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Original Research

Trends of Hospitalizations and In-Hospital Outcomes for Traumatic Cardiac Injury in United States

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ABSTRACT

Introduction. Traumatic cardiac injury (TCI) poses a significant risk of morbidity and mortality, yet there is a lack of population-based outcomes data for these patients.

Methods. The authors examined national yearly trends, demographics, and in-hospital outcomes of TCI using the National Inpatient Sample from 2007 to 2014. We focused on adult patients with a primary discharge diagnosis of TCI, categorizing them into blunt (BTCI) and penetrating (PTCI) cardiac injury.

Results. A total of 11,510 cases of TCI were identified, with 7,155 (62.2%) classified as BTCI and 4,355 (37.8%) as PTCI. BTCI was predominantly caused by motor vehicle collisions (66.7%), while PTCI was mostly caused by piercing injuries (67.4%). The overall mortality rate was 11.3%, significantly higher in PTCI compared to BTCI (20.3% vs. 5.9%, $\chi^2(1, N = 11{,}185) = 94.9$, $p < 0.001$). Additionally, 21.5% required blood transfusion, 19.6% developed hemopericardium, and 15.9% suffered from respiratory failure. Procedures such as heart and pericardial repair were more common in PTCI patients. Length of hospitalization and cost of care were also significantly higher for PTCI patients, $W(1, N = 11{,}015) = 88.9$, $p < 0.001$).

Conclusions. Patients with PTCI experienced higher mortality rates than those with BTCI. Within the PTCI group, young men from minority racial groups and low-income households had poorer outcomes. This highlights the need for early and specialized attention from emergency and cardiothoracic providers for patients in these demographic groups.

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INTRODUCTION

The 2015 National Trauma Data Bank (NTDB) annual report indicates that falls and motor vehicle collisions are the primary causes of traumatic injuries, with chest trauma reported in 23% of cases.[1] Chest trauma ranks as the second leading cause of death in vehicle collisions, second only to head injuries.[2] Traumatic cardiac injuries (TCI) are common in chest and polytrauma patients and are often fatal.[3-8]

TCIs can be classified into two categories based on the mechanism of injury: blunt traumatic cardiac injury (BTCI) and penetrating traumatic cardiac injury (PTCI). BTCI often is caused by a direct blow to the chest, compression of the heart between the sternum and the spine, shearing injury due to sudden deceleration, or a combination of these factors.[9] On the other hand, PTCI results from a direct stab wound, firearm/gunshot wound, or blast injuring the heart.[10,11] These injuries can range in severity from benign dysrhythmias to chamber contusions or rupture, valvular leaflet tears, and injuries to the great vessels or coronary arteries.[4-6,12,13] Despite the high mortality associated with TCI, there is a lack of data to adequately identify risk factors for poorer outcomes and guide early treatment strategies for these higher-risk patients. Therefore, this study aimed to assess temporal trends, demographic characteristics, and in-hospital outcomes of patients with TCI using a U.S.-based national population database.

METHODS

We utilized the National Inpatient Sample (NIS) from 2007 to 2014, a database maintained by the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality. The NIS represents a 20% sample of over 97% of inpatient discharges from non-federal hospitals in the U.S., stratified by hospital size, location, region, and teaching status. It excludes discharges from the emergency department and all patient information is deidentified. The database includes diagnoses and procedures reported using International Classification of Diseases, 9th Edition (ICD-9-CM) codes, as well as outcomes such as mortality and length of hospital stay. HCUP conducts numerous quality checks to ensure data accuracy, including cross-checking with the National Hospital Discharge Survey.[14]

The study included all adults (aged 18 and older) with a primary discharge diagnosis of TCI, categorized using ICD-9-CM codes. Comorbid conditions, complications, and associated trauma were extracted as secondary diagnoses, with associated trauma further categorized into thoracic, abdominal/pelvic, and back/spine. Modes of injury were defined using external causes of injury codes (ECODES) and grouped into four categories: any vehicle injury, falls, firearm injury, and piercing injury, as per Centers for Disease Control and Prevention (CDC) recommendations (Table 1).[15]

We identified patient demographics (age, gender, race, median household income) and hospital characteristics (region, bed-size, location, teaching status). Patients who died in the hospital were excluded, and the length of hospital stay was estimated in days using the length of stay variable. Total charges for each hospitalization were obtained from the NIS database and converted to hospitalization cost using cost-to-charge ratios (CCR) from HCUP. The total hospitalization cost was adjusted for inflation using consumer price index data from the U.S. Bureau of Labor Statistics to calculate an adjusted cost as of December 2014.[16]

Table 1. Patient characteristics in traumatic cardiac injury.

Measures	TCI (N=11,510)	BTCI (N=7,155)	PTCI (N=4,355)	p Value
Age, mean (SE), y	49.3 ± 0.6	58.4 ± 0.6	34.5 ± 0.5	<0.001
Gender (%)				
Male	71.2	58.5	92.0	<0.001
Female	28.8	41.5	8	
Age groups (%)				<0.001
18-45 years	46.6	27.5	77.1	
46-65 years	26.4	31.1	18.7	
66 years and above	27	41.4	3.2	
Race (%)				<0.001
White	55.4	70.0	32.0	
Black	20.6	11.3	35.6	
Hispanic	16.0	10.7	24.4	
Asian or Pacific Islander	2.6	2.8	2.2	
Native American	1.2	1.0	1.6	
Other	4.2	4.2	4.2	
Primary expected payer (%)				<0.001
Medicare	17.3	23.5	7.0	
Medicaid	15.6	6.4	30.6	
Private insurance	39.4	52.0	18.8	
Self-pay	15.2	8.8	25.8	
No charge	2.1	0.8	4.2	
Other	10.4	8.5	13.6	
Hospital bed-size (%)				<0.001
Small	5.9	7.8	2.8	
Medium	18.0	18.5	17.1	
Large	76.1	73.7	80.1	
Hospital location and teaching status (%)				<0.001
Rural	7.7	11.0	2.2	
Urban, non-teaching	23.5	28.7	14.8	
Urban, teaching	68.8	60.3	83.0	
Hospital region (%)				0.33
Northeast	22.1	22.8	21.1	
Midwest	19.5	20.7	17.4	
South	34.8	34.4	35.5	
West	23.6	22.1	26.0	
Median household income national quartile for patient ZIP code (%)				<0.001
0-25th percentile	35.0	28.2	46.6	
26-50th percentile	24.8	25.3	23.9	
51-75th percentile	22.8	24.7	19.9	
76-100th percentile	17.4	21.8	9.6	
Comorbidities (%)				
Chronic ischemic heart disease	13.6	20.8	1.7	<0.001
Hypertension	32.9	46.2	11.0	<0.001
Diabetes mellitus	11.8	17.0	3.2	<0.001
Heart failure	7.7	11.0	2.3	<0.001
Dyslipidemia	14.9	23.2	1.4	<0.001
Obesity	4.8	6.1	2.7	<0.001
Chronic kidney disease	4.7	7.4	0.2	<0.001
Atrial fibrillation/flutter	11.1	13.9	6.4	<0.001
Chronic liver disease	1.4	1.8	0.8	0.05
Chronic lung disease	8.8	11.7	4.0	<0.001
Mental disorders (psychotic/mood)	5.3	2.7	9.7	<0.001
Alcohol use disorder	7.2	5.7	9.6	<0.001
Smoking use disorder	17.2	18.8	14.6	0.01

BTCI: blunt traumatic cardiac injury; PTCI: penetrating traumatic cardiac injury; TCI: traumatic cardiac injury.

Weights from the variables "TRENDWT" (up to 2011) and "DISCWT" (from 2012 onward) in the NIS database were used in weighting and stratification methods to produce national estimates. Descriptive statistics were calculated for all study variables, with continuous variables presented as means ± standard error (SE) and compared between blunt and penetrating injury groups using appropriate statistical tests. Categorical variables were presented as frequencies (percentage) and analyzed using the two-way Chi-square test. Trend analysis for continuous and categorical variables was performed using the t-test and two-way Chi-square test, respectively. A p-value of <0.05 was considered statistically significant. Data analysis was conducted using STATA 13.0 SE Software package.

RESULTS

A total of 11,510 weighted discharges with a primary diagnosis of TCI were identified over the eight-year period. Among these, 7,155 (62.2%) patients had BTCI, and 4,355 (37.8%) patients had PTCI. Figure 1 illustrates that although there was a non-statistically significant declining trend in overall TCI admissions, the proportion of PTCI cases increased over the years.

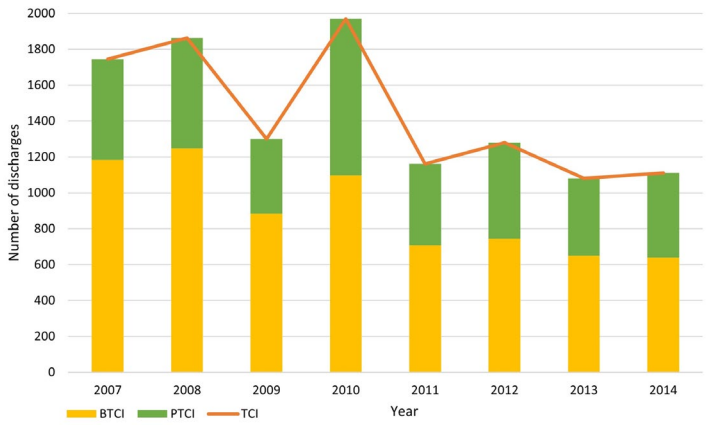

Figure 1. Trends of traumatic cardiac injury.

Demographic information and underlying comorbidities in the study population are summarized in Table 1. The patients were generally young (mean age 49.3 years), mostly male (71.2%), and tended to come from lower-income households. The majority were admitted to large (76.1%) and urban-teaching (68.8%) hospitals. Significant differences were observed between the BTCI and PTCI groups. Patients with PTCI were younger (mean age 34.5 years vs. 58.4 years), predominantly male (92% vs. 58.5%), of non-Caucasian races, and more likely to be from the lowest income quartile (46.6% vs. 28.2%). The PTCI group had fewer comorbidities overall, except for higher rates of mental disorders (psychotic/mood; 9.7% vs. 2.7%) and alcohol use disorder (9.6% vs. 5.7%).

Motor vehicle collisions were the most common cause of BTCI (66.7%), while PTCI were primarily caused by piercing injuries (67.4%) and firearm-related injuries (21.2%; Table 2). Additionally, most patients had associated non-cardiac thoracic injuries, with a minority also experiencing abdominal/pelvic or spine injuries.

Table 2. Traumatic cardiac injury, in-hospital complications, and procedures.

Measures	TCI (N=11,510)	BTCI (N=7,155)	PTCI (N=4,355)	p Value
External cause of injury (%)				
Motor vehicle collision	42.0	66.7	1.3	<0.001
Falls	6.7	10.0	1.2	<0.001
Firearms	8.3	0.5	21.2	<0.001
Piercing or cutting injury	26.9	2.3	67.4	<0.001
Associated injury (%)				
Extra cardiac thoracic injury	61	53.2	73.9	<0.001
Abdominal or pelvic injury	16.1	9.4	27.0	<0.001
Spine or back injury	8.4	10.8	4.6	<0.001
In-hospital clinical events (%)				
Need for blood transfusion	21.5	8.6	42.8	<0.001
Shock	13.9	5.9	27.1	<0.001
Myocardial infarction	3.4	4.0	2.5	0.07
Hemopericardium	19.6	6.4	41.4	<0.001
Ventricular arrhythmias	5.8	4.7	7.5	0.006
Acute kidney injury	7.6	7.1	8.6	0.21
Acute respiratory failure	15.9	9.4	26.6	<0.001
Sudden cardiac arrest	8.8	3.7	17.2	<0.001
Procedures (%)				
Endotracheal intubation	26.6	12.4	49.9	<0.001
Thoracentesis/ chest tube	19.8	6.6	41.6	<0.001
Thoracotomy	10.3	2.7	22.9	<0.001
Median sternotomy	1.0	0.3	2.2	<0.001
Heart or pericardial repair	35.5	7.1	82.3	<0.001
Pericardiocentesis	2.5	1.4	4.4	<0.001
Pericardial window	15.6	4.1	34.4	<0.001
Coronary angiography	5.9	8.5	1.5	<0.001
Coronary angioplasty	0.2	0.3	0.0	0.13
Coronary artery bypass grafting	0.7	0.5	1.2	0.07
Valve surgery	1.2	0.9	1.9	0.05

BTCI: blunt traumatic cardiac injury; PTCI: penetrating traumatic cardiac injury; TCI: traumatic cardiac injury.

