, there have been numerous reports regarding risk factors which predispose patients to infection and morbidity with COVID-19 in the scientific literature and popular press. The most noted were race and age, with non-white race and increasing age being risk factors for both infection risk and mortality.[5-7] Additionally, there has been reporting on age, hypertension, diabetes mellitus, and chronic lung disease as risk factors for higher severity of disease and mortality.[8-10]

The pandemic has caused changes to healthcare administration due to multiple challenges, including but not limited to testing, patient isolation, personal protective equipment, medication shortages, supply chain disruptions, and prolonged ventilation requirements. Early reports from China reported on shortages of oxygen, personal protective equipment, and ventilators.[11] To inform changes to the system, there has been a need for hospital systems to examine resource allocation, both within the individual institution and across multiple systems. This examination included closer contact between systems to act as a method for distributing needed materials and to act as a buffer for patients in the case a single or several individual locations reached capacity. To this end, an ad-hoc group of regional ICU leaders was assembled to facilitate discussions regarding immediate needs and best practices for this unique and evolving patient population. The group had a mandate to identify current and emerging needs across health care delivery, as well as to form (and share) mitigation strategies when shortages or potential shortages were identified.

This study reported on the creation of a collaboration network of critical care divisions from hospitals within the Kansas City metropolitan area and surrounding areas. Additionally, it reported on preliminary data, including demographics, about the patients who have been impacted by the COVID-19 virus in the Kansas City metropolitan area.

METHODS

The consortium of fifteen Kansas City COVID-19 medical intensive care units (MICUs) was established in March 2020 to communicate between the Kansas City metropolitan area hospitals and share information on COVID-19 preparedness. This information emphasized, but was not limited to, bed and ventilator availability at both current and surge capacity. Information regarding number of critical care trained providers, including attending-level, fellow, and advanced-practice providers (APP) also was obtained and distributed to the group.

Additionally, a retrospective case-control analysis was conducted using patients older than 18 admitted to a hospital within the newly formed Kansas City COVID-19 Critical Care Consortium. Patients with both SARS-CoV-19 polymerase chain reaction positive and negative results were selected from across all 15 sites. Data including demographics, level of service required, ventilator requirement, treatment strategy, and disposition were obtained from chart review and stored and analyzed as aggregate, de-identified data.

Study data were collected and managed using REDCap® (Vanderbilt University, Nashville, TN, USA) hosted at the University of Kansas Medical Center. Resources of the Critical Care Task Force were summarized descriptively. The t-test was used to compare patients' ages between the COVID-19 positive and negative groups. Chi-square tests or Fisher's exact tests were used to compare categorical variables (demographic information other than ages, patients receiving therapies, and outcomes), as appropriate. A significance level of 0.05 was used for all tests. All statistical analyses were conducted using SAS software version 9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

The consortium of Kansas City COVID-19 medical intensive care units (MICU) included 15 sites in the Kansas City metropolitan area and surrounding regions including Kansas City, Kansas and Kansas City, Missouri. Within those 15 sites, as of June 5, 2020, there were a total of 222 critical care trained providers (mean 14.8 per site, SD 22.9, median 6) with a minimum of 2 and a maximum of 87. There were 542 ICU beds available (mean 36.1 per site, SD 34.1) with a surge bed capacity to an additional 540 beds (mean 36 per site, SD 37.1). There were 487 available ventilators across all 15 ICUs (mean 32.5 per site, SD 34.1), with an additional 597 available as surge capacity (mean 39.8 per site, SD 39.4).

As of June 2, 2020, there were 10,320 total COVID-19 cases reported across Kansas, with 2,350 reported in the Johnson and Wyandotte counties.[12] Across the study sites, 160 COVID-19 confirmed patients (84.7%) were compared against 29 (15.3%) COVID-19 negative patients. Patients who were COVID-19 positive were more likely to be older (61.7 years old versus 50 years old, p = 0.001) and were less likely to be white (46.9% non-white race versus 10.3% white, p < 0.001) as compared to non-white (Table 1). Patients with COVID-19 were less likely to be immunosuppressed (28.1% versus 48.3%, p = 0.031) compared to COVID-19 negative patients (Table 2).

