TABLE OF CONTENTS

**Case Report**

1. Intravenous Fat Emulsion (IFE) Improvement of Qt-Interval in Tricyclic Antidepressant Overdose
   – Ryan Mason*, William Hurley and Richard B. Utarnachitt

**Research**

2. A Multisource Derivation of Guidelines for Education and Screening for Human Trafficking in the Emergency Department
   – Stephen Morris*, Marlee Hahn and Brandy Cluka

**Brief Research Report**

3. Point-of-Care Ultrasonography in a Domestic Mass Casualty Incident: The Boston Marathon Experience
   – Andrew J. Eyre*, Michael B. Stone and Heidi H. Kimberly

**Case Report**

4. Acute Flank Pain, Flank Mass and Hypovolemic Shock due to Kidney Cysts Rupture: An Emblematic Case of Wunderlich Syndrome
   – Giovanni Cacciamani*, Salvatore Siracusano, Maria Angela Cerruto, Silvia Bassi, Alessandro Tafuri, Vincenzo de Marco, Antonio Benito Porcaro and Walter Artibani

**Case Report**

5. A Distal Clavicle Fracture With Unusual Displacement of the Medial Part: A Case Report
   – Suzanne F. van Rijn*, Laurens Kaas, Annechien Beumer and Ronald Boer

**Retrospective Research**

6. A LEAN Approach to Emergency Department Crowding in a Southern California Health System
   – Ching Che J. Chiu, Tina T. Tsai*, Rachele Hwong, JJ Stewart, Su-yen Wu, Sasha Yu, Nicole Chorvat, Spencer Liu, William Huang, Michael Agron, Jon Aquino, Eing-Min Chang, Steve Giordano, Donald Lorack, Howard Ternes, Matthew Lin, Jonathan Wu and Wen-Ta Chiu
Intravenous Fat Emulsion (IFE) Improvement of Qt-Interval in Tricyclic Antidepressant Overdose

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ABSTRACT

Here we report a case of a 62-year-old female with a potentially lethal ingestion of a tricyclic antidepressant (nortriptyline) refractory to conventional therapy. In the emergency department, she was profoundly hypotensive and significantly acidotic. She received several sodium bicarbonate boluses followed by continuous sodium bicarbonate infusion in addition to multiple vasopressors. Despite these measures, the patient remained dangerously hypotensive with a prolonged QT interval. Lipid emulsion was started with a bolus and infusion. Subsequently, the patient successfully weaned off pressor support and her QT interval normalized. After a short hospital course, patient was discharged with only moderate cognitive impairment.

KEYWORDS: Tricyclic Acid Overdose; Intravenous Fat Emulsion Therapy.

INTRODUCTION

Intentional overdose of tricyclic antidepressants (TCAs) remains a potentially lethal ingestion commonly seen in emergency departments. Among the many toxicities related to TCA overdose, cardiac suppression along with prolongation of QT interval is most concerning manifestation as it can lead to lethal dysrhythmias.

Rescue therapy using intravenous fat emulsion (IFE) therapy has been demonstrated to be a beneficial antidote for many acute poisonings. IFE for the use of bupivacaine toxicity was first described in animal models in 1998. Clinically, the therapy was first used successfully for an intra-operative bupivacaine toxicity in 2006. Since then, the use of IFE indications have expanded to include many lipophilic medication overdoses including TCAs. A recent survey of poison control centers noted 69% now recommend IFE for TCA overdose.

We now present a case of TCA overdose refractory to traditional therapies, improved with IFE.

CASE REPORT

A 62-year-old female was found by her husband at 12:30 pm at home unresponsive next to a suicide note stating a mixed ingestion including nortriptyline, gabapentin and pregabalin at 10:30 am. Unfortunately, the exact dosages remain unknown. Eventually, EMS was called who arrived at 2:55 pm to find the patient to be unresponsive, reporting a Glasgow Coma Scale score of 3. She was noted to have had multiple seizure episodes. In addition, she was also found to be profoundly hypotensive with a blood pressure of 68/palpation and a heart rate of 84 beats per minute (bpm). After establishing IV access, the patient was intubated and started to receive fluid resuscitation on route to the emergency department (ED).

Upon arrival in the ED at 3:40 pm, the patient was still hypotensive with a blood pressure of 87/67 and a heart rate of 82 bpm. The initial 12 lead ECG tracing was concerning for a prolonged QRS interval of 192 milliseconds (ms) and QTc of 550 ms. (Figure 1) The patient’s...
arterial blood gas was significant for a respiratory acidosis pH of 7.28 and a lactate of 3.5 mm/L. Her respiratory rate on the ventilator was increased from 12 breaths per minute to 24 breaths per minute to account for her respiratory acidosis. The patient received a total of three boluses of sodium bicarbonate in addition to the continuous infusion of sodium bicarbonate. The patient was noted to have two seizure episodes each lasting less than 15 seconds, both of which were treated with 5 milligrams (mg) of intravenous (IV) diazepam. Concurrently with on-going fluid resuscitation, the patient was started on dopamine, norepinephrine and epinephrine infusions. Bedside ultrasound of the patient’s heart demonstrated poor cardiac contractility despite adequate fluid resuscitation and escalating doses of multiple vasopressors. Norepinephrine was infusing at 30 micrograms per minute (mcg/min), epinephrine at 40 mcg/min and dopamine at 15 mcg/min. Her blood pressure remained labile with mean arterial pressures ranging from 52 to 64 mm Hg. Twelve lead ECG also demonstrated persistently prolonged QRS and QTc intervals. The range of QRS intervals was between 128 and 192 and the range of QTc intervals was 586-706 ms. (Figure 2) The decision was made to initiate lipid emulsion rescue therapy given the refractory nature of this ingestion. Poison control was contacted and agreed with our plan to initiate lipid emulsion therapy in the ED with the initial bolus 100 millilitre (ml) bolus of 20% lipid emulsion then 0.25 milliliters per kilogram per minute (ml/kg/min) over 10 minutes for a total volume of 250 ml at 9:30 pm. Repeat 12 lead ECG approximately 2 hours after lipid administration showed resolution of prolonged QRS and QTc. (Figure 3). The patient required decreasing amounts of vasopressor support throughout the night. She was successfully weaned off of vasopressors between 6 and 9 hours after lipid administration. The remainder of her hospital stay was uneventful. She was noted to have some moderate cognitive deficit but able to perform activities of daily living. She was discharged to an inpatient psychiatric facility after hospital day eight.

![Figure 1. Initial 12-lead ECG demonstrating prolonged QRS and QTc.](image1)

![Figure 2. Subsequent 12-Lead ECG with continued QTc prolongation despite sodium bicarbonate therapy.](image2)

![Figure 3. 12-lead ECG after lipid emulsion infusion with normalization of QRS and QTc intervals.](image3)
DISCUSSION

In recent years, there have multiple well document case reports of IFE therapy used to successfully treat TCA overdose. We believe our study adds to this growing body of information. To our knowledge, this study is the first description of IFE therapy specifically in an overdose of nortriptyline, a metabolite of amitriptyline. Initially, the mechanism of IFE was unknown, theoretic mechanisms such as “lipid sink” were proposed, but lacked much evidence. As interest in IFE grows, more research has been undertaken to elucidate its action. This case report provides an opportunity to review current research in this area.