Table 2 presents in-hospital clinical events and procedures during TCI-related hospitalizations. Overall, 21.5% of patients required blood transfusion, 19.6% developed hemopericardium, and 15.9% experienced respiratory failure. The incidence of most complications was higher in PTCI patients compared to BTCI patients, with more PTCI patients undergoing operative management, including heart or pericardial repair (82.3%), pericardial window (34.4%), and thoracotomy (22.9%).

The overall mortality rate for TCI patients was 11.3%, with a mean length of stay of 7.9 days. Patients with PTCI had significantly higher mortality, longer hospital stays, and higher hospitalization costs compared to those with BTCI (Table 3). There were no significant changes observed in mortality, length of stay, or inflation-adjusted cost of hospitalization over the study period (Figure 2).

Table 3. In-hospital outcomes in traumatic cardiac injuries.

Measures	TCI (N=11,510)	BTCI (N=7,155)	PTCI (N=4,355)	p Value
Mortality (%)	11.3	5.9	20.3	<0.001
Mean Length of Stay (days)	7.9 ± 0.4	5.0 ± 0.2	13.4 ± 0.9	<0.001
Inflation adjusted hospitalization cost ($)	27,924.1 ± 1,280	17,717.6 ± 905.7	47,175.5 ± 2,843	<0.001
Disposition after live discharge (%)				0.27
Routine	71.5	70.8	72.8	
Transfer to short-term hospital	3.9	3.9	4.0	
Transfer other: SNF, ICF, other facility	15.3	15.1	15.8	
Home health care	7.8	8.8	5.9	
Against medical advice	0.1	0.01	0.2	

BTCI: blunt traumatic cardiac injury; PTCI: penetrating traumatic cardiac injury; TCI: traumatic cardiac injury.

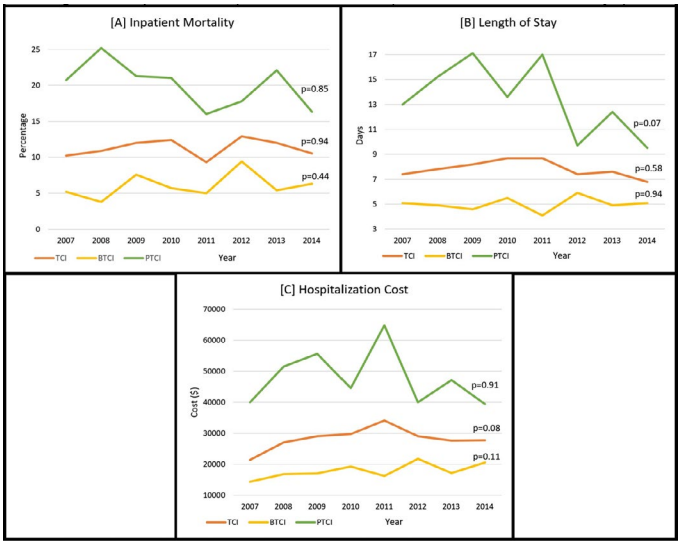

Figure 2. Yearly trends of hospitalization outcomes in patients with TCI.

DISCUSSION

This study represents the first nationwide, population-based analysis of TCI-related hospitalizations in the U.S. Our findings shed light on key aspects including demographics, in-hospital outcomes, cost of care, and national trends over an eight-year period.

Our analysis revealed that over 60% of patients had BTCI, with the remainder having PTCI. While previous studies, such as that by Asensio et al.,[7] have focused on outcomes associated with PTCI, limited attention has been given to BTCI. Unlike PTCI, BTCI can be challenging to confirm, particularly in cases of polytrauma, and can manifest as anything from minor myocardial contusions to dysrhythmias to cardiac rupture, with most cases likely involving non-life-threatening cardiac damage.[11,17] Due to the lack of standardized reporting criteria, the reported incidence of BTCI in chest trauma has varied widely, from 8% to 76%.[18] For example, a report from the Oklahoma trauma registry found that BTCI accounted for 62% of all TCI hospitalizations, a figure similar to our national findings.[13]

While our analysis did not identify a significant increase in overall TCI cases over the eight-year period studied, we did observe a rising trend in the proportion of PTCI cases. This increasing proportion of PTCI cases aligns with findings from the Oklahoma registry, suggesting a shifting landscape in traumatic cardiac injuries.[13]

Our findings support previous research from single-center and regional studies indicating that TCI patients are typically younger and predominantly male. We also observed that compared to those with BTCI, patients with PTCI tended to be younger, overwhelmingly male, and the majority were in the lower income category. For instance, Morse et al.[5] reported in their 36-year single-center study of PTCI that 86% of patients were male with a mean age of 32 years. These results closely resemble ours, where the mean age for PTCI patients was 34 years and 92% were male. Because PTCI patients were much younger, they also had a significantly lower prevalence of most co-morbidities, except for mental disorders and alcohol use, which were higher.

The differences in demographics and co-morbidities between BTCI and PTCI patients likely can be attributed to the causes of these injuries. Most BTCIs result from vehicular collisions, whereas PTCIs are more often related to stabbings or firearm injuries. We also noted significant racial differences, with Caucasians constituting the majority of BTCI patients, while non-Caucasians made up more than two-thirds of the PTCI group. This aligns with the findings of Mikhail et al.[19] in their study of a single trauma center population (not limited to TCI), where they observed that African American patients more frequently belonged to lower socio-economic strata, experienced penetrating injuries more often, and had a higher in-patient mortality compared to Caucasians.

Examining eight-year trends, we discovered that although the overall hospitalization rate for TCI remained stable, there was a rise in the percentage of TCIs resulting from piercing injuries. This trend likely signifies an increase in violent injuries from stabbings or gunshots. However, it also may be linked to enhancements in emergency medical services (EMS) delivery and the increased availability of specialty ground and air EMS vehicles, facilitating the rapid transport of these patients to hospitals.[20]

In a condition like TCI, which can be immediately fatal after occurrence and where survival depends on rapid triage to a major trauma center, one must be cautious when drawing conclusions based on hospital mortality data. Local EMS capabilities, trauma protocols, and ease of access to trauma centers directly impact in-hospital outcomes. For example, over a 36-year study period at Grady Memorial Hospital, overall mortality consistently increased from 1975-1985 to 2000-2010 (27% vs. 42%),[5] despite improvements in local EMS and institutional trauma protocols. The authors suggested that contributing factors were an improved survival rate to hospital arrival due to a better community ambulance system and a significant increase in gunshot wound-related TCI, which have a higher mortality rate. Similarly, the Oklahoma registry report found a significant 10-year trend toward increased mortality related to TCI, paralleling a significant increase in the proportion of PTCI.[13] They reported a mortality rate of 51.2% with PTCI and 26.3% with BTCI. Additionally, utilizing the NTDB databases, Teixeira et al.[7] reported a mortality rate of 67.6% for blunt cardiac ruptures, and Asensio et al.[8] reported a mortality rate of 66% for penetrating cardiac injuries. We found a significantly lower in-hospital mortality for both BTCI (5.9%) and PTCI (20.3%). Several factors could explain these differences, such as the inclusion of a wide variety of hospitals, regional or state-level differences, and the fact that we used the primary discharge diagnosis of TCI as an inclusion criterion. This might have resulted in the exclusion of patients who may have had other major associated trauma that resulted in a different primary diagnostic code.

Regarding major procedures performed, our findings were similar to those previously reported by Tran et al.,[13] who showed that patients with PTCI underwent significantly more procedures, including heart or pericardial repair in 82%. This likely explains the increased hospitalization cost in PTCI patients.

We observed a low mortality rate in BTCI patients and a non-significant downward trend in mortality over the study period. This trend may be related to the fact that most of these patients were involved

in vehicular collisions, which aligns with a report from the Insurance Institute of Highway Safety showing a 15% decline in deaths related to motor vehicle collisions between 2007 and 2015.[21] However, since motor-vehicle collision-related injuries were the most common cause of BTCI, our study aims to encourage discussions around more robust compliance with motor vehicle safety and seatbelt laws.

Myocardial infarction was the only complication that occurred more frequently in the BTCI group. Although rare, myocardial infarction has been reported after blunt chest trauma, with Demerouti et al.[22] reporting 189 such cases, where they found coronary artery dissection to be the major mechanism and the left anterior descending artery the most involved artery. In our study population, this also could be possible due to the finding that patients in the BTCI group were significantly older, with a higher burden of established risk factors for atherosclerotic cardiovascular disease, such as hypertension, diabetes mellitus, dyslipidemia, obesity, and smoking, as well as a higher burden of established chronic ischemic heart disease and heart failure.

The presence of these risk factors, combined with trauma, might have led to electrocardiographic abnormalities and cardiac enzyme elevations in patients, prompting clinicians to perform a coronary angiography, which was done in 8.5% of cases in our study. However, only 0.3% of patients required a coronary angioplasty, which could possibly indicate that myocardial contusion or a demand-supply mismatch could have contributed to these abnormalities.

Limitations. Our study has several limitations. Firstly, since all the data were obtained from the NIS database, the identification of the study cohort and the variables used in the study depend heavily on the accuracy of coding procedures. However, the NIS has been extensively validated over the years, and any misclassification occurring from inaccuracies in ICD-9-CM codes (including ECODES) would likely be distributed uniformly, allowing for the generalizability of the data.[23,24]

Another limitation is that we selected a population of only discharges with a primary discharge diagnosis of TCI. Many patients with TCI would have other significant diagnoses, which could have been coded as a primary discharge diagnosis, with TCI being coded as a secondary diagnosis. Additionally, the NIS does not incorporate discharges from the emergency department. Thus, our study likely underestimates the prevalence of TCI and the associated mortality. However, our reasoning behind including only those discharges with a primary diagnosis of TCI was to improve the accuracy of our study by eliminating those patients who could have been misclassified as having TCI.

It is important to note that NIS databases from 2007 to 2009 were not capable of excluding transfers to another facility, so there is a possibility that some discharges might have been double-counted, which is an inherent limitation of a large population-based database. Furthermore, while the NIS is available through 2019, we limited our study through 2014 because ICD-10-CM codes were adopted in the fourth quarter of 2015, and a direct conversion from ICD-9-CM to ICD-10-CM was not available for certain codes utilized in our study.

Additionally, higher Injury Severity Scores (ISS), which have been reported by studies utilizing trauma registries, seem to correlate with mortality. However, due to the nature of the administrative database used, we were unable to report ISS, which is another limitation of our study. Lastly, due to the cross-sectional nature of the database of hospitalization records, we do not have data on follow-ups or subsequent readmissions. Despite these limitations, we believe that our study offers the first look at national data on TCI and adds significantly to the literature on cardiac trauma.

CONCLUSIONS

In conclusion, our descriptive study outlines trends and in-hospital outcomes of TCI in the U.S. population. We found that compared to patients with BTCI, those with PTCI had significantly higher mortality rates. Young male patients from minority racial groups, who belonged to low-income households, were identified as being at higher risk for poorer outcomes. Therefore, emergency medicine and cardiothoracic providers should pay special attention when caring for patients from these demographic groups.

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Keywords: blunt cardiac trauma, penetrating cardiac trauma, nationwide outcomes

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Original Research

Factors Affecting Parental Intent to Vaccinate Against COVID-19 in the United States

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ABSTRACT

Introduction. The topic of childhood vaccinations has become increasingly contentious, sparking debate, and creating challenging decisions for parents. This study aimed to explore the factors influencing COVID-19 vaccination decisions for parents of unvaccinated children and identify the most common reasons for not vaccinating children against COVID-19 in the U.S.

Methods. Authors analyzed data from Phase 3.7, Week 53 of the United States Census Bureau's Household Pulse Survey (N = 68,504), collected from January 4 to January 16, 2023. Standard descriptive statistics and adjusted odds ratio (aOR) were used to analyze the data.

Results. The top three reasons for vaccine hesitancy were concerns about side effects, lack of trust in the vaccine, and the perception that children in the household were not part of a high-risk group. Among respondents, nearly 87% (n = 59,363) reported receiving a COVID-19 vaccination, and these individuals were more inclined to vaccinate their children across all age groups studied. Additionally, participants with higher levels of education (bachelor's degree or higher) were more likely to vaccinate their children against COVID-19 (aOR = 5.79; 95% CI, 5.43-6.17; p <0.001).

