# Lessons Learned from Health Care Students Playing Victim in Mass Casualty Incident Disaster Drill

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## Abstract

*Purpose To educate health care students on the importance of emergency preparedness and disaster response training related to self-confidence and critical thinking needed when caring for victims of mass casualty incidents (MCI).*

*Method A mixed-method design was employed. A post intervention-survey was administered to radiologic sciences and nursing students following their participation in a full-scale mass casualty disaster drill scenario. The quantitative data are presented as descriptive statistics along with Bowker's Test of Symmetry. The open-ended questions were analyzed for patterns of similarity and differences among student responses. Several questions asked participants to evaluate their perceived knowledge and confidence before and after their participation in the MCI simulation.*

*Results Data demonstrated that participants were made aware of their limited knowledge concerning necessary patient care skills needed during an MCI. In comparing the students' willingness to care for MCI patients before the mock drill to after the mock drill, the students' willingness increased and was statistically significant as indicated by a Bowker's Test of Symmetry. Similarly, in comparing the students' perceived confidence of their patient care skills before and after the mock drill, the participant's confidence level increased and was statistically significant as indicated by a second Bowker's Test.*

*Discussion Participants gained new knowledge of how community partners work together in response to an MCI event and the different roles each play. Additional take-away lessons revealed an increase in patient empathy. Both qualitative and quantitative questions highlight the students' emotions and behavioral reactions as a result of acting as a trauma patient in the disaster drill.*

*Conclusion The full-scale disaster drill was an effective tool in educating health care students of the diverse emergency operations that take place following a disaster and what is required to save lives.*

**Keywords:** students, mock drill, simulation, disaster, MCI.

## Introduction

According to Swiss Re, in 2020, there were 274 catastrophe events worldwide. Of those, 189 were natural catastrophes, and 85 were man-made disasters (Bevere & Weigel, 2021). In 2019, there were 8,500 terrorist attacks worldwide, causing more than 20,300 deaths with a countless number of injuries (Miller, 2020). With natural disasters on the rise, preparing health care students how to properly respond in disaster events is becoming more of the norm across health care curricula. For healthcare organizations

to readily receive and care for victims of such tragic catastrophes, effective emergency operations plans need to be in place. These plans are essential to accommodate the surge in demand for providing care to trauma victims of mass casualty incidents (MCI). Emergency operations plans are vital for health care organizations and should encompass all aspects of emergency planning, including mitigation, preparedness, response, and recovery. Emergency operations plans are also required by the Joint Commission as well as state licensure (TJC, 2021). Emergency operation plans include disaster response protocols, job responsibilities, staffing, and management of existing patients and disaster victims. As a result, the Occupational Safety and Health Administration (OSHA) recommends training health care workers annually to carry out disaster response procedures (OSHA, n.d.). To better prepare health care workers, an increase in emergency preparedness and disaster response competencies are being threaded throughout various educational program curricula. In particular, following the tragic terrorist attacks on September 11, 2001 in the United States, emergency academic programs, including emergency medicine, emergency medical technician, nursing, and allied health programs, have incorporated emergency preparedness competencies into their disciplines. Examples of basic competencies related to patient care include disaster communication, roles, limitations, critical thinking, and psychological care (Feldmann-Jensen et al., 2017). Determining how to teach students these competencies differ across disciplines. One teaching strategy found throughout literature is actively involving students in MCI disaster drills or mock simulations. Creative strategies have been implemented with various scenarios to challenge students' critical thinking skills in stressful situations (Hensarling et al., 2015).

## Purpose of Research

This study aimed to educate health care students on the importance of emergency preparedness and disaster response training when caring for victims of mass casualty incidents (MCI). Students were exposed to the critical thinking skills and decision-making strategies needed to care for trauma patients who are victims of an MCI. Students were also exposed to the functions of emergency medical service operations. Students observed the roles of key community response personnel, who have specialized training, working together as a team during a disaster response.

## Research Questions

The following research questions guided this study:

1. What patient care knowledge do health care students gain as a result of playing the role of a victim during a simulated MCI disaster drill?
2. What "take away" lessons do health care students learn as a result of playing the role of a victim during a simulated MCI disaster drill?

## Review of Literature

In an effort to explore existing studies in which health care students participated in emergency response and disaster drill exercises, a search of the literature was performed. Fifty-one articles were

found that discussed the education of nurses and allied health students learning about disaster preparedness. After filtering the inclusion criteria, 17 articles were isolated after extracting the duplicates. In these articles, some described students as participants in a disaster simulation and while other articles only discussed the education process. Nursing students, allied health students, occupational therapy students, and public health students were found to have participated in mock simulated disaster scenarios. In the majority of articles, the student roles were that of health care provider while some studies used students as both first responders and victims (Hensarling et al., 2015; Kaplan et al., 2012; Opsahl et al., 2019; Strout et al., 2017; Zinan et al., 2015). Of the various articles, no studies were found that solely used students as victims. A few non-peer-reviewed news stories surfaced in which high school students volunteered to play the victim in community drills for experienced first responders, but not as part of their academic training (Hammond, 2018; Rogers, 2019). As a result, this study will help fill the gap in presenting participants who volunteered as victims only in a disaster simulated learning event.

In a study by Opsahl et al. (2019), nursing students were assigned the roles of both health care providers and victims. The first-semester nursing students played the victim while the higher-level students acted as first responders responsible for the triage of victims. In this particular drill, nursing faculty from two separate schools collaborated with local military personnel to set up a mock disaster simulation involving a tornado striking a trailer park. The simulation took place in an urban training facility that is used to train first responders. Victims were staged throughout the facility “trapped inside of mobile homes, hiding inside of closets, bathtubs, inside of a pickup truck, under vehicles, and lying in the roadway” (Opsahl et al. 2019, p. 154). The purpose of this simulation was to help nursing students apply disaster-related content learned in the didactic setting in a safe clinical environment. Students also gained experience from collaborating with community partners and other nursing programs in a realistic natural disaster simulation.