From a treatment perspective, COVID-19 patients were more likely to require non-invasive ventilation (45.6% versus 24.1%, p = 0.031) and were more likely to undergo prone positioning (25% versus 3.4%, p = 0.007), but were equally likely to require invasive ventilation (33.1% versus 34.5%, p = 0.887). Vasopressor requirement (23.1% versus 24.1%, p = 0.906), renal replacement therapy usage (13.8% versus 10.3%, p = 0.772), and rate of tracheostomy placement (5.6% versus 10.3%, p = 0.400) were equal in the two populations (Figure 1).

Table 1. Demographic information of patients selected for evaluation based on SARS-CoV-2 (COVID-19) testing.

	COVID positive (n = 160)	COVID negative (n = 29)	p value
Age (mean, SD)	61.7 (16.3)	50.0 (19.2)	0.001
Female gender (n, %)	69 (43.1%)	10 (34.5%)	0.385
Race (n, %)			< 0.001
White	42 (26.3%)	21 (72.4%)	
Other	75 (46.9%)	3 (10.3%)	
Unknown	43 (26.9%)	5 (17.2%)	
Ethnicity (n, %)			0.111
Hispanic/Latino	34 (21.3%)	2 (6.9%)	
Not Hispanic/Latino	111 (69.4%)	23 (79.3%)	
Unknown	15 (9.4%)	4 (13.8%)	
Immunosuppressed (n, %)	45 (28.1%)	14 (48.3%)	0.031

Table 2. Number (%) of patients receiving therapies at any time during index hospitalization.

	COVID positive (n = 160)	COVID negative (n = 29)	p value
Non-invasive ventilation	73 (45.6%)	7 (24.1%)	0.031
Invasive ventilation	53 (33.1%)	10 (34.5%)	0.887
Prone positioning	40 (25.0%)	1 (3.4%)	0.007
Vasopressor use	37 (23.1%)	7 (24.1%)	0.906
Renal replacement therapy	22 (13.8%)	3 (10.3%)	0.772
Tracheostomy	9 (5.6%)	3 (10.3%)	0.400

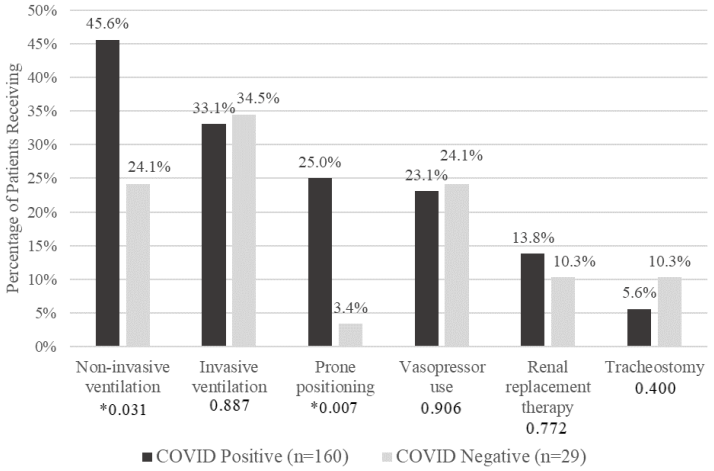

Figure 1. Comparison of therapy use as a percentage of patients receiving the indicated therapy at any point during the reference hospital stay. p value of difference is indicated below each therapy and significant differences are indicated with a *.

Table 3. Outcome of patients during index hospitalization (n, %).