Conclusions. Findings from the study suggest that some parents are still concerned about the COVID-19 vaccine and are hesitant to vaccinate their children against the disease. Information and insights from this study allow for a greater understanding of how parents are making this decision nearly three years after the pandemic officially began. Further studies are needed to determine how other factors, such as geographical location, also may affect parental COVID-19 vaccination hesitancy. ***Kans J Med 2024;17:51-56***

INTRODUCTION

In recent decades, childhood vaccinations have increasingly become a source of debate, controversy, and challenging decisions for parents.[1] The vaccine against the novel coronavirus infectious disease (COVID-19) is certainly no exception.[1,2] Considering the overwhelming amount of information and misinformation being generated and immediately available at the fingertips of most Americans each day,[2-3] it is important to understand what factors contribute to the decision parents in the U.S. make for vaccinating children against COVID-19.

The United States Food and Drug Administration (FDA) approved the Pfizer-BioNTech COVID-19 vaccine for those as young as 16 years old under an emergency use authorization on December 11, 2020.[4] Authorization was gradually expanded to include the Moderna COVID-19 vaccine, younger age groups, and eventually children as young as six months old in June 2022.[5] Despite this, many under the age of 18 years remain unvaccinated in the U.S. Currently, it is estimated that 15 million children between the ages of six months to four years, 17.5 million between 5 and 11 years, and 8.3 million between 12 and 17 years remain unvaccinated against COVID-19.[6] Unfortunately, COVID-19 infection in children and adolescents poses several risks, including long-term effects, such as trouble sleeping, concentrating, and fatigue.[7] Another complication associated with COVID-19 in children is multisystem inflammatory syndrome (MIS-C), which although rare potentially can be deadly.[8] Knowing the risks associated with COVID-19 infection in those under 18 years of age, it is important to obtain a clear understanding as to why so many remain unvaccinated.

According to the Kaiser Family Foundation (KFF) Vaccine Monitor poll in October 2021, which surveyed a nationally representative sample of adults in the U.S., 76% of parents of children ages 5 to 11 years reported being concerned about "not enough [being] known about the long-term effects of the COVID-19 vaccine in children."[9] Concerns about side effects and their children's future fertility also were reported.[9] According to the July 2022 KFF Vaccine Monitor poll, 81% of parents of unvaccinated children ages six months to four years also were concerned about serious side effects and a lack of knowledge existing about "long-term effects of the COVID-19 vaccine in children."[10] Despite these parental concerns, clinical trials have demonstrated that serious adverse events are rare.[11] Most adverse events in preauthorization trials were reported as being mild to moderate in severity and zero severe adverse events were reported for the Pfizer-BioNTech COVID-19 vaccine in children six months to four years and for the Moderna COVID-19 vaccine in children six months to five years.[11] Furthermore, while infection with COVID-19 could transiently affect fertility in males, fertility is not impaired in males or females after COVID-19 vaccination.[12]

Given that COVID-19 vaccines for those as young as 16 years old have been approved for over two years, along with now being approved for children as young as six months old, this study sought to determine what factors influence the COVID-19 vaccination plans for parents of unvaccinated children, as well as to identify which reasons for not vaccinating children against COVID-19 are the most common.

METHODS

In this study, the authors utilized data from Phase 3.7, Week 53 of the United States Census Bureau's Household Pulse Survey (HPS; N = 68,504), collected from January 4 to January 16, 2023.[13] The HPS began in April 2020 to provide insight into how the COVID-19 pandemic has affected households in the U.S. Data were originally collected in one-week periods but transitioned into two-week collection periods beginning in Phase 2 (August 2020). Data releases after this

transition are referred to as "Weeks" to ensure there is consistency with earlier phases.[14] The Census Bureau's Master Address File (MAF) was used as the source for Housing Units (HUs) sampled in the survey.[14] The bureau then used systematic sample approach to select 66 defined sample areas from the identified HUs that were interviewed once. Each HU was contacted by both email and text message if available[14] using Qualtrics, an online data collection platform. For Week 53, 1,049,855 HUs were identified, and surveys were received from 68,504 respondents in those HUs.[13] The Institutional Review Board (IRB) reviewed the data, confirming its public availability and de-identification. Consequently, our analyses did not involve human subjects and did not require IRB oversight.

Patient and Public Involvement. Patients/the public were not involved in the design or conduct of this research.

Statistical Analyses. For statistical analysis purposes, the respondents' intention to vaccinate was clustered into three groups (will vaccinate the children [combination of definitely and possibly get the children a vaccine], will not vaccinate the children [combination of definitely not and probably not get the children a vaccine], and unsure [combination of unsure about getting the children a vaccine and I do not know the plans for vaccination of the children]). Standard descriptive statistics were used to create a demographic profile and describe participant intentions to vaccinate.

Generalized linear mixed models were used to calculate associations between participant COVID-19 vaccination status, as well as those who received a positive COVID-19 test or were diagnosed with COVID-19 modeled as a binary outcomes (yes/no) against a single fixed effect for independent variables (likelihood of getting children vaccinated [under 5 years old, 5 to 11 years old, 12 to 17 years old], biological sex at birth, age, marital status, and highest level of education). Adjusted odds ratios (aOR) were estimated by modeling all significant independent variables against participant COVID-19 vaccination status, controlling for participant biological sex, age, race, ethnicity, marital status, highest level of education, income level, and type of insurance coverage. A sample size of 100 was calculated as necessary for adequate power (>0.85) to detect significant relationships among the variables with one degree of freedom, $p < 0.05$, and 0.5 effect size.[15]

RESULTS

Respondent Characteristics. Table 1 represents the demographic information of respondents (N = 68,504). The average age of respondents was 52 years old (standard deviation (SD), 15.8); 57.6% were biological female; 56.2% identified as female; and 88.1% were heterosexual. Most respondents (56.8%) reported being married; 90.9% were not from Hispanic, Latino, or Spanish origin; 82.0% were Caucasian or White alone; 53.8% completed a bachelor's or higher degree; 47.3% reported their household gross income as $75,000 or higher; and 47.2% had health insurance coverage through a current or former employer or union.

Table 1. Respondent's demographic information.

Characteristics	Measure (N = 68,504)
Age	
Mean (SD), y	52 (15.8)
Median	52
Minimum	18
Maximum	88
Marital status, no. (%)	
Never married	13,804 (20.2)
Married	38,937 (56.8)
Divorced	10,403 (15.2)
Separated	1,237 (1.8)
Widowed	3,674 (5.4)
Prefer to not answer	449 (0.7)
Biological sex, no. (%)	
Male	29,052 (42.4)
Female	39,452 (57.6)
Gender identity	
Male	28,343 (41.4)
Female	38,485 (56.2)
Transgender	261 (0.4)
None of these	639 (0.9)
Prefer to not answer	776 (1.1)
Sexual orientation	
Straight/heterosexual	60,376 (88.1)
Gay or lesbian	2,350 (3.4)
Bisexual	2,882 (4.2)
Something else	1,092 (1.6)
Prefer to not answer	964 (1.4)
I don't know	840 (1.2)
Ethnicity, no. (%)	
Hispanic, Latino, or Spanish origin	6,223 (9.1)
Not of Hispanic, Latino, or Spanish origin	62,281 (90.9)
Race, no. (%)	
Caucasian/White alone	56,158 (82.0)
African American/Black alone	5,522 (8.1)
Asian alone	3,375 (4.9)
Any other race alone, or race in combination	3,449 (5.0)
Highest degree/level of school completed, no. (%)	
Less than high school	453 (0.7)
Some high school	1,015 (1.5)
High school graduate or equivalent (for example GED)	8,476 (12.4)
Some college, but degree not received or is in progress associate's degree (for example AA, AS)	14,579 (21.3)
Associate's degree (for example AA, AS)	7,145 (10.4)
Bachelor's degree (for example BA, BS, AB)	19,356 (28.3)
Graduate degree (for example master's, professional, doctorate)	17,480 (25.5)

Table 1. Respondent's demographic information. *continued.*

Characteristics	Measure (N = 68,504)
Household gross income, no. (%)	
Less than $25,000	5,565 (8.1)
$25,000-$34,999	4,563 (6.7)
$35,000-$49,999	5,890 (8.6)
$50,000-$74,999	9,313 (13.6)
$75,000-$99,999	7,950 (11.6)
$100,000-$149,999	10,180 (14.9)
$150,000-$199,999	5,670 (8.3)
$200,000 and above	7,034 (10.3)
Prefer to not answer	1,497 (2.2)
Missing	10,842 (15.8)
Health insurance coverage, no. (%)	*n = 84,600**
Insurance through a current or former employer or union (self or through family member)	39,928 (47.2)
Purchased directly from insurance company (self or through family member)	12,537 (14.8)
Medicare, for people 65 and older, or with certain disabilities	16,335 (19.3)
Medicaid, Medical Assistance, or any kind of government-assistance plan for low income/disability	7,458 (8.8)
TRICARE or other military health care	2,709 (3.2)
VA (including those who have ever used/enrolled for VA health care)	3,090 (3.7)
Indian Health Service	480 (0.6)
Other	2,063 (2.4)

*Raw numbers are more than the sample size because some participants reported multiple insurance coverage.

COVID-19 Vaccine Hesitancy. As Table 2 shows, slightly over 43.4% (n = 29,712) of respondents reported having children under 18 years of age living in their household. As shown in Table 2, some respondents reported that they will not vaccinate children living in their household against COVID-19. Over 67% (n = 20,087) of the respondents with children in their household reported several reasons for not vaccinating their children against COVID-19 (Table 2). The top three reported reasons were: concerns about side effects of the COVID-19 vaccines on the children (22.9%), not trusting the COVID-19 vaccines as safe for the children (14.5%), and children in the household not being members of a high-risk group (14.2%; Table 2).

Nearly 87% (n = 35,857) of respondents reported receiving a COVID-19 vaccination. Table 3 illustrates the results of mixed model analyses, showing a significant positive association between respondents' COVID-19 vaccination status and their likelihood of vaccinating their children under 18 years old. Respondents who had received the COVID-19 vaccine were more likely to vaccinate their children: under 5 years old (aOR = 29.362; 95% CI, 19.98-43.90; p <0.001); aged 5 to 11 years old (aOR = 15.53; 95% CI, 10.45-23.07; p <0.001); and aged 12 to 17 years old (aOR = 10.14; 95% CI, 6.59-15.59; p <0.001). Additionally, participants with higher levels of education (bachelor's degree or higher) were more likely to vaccinate their children against COVID-19 compared to those with lower levels of education (aOR = 5.79; 95% CI, 5.43-6.17; p <0.001).

Table 2. Respondent's information regarding COVID-19 and COVID-19 vaccines.

Characteristics	Measure (N = 68,504)
COVID-19 vaccination status, no. (%)	
Received the vaccine	59,363 (86.7)
Not received the vaccine	8,458 (12.3)
Prefer to not answer	683 (1.0)
Tested positive or told by a physician or a health care provider that you have COVID?, no. (%)	
Yes	35,857 (52.3)
No	31,422 (45.9)
Prefer to not answer	739 (1.1)
Missing	486 (0.7)
Children living in household	*n = 29,712*
Children under 5 in household	7,845 (26.4)
Children 5 through 11 years old in household	11,061 (37.2)
Children 12 through 17 in household	10,806 (36.4)
Likelihood of getting children vaccinated (under 5 years old), no. (%)	*n = 5,438*
Definitely get the children a vaccine	599 (11.0)
Probably get the children a vaccine	542 (10.0)
Be unsure about getting the children a vaccine	716 (13.2)
Probably NOT get the children a vaccine	905 (16.6)
Definitely NOT get the children a vaccine	1,951 (35.9)
I do not know the plans for vaccination of the children under 5 in my household	670 (12.3)
Prefer to not answer	55 (1.0)
Likelihood of getting children vaccinated (5 to 11 years old), no. (%)	*n = 5,138*
Definitely get the children a vaccine	164 (3.2)
Probably get the children a vaccine	260 (5.1)
Be unsure about getting the children a vaccine	598 (11.6)
Probably NOT get the children a vaccine	947 (18.4)
Definitely NOT get the children a vaccine	2,532 (49.3)
I do not know the plans for vaccination of the children 5 to 11 in my household	545 (10.6)
Prefer to not answer	92 (1.8)
Likelihood of getting children vaccinated (12 to 17 years old), no. (%)	*n = 3,375*
Definitely get the children a vaccine	70 (2.1)
Probably get the children a vaccine	103 (3.1)
Unsure about getting the children a vaccine	258 (7.6)
Probably NOT get the children a vaccine	521 (15.4)
Definitely NOT get the children a vaccine	1,920 (56.9)
I do not know the plans for vaccination of the children 12 to 17 in my household	388 (11.6)
Prefer to not answer	115 (3.4)
Reasons for not getting children vaccinated, no. (%)	*n = 20,087*
Concern about side effect of the COVID-19 vaccine for children	4,609 (22.9)
Plan to wait to see if it is safe/may get later	2,140 (10.7)

Table 2. Respondent's information regarding COVID-19 and COVID-19 vaccines. *continued.*

Characteristics	Measure (N = 68,504)
Reasons for not getting children vaccinated, no. (%)	*n = 20,087*
Not sure if COVID-19 vaccine will work for children	636 (3.2)
Don't believe children need COVID-19 vaccine	2,466 (12.3)
Children in household are not members of a high-risk group	2,844 (14.2)
Children's doctor has not recommended COVID-19 vaccine	1,243 (6.2)
Parents/guardians in household do not vaccinate their children	352 (1.8)
Don't trust COVID-19 vaccines	2,915 (14.5)
Don't trust the government	1,967 (9.8)
Other reason	915 (4.6)

Nearly 87% (n = 35,857) of respondents reported receiving a COVID-19 vaccination. Table 3 illustrates the results of mixed model analyses, showing a significant positive association between respondents' COVID-19 vaccination status and their likelihood of vaccinating their children under 18 years old. Respondents who had received the COVID-19 vaccine were more likely to vaccinate their children: under 5 years old (aOR = 29.362; 95% CI, 19.98-43.90; p <0.001); aged 5 to 11 years old (aOR = 15.53; 95% CI, 10.45-23.07; p <0.001); and aged 12 to 17 years old (aOR = 10.14; 95% CI, 6.59-15.59; p <0.001). Additionally, participants with higher levels of education (bachelor's degree or higher) were more likely to vaccinate their children against COVID-19 compared to those with lower levels of education (aOR = 5.79; 95% CI, 5.43-6.17; p <0.001).