Another study in which students were not portrayed as victims only is found in Kaplan's et al., (2012) article, in which nursing students were assigned the role of first responders. This simulation took place in an assisted living facility in which a tornado caused structural damage, electricity outage, and emergency generator failure. Additional roles assigned to nursing students were team leader, second in command, triage nurse, and bedside assistants. Patient simulators and a mannequin were staged in the mock area. The scenario indicated that all ambulatory patients were gathered into a designated safe zone for triage. Three separate patient simulators were programmed with victims who were not able to respond and needed more advanced assessment to test the nursing students’ response skills. Faculty remained in a "control room'' with audiovisual capabilities. The scenario timeframe was 10 to 15 minutes in length. Before simulation, students received 10 hours of didactic disaster response content. After the simulation, the faculty conducted a debriefing and evaluation. The purpose of this drill was to increase nursing students’ confidence in caring for patients in a disaster setting. According to the results of the post-simulation five-point Likert scale survey, the majority of students (95%) agreed or strongly agreed that the mock simulation increased both their knowledge and confidence in working with disaster victims (Kaplan et al., 2012).

A different study in which students did not solely impersonate trauma victims during an MCI simulation involved a bus crash incident as described by Strout et al. (2017). Students were assigned the

roles of both nurses and victims. Students were given 6 hours of online modules to complete, textbook readings, and a 90-minute lecture 1 week before the simulation took place. Two nursing students were used as charge nurses, and victims were recruited from junior and senior-level classes in nursing, engineering, and business. The student victim volunteers memorized a script to align with triage and guidelines. Experienced RN evaluators observed the students' performance during the simulation and provided a summative evaluation with students after the drill. The post-debriefing covered the student's mistakes during triage and assessment. Nursing students also received formative evaluation while the simulation was taking place. In addition, nursing students were given a survey after the event probing their confidence level before and after the simulation. Although the actual tool used to survey the students was not described, the authors indicated that students felt a significant increase in confidence (96%) in being prepared for a disaster reaction as a result of participating in the scheduled event.

In a mock simulation described by Zinan et al. (2015), nursing students were divided into groups consisting of victims, care providers, triage, team leader, and logistics coordinator. Nursing faculty used their nursing lab to simulate a scenario of an assisted living institution in which student nurses were conducting a fictional blood pressure clinic when the facility caught on fire. Injuries from the fire included burns, smoke inhalation injuries, comorbidities, and emotional responses. A pre-test was administered before the simulation, as well as a 1-hour didactic lecture. Make-up and costumes were used for the low fidelity simulation with static manikins and live actors. The incident commander responsible for all aspects of emergency response was the class professor and assigned roles to the remaining participants. Students assigned to triage tagged the victims according to their symptoms. After the debriefing, a post-survey was conducted, which posed nine questions that reflected the educational objectives. The mean averages between the pre and posttests of all participants showed an increase in self-perceived knowledge, attitudes and skills regardless if they played the role of a first responder or patient.

Another mock simulation involving an out of control fire took a different twist which assigned nursing students the responsibility for setting up a triage station that received evacuees from the fire incidents (Hensarling et al., 2015). In addition to receiving evacuees, some victims were involved in a multiple vehicle accident caused by fog and a toxic chemical spill. The various types of injuries among the victims were chemical burns, amputations, impaled wounds, burns, and respiratory shock. The mock simulation was a unique collaboration with two southern Texas university nursing schools in which a disaster simulation was conducted at each university. The nursing students switched roles of first responder and victim at the opposite university. Summary comments were made by participants concerning what went right and what went wrong after the debriefing. Student victims had to learn chronic diseases and side effects of medications ahead of time in order to act out their assigned injuries. This knowledge also helped them in experiencing the importance of assessment. A significant comment from a nursing student was now he/she knew how it felt to be a patient in a disaster incident and the necessity of being prepared personally. Nursing students playing the role of the first responder were challenged with critical thinking skills, communication, and cultural sensitivity in a chaotic setting.

The review of literature presents several commonalities found among the various studies. First, each study used disaster simulation as an active learning tool for students to gain experience in a safe learning environment. Second, each study focused on increasing the student's confidence in caring for

victims of an MCI event. Third, while the realistic disaster scenarios varied, each simulation presented a chaotic event that stimulated the student's emotions, stress, and anxiety levels. Fourth, the aim of the studies was to help students improve their critical thinking and decision-making skills for preparation to work as part of a disaster response team member in their future employment. Fifth, students gained experience in prioritizing care for victims of a disaster situation that encompassed many unknown variables. Sixth, students were given the opportunity to work with community partners different from their own discipline to strengthen their team-building skills and enhance their interprofessional education. Lastly, all studies incorporated a type of reflection component to instill corrective actions and positive reinforcement for participating in disaster-related health care.

Many other MCI disaster simulation studies have been reported throughout literature among nursing and allied health students with various disaster scenarios setting the stage for diverse injuries as part of challenging students' patient care skills. In an effort to allow radiologic sciences and nursing students to experience what MCI victims face in a disaster event, this study highlights participants who played the role of the victim only (Zinan, et al., 2015).

## Methods

In an effort to educate health care students on the importance of emergency preparedness and disaster response training, a mixed method design was used for this study in which both quantitative and open-ended questions were included in a post-intervention survey to explore students' perceptions of their participation in the community MCI disaster drill. The first study was conducted in 2016 and then repeated in 2019 for comparison. The combined quantitative data are presented as descriptive statistics along with a Bowker's Test of Symmetry that was performed for two questions. The open-ended questions were analyzed for patterns of similarity and differences in responses. The university's Institutional Review Board (IRB) granted permission to conduct the study prior to both of the mock disaster drill events.

## Participants

### *Students*

In 2016, the study subjects were a convenience sample (N = 237) of baccalaureate radiologic science students (n = 41) and nursing students (n = 196) enrolled in both junior and senior levels for radiologic sciences and first through fifth clinical semesters for nursing. Similarly, in 2019, a different cohort of students (N = 213) was targeted in both radiologic sciences (n = 41), and nursing (n = 172) enrolled in the same levels of clinical as in the previous simulation. Looking at both years, a combined total of 450 students were invited to participate, with the majority of students (n = 276) assigned to play victim at different emergency department locations throughout the community while others (n = 139) were assigned to report to the airport. Incidentally, all hospital locations were established clinical sites for both radiologic science and nursing students. A few students (n = 35) who did not want to volunteer as a victim were assigned to apply trauma makeup or moulage to the students playing the victim (n = 415). The term moulage is a French word for casting and molding and is used in this study to describe the

art of applying wax and makeup to create mock injuries for the purpose of training emergency response teams and other medical and military personnel (Merriman Webster, n.d.). After the MCI mock event, the students assigned to play victims were asked to complete a post-intervention survey. All participants signed a "hold harmless form" provided by the local Sheriff's Office of Homeland Security and Emergency Preparedness. This form indicated that participants would engage in physical participation with a potential risk of personal injury, in addition, grant permission to publish photos.