Current research into the action of IFE therapy indicates it is likely multimodal, simultaneously affecting multiple physiologic processes. The 2015 Fettiplace et al study proposes three related mechanisms based on bench research. First, the lipid acts a shuttle, drawing the lipophilic toxin out of the cardiac tissue and transporting it to tissues where it can be safely metabolized. As the intra-tissue toxicity decreases, the lipid is then able to directly support cardiac inotropic function. Finally, free fatty acids from the lipids provide a supportive energy source throughout detoxification. These mechanisms of action help us understand how IFE supports cardiac function. However, this proposal of mechanism has few caveats when discussing its use specifically in TCA overdose.

The research undertaken and reviewed by Fettiplace et al looked primary at bupivacaine, a long-acting anesthetic. Bupivacaine acts primary on voltage-gated sodium channels while TCAs have multiple cellular targets, thus their mechanism of toxicity is primarily different. Secondly, bupivacaine is administered as a solution, as opposed to TCAs, which are absorbed through the gastric mucosa complicating the bioavailability and duration of action. Therefore, we should carefully interpret IFE in the setting of TCA overdose.

Beyond the inherent drawbacks to the case report format, our case study has a number of other limitations. Foremost, the patient suffered a multi-substance intoxication, as documented by her suicide note. Gabapentin and pregabalin present possible confounders as to which drug IFE was actually treating. However, the patient did present with hypotension and ECG changes consistent with TCA overdose, and these clinical manifestations have not been described with gabapentin or pregabalin.14

Also unfortunately, there was no documentation of the suspected amount of ingestion. The listed half-life of nortriptyline is 16-90 hours. Gastric absorption always makes this a moving target, but it is possible that the resolution of the patient’s hypotension was the natural course of her disease and that the IFE was merely a correlation.

CONFLICTS OF INTEREST: None.

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A Multisource Derivation of Guidelines for Education and Screening for Human Trafficking in the Emergency Department

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ABSTRACT

Trafficking in persons is a major problem that intersects many facets of society, including the legal system, law enforcement, and healthcare. While some elements of American society have been active in improving awareness and action against trafficking in persons, healthcare has been slow to adopt standardized education and training about this population. There remains some ambiguity regarding how to identify these victims, but some understanding of screening can be correlated from literature surrounding intimate partner violence. An understanding of what is known of the epidemiology, combined with evidence of efficacy of screening techniques for other vulnerable populations, supports targeted screening. Emergency medicine as the front line of the healthcare system has a unique opportunity to access these vulnerable patients and connect them with services. With a review of easily accessible literature, training, and legal documents, we make a case for a comprehensive training program for emergency medicine residents. Our recommended training would include epidemiology of the populations involved, screening and interviewing, training and practice, understanding of ways to access local resources, and education around risk factors and indicators to help identify victims.

INTRODUCTION

Human trafficking in persons (TIP) was defined in 2004 by the United Nations in Article Three, paragraph (a) of the Protocol to Prevent, Suppress and Punish Trafficking in Persons as “the recruitment, transportation, transfer, harbouring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation.”1

Due to the criminality of TIP there is no accurate way to determine incidence and prevalence. Estimates by various sources place the number of trafficked individuals in the range of 4 to 27 million globally with perhaps a half million of these people being exploited in the United States.2,3 The problem in the United States is particularly distressing given our cultural emphasis on freedom and our comparatively robust healthcare, social service, law enforcement, and legal systems. Healthcare offers a clear avenue for identification of victims and an opportunity to bring the victims to safety; however, the medical establishment has been slow to embrace the potential role they could serve in addressing this problem. Several recent review articles have highlighted the great overlap of health care and victims of TIP, with perhaps 50% of them seeking medical care while still under the influence of their captors.4-5 The problem in the United States is particularly distressing given our cultural emphasis on freedom and our comparatively robust healthcare, social service, law enforcement, and legal systems. Healthcare offers a clear avenue for identification of victims and an opportunity to bring the victims to safety; however, the medical establishment has been slow to embrace the potential role they could serve in addressing this problem. Several recent review articles have highlighted the great overlap of health care and victims of TIP, with perhaps 50% of them seeking medical care while still under the influence of their captors.4,5 Additionally, there is a clear lack of standardized education and training around TIP within the spectrum of medical education. Another excellent review of educational resources highlighted the inconsistency in resource quality and availability, emphasizing the need.8 It shows evidence that we have missed opportunities to identify and intervene as well as highlights the dearth of and need for clearer training guidelines within the medical profession.

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Emergency medicine as the front line of healthcare in the United States has a special role with regard to identification of victims and there is a clear need for improved education and standards for training. Many have called for the incorporation and standardization of TIP training in medical education and residency training, but the literature has few practical recommendations. Using the available literature on TIP and the literature on intimate partner violence (IPV), as well as an awareness of the overall curriculum of emergency medicine residency, we propose a series of guidelines for an emergency medicine curriculum in TIP.

METHODS

Because the literature on TIP traverses multiple social areas (legal, law enforcement, global and public health, economics, healthcare), a formatted comprehensive literature search was not possible. Therefore, the research team opted to use a combination of generalized Pub-Med searches and internet and lay-literature sources to gather the most prominent current literature that would be available to residency directors seeking to develop a program. While this non-traditional research method leaves the possibility of key components being missed, it represents a more practical approach to gaining an understanding of a subject that crosses multiple academic lines.

RESULTS

Screening: IPV as a guide to TIP

It is presumed that routine screening for victims of human trafficking in the emergency department is beneficial, given that there are few opportunities to identify these victims and that appropriate interventions may impact future health outcomes. The current absence of universal screening recommendations to detect victims of TIP in a healthcare setting is likely due to a limited understanding of this population, minimal research regarding the utility and effectiveness of a standardized approach, and unknown resource availability for those who screen positive. We can look at the extensive but sometimes contradictory literature regarding an analogous population, those suffering from IPV, to help guide our approach to screening for TIP in a healthcare setting. (Box 1)

| Box 1: Using IPV to help guide approach to trafficking. |

Historically, there has not been ample evidence to support routine screening for IPV in healthcare settings. For example, in a small randomized control trial (RCT) conducted in New Zealand, women presenting to the emergency department were randomized to one of two groups. A control group received standard of care and treatment group received risk stratification, a brief IPV screening questionnaire, and education. At short-term follow up there was no significant difference in subsequent IPV reported by women who had been randomized to either group, but long term implications of this intervention were not evaluated.

Furthermore, another RCT of IPV conducted in a variety of healthcare settings, including emergency departments, again randomized women to one of two groups. Women in the intervention group completed a survey prior to their interaction with a clinician. The clinician was then able to use his or her discretion to provide referrals or further intervention based on risk assessment ascertained from the survey results. The control group completed the survey as well, but only after the clinician visit. Although women in the intervention group had a lower rate of IPV and better quality of life at follow-up, there was not a statistically significant difference between the two groups.

More recent research has supported screening for IPV routinely and the United States Preventive Services Task Force recommends that healthcare providers screen for IPV in all women of childbearing age, even in the absence of risk factors. This recommendation is based on a systematic review that highlights multiple screening tools, which are short, simple to administer, and able to identify both those suffering from abuse currently and those at risk of future abuse. Examples of screening questions include “Has your partner pushed or slapped you?” and “Have you ever been afraid of a partner?”

An additional systematic review also determined that current research supports screening for IPV in a healthcare setting. Based on the studies evaluated, there is no evidence of harm due to screening; however, the literature does not clearly identify the best screening modality or intervention. Additionally, a variety of screening tools were determined to be effective, although some of these may be not be appropriate to utilize in the emergency department and it remains unclear which specific tools would be the most efficient and accurate in that setting.