Table 3. Odds ratios for independent variables and whether participant had received COVID-19 Vaccine (N = 68,504).

Variables	Odd ratio (95% CI)	p Value
Sex		
Female vs male	0.90 (0.86 to 0.95)	<0.001
Age (for each additional year older)	1.03 (1.02 to 1.04)	<0.001
Race		
Caucasian/White alone	1.41 (1.28 to 1.55)	<0.001
African American/Black alone	1.39 (1.23 to 1.56)	<0.001
Asian alone	6.21 (5.02 to 7.68)	<0.001
Any other race alone, or race in combination	Reference	-
Marital status		
Married	1.26 (1.19 to 1.34)	<0.001
Widowed	1.33 (1.19 to 1.49)	<0.001
Divorced	0.99 (0.92 to 1.07)	0.805
Separated	0.63 (0.54 to 0.73)	<0.001
Never married	Reference	-
Highest degree/level of school completed		
Less than high school	Reference	-
Some high school	0.95 (0.74 to 1.22)	0.689
High school graduate or equivalent (for example GED)	1.19 (0.95 to 1.46)	0.128
Some college, but degree not received or is in progress Associate's degree (for example AA, AS)	1.74 (1.41 to 2.15)	<0.001
Associate's degree (for example AA, AS)	2.01 (1.62 to 2.50)	<0.001
Bachelor's degree (for example BA, BS, AB)	4.50 (3.65 to 5.57)	<0.001
Graduate degree (for example master's, professional, doctorate)	9.17 (7.35 to 11.42)	<0.001
Likelihood of getting children vaccinated (under 5 years old)		
Vaccinate the children	32.18 (21.81 to 47.47)	<0.001
Unsure	4.07 (3.46 to 4.78)	<0.001
Not vaccinate the children	Reference	-
Likelihood of getting children vaccinated (5 to 11 years old)		
Vaccinate the children	12.89 (8.74 to 19.02)	<0.001
Unsure	3.08 (2.64 to 3.59)	<0.001
Not vaccinate the children	Reference	
Likelihood of getting children vaccinated (12 to 17 years old)		
Vaccinate the children	7.77 (5.11 to 11.80)	<0.001
Unsure	2.23 (1.86 to 2.66)	<0.001
Not vaccinate the children	Reference	-

Note: CI = Confidence interval

Just over 52% (n = 35,857) of respondents reported either testing positive for COVID-19 or being diagnosed with the virus (Table 2). However, having had a COVID-19 diagnosis did not significantly impact their likelihood of vaccinating their children under 18 years of age (Table 4).

Table 4. Odds ratios for independent variables and whether participant had been diagnosed for COVID-19 (N = 68,504).

Variables	Odd ratio (95% CI)	p Value
Sex		
Female vs male	1.11 (1.08 to 1.15)	<0.001
Age (for each additional year older)	0.98 (0.97 to 0.99)	<0.001
Race		
Caucasian/White alone	0.94 (0.87 to 0.99)	<0.05
African American/Black alone	0.66 (0.61 to 0.72)	<0.001
Asian alone	0.82 (0.74 to 0.89)	<0.001
Any other race alone, or race in combination	Reference	-
Marital status		
Married	1.14 (1.09 to 1.18)	<0.001
Widowed	0.53 (0.49 to 0.57)	<0.001
Divorced	0.76 (0.72 to 0.79)	<0.001
Separated	0.95 (0.84 to 1.07)	0.379
Never married	Reference	-
Highest degree/level of school completed		
Less than high school	Reference	-
Some high school	1.09 (0.87 to 1.37)	0.439
High school graduate or equivalent (for example GED)	1.29 (1.06 to 1.56)	0.011
Some college, but degree not received or is in progress associate's degree (for example AA, AS)	1.53 (1.26 to 1.86)	<0.001
Associate's degree (for example AA, AS)	1.57 (1.29 to 1.91)	<0.001
Bachelor's degree (for example BA, BS, AB)	1.82 (1.51 to 2.21)	<0.001

Table 4. Odds ratios for independent variables and whether participant had been diagnosed for COVID-19 (N = 68,504). *continued.*

Variables	Odd ratio (95% CI)	p Value
Highest degree/level of school completed		
Graduate degree (for example master's, professional, doctorate)	1.74 (1.4 to 2.11)	<0.001
Likelihood of getting children vaccinated (under 5 years old)		
Vaccinate the children	0.95 (0.82 to 1.10)	0.507
Unsure	0.97 (0.85 to 1.11)	0.640
Not vaccinate the children	Reference	-
Likelihood of getting children vaccinated (5 to 11 years old)		
Vaccinate the children	1.01 (0.82 to 1.25)	0.898
Unsure	0.99 (0.87 to 1.15)	0.954
Not vaccinate the children	Reference	
Likelihood of getting children vaccinated (12 to 17 years old)		
Vaccinate the children	0.88 (0.64 to 1.21)	0.432
Unsure	0.92 (0.77 to 1.11)	0.391
Not vaccinate the children	Reference	-

Note: CI = Confidence interval

DISCUSSION

This study aimed to investigate the likelihood of parents vaccinating their children against COVID-19. The findings of this study provided valuable insights into the parental intention towards vaccinating children and lay the foundation to improve child vaccination rates. The results indicated a significant influence of parental COVID-19 vaccination status on the likelihood of vaccinating their own children. Parents who received the COVID-19 vaccine displayed a stronger intention to vaccinate their children when compared to parents who had not received the vaccine. These findings are supported by a study done by Nguyen et al.,[16] which analyzed HPS data collected from September 14 to November 14, 2022, and found that parents who had received the COVID-19 vaccine were more likely to have their children vaccinated against COVID-19. This association may be attributed to the firsthand experience of vaccinated parents with the safety and efficacy of COVID-19 vaccines, fostering increased confidence in vaccinating their children.

Survey participants were asked to select their reasons for having concerns about vaccinating their children against COVID-19. Many of these answers were rooted in a lack of knowledge or fear of adverse effects, which indicated a need to prioritize the provision of accurate and accessible information to improve pediatric vaccination rates, with a focus on the parents who exhibit higher levels of hesitancy. These findings also are supported by the study done by Nguyen et al.,[16] which found that the main reasons for COVID-19 vaccine hesitancy in parents included side effect concerns. These findings underscore the importance of addressing vaccine hesitancy among parents to ensure optimal vaccination rates in the pediatric population.

Furthermore, subgroups analyzed based on age, biological sex, marital status, and level of education revealed that lower education levels among all parents were associated with a lower likelihood of vaccinating their children. The study done by Nguyen et al.,[16] also found primary COVID-19 vaccine series completion to be higher for children and adolescents living in households with parents with education levels higher than a college degree. The similarities in the findings from this study and the study done by Nguyen et al.[16] suggest that parents' reasons for COVID-19 vaccine hesitancy and the impact of certain factors such as parental COVID-19 vaccination status and education level have remained constant since the fall of 2022. This suggests potential long-term socioeconomic disparities in vaccine decision-making, highlighting the need for targeted interventions and education programs to effectively reach and support parents with lower educational attainment and lack of resources. These findings also are similar to a study by Bertoncello et al.,[17] which showed that the rate of vaccine refusal is associated with a lower formal education level.

Limitations. There are several limitations to this study that should be noted. First, data collection relied on surveys and self-reporting, which could introduce recall biases. Future studies might consider using more objective measures, such as vaccination status from medical records or immunization registries, where possible. Second, the data used for analyses were collected only during Week 53 over a 12-day period, providing just a snapshot in time. Parents' perceptions of COVID-19 vaccines may have evolved due to additional safety and efficacy data and increased education. Additionally, while the sampling method aimed to collect representative data, using data from only Week 53 may limit the study's generalizability to the broader U.S. population. Furthermore, the cross-sectional design of this study does not capture changes in parental intent to vaccinate their children against COVID-19 over time. Given that COVID-19 vaccines for younger age groups had been available for only a few months at the time of data collection, parental intent may have changed as more information about these vaccines in children became available. Follow-up studies that assess parental decision-making regarding COVID-19 vaccination in children longitudinally may provide additional valuable insights.

CONCLUSIONS

The COVID-19 pandemic has emphasized the importance of childhood vaccines, sparking discussions and concerns among parents nationwide. Understanding the factors influencing parents' decisions regarding vaccinating their children against COVID-19 is crucial for public health. The study's findings reveal that some parents remain hesitant about the COVID-19 vaccine for their children, citing various reasons. This study provides valuable insights into parental decision-making nearly three years into the pandemic. By examining how parental COVID-19 vaccination status, demographics, and previous parental COVID-19 diagnoses affect children's vaccination rates, targeted strategies can be developed to increase vaccine uptake. Future research should explore how geographical factors also may influence parental COVID-19 vaccination hesitancy.

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Brief Report

Influence of Bone Cement Augmentation on Complications in Cephalomedullary Nail Fixation of Geriatric Intertrochanteric Hip Fractures

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ABSTRACT

Introduction. The purpose of this study was to determine if augmentation of the helical blade with polymethylmethacrylate bone cement decreases the rates of varus cut-out and medial perforation in geriatric intertrochanteric hip fracture fixation.

Methods. This was a retrospective comparative cohort study at two urban Level I trauma centers. Patients with an intertrochanteric hip fracture (classified as AO 31A1-3) who were treated with the TFN-Advanced Proximal Femoral Nailing System (TFNA) from 2018 to 2021 were eligible for the study. Medical records and post-operative radiographs were reviewed to determine procedure complications and reoperations.

Results. Of the 179 patients studied, cement augmentation (CA) was used in 93 patients (52%) and no cement augmentation (NCA) was used in 86 (48%). There were no significant differences between group demographics and fracture reduction grades. Varus cut-out occurred three times in the CA group and five times in the NCA group ($p = 0.48$). Medial perforation occurred three times, all in the NCA group ($p = 0.11$). The most frequent complication was symptomatic blade lateralization from fracture collapse, with eight occurrences in the CA group compared with two in the NCA group ($p = 0.10$). There were 10 reoperations in the CA group and 9 in the NCA group ($p = 0.99$). The most common reason for reoperation was varus cut-out and the most common revision procedure was hip arthroplasty.

Conclusions. Intertrochanteric hip fractures treated with the TFNA fixation system with and without cement augmentation have similar complication profiles and reoperation rates.