	COVID positive (n = 160)	COVID negative (n = 29)
Death	22 (13.8%)	1 (3.4%)
ICU discharge	40 (25.0%)	7 (24.1%)
In ICU care	13 (8.1%)	2 (6.9%)
Non-ICU hospital care	7 (4.4%)	10 (34.5%)
Hospital discharge	78 (48.8%)	5 (17.2%)
Other	0 (0%)	4 (13.8%)

DISCUSSION

In terms of the patient population, patients who were admitted to the hospital or ICU in Kansas City followed similar patterns as those that have been reported across the country. Namely, patients were more likely to be older and non-white. Previous reports demonstrated that the majority of patients that required hospitalization were older than 50 years old and that the highest rates were seen in patients who were older than 65 years old.[2] This closely followed our findings with an average age of COVID admissions of 62 years old compared to 50 years old for non-COVID admissions.

Similarly, studies across the U.S. demonstrated disproportionately high rates of COVID-19 infections ranging from 18% to 70% of positive tests despite being approximately 13% of the U.S. population.[2,13] The preponderance of non-white patients and their elevated risk of hospitalization has been discussed elsewhere.[6,14-15] Proposals for the etiology include a combination of health care factors including elevated rates of comorbidities which have demonstrated elevated rates of disease, severity of disease, and exposure risk including higher rates of essential work that combine to result in higher infection rates and more severe morbidity.

Additionally, rates of invasive and non-invasive mechanical ventilation were comparable with rates that have been found elsewhere.[2] However, immunosuppressed patients comprised a smaller fraction of ICU patients in the COVID-19 positive group when compared to the COVID negative group. This could be explained by more stringent physical distancing and reduced exposure behavior in this group identified as being at higher risk for morbidity and/or mortality with exposure.

The start of the COVID-19 pandemic resulted in significant changes to the healthcare landscape. There has been great concern regarding capacity of hospitals, intensive care units, and ventilators, as well as access to new medications, established medications, and supply chain components. To address these concerns, a collaboration among critical care divisions in the Kansas City metropolitan area was created. The collaboration arose as a means for the various ICUs to share critically important information during the pandemic, including resource capabilities and COVID-19 infection rates. The hope was that this would allow for more effective sharing of resources in case a single ICU or group of ICUs were short of supplies or reached capacity to facilitate rapid transfer of patients and materials between hospitals.

Limitations. This study was small in scale and restricted to patients within the ICU setting in the Kansas City metropolitan area. We sought to explore if the COVID-19 patient population from this area was similar to those that have been reported in other regions globally and in disparate parts of the United States. However, our respective population was small and extrapolation must be made carefully. Notably, patients were not matched for degree of illness (other than requiring ICU level of care at some point in their stay) or based on demographics.

CONCLUSIONS

Networking between hospitals and hospital systems is an integral strategy to reduce the risk of shortages of supplies or bed availability and to improve the likelihood of rapid and efficient sharing of resources if they are distributed differently than current needs within a local area. This need had come to the forefront during the SARS-CoV-2 (COVID-19) pandemic as hospitals around the U.S. and around the world have faced shortages in needed supplies. Although the Kansas City metropolitan area consortium has not been required to facilitate transfers of patients or equipment to date, reporting of its existence and initiation can assist with its functioning. Additionally, the patient population that has been the most effected by the COVID-19 population in Kansas City has mirrored the national trend of older non-white people with an increased need for respiratory support.

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Keywords: SARS-CoV-2, intensive care units, critical care

KANSAS JOURNAL of MEDICINE

Coronary Embolism Presenting as NSTEMI in a Patient with Splenectomy

Omar Al-Taweel, M.D.[1], Farhad Sami, MBBS[1], Simon Pinsky, D.O.[1], Tracy Wineinger, MPH[1], Rafic F. Berbarie, M.D.[1,2]
University of Texas Medical Branch, Galveston, TX
[1]Department of Internal Medicine
[2]Division of Cardiology

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INTRODUCTION

The coronary arteries generally are protected from embolism as they arise at acute or right angles from the coronary cusps.[1] However, coronary embolism (CE) is a recognized and important cause of non-atherosclerotic acute coronary syndrome. The incidence of acute coronary syndrome (ACS) secondary to coronary embolism is reported to be around 3%.[1-3] The most common causes of CE include atrial fibrillation, infective endocarditis, iatrogenic causes, and prosthetic valve thrombi.[4] No consensus agreement has been established regarding treatment of ACS related to coronary artery embolism (CE). Irrespective of the treatment, clinical consideration of the source of embolism is very important for successful management and recurrence prevention.