While the medical literature does not have a validated screening tool for TIP, there exist screening and interviewing techniques employed by those outside of medicine. Some of these tools are widely accepted and validated for use in the legal and law enforcement domains. One such example is the Trafficking Victim Identification Tool (TVIT), which supports our recommendations below.
Awareness and Education

Though the global and national burden of TIP is difficult to quantify, there have been efforts on several fronts to increase the awareness and education regarding TIP. The Institute of Medicine National Research Council issued a report regarding trafficking of minors in the US and identified a guide for healthcare providers. They highlight the fact that there is not a strong universal language for communicating about trafficking of persons and that many factors contribute to the poor recognition of this problem, including underreporting, vulnerability of victims, poorly defined protocols, and lack of awareness in recognition.15 In 2013 a collaborative effort from the Administration for Children and Families and the Health and Human Services gave rise to a federal initiative “SOAR to Health & Wellness,” which moved to expand healthcare education regarding human trafficking.14 With a working group of healthcare professionals, survivors, and experts, a pilot training and evaluation was developed and implemented by 180 healthcare providers across the nation. (Table 1)

Other available resources have come from isolated local efforts. The University of Texas School of Public Health, in collaboration with The Houston Rescue and Restore Coalition, developed the “Health Professionals and Human Trafficking: Look beneath the Surface, H.E.A.R. Your Patient” for front line healthcare workers, which provides educational training and 3 month follow-up.15 Children’s Health Care of Atlanta developed a webinar e-learning training with five sessions to provide similar educational efforts.16 Further, the Polaris Project offers free webinars,17 however we have not found a universal curriculum specifically designed for the emergency medicine physician in training.

In an attempt to survey the educational modalities available, a recent literature analysis revealed 27 items providing basic guidance on human trafficking, none of which have been evaluated rigorously.18 The majority of these are geared toward the general healthcare community, not specifically MDs, and none of these evaluated outcomes on practice or successful implementation of curricula. They summarize that “appropriate education and training about human trafficking in professional school, continuing education, and in-service training can enable the healthcare workforce to become an active, vital partner in human trafficking identification, intervention, and prevention.” Thus, thoughtful design and development of such training would be the first step in capitalizing on the unique relationship between healthcare providers and victims of TIP.19

### DISCUSSION

The disconnect between the literature showing questionable efficacy of screening and institutional guidelines recommending routine screening creates ambiguity with regard to the implementation of programs in the emergency department. Nevertheless, an understanding of what is known of the epidemiology, combined with evidence of efficacy of screening techniques for other vulnerable populations (IPV), supports at a minimum

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Screening Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex Trafficking</td>
<td>History of victimization, mental health issues, or substance abuse</td>
</tr>
<tr>
<td></td>
<td>Reproductive or sexual-health related health concern (STD, pregnancy)</td>
</tr>
<tr>
<td></td>
<td>Monitoring or controlling behavior of another individual during medical visit</td>
</tr>
<tr>
<td></td>
<td>Injuries or unmet health needs</td>
</tr>
<tr>
<td></td>
<td>Absence of knowledge of local environment</td>
</tr>
<tr>
<td></td>
<td>Works in an industry with known history of abuse, such as massage</td>
</tr>
<tr>
<td>Labor Trafficking</td>
<td>Anxious, avoids eye contact</td>
</tr>
<tr>
<td></td>
<td>Lacking identification documents</td>
</tr>
<tr>
<td></td>
<td>Underage and physical evidence of manual labor (injury, etc)</td>
</tr>
<tr>
<td></td>
<td>Monitoring or controlling behavior of another individual during medical visit</td>
</tr>
<tr>
<td></td>
<td>In or from an agricultural or industrial area or one with seasonal employment</td>
</tr>
<tr>
<td>Domestic Servitude</td>
<td>From an immigrant population where domestic servitude trafficking is common (Southern and Southeast Asia, the Middle East.)</td>
</tr>
<tr>
<td></td>
<td>Anxious, avoids eye contact</td>
</tr>
<tr>
<td></td>
<td>Lacking identification documents</td>
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<tr>
<td></td>
<td>Underage and physical evidence of manual labor (injury, etc)</td>
</tr>
<tr>
<td></td>
<td>Monitoring or controlling behavior of another individual during medical visit</td>
</tr>
<tr>
<td>Immigrant Workers</td>
<td>Refuses to answer questions with another individual in the room</td>
</tr>
<tr>
<td></td>
<td>Refuses to engage with someone who speaks their language</td>
</tr>
<tr>
<td></td>
<td>Works in an industry known for abuse, such as nail salons, massage, restaurants, convenience stores etc</td>
</tr>
</tbody>
</table>

Table 1: Activity specific trafficking indicators and screening questions.
targeted screening. While this offers the possibility of missing patients, increasing awareness of the problem and highlighting known at-risk populations may yield a greater proportion of victims identified than generic screening tools. For example, tailoring screening questions around the nature of the trafficking, such as farm labor trafficking or sex trafficking, may improve catchment. Standardizing this approach as much as possible has been described as providing a “set of practice protocol and screening questions” for service providers and will give them the tools to identify victims.20

Emergency Medicine Residency Curriculum for TIP

A comprehensive TIP curriculum should be added to the emergency medicine residency program, preferably in the first year to maximize the development and implementation of these skills throughout the duration of training. In addition, as there is no standardization or national requirements of TIP curriculum in medical school, there is no guarantee of baseline knowledge. Familiarity with local resources, from hospital-based social work to law enforcement procedures and community-based support organizations, vary considerably and residents should be made aware of what resources are available and how to engage them. Additionally, tailoring scenarios and trainings to match local perceived or known prevalence and patterns of criminal behavior is appropriate and these scenarios should be emphasized to residents. For example, in areas where there is a significant migrant farm labor, male farmers may be the target population, in urban areas and on shipping corridors sex trafficking maybe of highest concern, or in certain populations domestic servants maybe at greatest risk. Site visits to organizations involved with anti-trafficking efforts, as well as simulation cases and provision of literature on TIP, would lead to a more robust curriculum tailored to principles of adult learning.

Identifying those at risk, screening them appropriately, and providing them with available services requires residents to understand the social forces at work, the patients perspective, and to set themselves up for success by maximizing their interview and the practice environment. The following section provides some guidelines for curriculum development, which will need to be augmented with local resources. (Box 3)

Emergency Department Practice Guidelines for screening of TIP

To effectively implement screening in the emergency department, it is important to clearly explain your role as a healthcare provider and advocate while being supportive and non-judgmental. To encourage engagement of other team members, emphasize your concerns to other health care providers (nurses, Sexual Assault Nurse Examiner, sexual health providers, violence evaluation team, etc.) and ensure their response is appropriate. Employ social work or available social services early to assist in evaluation and management whenever possible. Furthermore, it is of utmost importance to ensure safety and confidentiality of a potential victim while following institutional guidelines regarding reporting requirements, notification of social services organizations, and law enforcement. (Box 4)

Box 3: Recommendations for curriculum requirements.
- Understanding of local/national/global epidemiology.
- Scenario based screening and interviewing training.
- Local resources and how to access them.
- Warning signs of those being and vulnerable to being trafficked.
- Patient responses to disclosure of trafficking.
- Practice to reinforce appropriate and tailored interviewing skills.

Box 4: Recommendation for resident training in human trafficking.
- Targeted screening by emergency medicine residents after completing a training program.
- Use of patient specific standardized questions based on an understanding of risk factors and indicators of trafficking.
- Use of case based scenario testing to sharpen interviewing skills of residents.
- Comprehensive understanding of local resources for TIP.