Kans J Med 2024;17:57-60

INTRODUCTION

A well-known but uncommon surgical complication of cephalomedullary nail (CMN) fixation of low impact geriatric intertrochanteric (IT) proximal femur fractures is collapse of the femoral head/neck with varus cut-out of the lag screw or helical blade.[1-5] The helical blade was designed to achieve superior stability over traditional lag screws in CMN fixation through impaction of the cancellous bone within the femoral head.[6] However, some studies have indicated that there may be an increased rate of cut-out with helical blades as compared to lag screws.[2,3] Moreover, a complication unique to the helical blade is perforation of the medial femoral head without loss of fracture reduction.[1]

To decrease the rates of varus cut-out and other major complications, augmentation of the helical blade with cement injected through the blade into the cancellous bone of the femoral head has been proposed. Although biomechanical[7,8] and clinical[9-11] studies have demonstrated promising results with this technique, the issue as to whether cement augmentation significantly decreases surgical complication or failure rates is unsettled.[12,13] The aim of this study was to identify major (requiring operative intervention) and minor (not requiring surgery) complications in elderly patients who underwent CMN fixation of IT femur fractures, comparing the complication and reoperation rates of those who had cement augmentation (CA) with those who had no cement augmentation (NCA).

METHODS

We designed a retrospective comparative cohort study involving patients at two Level I trauma centers. Using Current Procedural Terminology code 27245, we identified all patients who underwent CMN fixation of IT femur fractures from 2018 to 2021. Operative reports and intraoperative flouroscopy images were reviewed to confirm the TFN-Advanced Proximal Femoral Nailing System (TFNA) manufactured by DePuy Synthes (West Chester, PA) was used for fixation. The fractures were classified based on preoperative radiographs and/or computed tomography according to the Arbeitsgemeinschaft für Osteosynthesefragen (AO) and Orthopaedic Trauma Association (OTA) system as AO/OTA 31-A type fractures.

Fracture fixation proceeded according to standard surgical technique. The decision to use polymethylmethacrylate (PMMA) bone cement augmentation was based on surgeon preference, considering the fracture reduction and the patient's bone quality at the time of surgery. No objective measures of bone mineral density were used in the decision-making process. Injected cement volume varied from 1 mL to 8 mL of PMMA and was determined by fluoroscopic evaluation of cement spread during injection. Intraoperative fluoroscopy was used to measure the tip-apex distance, the quality of fracture reduction,[14] cement spread, and cement extrusion.

Post-operatively, patients were allowed to weight bear as tolerated without hip precautions. Clinic records and post-operative anteroposterior and cross-table lateral radiographs of the hip were reviewed to identify complications and determine how these complications were addressed. Patients were included if they had a minimum follow-up of 10 weeks or if hip radiographs were performed 10 weeks or more after surgery.

Our primary outcome measures were the rates of varus cut-out and medial perforation of the helical blade. Varus cut-out was defined as any collapse of the fracture into varus resulting in blade migration

within the femoral head necessitating revision surgery or any varus collapse in which the blade penetrated the intra-articular space. Medial perforation was defined as medial migration of the blade without loss of fracture reduction or collapse of the helical blade, causing penetration of the articular surface. Secondary outcome measures included other complications such as implant failure, periprosthetic fracture, nonunion, malunion, avascular necrosis, fracture collapse resulting in a symptomatic prominent lateral blade, superficial wound infection, or deep wound infection.

Study data were collected and managed using the Research Electronic Data Capture (REDCap) system.[15,16] Descriptive statistics were used to summarize all data. Continuous variables were assessed for normality and reported as means and standard deviations or medians and interquartile ranges. Categorical data were reported as frequencies and percentages. Patient demographics and baseline characteristics of participants were compared by group using t-tests. Fisher's exact tests were employed to examine the association between categorical variables using a 2x2 cross-tabulation. All analyses were conducted using two-sided tests with alpha level of .05 in IBM SPSS Statistics version 29.

RESULTS

There were 179 cases meeting inclusion criteria for the study, 93 (52%) in the CA group and 86 (48%) in the NCA cohort. No statistically significant differences were found between the groups in terms of age at time of surgery, body mass index (BMI), biologic sex, smoking status, American Society of Anesthesiologists (ASA) scores, comorbidities, or mechanism of fracture (Table 1). The most often reported ASA score was 3.

Table 1. Patient demographics and clinical characteristics as a function of cement augmentation.

	Cement Augmentation Used?				
	Yes = CA		No = NCA		
Demographics	**n = 93**	**52%**	**n = 86**	**48%**	**p**
Mean, standard deviation (sd)	*mean (sd)*		*mean (sd)*		
Age at time of surgery, yr	82.4 (8.2)		82.1 (7.9)		0.821
Height, cm	165.3 (10.7)		165.9 (11.2)		0.738
Weight, kg	67.0 (15.0)		72.0 (17.0)		0.068
BMI, range 16.1 to 41.0	24.5 (4.9)		25.9 (5.0)		0.064
Frequency and percentage	*n*	*%*	*n*	*%*	
Biological sex					0.422
Female	67	72.0	57	66.3	
Male	26	28.0	29	33.7	
Smoking status					0.216
Smoker	12	12.9	8	9.3	
Nonsmoker	56	60.2	42	48.8	
Former smoker	19	20.4	27	31.4	
unknown	6	6.5	9	10.5	
ASA score					0.188
One	0	0	1	1.2	
Two	16	17.2	11	12.8	
Three	64	68.8	68	79.1	
Four	13	14	6	7	
Co-morbidities					
Diabetes mellitus	22	23.7	27	31.4	0.314
Osteoporosis	14	15.1	13	15.1	0.999
Prior fragility fracture	6	6.5	6	7.0	0.999
Mechanism of fracture					0.109
Low energy (fall from standing)	93	100	83	96.5	
High energy (MVC)	0	0	3	3.5	

Note: Continuous data were evaluated by group using t-tests for equality of means. Categorical data were evaluated by group using Fisher's Exact tests.

There were no significant differences in hip laterality, fracture classification, fracture reduction grades, and tip-apex distance (Table 2). CMN length differed significantly between groups with the most common length reported as intermediate. Cement extrusion was rare, occurring only twice, once through the femoral head and once through the fracture site.

Table 2. Hip laterality, pre- and post-operative radiographic findings as a function of cement augmentation.

	Cement Augmentation Used?				
	Yes = CA		No = NCA		
Description	**n = 93**	**52%**	**n = 86**	**48%**	**p**
Frequencies and percentages	*n*	*%*	*n*	*%*	
Hip laterality					0.456
Left	41	44.1	43	50.0	
Right	52	55.9	43	50.0	
Fracture classification					0.309
AO 31A1	32	34.4	35	40.7	
AO 31A2	44	47.3	42	48.8	
AO 31A3	17	18.3	9	10.5	
Nail length					<0.001
Short	11	11.8	28	32.6	
Intermediate	77	82.8	58	67.4	
Long	5	5.4	0	0.0	
Fracture reduction grade					0.554
Good	75	80.6	73	84.9	
Acceptable	18	19.4	13	15.1	
Mean, standard deviation (sd)	*mean (sd)*		*mean (sd)*		
Tip-apex distance	23.6 (5.4)		22.1 (5.6)		0.075

AO31A1: simple peritrochanteric, lateral wall >20.5mm
AO31A2: multifragmentary peritrochanteric, lateral wall incompetent < 20.5mm
AO31A3: intertrochanteric with reverse obliquity
Categorical data were evaluated by group using Fisher's Exact tests.
Continuous data were evaluated by group using t-tests for equality of means.

Procedure complications and reoperations did not differ significantly between the cohorts (Table 3). Fifteen patients in the CA group experienced 19 complications, whereas for the NCA group, 16 patients had 16 complications.

Table 3. Procedure complications and reoperations as a function of cement augmentation.

	Cement Augmentation Used?				
	Yes = CA		No = NCA		
Description	**n = 93**	**52%**	**n = 86**	**48%**	**p**
Complications	*n*	*%*	*n*	*%*	
Varus cut-out	3	3.2	5	5.8	0.484
Medial perforation	0	0.0	3	3.5	0.109
Implant failure	0	0.0	1	1.2	0.480
Periprosthetic fracture	1	1.1	0	0.0	0.990
Nonunion	1	1.1	1	1.2	0.990
Malunion	1	1.1	3	3.5	0.352
Avascular necrosis	3	3.2	0	0.0	0.247
Symptomatic blade lateralization	8	8.6	2	2.3	0.102
Deep wound infection	2	2.2	1	1.2	0.990
Reoperations	*n*	*%*	*n*	*%*	
Arthroplasty	4	4.3	4	4.7	0.990
Revision nail	0	0.0	2	2.3	0.229
Revision of blade only	4	4.3	2	2.3	0.684
Irrigation and debridement	2	2.2	1	1.2	0.990

More than one type of complication may have occurred in each patient. Results shown compared those who reported "yes" to a specific complication type against those who reported "no" and were tested using Fisher's exact test.

Regarding the primary outcome measures, there were eight cases of varus cut-out, three in the CA group and five in the NCA group. Medial perforation occurred three times, all in the NCA cohort. The most frequently reported complication was a symptomatic lateralized blade from fracture collapse; eight cases in the CA group and two cases in the NCA group.

There were 19 reoperations; 10 in the CA group and 9 in the NCA group. The most common reoperation was revision of the CMN to total hip arthroplasty.

DISCUSSION

In our study of geriatric IT fractures treated with CMN fixation, we were unable to demonstrate any statistically significant difference in post-operative complication rate or reoperation rate between the CA and NCA cohorts. We did not examine other outcome metrics.

Some clinical studies have demonstrated good results with CA. For example, at an average follow-up of four months, Kammerlander et al.[10] reported no cases of varus cut-out, medial blade perforation, unexpected blade migration, implant loosening or breakage in a series of 59 patients who underwent PMMA augmentation of Proximal Femoral Nail Antirotation CMN fixation. This group of researchers also reviewed the same patient cohort at 15 months, reporting a complication rate of 3% with none of the complications being related to CA.[9] However, both studies lacked a control group without CA for comparison.

In a retrospective review of patients who underwent CMN fixation with and without CA, Goodnough et al.[12] noted a 6% rate of cut-out and a 9% reoperation rate in their cohort with all adverse outcomes occurring in the non-cemented group. However, the study was limited by small sample size (11 cemented, 33 non-cemented), and the investigators were unable to demonstrate a significant difference between the groups. In a similar study of 76 patients (47 cemented, 29 non-cemented) at minimum six month follow-up, Yee et al.[11] showed a significantly lower rate of fixation failure and no instances of varus cut-out in the CA group. There were three cases of varus cut-out and one case of medial perforation in their non-cemented group, while none were noted in the cemented group.

In a randomized control trial of 253 patients, Kammerlander et al.[13] reported that no patient in the CA group suffered mechanical failure, but six failures were noted in the non-augmented group. Although this difference failed to achieve statistical significance, the study suggested that CA may prevent reoperations due to mechanical failure by creating a stronger osteosynthesis construct. We agree with their recommendation for a large-scale randomized controlled clinical trial to further investigate the utility of CA in CMN fixation.[13]

Limitations. Our study had limitations, including its retrospective design and relatively short follow-up duration. Additionally, the decision to use CA was not standardized but left to the surgeon's discretion based on intraoperative assessment of bone density and fracture reduction. Consequently, there was a strong bias towards using bone cement augmentation in patients with osteoporotic bone. This limitation could be addressed in a future study on CA by incorporating objective measures of bone mineral density.

CONCLUSIONS

This retrospective comparative cohort study of geriatric intertrochanteric hip fractures treated with the DePuy Synthes TFNA fixation system found no significant differences in complications or reoperations between cases with CA and those without. The traumatologists in this study continue to use CA in osteoporotic bone settings, as PMMA may help reduce CMN fixation failure, but they await more definitive studies.

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KANSAS JOURNAL of MEDICINE

Brief Report

Social Determinants of Health in a Kansas Community Health Center

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ABSTRACT

Introduction. This study explored the connection between social determinants and patient self-rated health at Health Ministries Clinic (HMC) in a rural Kansas community. Community health centers, like HMC, strive to deliver comprehensive care that addresses patients' social needs.

Methods. The authors employed a convenience sampling method to survey HMC patients with appointments from September to December 2018. The authors analyzed the data using Chi-square tests and descriptive statistics in RStudio, considering $p < 0.05$ as significant.

Results. Among 200 patient responses, education, income, employment, and insurance status were negatively correlated with self-rated health. Notably, 86.2% of college or graduate school graduates reported positive health ratings, compared to 40% of those who did not finish high school ($\chi^2(12, N = 185) = 25.75$, $p = 0.012$). Lower income individuals (income <$34,000 per year) consistently rated their health poorer than their higher income counterparts ($\chi^2(12, N = 174) = 23.96$, $p = 0.021$). Patients without insurance or with public insurance (Medicaid/CHIP) perceived their health as worse than those on private health insurance and Medicare ($\chi^2(12, N = 137) = 35.67$, $p < 0.001$).