Unclear causes of CE may prompt a hypercoagulable workup. Few cases of thromboembolism have been reported with a link to hereditary spherocytosis (HS), particularly in patients with a prior history of splenectomy.[5-9] We present a case of a patient who was transferred from an outside hospital showing non-ST elevation myocardial infarction (NSTEMI) and who subsequently was diagnosed with CE.

CASE REPORT

A 50-year-old Caucasian male with a past medical history of HS diagnosed in childhood presented to the emergency department as a transfer from an outside emergency department with worsening mid-sternal chest pain starting at rest, radiating to the left arm, and accompanied by nausea. He had a splenectomy performed for refractory hemolysis as a child. He had a prior history of tobacco abuse for 20 years, with smoking cessation noted for the past three years. At encounter, the patient had no signs of heart failure.

Physical examination was unremarkable. Blood pressure on presentation was 150/100 mmHg (equal in both arms) and his heart rate was 67 beats/min. Electrocardiogram (EKG) showed normal sinus rhythm with no acute ST changes (Figure 1). The troponin level at an outside hospital was 5.7 ng/ml and was repeated four hours later at initial presentation to the emergency department with a trended upward value of 12.5 ng/ml. Chest x-ray did not show any pulmonary edema or widening of the mediastinum. Bedside echo showed a preserved LV function and no pericardial effusion. A point of care cardiac ultrasound was not performed. The patient was loaded with 325 mg aspirin and was started on a heparin drip. Despite sublingual nitroglycerin and morphine, the patient's chest pain did not resolve. Repeated EKG showed normal sinus rhythm with no ST elevation.

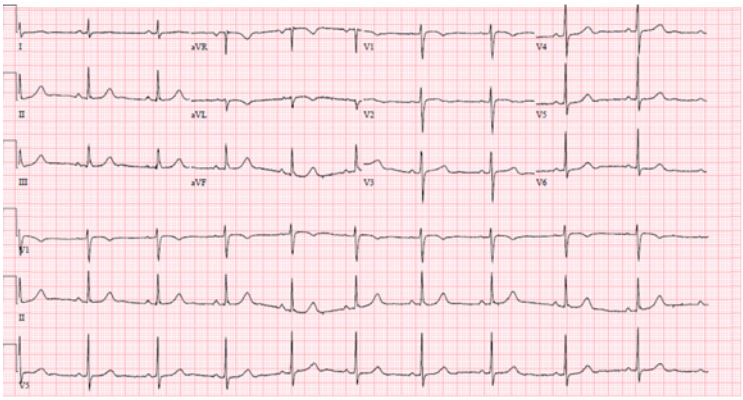

Figure 1. Electrocardiogram on patient presentation to the emergency department showed normal sinus rhythm with no acute S-ST changes.

The patient was taken to the cardiac catheterization lab. Angiography showed a 90% filling defect involving the distal left main coronary artery (LMCA) with an extension to the proximal left anterior descending (LAD) and proximal left circumflex (LCx; Figure 2). Distal LAD, LCx, and RCA showed no significant coronary artery disease. The described finding was most consistent with a coronary artery embolus rather than a ruptured coronary plaque.

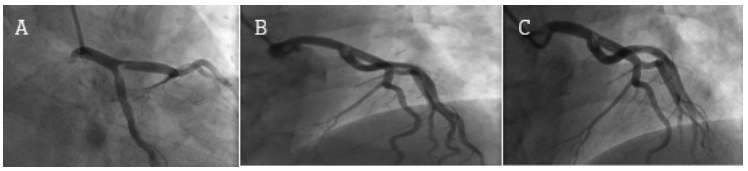

Figure 2. Multiple angiographic views of the distal left main filling defect involving the bifurcation extending into the left anterior descending (LAD) and proximal left circumflex arteries.

