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1 Survey of Current State and Response in Crowd Crush Injury

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Objective: The objective of this study is to identify the characteristics and appropriate response of the crowd crush disaster.

Background: On October 29, 2022, a crowd gathered for a spontaneous Halloween event in the Itaewon area of Seoul, South Korea, where a crowd crush accident occurred. At least 158 people were killed and at least 196 people were injured. The victims were mostly young adults. In this study, the authors tried to learn a lesson by investigating the worldwide crowd crush disaster and analyzing the differences and results.

Methods: First, the current crowd crush disasters were investigated and summarized through a literature review and internet search. Based on the results, we secondarily conducted a survey of experts to derive the prevention, management, emergency medical response of crowd crush disasters and the research contents needed in the future.

Results: Our research shows that crowd crush disasters have occurred in both developed and developing countries since the 1800s. Common characteristics include high crowd density due to crowds being concentrated in a specific location, a crowd collapse occurring at a certain point after a sustained period of crowd movement, a narrow section of the crowd that becomes a bottleneck, or a large number of people suddenly converging in a certain space. The largest loss of life occurred in 2015 during the Hajj pilgrimage in Mecca, Saudi Arabia, but the events varied from concerts, sporting events to funerals. It is important for organizers to ensure that crowd density does not exceed certain limits, and that efforts are made to maintain order and prevent accidents. While it is important to adhere to the principles of disaster medicine, such as rapid and dispersed transportation, crowd management may be more important due to the difficulty of accessing patients during a crowd crush. In the future, crowd management guidelines and a real-time crowd density monitoring system using CCTV or drones can be established.

Conclusion: Crowd crush disasters can occur in any type of crowd gathering where crowd density increases, and should be prevented through crowd management and managed through real-time crowd density monitoring.

2 Application of Anti-barotrauma System in Hyperbaric Oxygen Therapy for Patients Visiting Emergency Department

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Objective: Barotrauma is the most common complication during hyperbaric oxygen therapy (HBOT), and to prevent barotrauma during HBOT, authors developed a barotrauma early detection system (AntiBaroTrauma: ABT). The purpose of this study is to check whether early detection of barotrauma is possible when applying the ABT system to hyperbaric oxygen therapy.

Background: HBOT is required in many emergency situations such as fires, chemical accidents, CO intoxication and dysbarism. During HBOT, patients are usually required to perform pressure control efforts such as Valsalva maneuver periodically, and medical staff communicate with patients to check their condition, such as occurrence of ear pain to prevent barotrauma. However, if barotrauma causes ear pain, barotrauma has already progressed, so researchers have been looking for ways to detect barotrauma before symptoms occur. We developed a headset-type barotrauma early detection system and applied it to patients receiving hyperbaric oxygen therapy to identify its effectiveness, advantages and disadvantages.

Methods: The study was conducted in the form of a single-blinded prospective parallel randomized controlled study for two years from January 2021 to December 2022 in patients aged 18-65 years visiting one government-affiliated regional emergency center and receiving hyperbaric oxygen therapy. Pregnant women, pneumothorax, respiratory symptoms and diseases, high fever, history of thoracic/ear surgery, claustrophobia and other academic and clinical contraindications were excluded. Both test and control groups were pressurized to >2.4 atm during hyperbaric treatment, with ABT applied in the test group and regular questioning of patients by medical staff during pressurization in the control group to determine discomfort. Number of treatment interruptions/completions due to pressure damage,

otoscopic findings (Edmond's Score Grade 0~5), ear pain scale, and satisfaction of patient based on questionnaire were evaluated).

Results: The test group utilizing ABT had a longer pressurization time than the control group. In video otoscopic findings, Edmond's Score Grade increased less in the test group, but there was no statistical difference between the two groups. The test group took more pressurization time and total treatment time than the control group.

Conclusions: ABT allows for early detection of barotrauma compared to traditional periodic patient checks, but may add to pressurization time and total treatment time, and can reduce provider effort to check on patients during pressurization.

3 Summer Zoom Series: Topics in Medicine

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Objective: The COVID-19 pandemic and "shelter-in-place" orders reduced medical student opportunities for research, clinical activities and mentorship. We created a Summer Zoom Series of Topics in Medicine to increase engagement of incoming and first year medical students (MS) with the current medical school students and faculty.

Background: The COVID-19 pandemic resulted in dramatic changes to medical education. In 2020, California ordered a "shelter-in-place" and the AAMC recommended removing MS from clinical duties. Medical education went from in-person to remote. Incoming and MS1s found their summer research and travel plans canceled and MS3/4s faced limited clinical rotations. MS expressed concerns about decreased opportunities to explore specialties and effects on their future careers. We designed the "Summer Zoom Series: Topics in Medicine," a series for all incoming and current UC Irvine MS that featured medical and specialty talks that took place the summer of 2020, 2021 and 2022.