***Stakeholders***

In an effort to demonstrate the interdisciplinary planning efforts among various agencies and health disciplines, the following stakeholders are described who participated in the 2016 and 2019 disaster drills.

**Faculty and Staff.** Radiologic science faculty (n = 6), nursing faculty (n = 23), the university's counselor, and librarian participated in the full-scale MCI disaster drill exercises. In addition, radiologic science and nursing faculty were assigned to each community site that received the trauma victims played by the students. Some faculty (n = 18) helped coordinate students during the drill, while other faculty (n = 16) applied moulage to students prior to the start of the event.

**Community Partners.** The Federal Aviation Administration (FAA) airport compliance program requires airports to hold a full-scale disaster exercise once every 3 years to review and evaluate the airport's ability to respond to an actual emergency (FAA, 2021). Likewise, health care organizations are required by law, The Joint Commission (TJC), or the Centers for Medicare and Medicaid Services (CMS) to conduct emergency preparedness and disaster drills as part of their emergency plans (TJC, 2021). In an effort to meet these requirements and various other agency regulations, community partners joined together to launch a full-scale disaster drill. Twenty-nine local agencies and organizations participated in the exercise. The following are the types of agencies who participated in the full-scale MCI disaster drill exercise: Airport Authority, Ambulance Services, Bureau of Alcohol Tobacco and Firearms, Coroner (Medical Examiner), Federal Bureau of Investigation, Fire Department, Knights of Columbus, Military Air Force Base, local Hospitals representing all five levels of emergency room care, Office of Homeland Security and Emergency Preparedness, Poison Control Center, Police Department, Regional Hospital Preparedness Coalition Coordinator, Salvation Army, Sheriff's Office, State Police, and Veterans Health Administration Office of Emergency Management, and local media (See Table 1).

**Table 1**

*Community Partners*

| Agency | Type |
|---|---|
| Airport Authority | Law enforcement |
| Ambulance Services | Health care |
| Bureau of Alcohol Tobacco and Firearms | Law enforcement |
| Federal Bureau of Investigation | Law enforcement |

| | |
|---|---|
| Fire Department | Government fire and rescue |
| Knights of Columbus | Catholic fraternal service |
| Local Media | News |
| Medical Examiner | Medical legal officer |
| Military Air Force Base | Military aerial warfare |
| Office of Homeland Security | Law enforcement |
| Poison Control Center | Health care |
| Regional Hospital Preparedness Coalition | Health care |
| Salvation Army | Religious and charitable group |
| Sheriff's Office | Law enforcement |
| State and Parish Police | Law enforcement |
| Trauma Centers | Health care Levels I, II, III, IV, V |
| Veterans' Health Administration Office of Emergency Management | Health care |

## Instrument

The instrument in this study was originally designed for use in a previous study conducted by Zinan et al. (2015). In their study, nursing students played the role of victim and nurse for a MCI simulation. The authors implemented a quasi-experimental pre and post-test design to assess nursing students' willingness to respond to a disaster and their confidence in working as a team member during a disaster. In their study, the instrument was reported to have good internal consistency (Cronbach alpha = 0.87). The instrument appeared to be a good fit for this study, and permission was obtained from the previous authors to use the instrument with minor revisions for aligning the instrument with the current study. However, the only revision made was adding the term "radiologic sciences" to the first question to include radiologic science students. The instrument was administered as a posttest only. The number of students who actually participated and volunteered was not known until the students reported to the different locations and signed in for attendance. The student's university email was obtained after the events to send the post-intervention survey.

The instrument consists of three demographic questions identifying the students' age, major, and clinic level. Ten questions were short answer questions, and 14 questions were based on a 5-point Likert scale. Of these 14 questions, nine survey questions targeted the students' self-perceived knowledge and skill levels with choices that ranged from 5 as strongly agree to 1 as strongly disagree. Four additional questions were listed on a separate Likert scale with choices ranging from 5 as excellent to 1 as poor. Two questions investigated the students' willingness to respond to an MCI. In addition, two more questions asked the students to rate their confidence level in performing patient care on an MCI victim before participating in the mock drill as compared to their confidence level afterward. Both qualitative and quantitative questions addressed students' emotions, confidence, and what they learned from participating in the mock event. An informed consent was included with the survey instructions. The

terms *mock drill*, *disaster drill*, *disaster simulation,* and *MCI full-scale disaster drill* are used interchangeably in the survey and in this study.

**Mass Casualty Incident Full-Scale Disaster Drill Exercise Scenarios**

To better understand the students' participation in this study, the following are descriptions of the MCI full-scale disaster drill exercise scenarios. In 2016, as a result of 5 days of warm waters in the Gulf of Mexico, a tropical storm formed and matured into a category four hurricane. Weather models indicated a track with a possible landfall along the Louisiana coast, proposing a direct hit to the New Orleans, Louisiana area. Tourists and residents in low-lying areas were ordered to evacuate 48 hours prior to projected landfall. The National Disaster Medical System (NDMS) was activated to assist with patient transport from the New Orleans area to the Shreveport Federal Coordinating Center (FCC) Patient Reception Area (PRA) located at the Shreveport Regional Airport in Shreveport, Louisiana. A combination of military and civilian aircraft was used to move patients. An interesting true fact is during Hurricanes "Katrina" and "Rita," the Shreveport Regional Airport received numerous evacuee related flights including hospital and nursing home evacuees. As a Federal Coordinating Center (FCC) for the National Disaster Medical System, Shreveport, Louisiana could receive medical evacuees from future hurricanes, earthquakes or other catastrophic events in the United States (K. Andress, oral communication, October 2019).