LIMITATIONS

Our greatest limitation was that a thorough and formulaic review of the intimate partner violence and trafficking in persons literature was beyond the scope of our research. We realize an extensive review within the relevant academic and social fields would be useful, however, review of many aspects of social and legal literature regarding this subject is outside the scope of the realm of emergency medicine and thus our researchers.

An institutional review board review was not indicated due to the public nature of documents reviewed.

CONCLUSION

While the evidence on how to identify and manage the victims of human trafficking is inconclusive, what is clear is that there is a great unmet need with regard to healthcare providers awareness of and education on this subject. By utilizing and understanding the current literature on TIP, lessons learned in other realms, such as screening tools for intimate partner violence, interview techniques and practices from the legal and law enforcement literature, and what is known about the environment of the emergency department, we have constructed a guideline for the development of a curriculum on the subject for emergency medicine residents. This guideline, supplemented with an understanding of local epidemiology and available resources, can allow residency programs to fulfill a portion of the unmet educational need on this important subject.

CONFLICTS OF INTEREST: None.

REFERENCES


Point-of-Care Ultrasonography in a Domestic Mass Casualty Incident: The Boston Marathon Experience

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ABSTRACT

Background: The role of Point-of-Care (POC) ultrasonography in domestic Mass Casualty Incidents (MCI) has not been well established. On April 15th, 2013, two improvised explosive devices were detonated near the finish line of the Boston Marathon injuring 264 patients and killing 3. These patients were rapidly stabilized and transported to Boston area hospitals.

Objectives: To examine the role of POC ultrasonography during the Emergency Department response to a large-scale domestic MCI, and to identify successful processes as well as barriers to care delivery in order to best prepare for future events.

Methods: An online survey containing multiple-choice and open-response questions was distributed to Emergency Medicine housestaff, physician assistants, fellows and attending physicians in the Boston area Emergency Departments who cared for patients during the Boston Marathon MCI.

Results: There were 50 respondents from 6 hospitals who were directly involved with patient care. 23 respondents (46%) performed POC ultrasounds during the MCI, but only 8 of these respondents (35%) documented findings in the usual fashion by saving images including patient medical record numbers. Many respondents altered documentation patterns due to lack of patient information/registration data and to time constraints. Focused assessment with sonography in trauma (FAST) exams were reported as the most useful application (96%), followed by lung sliding (36%), and soft tissue/foreign body exams (18%). Respondents noted that POC ultrasound provided clinical information sooner than plain films and computed tomography (CT) scans, as these traditional imaging resources were significantly overwhelmed. Many described the value of POC ultrasound in resource allocation and triage once acute intra-abdominal and thoracic injuries had been excluded. Respondents reported being hindered by too few ultrasound systems or systems with long boot-up times and/or lack of battery power.

Conclusions: Though limited by our retrospective survey-based methodology, our findings indicate that POC ultrasound was utilized in the hospital-based response to a large-scale domestic MCI. POC ultrasound was especially useful given delays in traditional imaging. Our findings highlight the difficulties with normal documentation patterns during such events, and suggest that specific planning for POC ultrasound should be incorporated into future MCI preparedness.

KEYWORDS: Ultrasonography; Mass Casualty Incidents; Disasters.

INTRODUCTION

The use of Point-of-Care (POC) ultrasonography has been described during the emergency response to Mass Casualty Incidents (MCI) such as natural disasters and military battles.1-8 POC ultrasonography plays an increasingly important role in emergency medicine training and patient care.9 Additionally, POC ultrasonography has been incorporated into routine trauma management and is considered standard of care.10,11 However, the role of POC ultrasonog-
raphy has not been well established during domestic mass casualty incidents such as bombings, shootings, and other attacks targeting civilian populations. Unfortunately, domestic mass casualty incidents, such as bombings and mass shootings, are becoming more common. In recent years and months, the world has witnessed a large number of such man-made mass casualty incidents that have lead to significant loss of life and disability. During such events, hospital resources are overwhelmed and it can be difficult or impossible to provide care in the routine, standard fashion. As a low cost, rapid, easily repeatable, focused, and clinician-performed modality, POC ultrasonography offers many characteristics that may be valuable during a domestic mass casualty event.

On April 15th, 2013, two improvised explosive devices were detonated near the finish line of the Boston Marathon in Boston, Massachusetts, USA. As a result of these explosions, 3 patients died at the scene, and an additional 264 patients were injured. These patients were rapidly stabilized and transported to one of several Boston area hospitals within 45 minutes of the explosions.12-13 This mixed-methods study sought to build on personal experience by describing the role that POC ultrasonography played during the Emergency Department response to this large-scale domestic MCI.14 Additionally, we sought to identify successes and challenges related to the use of POC ultrasonography in this setting, in order to best prepare and train for inevitable future events.

METHODS

We created an 11-question, mixed-methods, and online survey (surveymonkey.com) containing demographic, multiple-choice, and open-response questions. Given the unanticipated nature of the bombing and our desire to limit the time that elapsed from event to survey response, the survey questions were not prospectively validated. A link to the survey was distributed via email to all emergency medicine providers, including housestaff (resident physicians), physician assistants, fellows and attending physicians, at the Boston area hospitals who received patients directly from the Boston Marathon MCI, including 2 adult level 1 trauma centers, 2 level 1 adult/level 1 pediatric trauma centers, 1 adult level 1/level 2 pediatric trauma center, 1 level 1 pediatric trauma center, and one academic-affiliate community hospital. Non-emergency medicine providers were not included in the study. After an initial email inviting participation, a second follow-up email was sent ten days later. These emails were distributed by the emergency medicine ultrasound directors of the participating institutions. Only providers who directly cared for patients during the incident were asked to respond. Given the inability to directly target specific providers with the survey, a response rate could not be calculated. The study was reviewed and exempted by the Institutional Review Board (IRB).

RESULTS

There were 50 respondents from 6 hospitals who were directly involved with patient care of victims from the Marathon. 19 respondents (39%) were Emergency Medicine housestaff, 2 (4%) were physician assistants, 1 (2%) was a fellow and 27 (55%) were attending physicians, with one respondent declining to reveal their level of training. See Figure 1 of the 50 respondents, 23 (46%) performed POC ultrasounds during the MCI. Providers reported caring for an average of 4.7 MCI patients (range 1-15) and performing 2.6 ultrasounds (range 1-10) on those patients. While FAST exams were reported as the most useful application (96%), followed by lung sliding (36.4%) for pneumothorax, providers also utilized POC ultrasonography for soft tissue/foreign body exams (18.2%) and vascular access (4.6%). Figure 2.

However, only 8 (35%) of the respondents who utilized POC ultrasonography documented findings in the usual fashion by saving digital images and/or video clips that included patients medical record numbers. Respondents reported altering documentation patterns both due to lack of patient information or registration data and to time constraints. In the open response questions, respondents noted that POC ultrasonography was especially useful given the delay in plain radiography and CT scans. Many respondents described the value of POC ultrasonography in resource allocation and triage once acute intra-abdominal and thoracic injuries had been excluded. Respondents reported being hindered by ultrasound systems with long boot-up times and/or lack of battery power and by having too few ultrasound machines available.