Methods: For the summer of 2020 Summer Zoom Series, a faculty member organized the one-hour Zoom based didactic sessions that occurred from June 2020 to August 2020. Based on student feedback sessions included a variety of speciality specific talkshops called "Why I chose XXX" that focused on why faculty chose their specific specialties, "Story Time" sessions that focused on clinical stories from various specialties and clinical topics sessions such as EKG reading, common labs, ultrasound, COVID-19 updates, intro to radiology, LGBTQ+ care, Anti-Racism, and a few hands on topics such as suturing and intravenous line placement where students picked up materials and then participated in instructional sessions on Zoom. The series was then repeated in the summer of 2021 and again in 2022-each year with increased student involvement in planning and creation. New sessions included student run "So you wanna be a first year" and "So you wanna be a second year" which focused on upperclassmen advice with respect to each year. In 2021 and 2022 there were in-person suturing, IV placement and ultrasound sessions. Attendance to sessions was tracked, all sessions were recorded and student comments were collected. Recordings were posted to the learning management system and views were recorded.

Results: The summer of 2020, 36 Zoom based sessions occurred with an average of 14.25 students/session, composed of incoming first year and current MS1-4s. Posted recordings were viewed a total of 245 times by 104 unique viewers with a total of 3244 viewing minutes. The summer of 2021, 31 total sessions occurred, 27 Zoom and 4 in-person skills sessions, with an average of 9 students/session, composed primarily of incoming and current MS1s. Posted recordings were viewed a total of 407 times by 119 unique viewers with 10592 viewing minutes. The summer of 2022, there were 57 total sessions, 50 Zoom and 7 in-person skills sessions. Sessions were primarily attended by incoming first year and current MS1s, averaging 7.4 students/session. Posted recordings were viewed 666 times by 138 unique viewers with 18814 viewing minutes. Overall the 2020 Summer Zoom Series was the most attended-likely due to "shelter-in-place" orders and students having limited opportunities for activities outside of home. As restrictions were lifted we saw a decrease in Zoom session attendance, however an increase in posted recordings views and increased attendance at in-person events. Overall student and faculty satisfaction each year was very high-verbal and written comments were overwhelmingly positive and appreciative.

Conclusions: The Summer Zoom Series provided MS the opportunity for faculty interaction/

mentorship during an isolating time. We anticipated decreased attendance in 2021 and 2022 but were pleased with positive feedback and recording viewership. We plan to continue the series with standardized session times to improve attendance and increased in-person events.

4 The Stanford Emergency Medicine Partnership Program: A Novel Approach to Streamlining the Evaluation and Implementation of Emerging Health Technologies Through Academic-private Partnerships

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Objective: We describe a novel, step-wise approach to rapidly screening opportunities to create emergency medicine research partnerships with private companies developing innovative medical devices, digital health tools, and artificial intelligence algorithms. The Stanford Emergency Medicine Partnership Program (STEPP) applies best practices from venture capital, including both a funnel and evaluation practices, to centralize and streamline the evaluation and execution of innovative partnerships. Over a 1.5-year period, STEPP evaluated 68 potential partners and initiated partnerships or collaborations with 10 of them; engaged 64 faculty, fellows, residents, and students; and produced nine peer-reviewed articles and conference presentations. STEPP has provided operational benefits, increased faculty and learner development, and improved engagement with industry to innovate in the emergency medicine space. Our model could be adapted and applied to other healthcare departments seeking to promote innovation and improve operations to enhance patient care.

Methods: STEPP was developed in response to the realization that our department struggled with a few different issues: 1. We did not have an easy way for innovative companies to interface with our department if they were interested in a partnership. 2. We found that we did not have a standardized way of evaluating these companies when approached, and in fact, a number of our faculty ended up pursuing partnerships that were ill-advised or not worth the time. 3. As the complexity of the healthcare system increased, we found that our faculty needed help with the numerous hurdles that needed to be navigated in order to take a partnership from concept to execution. Department leadership, including representatives from research, strategy, operations, digital health, and education, designed a new program that would address these issues and improve our ability to execute innovative partnerships. As there are limited models for industry partnership evaluation in healthcare, we examined best practices in business. Based on the parallels related to the evaluation of new ideas, we ultimately patterned STEPP after the process used by venture capital firms to evaluate companies for investment. Specifically, we incorporated and applied two best practices used in the venture capital industry—the pipeline funnel and company evaluation. While there is no standardized approach to evaluate and determine what to invest in, most venture capital firms follow a general process that resembles a funnel. This process involves several stages through which a large number of potential investments are evaluated and gradually narrowed down to a few select opportunities (typically <0.1%). After sourcing potential opportunities through active searching and accepting unsolicited pitches from entrepreneurs, the first step is the initial screening. Here, each opportunity is assessed based on various factors, including the problem space, product approach, go-to-market strategy, and the team. For those opportunities that pass the initial screening, venture capital firms will conduct more in-depth research and analysis, for example, assessing the technology or intellectual property and verifying claims made. Venture capital firms may also seek input from industry experts or consult third-party sources to validate the potential for impact and return on investment. The next step is to decide whether to invest in the opportunity or not, which is often done collectively by the firm's investment committee, which weighs the potential risks and rewards. If the venture capital firm decides to invest, they will negotiate the terms of the investment, and the deal is closed. They will also contribute to the company's success as advisors, as board members, and with strategic introductions. Ultimately, they will report on the company's progress to their investors.