As part of the evacuation, a C-130 aircraft carrying 31 hurricane evacuees landed at the airport located in Shreveport, La. As soon as they landed, the aero-medical crew, fire and EMS personnel reported the status of patients on the aircraft which included vomiting, diarrhea, dehydration, rash, fever, respiratory infections, hypertension, unintentional injuries, and additional preexisting medical conditions. Approximately 45 minutes later, a second aircraft, an American Eagle ERJ-145, carrying 50 passengers, landed at the same airport, but overshot the runway, and caused the airplane's nose and mid-section to slide off the end of the runway. The crash landing injured the crew and an unknown number of passengers on-board. The fuselage ruptured, and fuel leaked from the airplane. This aircraft was a routine flight and unrelated to the evacuation of hurricane victims. At the time of the landing, the tower was unable to reach the crew by radio (K. Andress, oral communication, October 2019).

Taking a closer look, there were two mock MCI disaster areas at the local airport: (Scene 1) the National Disaster Medical System (NDMS) patient reception area for C-130 from south Louisiana hurricane victims, and (Scene 2) the American Eagle crash. The first disaster scene was pre-staged with 31 student actors exhibiting various forms of injury due to the hurricane and from being displaced. These students needed immediate medical attention, were triaged and assigned to be transported to appropriate NDMS member hospitals in the local area. The student actors at scene one were not actually transported but only staged for transportation. At scene 1, the students were unloaded and loaded unto the aircraft by wheelchairs, stretchers, and military-style line walking.

The second scene consisted of 50 passengers from the American Eagle crash. These student actors presented an unknown injury count along with three injured crew members. Student actors were spread out and staged over the entire tarmac as well as the grassy area beyond the tarmac. At this scene, there

were airplane parts scattered over the tarmac and fake smoke to help make the crash appear more realistic.

Simultaneously, student actors were assigned to arrive at seven different local hospital emergency departments as surge patients. These students represented the victims who were supposedly transported from the airport by emergency medical services (EMS) as well as victims who self-transported via personally operated vehicle (POV). Injuries reflected potential traumatic conditions and other health threats that could be encountered as a result of evacuating a hurricane and surviving an airplane crash. Each participating hospital was surveyed ahead of time and asked the number and type of surge patients they wanted to receive in order to test their emergency operations plan. For example, a local level one-trauma center specifically requested student actors to test their hazmat decontamination procedure. Another facility requested a pregnant mother with fetal demise since they mainly deal with pediatric patients. Several sites requested patients to expire upon arrival to test their mass fatality capabilities. To accommodate these requests, the state regional hospital preparedness coalition coordinator asked a local physician to create symptomology tags that included a tracking number, hospital location, mode of transport, triage color code (black, red, yellow, green), symptoms, physical findings, and specific instructions for students to act out as requested (See Table 2). The medical triage colors identify the condition and current treatment required for each victim. The black tags are used for victims who are deceased or not expected to live due to their injury. The red tags are used for victims who have suffered life-threatening injuries but have a chance for survival. The yellow tags are for victims who are stable but can with for triage. The green tags are for victims who have the least amount of injuries and need the least amount of care.

**Table 2**

*Student Actor Request Per Receiving Site*

| **Assigned Sites** | **Triage Color Code** | | | | **Number of Student Actors** | **Special Requests** |
|---|---|---|---|---|---|---|
| | **Black** | **Red** | **Yellow** | **Green** | | |
| Hospital 1 | 0 | 3 | 5 | 7 | 15 | 1 patient expires after arrival |
| Hospital 2 | 0 | 6 | 7 | 7 | 20 | 5 patients expire after arrival |
| Hospital 3 | 0 | 6 | 10 | 5 | 21 | 2 Hazmat contamination |
| Hospital 4 | 0 | 4 | 8 | 8 | 20 | |
| Hospital 5 | 5 | 4 | 8 | 8 | 25 | |
| Hospital 6 | 0 | 2 | 4 | 4 | 10 | |
| Hospital 7 | 0 | 2 | 3 | 5 | 10 | Pediatric patients; OB w fetal demise |
| Airport Scene 1 | 5 | 8 | 10 | 6 | 31 | |
| Airport Scene 2 | 5 | 8 | 10 | 27 | 50 | |

Symptomology tags were also created for student actors participating in the two separate disaster sites at the airport. Table 3 displays sample symptomology cards. All tags were distributed when students checked in the morning of the event.

**Table 3**

*Sample Symptomology Cards for Student Actors*

| **Tag Number** | #1 | #2 | #3 | #4 |
|---|---|---|---|---|
| **Location** | Hospital 1 | Hospital 2 | Hospital 3 | Airport Scene 2 |
| **EMS Triage Acuity** | Yellow | Red | None | None |
| **Patient Name** | Clark Gable | Thomas Jefferson | Scarlett O'Hara | James Dean |
| **Transport Mode** | EMS | EMS | POV | On Scene |
| **Symptoms** | R arm pain, bone protrusion | Unresponsive to verbal stimuli; bruised forehead, | Unable to walk, bleeding to Lt ankle, confused | Face down, bloody wound on back of head |
| **Physical Findings** | RR 20; BP 110 / 80; P 104 | RR 40; BP 80 / 50; 115 | RR 30 | RR 14 - irregular; unresponsive, Left pupil large and fixed |
| **Other Patient Information:** | R arm open wound; was Amer. Eagle passenger | Poorly controlled bleeding. Expires during triage | PMH of dementia; NDMS flight evacuee | No response to resuscitation |

In 2019, the MCI full-scale disaster drill exercise scenario was on a smaller scale at the airport with only one active scene which involved a FedEx airplane and another aircraft collided upon landing due to misunderstanding from the air traffic control tower. Both airplanes were carrying passengers. Upon impact, one of the airplane's fuselage leaked fuel and erupts into flames while the front of the other aircraft is ripped away. Cargo is thrown all over the runway. Surviving passengers are wounded, screaming, some burnt, some bleeding. Others were deceased upon impact. Each student actor was staged and given a symptomology card to play their role of trauma victim. Simultaneously, eight different local hospital emergency departments geared up to receive our student actors as surge patients. Once again, each hospital had special requests for the type of patients they wanted to test their emergency

operations plan. Therefore, the students arriving at the emergency departments were also in costume, moulage, and given a scenario of patient condition.