Conclusions. Our findings suggest that low educational attainment, income, and lack of health insurance are associated with barriers to healthcare, resulting in poor health outcomes and chronic disease among those with lower socioeconomic status. This underscores the strong association between social determinants and self-rated health among HMC patients. These results can be used by other clinics to assess the needs of their patient population and enhance community health initiatives. ***Kans J Med 2024;17:61-63***

INTRODUCTION

In 2010, the World Health Organization (WHO) emphasized health equity in their report *Closing the Gap*, urging global action on social determinants of health.[1] In the U.S., literature confirms a link between low-income and impoverished communities and a higher risk of chronic disease, mental illness, high mortality, and low life expectancy.[2,3] Studies by Mode et al.[3] and Braveman et al.[2] found a negative correlation between economic status and mortality rates, as well as with chronic conditions such as coronary heart disease and diabetes. Braveman et al.[2] attributed this to a dose-response relationship, where poorer socioeconomic status is associated with poorer health outcomes. Cockerham et al.[4] suggested that the higher rates of chronic diseases among lower socioeconomic status individuals are not only due to poor access to care but also limited financial resources that hinder healthy lifestyles.

Alongside income, educational attainment also plays a crucial role in health outcomes. Krueger et al.[5] found that males without a high school diploma faced a 23% higher risk of death compared to those with diplomas. Additionally, Vaughn et al.[6] reported that individuals without high school diplomas had higher odds of chronic diseases, including diabetes (OR = 1.32), heart disease (OR = 1.18), and stroke (OR = 1.55). Hahn and Truman have documented that individuals with no high school diploma often rate their health lower than those with higher educational attainment.[7] Self-rated health has been shown to be a reliable indicator of overall health and a strong predictor of mortality.[8,9]

In Kansas, numerous populations, both urban and rural, face challenges in accessing quality healthcare. Historically, Harvey County, located approximately 25 miles north of Wichita, has been one such area. HMC was established with the mission of providing healthcare to vulnerable populations in Harvey County, aiming to improve healthcare access and equity in the community.[10] In 2007, it officially became a Community Health Center (CHC). After Ascension Via Christi Clinic left Harvey County due to financial reasons, HMC took over the remaining patient population on October 27, 2017, becoming the largest primary care provider in the county.[10] This study examined how social determinants of health relate to the self-rated health of patients at HMC, a CHC in central Kansas. Understanding these local health influences is vital for effective community health initiatives. The goal was to gain a deeper understanding of how social determinants of health impact the patient population in Harvey County, KS.

METHODS

From September to December 2018, we invited a convenience sample of HMC clinic patients to participate in the study. Informed consent and paper surveys were provided by front office staff during check-in. Participation was optional, and it did not affect the care received. Completed surveys were placed in a locked drop-box, which was collected weekly by the research team. The inclusion criteria were adult patients (18 years and older) with clinic appointments during the specified months, excluding children and those who had previously participated. Additional survey details are available in the online Appendix A (appendix is only available online at journals.ku.edu/kjm).

We concluded data collection after receiving 200 completed surveys. Each participant was assigned a unique identification number, which was linked to their responses. The data were entered into Google Sheets and then exported to RStudio for analysis. We utilized Pearson's Chi-square tests for independence, with a significance level of $\alpha = 0.05$.

RESULTS

Data from 200 patients were included in data analysis. The majority of respondents identified as female (67.5%), white (78%), and middle-income (41.5%). Full demographic data is available in Appendix B (appendix is only available online at journals.ku.edu/kjm).

Education. Higher levels of educational attainment are associated with higher self-rated health scores ($\chi^2(12, N = 185) = 25.75$, $p = 0.012$). Among the patient population, 86.2% (n = 50) of college or graduate school graduates rated their health as good, very good, or excellent,

whereas only 40% (n = 4) of individuals who did not finish high school gave positive ratings. Similar trends were observed for fair health ratings, represented in Table 1.

Table 1. Respondents' education level and self-rated health.[a]

	Finished College or Graduate School	Some College or Vocational Training	High School Diploma or GED	Did Not Finish High School
Excellent, no. (%)	10 (17.2)	5 (7.6)	5 (9.8)	0 (0)
Very good, no. (%)	21(36.2)	12 (18.2)	11 (21.6)	1 (10)
Good, no. (%)	19 (32.8)	34 (51.5)	15 (29.4)	3 (30)
Fair, no. (%)	6 (10.3)	12 (18.2)	15 (29.4)	5 (50)
Poor, no. (%)	2 (3.4)	3 (4.5)	5 (9.8)	1 (10)
Total	**58**	**66**	**51**	**10**

[a]$\chi^2(12, N = 185) = 25.75, p = 0.012$

Income Level. Lower income status patients rated their health poorer compared to middle- and high-income patients ($\chi^2(12, N = 174) = 23.96, p = 0.021$). Analysis showed that 42.6% (n = 29) of low-income patients viewed their health as fair or poor, while only 14.5% (n = 12) and 9.1% (n = 1) of middle- and high-income patients viewed their health as poorly, respectively. Table 2 represents this trend and shows middle- and high-income groups consistently rating their health as very good or excellent at higher rates.

Table 2. Respondents' income levels and self-rated health.[a]

	Prefer Not to Answer	Low	Middle	High
Excellent, no. (%)	1 (8.3)	5 (7.4)	9 (10.8)	1 (9.1)
Very good, no. (%)	3 (25)	11 (16.2)	27 (32.5)	5 (45.5)
Good, no. (%)	4 (33.3)	23 (33.8)	35 (42.2)	4 (36.4)
Fair, no. (%)	4 (33.3)	20 (29.4)	11 (13.3)	1 (9.1)
Poor, no. (%)	0 (0)	9 (13.2)	1 (1.2)	0 (0)
Total	**12**	**68**	**83**	**11**

[a]$\chi^2(12, N = 174) = 23.96, p = 0.021$

Insurance Status. Table 3 shows those who lack insurance or are publically insured view their health as worse than those on private health insurance and Medicare ($\chi^2(12, N = 137) = 35.67, p < 0.001$). Notably, 83.3% (n = 10) of individuals on Medicaid or other public insurance and 46.2% (n = 6) of the uninsured population rated their health as fair or poor. In contrast, 14.7% (n = 11) of privately insured and 21.6% (n = 8) of Medicare patients rated their health as fair or poor.

Table 3. Respondents' insurance status and self-rated health.[a]

	None/ Uninsured	Medicaid/ CHIP/Other Public	Medicare	Private
Excellent, no. (%)	1 (7.7)	0 (0)	3 (8.1)	9 (12)
Very good, no. (%)	1 (7.7)	0 (0)	9 (24.3)	22 (29.3)
Good, no. (%)	5 (38.5)	2 (16.7)	17 (45.9)	33 (44)
Fair, no. (%)	4 (30.8)	7 (58.3)	8 (21.6)	9 (12)
Poor, no. (%)	2 (15.4)	3 (25)	0 (0)	2 (2.7)
Total	**13**	**12**	**37**	**75**

[a]$\chi^2(12, N = 137) = 35.67, p < 0.001$

DISCUSSION

Our findings show that the social determinants of health surveyed correlated significantly with participants' self-rated health, with the strongest relationships being on insurance status. Overall, there is a connection that exists between self-rated health, chronic disease, continuity of healthcare, and barriers to care with those on the margins of society reporting poorer health. This is consistent with the observations from prior studies suggesting that individuals with low education and income experienced both lower health ratings and higher rates of chronic disease.[2,3,7]

The findings suggest a system of low educational attainment, income, and lack of health insurance influencing the formation of barriers to healthcare, further cascading to poor health outcomes and chronic disease for those with lower socioeconomic status. Khullar and Chokshi[11] suggested that poor health limits a person's ability to work and reduces economic opportunities, limiting further educational attainment and an increased risk of taking on medical debt. Bor and Galea[12] called this a cycle, noting the reciprocal impact health and poverty have on each other. This cycle continues due to rising healthcare costs in the U.S., disadvantaging those who do not have incomes to support their health. The cost of living a healthy life is also increasing in the U.S., with expensive fruits and vegetables, gym memberships, and the like becoming a necessity.[12] For those with less income, the cheaper options are to pick unhealthier lifestyles.[13]

The association between poor self-rated health and lower income status in this study was also demonstrated by Hamel et al.[14] who identified that 4 in 10 people making under $50,000 a year struggled to pay for their medical bills. This trend extended based on insurance status, with 53% of uninsured people reporting to struggle to pay their medical bills, and only 20% of the insured population describing the struggle to pay for services.[14] This underscores the impact of lower socioeconomic status, specifically uninsured individuals, avoiding health services due to fear of cost.[15]

Limitations. The authors acknowledge the major limitation of this study is the age of the data presented. Due to pressures of the COVID-19 pandemic, public dissemination of these data were delayed. Despite being five years old, the authors argue these data offer lasting insight on the impact of social determinants of health in a specific Kansas community. According to the WHO, local data "is an integral part of the overall health equity surveillance process," and can be used to improve local change, and lead to health empowerment.[1(p.183)] This research, conducted with HMC, aimed to identify gaps in their care.

Another limitation is the use of a convenience sample, potentially not fully representative of HMC's patient population. Of this sample, the majority of survey completions were by women. This gender disparity may result from women's higher healthcare service utilization.[16] Another limitation included the reliance on clinic staff for survey distribution. Throughout the study, the research team needed to regularly communicate with staff to remind them of the study's importance and

the need to distribute it to all patients who met inclusion criteria. Survey data, by nature, provides insight that is limited to a single period in time. Additionally, it is difficult to establish direct cause-and-effect relationships between variables in survey data, as correlation does not imply causation. These factors should be considered when recognizing constraints of survey-based research.

Furthermore, these data were intended to gain a better understanding of the social determinants of health affecting a single clinic's population in rural Kansas. This was not intended to be representative of the U.S. population as a whole, but rather provide a snapshot of the patient population at HMC. The authors relayed these results back to leadership at HMC to guide quality improvement at the clinic.

CONCLUSIONS

This study highlights correlations between low income, limited education, and poor insurance coverage with lower self-rated health in the Newton, KS community. Integrating this into existing literature, the authors demonstrate the specific social determinants of health that affect the patients at HMC. This study identified areas of improvement at HMC, and further use of this survey can prompt additional quality improvement studies at healthcare facilities.

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Keywords: social determinants of health, community health center, health status, health inequities, health disparities, medically underserved area

KANSAS JOURNAL of MEDICINE

Case Report

Multiple Myeloma with Concurrent Pericardial Effusion

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INTRODUCTION

Multiple myeloma (MM) is a malignant neoplasm characterized by the clonal proliferation of plasma cells within the bone marrow, leading to the overproduction of monoclonal immunoglobulins.[1] It is a relatively rare malignancy, with an annual incidence rate of 7.1 cases per 100,000 people.[2] MM predominately occurs among the elderly, with a median age of 69 years and displays a higher incidence among males.[3] Despite advancements in treatment modalities, MM remains an incurable disease, necessitating ongoing research into novel therapeutic strategies.[4] This case report highlights the unexpected diagnosis of MM in a patient who initially presented to a hospital with a pericardial effusion.

CASE REPORT

A 54-year-old female with a past medical history of cutaneous lupus erythematous, presented to the emergency department (ED) complaining of severe right upper quadrant abdominal pain radiating to her back for the last three weeks. The patient was noted to have a low hemoglobin (Hgb) of 7.4 gm/dl (12-16gm/dl), high creatinine (Cr) of 1.67 mg/dl (0.6-1.0 mg/dl), elevated calcium (Ca) of 10.3 mg/dl (8.5-10.1 mg/dl), and an elevated serum total protein level of 11.9 gm/dl (6.4-8.2 gm/dl). Ultrasound of the liver and gallbladder showed mild hepatomegaly, with no sign of cholelithiasis or acute cholecystitis, which was of primary concern to the patient upon presentation to the ED. A follow-up computed tomography (CT) of the abdomen and pelvis without contrast was completed, which showed a T11 compression fracture (Figure 1) and a large pericardial effusion with a maximal depth of 3.3 cm (Figure 2).

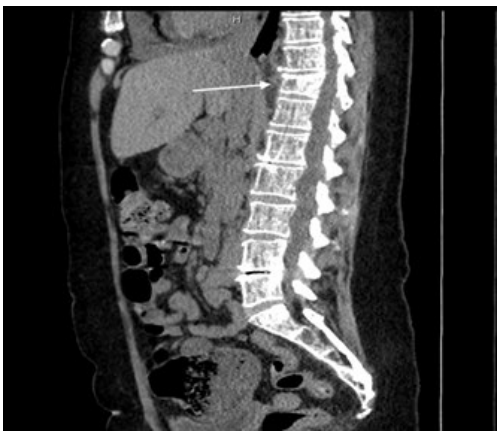

Figure 1. T11 compression fracture.