Figure 1: Level of training of survey respondents.
DISCUSSION

The unpredictable nature of mass causality incidents makes them difficult to investigate systematically and in a rigorous fashion. Our study, while limited by its retrospective survey design, is one of the few studies to describe the utility and limitations of point-of-care ultrasound during domestic mass casualty events such as bombings, mass shootings, and other man-made disasters. We found that nearly half of respondents reported using POC ultrasonography to assess and treat patients during the hospital-based response to a large-scale domestic MCI. As might be expected in a multi-trauma incident, the most commonly utilized applications included the FAST exam and chest ultrasonography, which allowed providers to quickly assess for life threatening thoracic or abdominal trauma. POC ultrasonography was also utilized to evaluate soft tissues given the multiple shrapnel injuries and for procedural guidance during central venous catheter placement. In addition, we found that POC ultrasonography was utilized by providers at all levels of training.

The anecdotes shared by respondents in the open response questions describe both the utility and challenges of POC ultrasonography during this incident. Traditional radiology imaging resources were overwhelmed during this incident and have been shown to be heavily utilized in other MCIs. The ability to perform rapid bedside POC ultrasonography provided crucial clinical information early on given significant delays in obtaining plain radiography studies or CT scans due to the large surge of patients. POC ultrasound was also described as a triage tool in patients awaiting CT scans or operative intervention. In some cases, ultrasound was able to exclude significant life threatening injuries allowing expedited operative management for patients with isolated extremity injuries.

While about half of the survey respondents utilized POC ultrasonography, the other half reported their ability to utilize POC ultrasonography was limited by access to ultrasound machines, and delayed machine boot-up times. Some described lack of training or comfort level with ultrasound as a barrier and others described the scene as too chaotic to incorporate ultrasound. It is possible that given more readily available ultrasound systems specifically targeted to the point-of-care applications (i.e. portable systems with extended battery life and rapid boot up times) ultrasound would have been even more widely utilized during this event.

Another significant challenge cited by survey respondents involved documentation of ultrasound findings. We found that normal documentation patterns of saving digital images and/or video clips that included patients medical record numbers were followed only in a minority of cases. Respondents cited lack of time and unregistered patients as the main barriers to documentation. When ultrasound findings are not recorded and documented appropriately, it may hinder the ability to perform serial examinations, communicate findings with other team members, and perform quality assurance. As a result of this incident, our institution revised our unidentified patient registration process and charting protocols. Paper charts that stay with the patient include an area for documentation of the bedside ultrasound. Our experience highlights the importance of incorporating POC ultrasonography use and documentation into MCI and emergency preparedness planning.

This study was designed to describe the role of POC ultrasonography in a domestic MCI, both how it was utilized and the barriers to its effective use in order to assist in preparation for future MCI events. Given the unanticipated nature of such events, our study was retrospective in nature and is limited by its survey-based design. We were unable to calculate a response rate as the survey was sent to all ED providers at the 6 sites although only those who were actively involved in the care of patients were asked to respond. We did not include other departments and it is possible that surgical/trauma services also utilized POC ultrasonography. Given that the majority of ultrasound exams were either not linked to patient medical record numbers or the images were not saved, we were unable to review ultrasound clips to perform quality assurance or evaluate clinical outcomes. Similarly, we did not evaluate participant’s level of
experience, certification, or comfort level with POC ultrasonography. Finally, this study is specific to the Boston Marathon MCI where multiple academic medical centers are located, and may not be generalizable to other incidents in other locations. Despite these limitations, this study suggests that POC ultrasonography was utilized during the hospital based response to a large scale domestic MCI. Given the unfortunate increase in urban mass casualty incidents, future investigations evaluating how POC ultrasonography affects clinical care and outcomes during both domestic and international MCI’s would be of great benefit. We recommend incorporating POC into disaster preparedness planning.

CONCLUSIONS
In this retrospective survey of emergency providers, we found that POC ultrasound was utilized by almost half of respondents during the hospital-based response to a large-scale domestic MCI, enabling rapid bedside evaluation and triage of multiple patients. Our findings also highlight the barriers to use such as machine specific issues and challenges with normal documentation patterns. Specific planning for POC ultrasound should be incorporated into disaster protocols and preparation.

CONFLICTS OF INTEREST
The authors have no conflicts of interest to disclose.

AUTHOR’S CONTRIBUTIONS
All authors assisted with study design; study materials; data review; and manuscript preparation.

ETHICAL CONSIDERATIONS
This project was approved by the Institutional Review Board (IRB). Participant consent was completion of the survey. No consent is required to publish our article.

REFERENCES
Acute Flank Pain, Flank Mass and Hypovolemic Shock due to Kidney Cysts Rupture: An Emblematic Case of Wunderlich Syndrome

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ABSTRACT

Spontaneous perinephric hemorrhage (SPH) due to kidney cysts rupture is uncommon complication but when it occurs can cause an emergency situation that may endanger the patient’s life. Wunderlich first described the condition of spontaneous, non-traumatic renal bleeding confined to the subcapsular and perirenal spaces. Herein, we report a case of Wunderlich syndrome (WS) due to spontaneous rupture of a simple kidney cyst. In our case, the spontaneous retroperitoneal hemorrhage (SRH) was associated to a probable giant haemorrhagic cyst that is uncommon since cyst rupture occurs into caliceal system rather than the perinephric space. Wunderlich syndrome after spontaneous, non-traumatic kidney cyst rupture is a rare entity. A multimodality approach is necessary to have a definitive diagnosis in order to choose the best treatment possible for the patient.

KEYWORDS: Lenk’s triad; Wunderlich syndrome; Renal cysts; Retroperitoneal hematoma; Spontaneous Retroperitoneal Hematoma (SRH).

INTRODUCTION

Kidney cysts (KC) include both benign and malignant etiology and can occur spontaneously or be caused by acquired cystic kidney disease, such as polycystic kidney disease (PKD). KC are masses that are predominantly composed of spaces filled with clear or straw-colored fluid. Spontaneous perinephric hemorrhage due to KC rupture is uncommon complication but when it occurs can cause an emergency situation that may endanger the patient’s life.

In 1856 Carl Wunderlich first described the condition of spontaneous, non-traumatic renal bleeding confined to the subcapsular and perirenal spaces that may present with a classic triad of symptoms known as “Lenk’s triad”: acute flank or abdominal pain, flank mass and hypovolemic shock. Herein, we report a case of Wunderlich syndrome (WS) due to spontaneous rupture of a simple KC.

CASE REPORT

A 75-year-old man presented to the emergency department with left flank pain that lasted for 5-6 hours. His medical history included hypertension, mitral regurgitation, aspirin therapy, implantation of cardiac pacemaker for an atrioventricular block, infrarenal aorticaneurysm repair, chronic renal failure (serum creatinine 6 mg/L, creatinine clearance sec., Cockcroft-Gault 10 ml/min). He had no history of previous abdominal trauma. Physical examination indicated moderate tenderness across the whole abdomen, which was more evident on the left side. He had a severe hypotension, pulse rate of 92 beats/min, respiratory rate of 24 breaths/min and body temperature of 36.8 °C.
A complete blood count revealed a hemoglobin (Hgb) of 6 g/dL and a severe thrombocytopenia.

A computed tomography (CT) scan was performed. It showed a retroperitoneal hematoma on left side and left hemoperitoneum extended to the pelvic cavity (Figure 1A and 1B).

The patient underwent an angiography scan showing a hemorrhagic spreading from the left kidney. Due to the rapid worsening of clinical conditions the patient underwent an explorative laparotomy. A large retroperitoneal hematoma extending from the renal region to the pelvis was found and a left nephrectomy was done.

During this surgical manoeuvre an accidental injury of the tail of the pancreas occurred with a modest parenchymal laceration that was immediately sutured. Five hours later, a second explorative laparotomy due to persistent abdominal bleeding and hemodynamic instability was done.