## Preparation

Prior to the events, the radiologic science educator completed multiple tasks and attended several community meetings in preparation for the students and faculty to participate in the community disaster drills. Other major responsibilities included scheduling, coordinating, assigning roles to both students and faculty, as well as coordinating transportation to secure areas at the airport. On the day of the event both in 2016 and again in 2019, city buses were scheduled to transport student actors from the school campus to the airport and back after the drill was completed. The bus transportation was necessary to escort the students to the designated secure areas inside the airport. The student actors assigned to report to the local hospitals drove their personal vehicles. A nursing faculty member was scheduled at each hospital site to receive students in a pre-designated area to apply moulage, assign symptomology tags, and direct students in the mock surge. As mentioned, coordinating moulage application training was an important undertaking.

### *Moulage Training*

Before the exercises started, moulage (trauma makeup) was applied to each student playing the role of victim in order to make the trauma injuries seem more realistic. Beforehand, both students and faculty volunteered to learn how to apply the moulage to student actors. Moulage workshops were offered on the school campus. These workshops were conducted by volunteer military personnel who work at the local community's air force base. One of their job responsibilities is to apply moulage for realistic combat injury simulation training. While moulage maximizes the simulation exercises, the drills allow participants to test disaster planning in a low-risk environment. In previous local community MCI disaster drills, the casualty actors did not have moulage applied; therefore, the first responders would simply read the tags worn by victims and then try to imagine the injuries (K. Andress, oral communication, October 2019). However, for the exercises in this study, moulage was applied to student actors to better equip medical personnel when dealing with actual battlefield trauma and triage. The moulage matched the symptomology cards which represented injuries and health issues commonly seen in mass casualty incidents such as the following: chronic health issues, mental health concerns, vulnerable population health needs, head injuries, internal chest and abdomen injuries, bone protrusion, burns, open wounds, multiple fractures, perspiration, clammy skin, bruising etc. Student actors received a "symptomology tag" assigned by faculty moulagers to wear. Tags indicated a casualty tracking number; location (Hospital or Airport); an EMS triage acuity; transportation via EMS or POV; fake patient names; symptoms; physical findings such as vital signs; and "other" information. First responders and first receivers used the information on the symptomology tags to triage and treat patients/casualties.

### *Student and Faculty Orientation*

To educate students and faculty of their role and what to expect on the day of the events, the regional hospital preparedness coalition coordinator provided several orientation presentations to the students and faculty in different class periods. The regional coordinator also explained the importance of the drill and how local agencies work together to prepare for real disasters. Students were given guidelines and instructions as to where to report and whom to contact. Students were also warned not to add their own made-up drama or storyline to the scenario so that law enforcement and responders would not think a real event was triggered, such as a bomb threat or a fight, which was not part of the planned drill. If a real situation unfolded, students were to mention the keywords "real world." Students were also instructed to wear old clothes due to the moulage staining their clothes.

**Data Collection and Statistical Analysis**

Data for this study were collected electronically through the distribution of a post-intervention online survey using SurveyMonkey platform. The survey was emailed to the participant's school email accounts one day after the disaster drill exercises, and then again a week later. The survey included both an informed consent statement and a volunteer agreement for participating in the survey. Statistical analyses for this study were performed using SAS, Version 9.4. All statistical hypothesis tests were conducted at the 0.05 level of statistical significance. A Bowker's Test of Symmetry was performed to investigate if students' willingness to respond changed after participating in the disaster drills. The Bowker's Test of Symmetry is similar to McNemar's test but not restricted to 2 categories. Bowker's test evaluates the changes before and after responses in contingency tables when there are multiple categories (Bowker, 1948). For open-ended questions, a content analysis was conducted for emerging trends and patterns until saturation of data no longer yielded new themes.

## Results

**Student Demographics**

After the MCI mock event, the students assigned to play victims were asked to take a post-intervention survey. The first three questions of the survey addressed student demographics. In 2016, even though a higher number of students were targeted, a total of 201 students volunteered to participate in the disaster drill. However, only 138 completed the post-intervention survey yielding a response rate of 68%. In 2019, 214 students were assigned to portray the victim, but only 52 completed the post-intervention survey with a response rate of 24%. The combined total of students who completed the post-survey for both years was 190 yielding a response rate of 45%.

Students enrolled in the first through fifth clinical semesters of nursing as well as junior and senior-level radiologic sciences clinical answered questions (See Table 4). In both disaster drills, the student ages ranged from 20 to 47 years of age. The remaining results will be reported as combined totals for 2016 and 2019 participants' responses.

**Table 4**

*Current Clinic Level (n=189)*

| Program Level | 2016 n (%) | 2019 n (%) | Total n (%) |
|---|---|---|---|
| RadSci Junior | 12 (9) | 4 (8) | 16 (8) |
| RadSci Senior | 14 (10) | 6 (12) | 20 (11) |
| Nursing 1st | 16 (12) | 1 (1) | 17 (9) |
| Nursing 2nd | 3 (2) | 19 (37) | 22 (12) |
| Nursing 3rd | 35 (25) | 3 (6) | 38 (20) |
| Nursing 4th | 27 (20) | 1 (1) | 28 (15) |
| Nursing 5th | 30 (22) | 18 (35) | 48 (25) |

**Background Knowledge**

Four questions probed students of any prior experience or knowledge related to mass casualty incidents, emergency preparedness, and response. The majority of students (84%; n=160) indicated that they had never participated in an MCI drill or simulation. Likewise, 92% reported they (n=173) had no prior experience in participating or managing an actual MCI. As far as patient care experience, over half (41%; n=78) of the students indicated they have worked as a health care provider such as a certified nurse assistant, patient care associate, or medical assistant, not including student experience. Lastly, students were asked if they have been taught any emergency preparedness or disaster response content since enrolled in their clinical education program and, if so, estimate hours of content they learned. The majority of students (61%; n=116) reported that they had not been exposed to emergency preparedness or disaster response content in their courses. The other 39% (n=73) indicated the number of hours spent learning emergency preparedness or disaster response content ranged from 1 to 12 hours, with an average of 4 hours.

**Self-Perceived Knowledge**

Nine questions specifically inquired about the students' perceptions of knowledge gained and self-perceived patient care related abilities as a result of participating in the mock drill (See Table 5). Taking into consideration the students who selected "agreed" and "strongly agreed combined responses," the top two perceptions were, "I recognize the limits to my knowledge, skills, and authorities related to a mass casualty event" (n=189; 89%) and "I am able to assess the safety of self and others during a mass casualty event" (n=189; 83%). The top two self-perceived knowledge and skill levels reported by the students who "disagreed" and "strongly disagreed" were, "I am familiar with mass casualty triage" (n=188; 25%) and "I understand the team roles in a mass casualty disaster" (n=189; 20%) (See Table 5).