Given the location of the thrombus and the risk of distal extension, mechanical thrombectomy was avoided. The patient continued to be stable and reported an improvement in chest pain. The treatment plan was to continue medical management because the lesion was non-flow limiting, embolic in nature, and there was a lack of coronary artery disease.

The patient was admitted to the cardiac care unit and was started on an IV heparin drip, dual antiplatelet therapy with aspirin, and IV tirofiban drip. Over the next 24 hours, the patient's chest pain completely resolved and the troponin value trended downward. Tirofiban was discontinued after 24 hours. Telemetry showed no ventricular tachycardia (VT), atrial fibrillation, or heart block. The patient's lab work was unremarkable.

Transthoracic echocardiography (TTE) showed a normal ejection fraction of 55 - 60% without any wall motion abnormalities. Bubble study on TTE suggested an intra-atrial shunt. Transesophageal echo (TEE) revealed an atrial septal defect (ASD) measuring 0.9 x 0.6 cm and was confirmed using echo colored Doppler and an agitated saline bubble study (Figure 3). There was no left atrial appendage thrombus (LAA), valvular vegetations, or left ventricular thrombus.

Doppler ultrasound of lower extremities was negative for deep vein thrombosis (DVT). A repeat coronary angiogram done after 72 hours of medical management showed complete resolution of the thrombus without any residual stenosis (Figure 4). The patient was discharged on apixaban, aspirin, and atorvastatin.

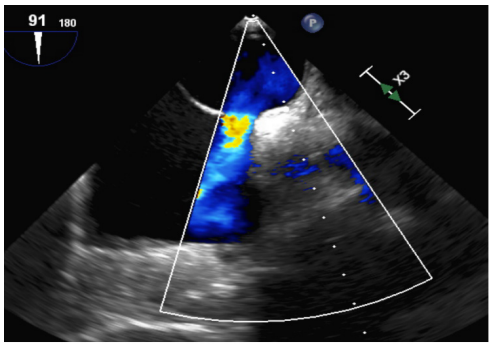

Figure 3. Transesophageal echocardiogram view showing the atrial septal defect.

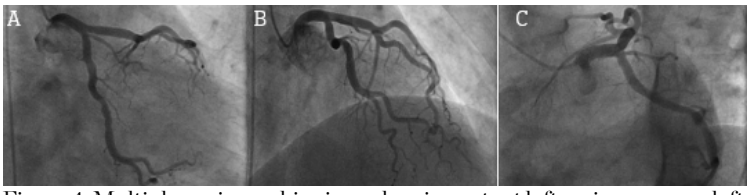

Figure 4. Multiple angiographic views showing patent left main coronary, left anterior descending, and left circumflex arteries.

The patient was seen in the interventional cardiology clinic a month after discharge and remained in good health. He was offered the option to pursue closure of the ASD but deferred the decision at that time.

DISCUSSION

The most common etiology of NSTEMI is an atherosclerotic plaque rupture.[10] However, non-atherosclerotic causes should be considered in absence of atherosclerotic risk factors. Differential diagnosis in this case would include CE secondary to paradoxical venous emboli in the setting of an ASD, paroxysmal atrial fibrillation, hypercoagulable condition, recreational drugs, septic embolism, and, less commonly, tumors such as myxomas. There are no guidelines for management of NSTEMI due to coronary embolism. In this case, mechanical thrombectomy had been deemed high risk for distal embolization. Additionally, the patient was clinically stable, and the lesion was embolic in nature and non-flow limiting. Therefore, the care plan was to proceed with medical management.

The causes of CE can be classified according to the location and mechanism of its origin.[1] CE can arise from a cardioembolic source or can be paradoxical emboli arising in the venous system (e.g., from DVT) and crossing into the left-sided cardiac chambers through a patent foramen ovale or ASD. Additionally, CE also can arise at the time of diagnostic or therapeutic interventions through iatrogenic means.