Twenty-four hours later a CT scan angiography showed a modest hemorrhagic spreading from a minor branch of the superior mesenteric artery that was unsuccessfully embolized. Nevertheless, the patient showed a hemodynamic stability which was maintained as such in the following days. A haemodialysis therapy started in the subsequent days.

Histopathological examination described an atrophic kidney end-stage-type with cortico—medullary atrophy, multiple giant cystic lesions without specific coating.

DISCUSSION

The WS is a potentially life threatening condition. In a meta-analysis on spontaneous perirenal hemorrhage, the most common etiology are benign or malignant neoplasms (61%) with angiomyolipoma being predominant (29.1%) followed closely by renal cell carcinoma (26.1%) and vascular disease (17%) with polyarteritis nodosa occurring most frequently (12%).

This emergency condition may occur with acute flank pain, flank mass and hypovolemic shock in 83%, 19% and 11% respectively.

In our case, the spontaneous retroperitoneal hemorrhage was associated to a probable giant haemorrhagic cyst that is uncommon since cyst rupture occurs into caliceal system rather than the perinephric space. In this context large KC, hemorrhage and infection and a coexisting urinary tract obstruction are predisposing factors for spontaneous cyst rupture.

In literature sparse cases of WS due to the non-traumatic rupture of a simple KC were reported. In particular Puerta et al described a case of perirenal hematoma due to rupture of a KC in a 50 years old female occurred with pain, a mass in left renal fossa and hypovolemia, who needed surgical drainage of the hematoma without nephrectomy. Finally, Lin et al described another case of spontaneous perinephric hemorrhage due a hemorrhagic renal cyst in 46-years-old women that was conservatively treated.

In our case, the presence of hemoperitoneum not allowed a conservative treatment and an explorative laparotomy was mandatory.

CONCLUSION

Wunderlich syndrome after spontaneous, non-traumatic kidney cyst rupture is a rare entity. A multimodality approach is necessary to have a definitive diagnosis in order to choose the best treatment possible for the patient.

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CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CONSENT

The patient has provided written permission for the publication of this case details.
REFERENCES


A Distal Clavicle Fracture With Unusual Displacement of the Medial Part: A Case Report

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ABSTRACT

Introduction: A 22-year-old man came to the emergency department after a fall on right shoulder. The radiographs showed a distal clavicle fracture with apparent disruption of the acromioclavicular joint (AC-joint). The CT-scan however showed an intact AC-joint with a Neer type IIb fracture pattern, except for a dislocation of the medial fragment to dorsocaudal.

Intervention: Ten days after trauma the patient was treated with open reduction and internal fixation using a hook plate.

Outcome: Six weeks after surgery the patient had no pain and full range of motion of the arm.

Discussion: There are two ways to classify a distal clavicle fracture; the Craig’s classification or the Neer classification. In both classifications there is the medial part of the clavicle is elevated in a type IIb distal clavicle fracture. The X-ray in this case was misleading, appearing as a disruption of the AC-joint. In this case there probably was a blow to the shoulder and the medial part of the clavicle was pushed caudally and got captured under the distal fragment of the clavicle. There are two systematic reviews and one meta-analysis about the treatment of a distal clavicle fracture. They all state that a hook plate is the most frequently used fixation technique, although it seems to have the highest complication rate.

INTRODUCTION

A distal clavicle fracture is a relatively uncommon injury.1 When a distal clavicle fracture occurs, there is usually elevation of the medial part of the clavicle as the lateral fragment is held in place with the acromioclavicular (AC) capsule. Hereby, we present a case of a 22-year-old male with an unusual fracture dislocation of the distal clavicle.

Patient

A 22-year-old male presented himself at the emergency room with pain at the right shoulder after a motor-bike accident. He had fallen on his right shoulder when driving approximately 35 km/h. On physical examination, we found elevation of the distal clavicle with displacement of the medial part caudally. There was pain on palpation. The piano key test was negative. The skin was intact and without tension. Abduction and flexion of the arm were painful. Neurovascular examination of the arm was normal.

The radiographs showed a distal clavicle fracture with an apparent disruption of the AC joint (Figure 1). A CT-scan (Computed Tomography) was obtained because physical examination and the radiographs did not comply. The CT-scan showed an intact AC-joint with a Neer type II B fracture pattern, except for a dislocation of the medial fragment to dorso-caudal (Figure 2).2
Intervention

Ten days after the initial trauma, the patient was treated with open reduction and internal fixation using a hook plate (Figure 3). A dorsocaudal displacement of the medial part of the clavicle was seen. The fracture was reduced using reduction clamps and the hook plate was placed. Due to the small distal part, only screws medial to the fracture was placed. After the surgery the patient was allowed 90 degrees abduction and forward flexion of the right arm for six weeks.

Outcome

Six weeks post-operative the patient had no pain and full range of motion of the arm. He reported some loss of muscle strength with abduction. The hook plate will be removed in three months.

RELEVANT LITERATURE/DISCUSSION

A fracture of the distal clavicle is relatively uncommon. It accounts for approximately 10-15% of all fractures of the clavicle.1 There are two ways to classify a distal clavicle fracture: The Craig’s classification or the Neer classification.2,3 In both of these a type II distal clavicle fracture is unstable, where type II A occurs medial to the coronoid and trapezoid ligament and type II B occurs medial or lateral to the trapezoid ligament where either the coronoid ligament is torn exclusively or both ligaments are torn. In both classifications the medial part of the clavicle is elevated. None of the classification describes dorsocaudal displacement of the clavicle. In this case there was probably a blow to the shoulder, which pushed the medial part of the clavicle caudally where it became captured under the distal fragment. The X-ray in this case was misleading, appearing as a disruption of the AC joint. To our knowledge, this has never been published before. We obtained a CT-scan because the X-ray did not comply with physical examination. The risk of a misleading X-ray is either malunion of the clavicle in conservative treatment, which can lead to shoulder complaints or unexpected finding during surgery, which can complicate the operation.4

Due to the risk of non-union and the young age of the patient an operation was planned. Although this type of fracture (and the operative possibilities) is already described by Neer in 1963, till this date there is no universally agreed standard operative procedure for displaced distal clavicle fractures.5 We found two reviews and a meta-analyses concerning the treatment of a distal clavicle fracture. Oh et al, found no statistical differences in union/non-union rates but more complications in the group treated with a hook plate or Kirschner wires in combination with Tension Band Wiring (TBW).6 They advised using intramedullary screw fixation, CC stabilization or interfragmentary fixation. Although they do state that the results should be interpreted with caution, ‘as the validity of the observational studies is limited by the lack of a control group (case series), imbalances between the comparison groups because of the lack of randomization (retrospective case control studies), and potentially biased assessment of outcome measures due to the lack of blinding’. Sambandam et al7 stated that all techniques give good functional outcomes, but flexible and semi-rigid fixation like open or arthroscopic coracoclavicular (CC) fixation, tension banding with sutures and coracoclavicular screws seem to avoid most of the implant related secondary complications.5
Also in this review, they state that the level of evidence is low. Stegeman et al7 stated that a hook plate is the most frequently used fixation technique, although it has the highest complication rate compared to intramedullary fixations and sutures.

RECOMMENDATIONS

In case of inconclusive physical examination or radiographs of a distal clavicle fracture, we advise to obtain a CT-scan. There is no optimal treatment for distal clavicle fractures. We advise a critical assessment of individual case. Until more research is undertaken, the best treatment is the surgical technique in which the operating surgeon is most experienced and familiar with.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

CONSENT

Since we did not add photographs in which the patient was recognizable, we did not obtain informed consent.