**Table 5**

*Students' Self-perceived Knowledge and Skill levels (n=189)*

| Item Description | *n* per question | Strongly Disagree | Disagree | No Opinion | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| | | n (%) | n (%) | n (%) | n (%) | n (%) |
| I am familiar with mass casualty triage. | 188 | 12 (6) | 35 (19) | 21 (11) | 103 (55) | 17 (9) |
| I understand the team roles in a mass casualty disaster. | 189 | 9 (5) | 29 (15) | 19 (10) | 106 (56) | 26 (14) |
| I am able to respond as a care provider during a mass casualty event. | 189 | 13 (7) | 16 (8) | 47 (25) | 90 (48) | 23 (12) |
| I am able to prioritize the care of victims affected by a mass casualty event. | 189 | 6 (3) | 18 (10) | 26 (14) | 114 (60) | 25 (13) |
| I am able to provide safe and effective basic first aid during a mass casualty event. | 188 | 2 (1) | 7 (4) | 18 (9) | 128 (68) | 34 (18) |
| I am able to identify the ethical issues related to providing care to all victims during a mass casualty event. | 189 | 6 (3) | 13 (7) | 33 (18) | 112 (59) | 25 (13) |
| I recognize the limits to my knowledge, skills and authorities related to a mass casualty event. | 189 | 3 (2) | 3 (2) | 15 (7) | 115 (61) | 53 (28) |
| I am able to assess the safety of self and others during a mass casualty event. | 188 | 2 (1) | 8 (4) | 23 (12) | 125 (67) | 31 (16) |
| I am able to recognize the most appropriate healthcare role for myself during a mass casualty event. | 187 | 3 (2) | 9 (5) | 34 (18) | 117 (61) | 26 (14) |

**Not all participants answered each question.*

**Willingness to Respond**

Students were specifically asked their willingness to respond as a care provider to a mass casualty

event *prior* to participating in the disaster simulation as compared to their willingness to respond *after* the mock drill. Eighty-five percent (n=189) of students indicated they had an average or above willingness to take on the role of a care provider during an MCI event prior to participating in the mock drill. However, 93% (n=189) of students expressed an average or above willingness to respond after participating in the mock drill (See Table 6).

**Table 6**

*Students' Willingness to Respond to an MCI (n=189)*

| **Item Description** | **Poor** | **Below Average** | **Average** | **Above Average** | **Excellent** |
|---|---|---|---|---|---|
| | **n (%)** | **n (%)** | **n (%)** | **n (%)** | **n (%)** |
| My willingness to respond as a care provider to a mass casualty event prior to the disaster simulation. | 11 (6) | 17 (9) | 95 (50) | 37 (20) | 29 (15) |
| My willingness to respond as a care provider to a mass casualty event after the disaster simulation. | 7 (4) | 7 (4) | 70 (37) | 72 (38) | 33 (17) |

**Not all participants answered each question.*

Taking a more detailed look in comparing if students' willingness to respond changed after participating in the disaster drill, a Bowker's Test of Symmetry was performed. Table 7 shows the distribution of the students' willingness to respond both before the simulation (rows of the table) and after the simulation (columns of the table). Responses above the table diagonal correspond to increased willingness to respond due to the simulation. For example, 36 students who had an average willingness (row) before the simulation, had above average willingness (column) after the simulation. Similarly, responses below the diagonal indicated a reduced level of willingness to respond due to the simulation. A total of 58 (31%) students had an increased willingness to respond and only 4 (2%) had a reduction in willingness due to the simulation. This result was statistically significant using Bowker's Test $X^2$ (10) = 48.79, $p < 0.0001$.

**Table 7**

*Bowker's Test of Symmetry to Determine if Willingness Changed*

| Table of N24 by N25 | | | | | | |
|---|---|---|---|---|---|---|
| **N24 (Willingness Before Simulation)** | **N25 (Willingness After Simulation)** | | | | | |
| **Frequency Percent** | **Poor** | **Below Average** | **Average** | **Above Average** | **Excellent** | **Total** |
| **Poor** | 7 | 1 | 3 | 0 | 0 | 11 |
| | 3.70 | 0.53 | 1.59 | 0.00 | 0.00 | 5.82 |
| **Below Average** | 0 | 5 | 9 | 3 | 0 | 17 |
| | 0.00 | 2.65 | 4.76 | 1.59 | 0.00 | 8.99 |
| **Average** | 0 | 1 | 57 | 36 | 1 | 95 |
| | 0.00 | 0.53 | 30.16 | 19.05 | 0.53 | 50.26 |
| **Above Average** | 0 | 0 | 1 | 31 | 5 | 37 |
| | 0.00 | 0.00 | 0.53 | 16.40 | 2.65 | 19.58 |
| **Excellent** | 0 | 0 | 0 | 2 | 27 | 29 |
| | 0.00 | 0.00 | 0.00 | 1.06 | 14.29 | 15.34 |
| **Total** | 7 | 7 | 70 | 72 | 33 | 189 |
| | 3.70 | 3.70 | 37.04 | 38.10 | 17.46 | 100.00 |

**Confidence**

Students' confidence in their ability to perform as a health care provider *before* participating in the disaster drills was compared to their perceived confidence *afterward*. Seventy-seven percent (n=189) of students declared they had an average or above confidence level in their abilities as a health care provider before participating in the mock drills. After participating in the disaster drills, 87% of students reported an average or above confidence level in their abilities as a health care provider (See Table 8).

**Table 8**

*Confidence in Providing Patient Care Before vs Afterward Participating in Drill (n=189)*

| **Item Description** | **Poor** | **Below Average** | **Average** | **Above Average** | **Excellent** |
|---|---|---|---|---|---|
| | **n (%)** | **n (%)** | **n (%)** | **n (%)** | **n (%)** |
| My confidence in my abilities as a healthcare provider prior to the disaster simulation. | 11 (6) | 33 (17) | 92 (49) | 28 (15) | 25 (13) |
| My confidence in my abilities as a healthcare provider after the disaster simulation. | 10 (5) | 14 (7) | 90 (48) | 49 (26) | 26 (14) |

**Not all participants answered each question.*

Taking a closer look at comparing students' confidence before and after participating in the disaster drill, a Bowker's Test of Symmetry was performed. Table 9 shows the distribution of students' confidence in their ability to respond both before the simulation (rows of the table) and after the simulation (columns of the table). A total of 46 (24%) students had an increased (above diagonal) level of confidence, and only 3 (2%) had a reduced level of confidence due to the simulation. This result was statistically significant using Bowker's Test $X^2$ (10) = 39.75, p < 0.0001.