Results: Between July 1, 2021, and December 1, 2022, the STEPP team screened 68 companies that sought partnership through the STEPP website or networking events. Almost half of these companies (n=32) moved on to evaluation in an SME meeting.

Of those, 12 were recommended for further evaluation in a partner specification meeting. Of these 12 potential partners, eight were found to have a potential impact on clinical operations or involved EHR integration and were evaluated by IPEC. Collaborations were pursued with the other four companies, and these projects are in various stages of completion. Of the eight companies that gave IPEC presentations, six were cleared and are in various stages of implementation. The six partnerships and four collaborations that emerged from the STEPP funnel include efforts to pair AI and blood banking to identify new diagnostic biomarkers, develop monitoring devices that can identify intracranial hemorrhage without advanced imaging, a device that uses computer vision to focus room-cleaning and improve patient turnover, and a bedside test that diagnoses and quantifies concussions, among others. Of the original 68 companies seeking partnerships, 58 did not move on to either SME evaluation (n=36) or Partner Specification meetings (n=20), and two were not cleared by IPEC. Of these 58 companies, 43 continue to be actively tracked for future potential opportunities while 15 have been rejected from the STEPP process. A total of 44 faculty members were engaged at various steps of the STEPP funnel to evaluate potential partners and their projects, participating as STEPP team members, SMEs, or IPEC members. In addition to faculty, 20 fellows, residents, and medical students were members of the STEPP team, participated in SME calls and IPEC meetings, or engaged with STEPP during an elective rotation. The STEPP process resulted in three publications. In addition, eight abstracts were submitted for presentation, of which six have been accepted and will be featured as talks and poster presentations.

Conclusions: Four specific lessons were learned from the implementation of STEPP: 1. Leveraging industry concepts: The successful application of sales funnels and venture capital evaluation methods within an academic department context underscores their utility in providing a structured framework for evaluating and implementing innovative partnerships. 2. Centralizing processes: By centralizing the evaluation and execution of partnerships, we achieved operational benefits that streamline our department's ability to tackle the complex, yet essential, aspects of remaining a forward-thinking and innovative institution. 3. Promoting faculty engagement: Contrary to concerns that centralization might limit faculty stakeholder participation, faculty participated in various aspects of STEPP, including serving as STEPP team members, SMEs, and research partnership evaluation committee members, and authoring scholarly publications. 4. Early partnership implementation: STEPP projects had the most success when stakeholders from research and digital health were involved early. Involving these experts helped accelerate the evaluation of each company and its technology, address project financing, and ensure appropriate technology capabilities and approval. Early engagement of industry partners with key stakeholders can also help reduce friction and anticipate needs early in the process to improve implementation. Our findings build upon existing research that establishes the relevance of business concepts, such as lean principles and throughput analytics, for enhancing ED operations. Additionally, our contribution showcases the successful implementation of industry and innovation within the medical field.

5 Understanding the Effect of Recreational Drug Use on Bone Health and Musculoskeletal Disease in Establishment of Pain Regimens in An Emergency Department

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Objective: To review the pathophysiology and deleterious effects of recreational drug use on bone health and musculoskeletal disease in order to establish appropriate screening and pain management regimens.

Background: In the past decade, recreational drug use has become rampant within the United States. The widespread use of recreational drugs raises significant concern regarding their effects on various organ systems. In addition, the use of cannabis and opioids in chronic pain management increases the prevalence of these substances among patients with musculoskeletal conditions whose bone health may already be compromised.

Methods: A literature review was conducted on the epidemiology, pathophysiology, and side effects of recreational drug use on musculoskeletal disease and bone health. Such information was utilized in

the establishment of pain regimens and screening protocols for recreational drug users with chronic pain presenting to outpatient clinic and emergency departments.

Results: Cannabis, stimulants, opioids, hallucinogens, and inhalants are the most frequently used drugs in the U.S, especially among the adolescent population. Illicit substance use is particularly prevalent among individuals with chronic musculoskeletal ailments due to the analgesic effects of such substances. Despite their analgesic effects, cannabis, stimulants, opioids, and inhalants impact bone maintenance, specifically osteoblast and osteoclast activity, as well as impede hormone production. Such substances therefore lead to inhibition of bone remodeling and development, manifesting as lower bone mineral density and increased fracture risk in chronic users. Consideration of their overall lower bone mineral density and increased fracture risk is crucial in establishment of acute and chronic pain regimens for such patients.

Conclusions: Although current literature suggests a deleterious effect of recreational drugs on bone health and musculoskeletal disease, further research is warranted to evaluate the clinical effects of long-term substance use. Evaluation of such effects will aid in establishing appropriate pain management regimens, as well as appropriate screening and treatment plans for recreational drug users within outpatient clinics and emergency department visits.