REFERENCES


A LEAN Approach to Emergency Department Crowding in a Southern California Health System

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ABSTRACT

Background: Emergency Department (ED) crowding has been proven to lead to longer length of stay (LOS) minutes per patient’s arrival. Within AHMC HealthSystem (AHMC) in Fiscal Year (FY) 2016, all facilities experienced a 6.3% census increase from 181,818 in FY 2015 to 193,215. The need for increased efficiency and effectiveness in meeting increased demand was recognized by health system and emergency department leadership.

Objective: AHMC implemented an ED initiative task force of 5 goals for all facilities to follow and achieve by the end of Fiscal Year 2016.

Methods: This initiative required all facilities’ EDs to achieve door to doctor time <30 minutes, ancillary turnaround time (TAT) <60 minutes, total length of stay (LOS) <150 minutes, left without being seen (LWBS) <1%, and Emergency Department Patient Experience of Care (ED-PEC) Top Box >70%. AHMC utilized prospective improvement process tools such as LEAN, monthly site visits, best practice and quality meetings, and social media reviews. AHMC implemented an internal centralized online data collection tool through all facilities and AHMC corporate with the ability to track Centers for Medicare and Medicaid Services (CMS) mandated metrics.

Results: By the end of FY 2016, AHMC hospitals reduced their LOS from over 200 minutes to 180 minutes, LWBS rates decreased from 3-5% to less than 1%, door to doctor times decreased to an average of 31 minutes, and EDPEC satisfaction scores increased from 44% to 50%.

Conclusion: AHMC’s EDs’ significant improvement demonstrated the strong potential of replicating their efforts on improving patient experience and quality measures to other departments and community hospitals.

KEYWORDS: LEAN; ED crowding; ED management; Patient satisfaction; Quality of care.

INTRODUCTION

Emergency Department (ED) crowding is a major challenge across the nation. While ED crowding is equated into longer wait times, evidence suggests a strong correlation with compromised quality of care, patient safety, patient experience, and increased mortality. More proactive focus and action conducted on patient care has been proven to effectively reduce waste and cost, while also improving quality measures. A common evidence-based method among several public healthcare systems to decrease wait times was the LEAN methodology. LEAN is a myriad of tactics and process approaches acquired from the Toyota Motor Corporation. In a healthcare environment, LEAN’s main purpose is achieved by eliminating all potential delay factors of a patient’s ED stay that affects their wait times. According to a 2009 survey from the American Society for Quality of US hospitals, LEAN was executed in 53% of health facilities, while 60% also executed LEAN in the ED.
Under Centers for Medicare and Medicaid Services (CMS) application of Consumer Assessment of Healthcare Providers and Systems (CAHPS), an Emergency Department Patient Experience of Care (EDPEC) survey is in current development. Through the assistance of reviewing patient feedback, health facilities focus on improving patient satisfaction measurements as the initial step to effectively improve ED performances. Social media reviews which are closely related to patient satisfaction results provide further assistance on improving health facilities.

Increased Length of Stay (LOS) often result in patients leaving ED prior to provider examination, or formally known as left without being seen (LWBS). LWBS represents not only failures of EDs to provide care to patients, but also patient safety concerns as patient’s conditions may worsen without medical attention. In order to ensure every patient’s diagnosis and treatment, patients must be cared for in the timeliest manner possible. Longer LOS may largely indicate subpar ED hospitality and services due to overworked ED staff, unorganized ED layout and environment, and inadequate clinical care.

At AHMC Health System in Southern California, effective managerial interventions before LEAN involved working towards decreasing the ED crowding through close collaboration between providers and clinical managers. This included expediting patient’s arrival to medical screening exam, decreasing ancillary turnaround time, and streamlining diagnostic review and decision making. AHMC’s specific aim of this study covers three new findings: 1). ED improvement was led through 5 measures (door to doctor time ≤30 minutes, Ancillary TAT ≤60 minutes, total LOS ≤150 minutes, total LWBS ≤1%, and EDPEC top box score ≥70%), 2). All hospitals showed improved results, however, the degree of improvement ranged from limited to major improvement, 3). EDPEC results correlate with the findings of our ED improvement efforts. LEAN implemented an overall average of a 63% improvement in LWBS rates throughout a 9-month period (Table 1 and Figure 1). With the largest margin of improvement solely seen in LWBS, there still remains a knowledge gap with LEAN’s implementation on healthcare environments, since the overall LOS improved by 6% (Table 1).

A pivotal drawback that prevents LEAN from becoming persistent is a lack of faith, motivation, and agreement for the team to maintain LEAN principles.

MATERIALS AND METHODS

ED Initiative Task Force Goals

AHMC Health System (AHMC), a network of seven community hospitals in the greater Los Angeles and Orange County regions, experienced a 6.3% increase in their ED visits from 2014 to 2015. AHMC hospitals consist of Alhambra Hospital Medical Center, Anaheim Regional Medical Center, Garfield Medical Center, Greater El Monte Community Hospital, Monterey Park Hospital, San Gabriel Valley Medical Center, and Whittier Hospital Medical Center. Each AHMC facility boards their own emergency department, with a total of 128 available emergency beds across the system. This includes 84 ED beds, 23 hallway beds, and 21 fast track beds. The total ED census from July 2015 to June 2016 resulted with 193,215 patients, with an average monthly census of 16,101 patients.

In June 2015, AHMC Health System established a ED initiative task force and created 5 goals for each facility to achieve by the end of the FY: door to doctor time ≤30 minutes, ancillary TAT ≤60 minutes, total LOS ≤150 minutes, total LWBS ≤1%, and EDPEC top box score ≥70%.

LEAN

For healthcare services, LEAN methodology, formally from LEAN 6 Sigma, heavily emphasizes on the technique of identifying the value of services from the patient’s perspective. Through the application of LEAN methodology, each step in a process is carefully examined to identify and eliminate waste with time, staff, and supplies. It is a continuous effort to optimize efficiency and leaving only value-adding activities that meet the patient’s expectations. In contrary to the traditional top-down change model, changes in LEAN are implemented and sustained jointly by the support of leadership and collabora-
tion with the frontline staff.

AHMC adopted the LEAN methodology in September 2015, and launched the ED initiative to improve patient experience and ED throughput times. Through LEAN, a multidisciplinary team examined the ER and identified opportunities for improvement. The team prioritized projects based on its potential impact with the utilization of past and current data. According to Kurt Stuenkel, the president of Floyd Medical Center in Rome, Georgia, data reveals opportunities for improvement. With every AHMC hospital’s ED data displaying different strengths and weaknesses, each hospital focused on different projects. LEAN projects ranged from LOS, fast track, ancillary TAT, discharge process, and patient satisfaction improvement processes.

Replication of the ED LEAN project was executed by administrative leaders across the seven hospitals in the AHMC system. Site visits to our initial pilot LEAN project at one of our facilities were scheduled for these leaders to identify ED process changes, and how these changes were accomplished. Change leaders joined LEAN meetings on a weekly basis to better familiarize themselves with LEAN, the LEAN methodology, and the importance of evidence-based data.

AHMC’s LEAN interventions were primarily measured through observing the five ED initiative task goal measurements. Each facility’s LEAN team monitored each ED task goal rate on a daily basis starting from the week of LEAN implementation in the ED. LEAN teams were able to identify which proposed LEAN methods were and were not effective when studying each ED physician’s shifts and the ED’s productivity level during the physician’s shift period.