**Table 9**

*Bowker's Test of Symmetry to Determine if Confidence Changed*

| **Table of N26 by N27** | | | | | | |
|---|---|---|---|---|---|---|
| **N26 (Confidence Before Simulation)** | **N27 (Confidence After Simulation)** | | | | | |
| **Frequency Percent** | **Poor** | **Below Average** | **Average** | **Above Average** | **Excellent** | **Total** |
| **Poor** | 8 | 2 | 1 | 0 | 0 | 11 |
| | 4.23 | 1.06 | 0.53 | 0.00 | 0.00 | 5.82 |
| **Below Average** | 1 | 11 | 17 | 4 | 0 | 33 |
| | 0.53 | 5.82 | 8.99 | 2.12 | 0.00 | 17.46 |
| **Average** | 0 | 1 | 71 | 20 | 0 | 92 |
| | 0.00 | 0.53 | 35.57 | 10.58 | 0.00 | 48.68 |
| **Above Average** | 0 | 0 | 1 | 25 | 2 | 28 |
| | 0.00 | 0.00 | 0.53 | 13.23 | 1.06 | 14.81 |
| **Excellent** | 1 | 0 | 0 | 0 | 24 | 25 |
| | 0.53 | 0.00 | 0.00 | 0.00 | 12.70 | 13.23 |
| **Total** | 10 | 14 | 90 | 49 | 26 | 189 |
| | 5.29 | 7.41 | 47.62 | 25.93 | 13.76 | 100.00 |

## Open-Ended Questions

### *Behavioral Reactions*

Two questions explored the students' emotions during and after participating in the MCI simulation. An analysis of student responses yielded a variety of emotions. Table 10 shows students' responses and the frequency of their emotions *during* the MCI drill. The top three emotions expressed during the MCI simulation were "excitement" (29%), feeling "nervous" (12%) and "confusion" (12%).

**Table 10**

*Students' Emotions During the MCI Drill*

| **Student Feelings** | ***f*** | **% of Total Responses** |
|---|---|---|
| Anxiousness | 8 | 6 |
| Anxiety | 12 | 10 |
| Boredom | 6 | 5 |
| Chaos | 2 | 1 |
| Curios | 2 | 1 |
| Confusion | 15 | 12 |
| Disappointment | 6 | 5 |
| Excitement | 36 | 29 |
| Fear | 3 | 2 |
| Frustration | 6 | 5 |
| Nervous | 15 | 12 |
| Overwhelmed | 5 | 4 |
| Sadness | 4 | 3 |
| Shock | 1 | 1 |
| Stress | 3 | 2 |
| Urgency | 2 | 1 |
| Total | 126 | |

The second behavioral reaction question focused on students' emotions after the MCI drill was over. The two most repetitive answers were "relief" (43%) and "disappointment" (27%) (See Table 11).

**Table 11**

*Students' Emotions After the MCI Drill*

| **Student Feelings** | ***f*** | **% of Total Responses** |
|---|---|---|
| Calm | 7 | 8 |
| Confident | 2 | 2 |
| Confused | 2 | 2 |
| Disappointment | 22 | 27 |
| Enjoyed | 2 | 2 |
| Exhaustion | 4 | 5 |
| Frustration | 3 | 4 |
| Happy Over | 5 | 6 |
| Relief | 36 | 43 |
| Total | 83 | |

***Knowledge Gained***

Three open-ended questions asked students to report their knowledge gained related to patient care, roles of key community response personnel, and lesson learned. The first question asked students what new knowledge they gained related to patient care and their feelings concerning caring for trauma victims of mass casualty incidents in the near future. Table 12 shows students' perceived knowledge gained related to taking care of patients. The greatest response was learning the importance of patient triage and using the triage color codes (37%) to emphasize the urgency of which patients need immediate care.

**Table 12**

*Students' Perceived Knowledge Gained Related to Patient Care*

| **Knowledge Gained** | ***f*** | **% of Total Responses** |
|---|---|---|
| Importance for preparedness | 5 | 6 |
| Importance of Triage and Color Codes | 31 | 37 |
| Community not ready for a disaster | 1 | 1 |
| Communication is key | 1 | 1 |
| Importance of teamwork | 8 | 10 |
| Importance of quick decision making | 2 | 2 |
| Importance of time management | 3 | 4 |
| Organization | 7 | 8 |
| Respond quickly | 1 | 1 |
| Hectic situation can be | 3 | 4 |
| How victims feel | 8 | 10 |
| Witnessed ethical dilemmas | 1 | 1 |
| Deceased over looked | 5 | 6 |
| Remain calm | 6 | 7 |
| Role of Chaplain | 1 | 1 |
| Psychological preparation | 1 | 1 |
| Total | 84 | |

The second open-ended question explored students' knowledge gained related to the roles of key community response personnel during a disaster response. Two major themes emerged. The first theme was realizing the different roles and responsibilities of community first responders (41%). The second theme was the importance of teamwork (38%) during a disaster response. Other common responses were the importance of communication (9%) and patient triage (12%) (See Table 13).

**Table 13**

*Students' Perceived Knowledge Gained Related to Roles of Community Response Personnel*

| **Knowledge Gained** | ***f*** | **% of Total Responses** |
|---|---|---|
| Diversity of community personnel roles | 24 | 41 |
| Importance of teamwork | 22 | 38 |
| Importance of communication | 5 | 9 |
| Importance of Triage | 7 | 12 |
| Total | 58 | |

The third question asked students to reflect on any "take away" lessons related to what they learned from participating in the MCI drill. Three major themes emerged. The first was the importance of emergency preparedness and disaster response plans (33%). The second theme was the importance of practicing response drills (28%). The third theme was the importance of patient triage (20%) to determine which patients need immediate care. Other take away lessons included the importance of teamwork, communication, remaining calm, and knowing the role of first responders (See Table 14).