HS patients with subsequent splenectomy are at higher rates of arterial and venous thrombosis compared to their HS counterparts without splenectomy as reported by an observational study.[11] The previous study estimated an occurrence of five times the risk of arterial events in individuals with HS who had splenectomy compared to those who had an intact spleen. The pathogenesis of these thromboembolic events after splenectomy is likely multifactorial. Persistence of abnormally shaped red blood cells, disturbance and activation of the endothelium, platelet activation, endothelial alteration, abnormal lipid profiles, and a reduction in the removal of circulating procoagulant factors from the bloodstream after splenectomy are all potential risk factors.[12]

Aside from the need for anticoagulation, there are no standard guidelines in the treatment of CE patients presenting with ACS. Management options in CE were based on the patient's hemodynamic stability. Treatment options include thrombectomy, intracoronary thrombolysis, percutaneous coronary intervention, or medical management alone.[1]

Identifying the cause of CE is important as the results could determine clinical management and long-term treatment to prevent recurrence. TEE was used to confirm the presence of ASD and to rule out LAA thrombus. Atrial fibrillation also was ruled out. As CE patients presenting with ACS have acute thrombosis and are initiated on anticoagulation in an emergent manner, thrombophilia workup at presentation is not recommended due to flawed interpretation of the results because of the anticoagulant.[13]

This case represented educational value in its novelty in reporting an association between HS and CE in a patient with an ostium secundum ASD and in describing a step-wise approach to the case starting from initial management followed by investigational workup to identify the etiology of the embolus.

CONCLUSIONS

CE as a complication of splenectomy in hereditary spherocytosis patients should be recognized in patients with the correct clinical picture. However, complete workup should be pursued to identify any reversible causes of CE which might preclude the need for long-term anticoagulation. Emergent management of the CE cases should be similar to any ACS patient, but definitive management can differ based on the individual case.

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Keywords: acute coronary syndrome, percutaneous coronary interventions, coronary angiography, myocardial infarction

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SJS/TENN: A Mnemonic for Early Clinical Diagnosis of Stevens-Johnson Syndrome and Toxic Epidermal Necrolysis

Brett C. Neill, M.D., Edward W. Seger, M.D., M.S., Jessica E. Ferguson, B.S., Tyler Hooton, M.D., Jace J. Rickstrew, B.S., M.D., Anand Rajpara, M.D.
University of Kansas Medical Center, Kansas City, KS
Department of Internal Medicine, Division of Dermatology

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INTRODUCTION

Stevens-Johnson Syndrome (SJS) and toxic epidermal necrolysis (TEN) represent a spectrum of the same condition defined by its widespread skin and mucosal loss.[1] SJS/TEN represents a true dermatologic emergency, as the disease quickly evolves and is often fatal without early identification and treatment. It is essential for all clinicians to be familiar with common signs associated with SJS/TEN, as patients are more likely to present initially to primary care providers and emergency physicians than they are to a dermatologist. Certain characteristics of SJS/TEN allow it to be distinguished from common mimickers such as Drug Rash with Eosinophilia and Systemic Symptoms (DRESS), Erythema Multiforme (EM), and morbilliform drug reactions.[1] We present the "SJS/TENN" mnemonic of clinical characteristics to aid in the early diagnosis for suspected cases (Table 1).

SJS/TENN – A Mnemonic for Improving Accuracy of Clinical Diagnosis

Systemic Symptoms. A prodrome of symptoms, including fever greater than 39°C, general malaise, sore throat, and cough with onset of days prior to cutaneous manifestations. Approximately 63 - 65% of SJS/TEN cases presented with history of fever,[1,2] with rates increasing to 91% when ocular involvement was present at time of presentation.[8] By comparison, 33 - 44% of patients with DRESS presented with fever, and even lower rates were found in EM and morbilliform drug eruptions.[1,2] Similarly, general malaise was documented in 55% of SJS/TEN cases, compared with 19% of DRESS cases.[3]

Jarring Pain. Skin tenderness was found in up to 90% of patients, related to the onset of blistering and erosions.[1] This may be present before skin loss and ulceration is observed. By comparison, skin tenderness was observed with 29% of patients with DRESS and 31% with acute generalized exanthematous pustulosis, another common mimicker.[1]