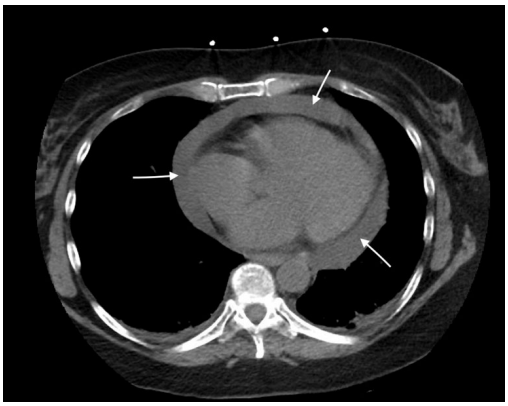

Figure 2. Pericardial effusion, max depth 3.3 cm.

Given the persistent upper abdominal pain, along with the CT findings of a large pericardial effusion, a stat echocardiogram was ordered, and a pericardial window was scheduled for the following day. Upon completion of the procedure, the patient reported that her upper abdominal pain was resolving, and she was feeling better. Despite these positive reports, the patient was noted to have persistent hypercalcemia with calcium at a level of 12.3 mg/dl (8.5-10.1 mg/dl) and ionized Ca at 6.8 mg/dl (4.5-5.3 mg/dl), as well as anemia with Hgb at 8.2 gm/dl (12-16 gm/dl), and an acute kidney injury with Cr at 1.26 mg/dl (0.6-1.0 mg/dl). The patient exhibited symptoms of hypercalcemia, including constipation, extremity paresthesia, frequent urination, and persistent thirst. Due to these symptoms, along with laboratory reports, concurrent back pain, an established T11 compression fracture, and other findings commonly seen in MM patients (Table 1), a workup for this disease process was initiated.

Table 1. Common signs and symptoms of multiple myeloma.[5]

Signs and Symptoms	Incidence, %
Anemia	73
Bone pain (generally severe and provoked by movement)	58
Elevated creatinine	48
Fatigue/generalized weakness	3
Hypercalcemia	28
Pathologic fracture	26-34
Weight loss	24
Paresthesias	5
Hepatomegaly	4
Splenomegaly	1
Lymphadenopathy	1
Fever	0.7

A peripheral blood smear was completed first, which showed 2 plus rouleau formation within the specimen. Serum protein electrophoresis with monoclonal protein was ordered, along with kappa/lambda light chains. IgG monoclonal protein was seen on immunofixation (IgG 5672 mg/dl Normal: 586-1602 mg/dl) with a lambda light chain specificity (K/L ratio of 0.03, Normal ratio 0.26-1.65). Upon receiving these lab reports, a bone marrow biopsy was conducted, which revealed diffuse

hypercellularity of the bone marrow, with up to 70% tumor burden of clonal malignant plasma cells within the specimen. Given these findings, a diagnosis of MM was made based off the updated MM diagnostic criteria (Table 2). At this time the patient was noted to have a significantly altered mental status with hallucinations, which was attributed to hypercalcemia and hospital-induced delirium. Her mental status improved significantly with management of the hypercalcemia. The patient completed her first course of chemotherapy in the hospital and was scheduled to continue with outpatient treatment at a community hematology/oncology clinic.

Table 2. Multiple myeloma diagnostic criteria.[6]

Both criteria must be met:
1. Clonal bone marrow plasma cells ≥10% or biopsy-proven bony or extramedullary plasmacytoma 2. **Any one or more of the following myeloma defining events:** • Evidence of end organ damage that can be attributed to the underlying plasma cell proliferative disorder, specifically: • Hypercalcemia: serum calcium >0.25 mmol/L (>1 mg/dL) higher than the upper limit of normal or >2.75 mmol/L (>11 mg/dL) • Renal insufficiency: creatinine clearance <40 mL per min or serum creatinine >177 µmol/L (>2 mg/dL) • Anemia: hemoglobin value of >2 g/dL below the lower limit of normal, or a hemoglobin value <10 g/dl • Bone lesions: one or more osteolytic lesions on skeletal radiography, CT, or PET-CT • Any one or more of the following biomarkers of malignancy: • Clonal bone marrow plasma cell percentage ≥60% • Involved: uninvolved serum free light chain ratio ≥100 • >1 focal lesions on MRI studies

DISCUSSION

Etiologically, MM is thought to arise from genetic abnormalities, particularly chromosomal translocations involving chromosome 14.[7] The aberrant proliferation of plasma cells disrupts the delicate balance within the bone marrow microenvironment, causing bone destruction, anemia, hypercalcemia, and renal impairment.[8] The patient presented with lab abnormalities consistent with bone marrow aberrancy, but she was much younger than the usual median age for MM (69 years) diagnosis.

While MM patients can be asymptomatic, the two most common presenting symptoms are fatigue and bone pain.[9] Hyperviscosity can also be an issue due to the altered makeup of the vascular environment with some patients ending up with pulmonary emboli or ischemic strokes.[10] Hypercalcemia symptoms, such as constipation, nausea, vomiting, psychosis, and increased thirst and urination, also can manifest after the lytic bone process has taken place. While the patient manifested some of the above symptomatology later in her hospital stay, her only complaint upon admission to the ED was radiating upper abdominal pain, which was an unusual disease presentation.

This unusual disease presentation was eventually attributed to this patient's pericardial effusion. MM can be a rare cause of pericardial effusion and if MM is suspected to be the cause of the effusion, this can be determined by identifying plasma cells in the pericardial fluid and within the pericardial biopsy specimen itself.[11,12] While this patient presented with a pericardial effusion prior to the eventual diagnosis of MM, the final etiology of the effusion was determined to be idiopathic, as no plasma cells were noted on cytology of the pericardial fluid, and no other inflammatory infiltrates were seen within the pericardium itself. However, it is worth noting that the sensitivity of detecting malignancy on pericardial fluid has been found to be approximately 70% and as such there is a sizable possibility of a false negative result.[13]

After a diagnosis of MM has been made based on lab results and symptomatology, the five-year survival of this disease is 57%.[14] Age is one of the most influential factors in this disease process as those older than 66 years have a significant decrease in overall survival compared to younger individuals.[15] Cytogenetic proliferation index, as well as other intrinsic properties like cellular characteristics of the tumor cells themselves, also play a significant role.[16] Hypoalbuminemia and AKI were both noted during lab evaluation of this patient; both of these are independent negative prognostic indicators for MM.[17,18] In this patient's case, her younger age at diagnosis may allow for longer survival and more prompt and effective response to treatment.

Treatment regimens vary mildly between cases, depending on practice preference and response rates. One primary facet of care that must be addressed is the hypercalcemic response seen among MM patients from the destruction of bone due to the lytic myeloma lesions. For this, isotonic saline and bisphosphonates are mainstays of treatment in the reduction of the osteoclastic response.[19] This patient received both treatments, and a reduction in excess urination, constipation, and confusion were noted.

Once symptomatic treatment has been disseminated, goal-directed therapy can be the focus. MM therapy is dominated by three drug regimens such as Bortezomib cyclophosphamide and dexamethasone (VCD), which was the initial regimen given to this patient during hospitalization. This is typically given in cycles of four, with subsequent autologous stem cell transplant (ASTC) to follow. Ineligibility criteria for ASTC include exclusion parameters such as patients older than 77 years, those with cirrhosis, Eastern Cooperative Oncology Group performance status of 3 or 4, or New York Heart Association class III or IV heart failure.[20] Although remission can be achieved through this therapeutic regimen, no current cure exists. Further research must be done into new therapeutic approaches with the hope of not only inducing remission but curing the patient of disease.

In conclusion, this case involved a unique blend of presenting characteristics in a patient with MM. MM does not always present with a clear symptomatology, which is exemplified by this case where the patient was much younger than the median age at presentation and presented due to symptoms stemming from a pericardial effusion of an ultimately unknown source.

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Keywords: multiple myeloma, pericardial effusion

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Case Report

Challenges in Anesthetic Management in a 25-Year-Old Patient with Ichthyosis

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INTRODUCTION

Ichthyosis is a group of skin disorders caused by abnormalities in skin growth and shedding, leading to excessive keratinization. There are over 50 types of ichthyoses, each with varying symptoms, but all are characterized by abnormal skin cornification.[1] The condition is rare, with less than one case per 2,000 individuals.[2] Ichthyosis can result in skin barrier issues, eyelid ectropion, joint mobility difficulties, and reduced sweating, posing risks for infections, sepsis, and other complications.[1-4] Prior reports have suggested that malnutrition and vitamin deficiencies are more common in patients with ichthyosis, especially with severe forms.[5-7] Ichthyosis can be genetic or acquired,[8] and while there is no cure, treatments focus on managing symptoms.[9]

This report describes a unique case of an adult patient with suspected lamellar ichthyosis undergoing elective shoulder surgery. The lack of pre-operative communication about the patient's condition required problem-solving strategies that led to a delay in the surgery. The patient provided written, informed consent for the publication of this report.

CASE REPORT

A 25-year-old female underwent shoulder surgery at an outpatient surgery center. The anesthesiologist noted several physical characteristics, including thickened skin, ectropion, and an eclabium, which made preparation for surgery challenging. The team used ultrasound guidance to secure intravenous (IV) access in the antecubital fossae due to non-visible and non-palpable veins. However, the patient's skin caused the IV lines to clot, requiring a new line to be inserted in the leg at a shallow angle under ultrasound guidance. The IV was sutured into place due to the patient's skin scales preventing the use of tape or other securing methods.

During induction, the patient was given lidocaine, fentanyl, propofol, and succinylcholine. Intubation was successful with a GlideScope® on the first attempt. To secure the endotracheal tube, the team tied a gauze roll around it and circumferentially wrapped it around the patient's head. Gel lubricant was applied to the eyes and covered with gauze due to ectropion. The patient was rolled laterally during the procedure, and precautions were taken to prevent the tube from dislodging. Electrocardiogram (EKG) electrodes were secured with lateral pressure from rolled-up towels for continuous cardiac monitoring.

The patient maintained stable vitals throughout the procedure, was extubated without difficulty, and transferred to the post-anesthesia care unit. The IV was removed post-operatively.

DISCUSSION

Lamellar ichthyosis, a non-fatal form of ichthyosis, is likely the subtype affecting the patient, given her age and facial features.[10] Lamellar ichthyosis typically is identified at birth by the presentation of a collodion baby with features like ectropion and eclabium.[11] Despite increased risks of infection, dehydration, and malnutrition, patients with lamellar ichthyosis generally have a normal life expectancy.[4] Alternatively, the patient could have an acquired form of ichthyosis, but without a comprehensive history, determining the exact type is challenging.[1] Regardless of the specific form, long-term and perioperative management are similar among the subtypes.[2,12]

Ichthyoses present various anesthetic challenges. In this case, the patient's skin condition made it difficult to place an IV line without ultrasound guidance. Due to the skin's inefficacy with adhesives, the team sutured the IV in place and used alternative methods to secure the endotracheal tube and EKG electrodes.[4,13,14] Limited mobility and difficulty with intubation due to facial involvement and reduced neck extension also are considerations.[4,5] Lubricating gel and careful positioning have been used to address these issues in previous cases.[4,13-15]

There are no specific contraindications to anesthesia for patients with ichthyosis,[4,5] and both inhaled anesthetics and total intravenous anesthesia have been used.[13-15] However, it is important to note that systemic retinoids, a common treatment for ichthyosis, can be harmful to the liver and bones.[16] Pre-operative communication about the patient's skin condition is crucial to prepare for potential challenges. Improved communication, possibly through a perioperative surgical home model, can enhance perioperative care and patient outcomes.

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Commentary

Integrating Trauma-Informed Care into the University of Kansas School of Medicine Utilizing the Curriculum, a Student Interest Group, and Community Partnerships

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INTRODUCTION

Trauma is prevalent throughout the general population with a significant impact on morbidity and mortality. An estimated 89% of Americans have experienced a traumatic event, with many people reporting exposure to frequent traumatic events.[1] Individual trauma, such as motor vehicle accidents, causes lasting distress and adverse health effects. Interpersonal trauma encompasses human trafficking, elder abuse, and other events that occur in a relationship between two or more individuals. Collective trauma includes systemic social issues, such as homophobia and racism, that affect a group of people.[2,3] Data show that trauma increases the likelihood of developing chronic illnesses such as bipolar disorder, depression, diabetes, substance use disorder, cancer, cardiovascular disease, and asthma.[4-13] Furthermore, trauma can affect patients' overall healthcare utilization, which can further lead to negative health outcomes.[14] Therefore, trauma on individual, interpersonal, and collective levels is an important social determinant of health.