Statistical Analysis

All analysis was conducted in Microsoft Excel 2010. Changes in door to doctor, Ancillary TAT, and LOS times before and after the LEAN projects were assessed through a 2-sample t-test (t.test function), while LWBS% and EDPEC top box score were assessed through a chi-square test (chisq.test function) (Table 1).

RESULTS

All hospitals have shown improvements from July 2015 to June 2016. There was a significant difference ($p<0.001$) in door to doctor, Ancillary TAT, LOS, and LWBS%. There was a 6% increase in the EDPEC Top Box Score; however, this difference was not significant ($p=0.061$). Each hospital has shown improvements in different aspects of their ED as accordingly through the implemented ED improvement methods. The effectiveness of LEAN further encouraged some hospitals to initiate additional LEAN projects outside of the ED.
LEAN Implementation

AHMC facilities have applied LEAN methodologies in different aspects of the ED process, such as Fast Track, Ancillary Turnaround Time, and the discharge process (Table 2).

ED Initiative Task Force Goals

Evidence states that facilities with shorter wait times from the start have more challenges in producing significant reductions with overall ED length of stay.11 With AHMC facilities ED LOS averaging at 193 minutes, this left a large window of opportunity to improve our LOS minutes. Studies have mentioned long wait times are most likely linked to the result of poor patient satisfaction results, and the consequence of patients leaving without being seen.32 Laboratory and additional ancillary testing have been correlated to ED length of stay.7 In addition, methods to reduce door to doctor times have also shown evidence of reducing LWBS rates.25 In response to the data evidence, we utilized these measures as the most effective way to reduce our overall ED LOS and improve our EDs within the entire healthcare system.

ED Web Access

In June 2015, AHMC HealthSystem implemented a centralized online data collection tool known as the “ED Portal.” Through the ED Portal, all seven facilities in the AHMC system have the ability to track CMS mandated metrics. The purpose of the ED Portal was to create a transparent and central location where all measures can be accurately recorded and compared. With the ED Portal, AHMC facilities are able to monitor patient flow times such as: arrival to physician seen time, ancillary TAT, provider decision to actual discharge time, and total time the patient spent in the ED. The data is uploaded to a central location every 24 hours, offering each facility an almost real-time assessment of current metrics. By creating a centralized data collection system, AHMC established standardized practices for the whole system’s emergency departments. Tracking the metrics with clear definitions and guidelines has led to less confusion between the facilities. The ED Portal data has helped maintain improvement throughout the AHMC system and continues to guide ED staff on the measures being tracked.

Social Media

Social media is an essential tool under AHMC to accurately determine how the community perceives our hospital. With the increasing development of social media engines and usage, social media technology is now largely seen as the main marketing and publication tool for companies.13 Unlike EDPEC, social media allows patients to immediately post online their initial thoughts and experiences of a facility. After screening AHMC Yelp reviews, higher rated AHMC facilities on social media displayed a higher percentage of reviews related to a patient’s ED experience. Studies have shown that long ED wait times leave a poor first impression among patients and their families. This dissatisfaction likely leads to a decreased chance of patients to return to the same facility.14 The popular accessibility of social media reviews among many of our patients have been particularly evident when patients encountered negative experiences. AHMC hopes to widen social media review recognition to other departments outside of the ED as an effective solution to improve our overall social media review recognition.

DISCUSSION

From the hospitals in the ASQ study, the ED presented an 86% success rate, radiology department reported 87% success rate, and admissions and discharge with a 90% success rate.7 Within

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<td>Planning</td>
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Table 2: AHMC facilities LEAN project progress.
a 12-month period, AHMC achieved significant improvements in the ED through an ED-formatted taskforce goal system. Through this study, AHMC found 1) LWBS improved by 63%, Door to Doctor Time improved by 16%, EDPEC improved by 14%, Ancillary TAT improved by 12%, and LOS improved by 6%. 2) A comparison between the top performing hospital and least improved hospital showed a 78% difference in door to doctor times, 43% difference in ancillary TAT, 52% difference in LOS, 75% difference in LWBS rate, and a 50% difference in top box scores. 3) The lower performing hospital had an EDPEC top box score of 34%, which reflects the dissatisfaction of the patient experiences from the long ED wait times. The higher performing hospital had an EDPEC top box score of 68%, which is a direct correlation to short times throughout the entire ED clinical process.

LEAN

The application of LEAN requires evidence-based proof, thorough evaluation, and a sense of knowledgeable expectation that this method may not work for all organizations.11 Although all facilities faced at least one type of improvement among the five ED task initiative goals, some facilities did not reach an overwhelming improved result. With the assistance of the initial LEAN project implementation, AHMC facilities encountered other ED flow process areas for their future LEAN projects.

Monthly Site Visits

Once a month, AHMC corporate conducts a site visit to each facility to discuss wins and opportunities within the ED. From each facility the Chief Executive Officer (CEO), Chief Operating Officer (COO), Corporate Quality Director, Medical Director, ED Director, and ED staff meet with individuals from corporate to discuss the ED initiative task force goals. When goals are not met, interventions are discussed, along with additional events that may have obstructed improvement. Other topics are also discussed each month such as census, flu season, community perception, and potential solutions to treat low acuity patients in the most time efficient way possible.

Best Practice and Quality Meetings

When a best practice is discovered and confirmed with data, it is shared with the other facilities as a suggestion to implement through “How I Do It” meetings. These meetings are held quarterly with all seven facilities present to listen in and inquire about the best practice methods. Some key topics for the best practice standards of the ED throughput are alignment of goals, following evidence based practices (EBP), staff empowerment, effective resource allocation, and celebrating small wins. The ED goals are aligned with corporate goals and are then communicated with all staff. Additional topics shared are participation in professional organizations, review of community standards and practices at sister facilities, and ideas to adopt from the ED throughput meetings. Staff can be empowered through transparent two way communication, front line staff involvement, and the formula of acceptance plus accountability equals achievement. To celebrate small wins there is a weekly update on the AHMC ER monitors, positive reinforcements are made to the team as well as high performing individuals, and achievements are shared with all related departments.

Social Media

Internet usage has become a central component of our lives.13,15 At AHMC, patient experience coordinator positions were created to update social media platforms such as the official website and Facebook pages. Patient experience coordinators maintain AHMC’s image on the web. Their responsibilities include responding to negative and positive reviews on Yelp through feedback in a time efficient manner. It is important to interact with the community from social platforms as this is the direct voice from hospital to community perception. AHMC has seen the social media interaction increase our brand recognition as well as community perception. AHMC Yelp scores have increased on a monthly basis from June 2015 to July 2016 (Figure 1).

CONCLUSION

LEAN is indicated as a process improvement intervention; therefore, process improvement was the main objective of LEAN rather than an intended solution.6 AHMC ED LEAN teams were able to detect specific areas of improvement with LEAN tools. Through the implementation of the ED initiative task force, AHMC facility leadership teams were strongly encouraged to depend on staff and patient feedback and incorporate these comments to re-engineer the ED processes. Due to the improved ED wait times, EDPEC top box scores, and social media reviews seen throughout AHMC, this study has signified the importance of LEAN in the ED.

There still remains a performance gap for total LOS seen throughout this study, however more studies in additional healthcare environments may need to be conducted to better assess LEAN’s influence on ED wait times.

In the future, AHMC looks forward to enhance the ED’s efficiency and quality with the recognition of providing the best healthcare in the San Gabriel Valley region. From a larger perspective, the ED crowding crisis has initiated more attention towards a safer and more efficient ED.

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CONFLICTS OF INTEREST
The authors declare that they have no conflicts of interest.

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