Surfaces Mucosal. Involvement of skin, as well as mucosal surfaces, is a hallmark of SJS/TEN. Particular consideration for SJS/TEN should be given if oral (mucosal ulcerations and erosions), ocular (conjunctival injection, desquamation of eyelid skin, and corneal ulceration), or genital (vulva ulceration and desquamation of scrotum or glans penis) involvement is noted. Oral involvement was present in 71 - 94% of cases, ocular involvement in 57 - 100% of cases, and genital involvement in 11 - 63% of cases.[2-8]

Targets Atypical. Flat or elevated targetoid lesions with poorly defined boarders and with or without bulla/erosion, which are present in two distinct skin zones, raises suspicion for SJS/TEN.[1] A macule with a central dusky violaceous hue ("dusky macule") also is considered an atypical lesion. These atypical lesions were present in 65% of SJS/TEN cases, compared with 5% of DRESS and 13% of EM cases.[1,2]

ENT. Otolaryngologic complaints often are seen, including odynophagia, dysphagia, nasal obstruction, and otalgia. Ninety-eight percent of patients evaluated by an Ear-Nose-Throat (ENT) specialist had otolaryngologic involvement during the acute phase (with 94% in the oral cavity, lips, buccal mucosa, and gum).[2] Importantly, a presentation of dyspnea or dysphonia was associated with a severe ENT form of disease characterized by supraglottic and laryngeal lesions (due to the risk for upper airway obstruction).

Table 1. Prevalence of clinical findings included in SJS/TENN mnemonic.

Clinical finding	Bequignon et al.[2] 2015	Jeung et al.[3] 2010	Kamaliah et al.[4] 1998	Kim et al.[5] 2012	Rajaratnam et al.[6] 2010	Revuz et al.[7] 1987	Sotozono et al.[8] 2009	Weinkle et al.[1] 2019	Yamane et al.[9] 2015
Systemic symptoms	-	65%	62%[a]	60%	62%		91%	63%	-
Jarring pain	-	-	-	42%	76%		-	90%	-
Surfaces mucosal									
Oral	94%	90%	-	85%	71%	93.1	87%	-	79%
Ocular	-	90%	-	60%	57%	78.2	100%	-	64%
Genital	-	11%	-	33%	57%	63.2	49%	-	41%
Targets atypical	-	-	-	-	-		-	64%	-
ENT symptoms	98%	90	-	85	71%		87%	-	79%
New drug	84%	100%	88%	52%	95%		89%	97%	72%
Nikolsky sign	-	-	-	-	86%		-	-	-

[a]Percentage of cases reported for a combined cohort of SJS/TEN (n = 25) and EM (n = 4).

New Drug. Clinical suspicion for SJS/TEN immediately should prompt a thorough medication review, as nearly all cases are triggered by new drug exposure within the past 4 - 28 days.[4,6,9,10] The list of culprit medications is vast; however, commonly implicated drugs include antibiotics (particularly ones containing sulfonamide), antiepileptics (such as lamotrigine and phenytoin), and allopurinol.

Nikolsky Sign. This sign is defined by sloughing of the skin induced by applying firm sliding tangential pressure. It is not specific to SJS/TEN and is seen in other conditions, such as staphylococcus scalded skin syndrome and pemphigus vulgaris; however, its presence helps to distinguish SJS/TEN from EM and morbilliform drug eruptions (where it would be absent).

Systemic symptoms preceding onset of skin and mucosal lesions, particularly if these lesions are painful and present with pressure induced skin sloughing (indicating a positive Nikolsky sign), are all suggestive of potential SJS/TEN. Additional signs, such as dyspnea and dysphagia, may point to a more severe ENT form with an increased risk for upper airway obstruction. Prompt identification and onset of treatment is essential and can be lifesaving with SJS/TEN; therefore, this proposed mnemonic will provide particular utility to clinicians who are infrequently exposed to this condition and its acute signs and symptoms.

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