Despite the high prevalence of trauma, many providers lack trauma-informed care (TIC) training.[15] The TIC framework teaches professionals awareness of trauma and knowledge of its impacts. TIC works on six main principles: safety; trustworthiness and transparency; peer support; collaboration and mutuality; empowerment, voice, and choice; and cultural, historical, and gender issues.[10,11,16-20] Adopting these TIC principles improves patient engagement, treatment adherence, and health outcomes.[21] TIC also helps providers practice better self-care, develop stress management and second-hand trauma management strategies, and improve quality of care for their patients.[3,20] Therefore, due to its improvements in both patient and provider outcomes, TIC should be prioritized in medical practices and education.

Medical students are in the unique leadership position to influence changes on both the educational and clinical levels of the medical school to incorporate TIC.[3] TIC practices must be incorporated throughout the medical school, including the curriculum and student extracurricular activities, to thoroughly educate medical students on the principles of TIC and the effects of trauma. We based our intervention off the "Learn, See, Practice, Prove, Do, and Maintain" approach to learning.[22] A summary of our intervention goals is shown in Figure 1. In this paper, we discuss TIC integration at the University of Kansas School of Medicine (KUSOM) through a novel student-lead initiative, which includes curriculum changes, a TIC student interest group (TICIG), and partnership with the JayDoc Free Clinic in Kansas City, KS.

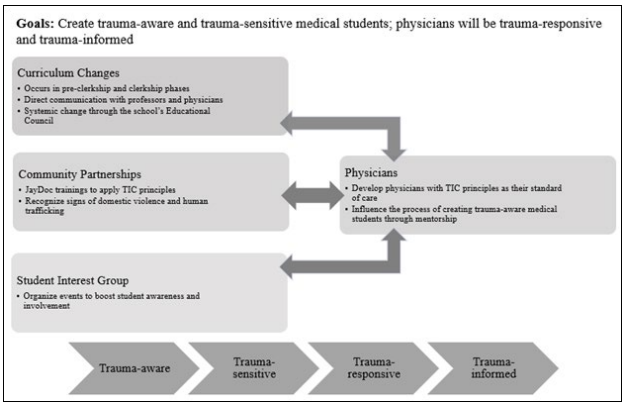

Figure 1. Analysis of approach.

Curriculum Integration

The KUSOM utilizes the unique Active, Competency-based, Excellence-driven (ACE) curriculum. Phase I (years one and two) of the ACE curriculum combines traditional lectures with small group case-based and problem-based learning sessions, anatomy lab, and clinical skills practice. Phase II (years three and four) includes clerkships, with a required rural Kansas rotation. Year three also includes an 'Issues in Clinical Medicine' course that incorporates interprofessional and specialty-specific clinical scenarios/simulations. Both Phases I and II emphasize coaching where students receive personalized feedback from multiple assigned faculty mentors to help students reach their personal and professional goals.[23-27] The overall curriculum follows graduation competencies, which lay the framework for learning objectives tracked in Phase I and II.[23] The Educational Council oversees changes to the curriculum.[23] We based our intervention off the "Learn, See, Practice, Prove, Do, and Maintain" approach to learning.[22] Students learn TIC principles through lectures and JayDoc clinic trainings; see TIC by providers in the clinical skills lab of the Phase I curriculum, clerkships in the Phase II curriculum, and the JayDoc clinic; practice in curriculum sponsored and extracurricular activities; prove TIC competence through standardized assessments incorporating TIC learning objectives;[23] do TIC themselves at the JayDoc clinic and in Phase II; and maintain TIC throughout their careers. Incorporation of TIC principles into the curriculum has been demonstrated to improve TIC knowledge and help maintain student empathy.[24]

First utilizing a top-down/administrative[28,29] approach, we contacted the director of the Phase I curriculum. We gave a 10 minute presentation which included TIC-based learning objectives that could be threaded throughout the existing pre-clerkship curriculum, example slides for assimilation into pre-existing lectures, and a list of lectures that could benefit from TIC. The TIC learning objectives displayed in Table 1 were formulated based on existing ACE curriculum objectives, the TIC principles, and current literature.[20,23,30-32] Due to administrative requirements, these objectives have not yet been presented to the Educational Council, which will lead to official incorporation into the KUSOM curriculum.

Table 1. Trauma informed care learning objectives.

1. Recognize the six key principles of trauma informed care (TIC) and how practicing TIC leads to improved patient communication.
2. Understand the term "trauma informed care," and its relevance in organizational reform for policies and procedures.
3. Distinguish between trauma specific and trauma informed.
4. Identify ways of understanding possible reasons behind an individual's thinking, behavior, and way of relating by using their knowledge of NEAR science.
5. Participants will explore the historical context of TIC and its impact on the development of current medical practices.
6. Define trauma on individual, interpersonal, and societal levels by addressing topics such as systemic oppression, historical and collective trauma, and chronic stress.
7. Recognize the etiology, prevalence, and signs of trauma and how that may influence the patient's values and care preferences.
8. Understand the relationship between social determinants of health and trauma.
9. Recognize how adverse childhood events affect psychological and social development across the lifespan including expected reactions to stress, economic, cultural and gender influences.
10. Understand how a personal history of trauma can impact the patient's ultimate care goals and approach to care.
11. Participants will take an appropriate and sensitive patient history and exam, prioritizing the safety and needs of a patient by selecting techniques and language outlined in TIC guidelines.
12. Describe the medical and psychosocial effects of trauma and how they impact patient care.
13. Practice trauma-informed language and behaviors during all patient interactions, regardless of disclosed history.
14. Students will acknowledge the potentially stressful impacts of healthcare on patients that may elicit a trauma response and utilize TIC to reduce patient discomfort.
15. Recognize how trauma informed care can improve patient experiences, treatment compliance, and outcomes.
16. Integrate community resources and assistance from other professionals to comprehensively address the full needs of the patient including emotional distress and social determinants of health in a timely manner.
17. Acknowledge how the TIC framework is applicable to chronic and acute traumatic events.
18. Define secondary traumatic stress. Describe healthy coping techniques that can be used to prevent and manage secondary traumatic stress.

While waiting for curriculum procedure in the top-down approach, a simultaneous bottom-up/demonstration[28,29,33] approach was deemed necessary. Therefore, we gathered a team of advisors including a clinical nurse coordinator and KUSOM faculty. The advisors acted as liaisons between faculty and students, and as expert resources in their respective fields. Our team reached out to the faculty authors of existing lectures that could benefit from TIC content. When contacting a specific faculty member regarding alterations to their lectures, topic specific resources were included to guide them in their edits. Suggested edits included the addition of new concepts, such as information on adverse childhood experiences, or adding content warnings for distressing images to prevent secondary traumatic stress. Edits emphasized the use of trauma-informed language. Our faculty advisors also worked with the lecturer as needed to incorporate adequate changes. Our combined efforts for the curriculum are displayed in Figure 2.

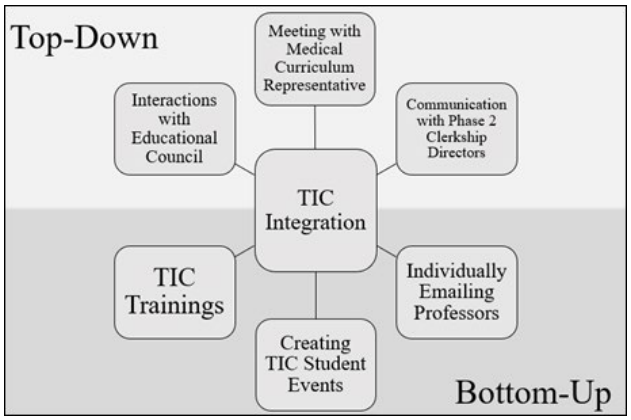

Figure 2. Multifaceted approach.

TIC training is provided for physicians in the University of Kansas Health System, but not students at the KUSOM. Therefore, a knowledge gap is currently present between students graduating from KUSOM and those entering the workforce as residents. To address this, future plans for the integration of TIC include introducing it in the Phase II curriculum and in the clinical skills lab[23] to prepare KUSOM students for residency and their careers as physicians. Official integration will also ensure TIC learning objectives are testable material on Phase I and Phase II exams. Including TIC in both phases of the curriculum will optimize spaced repetition learning and enforce TIC use in clinical practice.[34,35]

Community Partnerships

JayDoc is a KUSOM student-run, free, urgent-care clinic located in Kansas City, KS.[23,36] The clinic offers a variety of specialty services including Women's Health in Pregnancy (WHIP) Night, which prioritizes OB/GYN care for uninsured women.[36] At WHIP Night, patients are screened for intimate partner violence.[34] Domestic violence is a growing problem within the patient community, affecting their health outcomes.[35,37-39] Students were not previously trained in interacting with patients who had experienced trauma. Assisted by our faculty mentors, we trained all first- and second-year student volunteers on TIC principles, recognizing signs of domestic violence and human trafficking, and community resources. Informal survey results showed positive responses to the TIC-focused training. A WHIP Night focused training on trauma-informed pelvic exams[40] also was incorporated. Furthermore, we established a partnership between the JayDoc clinic and local domestic violence shelters to improve access to OB/GYN appointments. At these appointments, a trained sexual assault nurse examiner was present to ensure patients received optimal TIC and provided brief TIC informational sessions for volunteers at the beginning of the clinic session.

TIC Student Interest Group (TICIG)

Medical school student interest groups nurture leadership, influence specialty choices, and build relationships among students, faculty, and the community.[41-45] Several institutions have initiated TIC interest groups and training sessions.[46-49] The bottom-up approach to

curriculum changes necessitated student involvement in TIC practices, leading to the establishment of a student-led TIC interest group (TICIG). TICIG offers additional education on TIC beyond the curriculum, organizing monthly events and an annual TIC Week each fall. Events include lunch lectures, volunteer opportunities, and clinical skills practice. Previous TIC integration efforts lacked emphasis on multiple specialties.[31] TICIG addresses this by offering diverse events, showcasing the relevance of TIC across various specialties.

Before becoming an official KUSOM group, we hosted events like the 2022 TIC Week, emphasizing women's health. The week offered hands-on training in trauma-informed pelvic exams, insights into local trauma survivor resources, awareness of domestic violence and human trafficking signs, and a supply drive for a nearby shelter. KUSOM's approval of TICIG as an official interest group enabled funding for student lunches and event supplies, leading to our inaugural TICIG event in May 2023. Future plans include collaborating with specialty-specific student groups for guest speakers in fields like gastroenterology, cardiology, and gender-affirming care.

TICIG's executive board oversees event organization, curriculum development, and the JayDoc free clinic partnerships. TICIG executive board leaders, in the pre-clerkship phase of the ACE curriculum, have the unique ability to suggest real-time content changes. As they advance through medical school, they continue identifying lectures that would benefit from TIC content and collaborate with faculty authors. Faculty have been supportive, incorporating suggested curriculum alterations promptly. With faculty sponsor assistance, the executive board will actively seek TIC opportunities in the ACE curriculum, creating a self-sustaining model

CONCLUSIONS

Trauma is common and can lead to adverse health effects. Therefore, health care professionals must be educated in recognizing trauma, the effects of trauma, and how to combat initial trauma, re-traumatization, and second-hand trauma. Adopting TIC principles in a hospital setting improves patient engagement, treatment adherence, and health outcomes. Incorporation of TIC principles into the curriculum has been demonstrated to improve TIC knowledge and help maintain student empathy. For TIC to be accepted as the standard of care, it must be reinforced in medical school curriculum, extracurricular student activities, and the hospital system. Our approach to integrating TIC into the KUSOM offers a cyclic repetition style of introduction to TIC principles, strategies for interacting with patients with a traumatic history, and emphasizing a wide range of TIC across medical specialties. Barriers to implementation included a lack of literature regarding the incorporation of learning objectives into the KUSOM curriculum. Furthermore, the need to navigate multiple levels of school administration (reaching out to lecturers, contacting representatives of the Educational Council, etc.) as first-year medical students with few pre-existing connections was daunting. However, faculty contacted by students expressed interest in the mission of TIC and were supportive (changed their language during lecture, facilitated connections with other faculty members, guided students in how to follow the path to the Educational Council, etc.). Future work should include official integration into the KUSOM curriculum to ensure that the "Learn, See, Practice, Prove, Do, and Maintain" model is completed.

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