**Table 14**

*Lessons Learned*

| **Lessons Learned** | ***f*** | **% of Total Responses** |
|---|---|---|
| Importance of emergency preparedness and disaster response plans | 28 | 33 |
| Importance of practicing response drills | 24 | 28 |
| Importance of teamwork | 7 | 8 |
| Importance of patient triage to save lives | 17 | 20 |
| Role of community response personnel | 2 | 2 |
| Importance of communication | 2 | 2 |
| Importance of remaining calm | 5 | 6 |
| Total | 85 | |

## Discussion

Prior to the disaster drills, the majority (84%) of radiologic sciences and nursing students indicated that this was their first time to participate in a mock MCI drill and had not been involved in a real-life (92%) MCI event. However, over half the participants had some previous patient care experience. The first research question explored patient care related knowledge gained as a result of participants playing the role of the victim during the simulated MCI disaster drill. Participants (88%) were made aware of their limited knowledge concerning the necessary patient care skills needed during an MCI. In comparing the students' willingness to care for MCI patients before the mock drills to after the mock drill, the

participant's willingness increased by 8%. Similarly, in comparing the students' perceived confidence in their patient care skills before and after the mock drills, the participant's confidence level increased by 10%. In particular, participants listed the following as the top five patient care related skills recognized to care for trauma patients: (1) Importance of patient triage and color code system, (2) Importance of teamwork, (3) Importance of organization (4) Importance of how victims feel and (5) Importance of remaining calm. In addition, radiology and nursing students shared the following comments concerning their thoughts of what real victims might experience during an MCI event:

- *During the experience, I got a glimpse of what it would be like to be a victim of this situation. While I was not in pain from my "injuries," I still got an idea of what it would be like to be waiting on assistance and how long the process actually takes.*
- *I felt overwhelmed, mainly. Acting everything out and not having anyone come even look at me or my tag was definitely overwhelming.*
- *What if something like this actually happened? It is very unsettling thinking about leaving someone to die so you can go on to have someone who is savable.*
- *During the drill exercise, although it wasn't real, it got me thinking about how people have already experienced something of this nature, but they probably weren't as prepared as I was this time. The reality settled in.*

Students were asked to share their emotions during the drill and their emotions after the drill in an effort to connect their sentiment to emotions real MCI patients may experience. The top four emotions students' felt during the event were "excitement" (29%), feeling "nervous" (12%), "confusion" (12%) and "anxiety" (10%). After the drills, the majority of students experienced "relief" (43%) and "disappointment" (27%). The following are examples of student reflections:

- *After the drill, I felt like I had a better understanding of how things would work if something like that were ever to happen. I also felt like I would be able to relate to the feelings of the people involved in the disaster as well as the people trying to help them. The disaster people would be frightened and scared, and the help would be overwhelmed and maybe even flustered.*
- *I was glad that I was a part of it. I am glad that I was able to play it from the victim side to see what they go through while the response teams are doing what they need to. I think it will improve my patient care skills if I were ever needed to work a situation like this one.*
- *It was a scary feeling to have no control over such things in real life.*

In addition to learning patient care skills needed to care for MCI patients, participants also gained new knowledge of how community partners come together in response to an MCI event and the different roles each play. The second research question asked participants, "What take away lessons do health care students learn as a result of playing the role of a victim during a simulated MCI disaster drill?" Students responded they realized the importance of having emergency preparedness and disaster response plans (33%) in place to alleviate some of the chaos caused by an unexpected crisis. Participants also indicated the importance of practicing response drills (28%) to test existing plans to help prepare responders in decision making when recusing victims. This includes differentiating individual roles and responsibilities of community first responders (41%) and the importance of teamwork (38%) during a disaster response. The results of this study are consistent with findings in the review of literature in which the majority of

participants across studies showed an increase in self-perceived knowledge, positive attitudes, recognition of advanced patient care skills needed in MCI events, and understanding of triage level categories for various injuries. In particular, when comparing the results of this study to Opsahl et al. (2019), Hensarling et al. (2015), Strout et al. (2017) and Zinan et al., (2015) in which students were assigned the roles of either health care provider or victims, both non-victims and victims indicated the simulation exercise supported learning critical aspects of triage related skills, prioritization of caring for patients, interdisciplinary teamwork, disaster communication, and importance of community partners. Additional similarities noted in this study when compared to findings in the review of literature were the emotions students reported experiencing, such as stress, anxiety, chaos, frustration, and satisfaction. In contrast, students playing victims only were not given the opportunity to make decisions concerning the most critical first steps in triaging a disaster victim.

Based on these findings, healthcare educators should consider incorporating disaster response and emergency preparedness simulation into their curricula to help prepare students with the knowledge, confidence, and skills needed to care for victims of a disaster. Simulation allows students to gain disaster response experience in a safe learning environment. Likewise, healthcare managers should incorporate disaster response and emergency preparedness training for employees as part of their emergency operations plan.

## Limitations and Recommendations for Further Study

This study limitations include small convenience, homogeneity samples of radiologic sciences and nursing students as participants; therefore, the subjects are not considered to be representative of the entire population. This study relied on self-reported data from participants in which answers could have been exaggerated or not taken seriously. Participants may have been too embarrassed to share their real feelings. Recommendations for future research, if repeating this study, would be to administer a pre and posttest survey and compare responses to see if the participant's self-perceived knowledge and critical thinking skills regarding disaster response improved. This study can also be repeated with different cohorts and then compare results. An added variable could be offering emergency preparedness and disaster response education to students prior to participating in the MCI drill and comparing the results to previous participants who did not receive emergency preparedness and disaster response education.

## Conclusion

This study focused on educating health care students on the importance of emergency preparedness and disaster response training among radiologic sciences and nursing students in an effort to better prepare them for their future careers. Students were exposed to the critical thinking skills and decision-making strategies needed to care for trauma patients who are victims of an MCI. Students were also exposed to the functions of emergency medical service operations. Students observed the roles of key community response personnel who have specialized training, working together as a team during a disaster response. The results of this study support using simulation as a learning tool that exposes students to the skill set needed when caring for victims of a disaster in their future professional practice.

In particular, the full-scale disaster drill was an effective strategy in educating health care students of the diverse emergency operations that take place following a disaster and what is required to save lives.

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