Final submission

Mass Casualty Incident Management and Preparedness in Sichuan's and Quebec's Trauma Centers: A Focus study and Analysis

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Abbreviations

WCSM: West China School of Medicine
MUHC: McGill University Health Center
MCIs: Mass Casualty Incidents
CBRN: Chemical, Biological, Radiological and Nuclear
MASCAL: Mass Casualty
MSI: Medical Severity Index
PICE: Potential Injury Creating Event
DSS: Disaster severity scale
GDP: Gross domestic product
LMICs: Lower- and Middle-Income Countries
WHO: World Health Organization
WHO TMSI: World Health Organization Trauma Systems Maturity Index
BLS: Basic Life support
ACLS: Advanced Cardiac Life Support
ATLC: Advanced Trauma Life Support
JMA: Japan Medical Association
AAR: After Action Report
PALS: Pediatrics Advanced Life Support
DSTC: Definitive Surgical Trauma Course
DATC: Definitive Anesthetic Trauma Care
NTMC: National Trauma Management Course
ATOM: Advanced Trauma Operative Management
ETC ADMS: Environmental Tectonics Corporation's Advanced Disaster Management Simulation
NDLS: National Disaster Life Support

Abstract

Background

Knowledge dissemination about the level of preparedness in trauma centers is still limited. Trauma management in mass casualty incidents requires a change from the application of unlimited resources for each patient's greatest good to allocating limited resources for the greatest good of the greatest number of casualties. In most MCIs, the regular hospital protocols cannot control patients' load, and the surgeons and physicians are required to know the special protocols.This research provides a unique opportunity to examine the level of preparedness in the target trauma centers to deal with mass casualty events.

Methods

- Library research and literature review about the best and optimal trauma preparedness guidelines present and published. It is a significant part of the research and the initial step towards shaping the whole thesis.
- Then, we surveyed the surgeons and physicians working at the West China School of medicine to characterize their existing disaster-response plans and identify areas where preparedness could be improved. A part of the survey was directed to the departments' leadership, which included questions about hospital training and teamwork.

Significance and Results

The study helped explore mass casualty incident preparedness and techniques that support surgeons and emergency doctors to respond to disasters in a more efficient way to reduce the risks of mortality**.**

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Introduction

Background to the study

Trauma centers are essential for a local response to mass casualty incidents (MCIs), especially in disasters like earthquakes or floods. This research will focus on how prepared the trauma centers and surgeons are to tackle these disaster situations and identify the gaps and challenges.

The area of study, Sichuan and Quebec, both are known to be prone to mass casualty incidents for years. Sichuan's tragic earthquake of 2008, 2013 and 2017 and Montreal's mass shooting in 2006 and 1986 have taught some lessons in disaster and Trauma preparedness and highlighted the importance during such events. [1] However, based on similar MCIs (recent incidents occurred in 2017), it has been observed that in both provinces, a substantial gap still exists in the Trauma and surgical preparedness.

On August 8, 2017, at 21:19 hrs. Local Sichuan time, a massive 7.0 magnitude earthquake shook Jiuzhaigou's township in the province of Sichuan, China. The medical rescue teams arrived at the earthquake affected area in an hour. [2] An injury characteristic report in a local hospital shows that 30 patients received operative care, 28 patients for orthopedic surgeries and 16 patients received conservative treatment. [3] The operations included internal fixation, soft tissue debridement, external fixation, bipolar femoral head replacement, embolization of carotid-cavernous sinus arteriovenous fistula, and amputation. [3] Unfortunately, even after the quick response and extensive rescue efforts, this natural disaster took 25 lives and injured 525 people. After investigations, the primary cause of injury was due to landslides and dam damage. [3]

During the same period, on May 3, 2017, and in late October 2017, southern Quebec, Canada, was also hit by disastrous floods. [4] Reports mention that around four hundred soldiers were deployed in Quebec for rescue, as floodwaters threatened many areas of the province. [4] All the local hospitals were on alert, and Montreal even declared a state of emergency due to continuous flood. [5] Even after such a large and fast response, two deaths were reported, and many people were missing. Around 2,426 residences were flooded, 2,720 people were forced to evacuate from their homes, and 146 municipalities were affected by this flood. [6]

Below is A brief introduction to the two target hospitals and their trauma centers.

Every year MUHC receives over 715,000 ambulatory visits, which includes 177,000 emergency department visits. [7] The Hospital has almost 40,000 inpatients yearly and performs almost 35,000 surgeries. [7] McGill University Health Center is Classified as one of the top Tertiary and Quaternary care providing hospitals in Canada, especially in Trauma and emergency care.

WCSM received 263,700 Inpatient visits in 2018 and 175,300 surgeries were performed in 2018. [8] West China School of Medicine is the second largest Hospital in the world. [8] In a Recent Comparison study of the two earthquakes of 2008 and 2013, we learnt that the ratio of dead to injured dropped from 18.5% to 1.5%, and West China Hospital was a major contributor to this. [10] [9]

Knowledge dissemination about the level of preparedness in surgical trauma centers is still limited. Trauma management in mass casualty events requires a change from the use of unlimited resources for each individual patient's well-being to the usage of limited resources to treat the most significant number of casualties. [11] In most MCIs, the regular hospital protocols cannot control patients' load, and the surgeons and physicians are required to know the particular protocols. This

research will provide a unique opportunity to examine the level of preparedness in the target trauma centers to deal with mass casualty events.

Literature review: scoping review

Trauma management

Trauma management includes both operative and nonoperative management of traumatic injuries, especially in acute settings. It includes constant care to treat injured patients. The American College of surgeons defines trauma management as a system of definitive care facilities that provides a variety of care for all injured patients in a defined geographic area. Trauma care involves a systematic approach of a team of health care providers to provide the best care. Trauma systems can have an inclusive approach in which the health care facility has a distinct role based on the available resources and the community's needs or an exclusive system that focuses on the major trauma centers. [(12)]

Mass Casualty Incidents

Mass casualty incidents are events in which the hospital trauma management system is overwhelmed by the number of injured patients, and standard trauma management protocols are no longer helpful to control the situation. [(13)] These events include accidental fires, natural disasters, or purposeful terrorism.
The US department of homeland security has created a list of 15 such mass-casualty incidents that can be either man-made or natural and result in many casualties. These incidents can predict hundreds to thousands of critically injured patients. [(14)]
The above definition implies that the motivation to create and practice MCI protocols should arise before any such event occurs, and physicians should be aware of their hospital's MCI protocols and guild lines. [(13)(14)]

Trauma management guidelines

In a typical emergency trauma case, the trauma teams are supposed to follow specific guidelines to ensure optimal outcomes with all the available resources. Trauma systems play a significant role in the care of the injured, and WHO recognizes the disparity between the trauma responses in the different parts of the world. They have created a unique tool known as the WHO trauma system maturity index (WHO TMSI) to assess and compare the world's different trauma systems and assist the under-performing trauma systems in understanding the gaps and encouraging them to create better protocols and guild lines. [(12)] The WHO TMSI includes aspects of a trauma system like prevention policies, pre-hospital care, and Acute hospital care of the trauma systems.
These are the significant factors of standard trauma management guidelines, which are part of the training of all medical professionals who are a part of the trauma system of any hospital. [(12)]

MCI Guidelines and protocols

An excellent response to any MCI involves speed, repetition, simplicity, and creativity among the trauma system's health care providers. [15] In case of any mass casualty incident, the emergency physicians are among the first to know. [16] However, soon different departments like the anesthesia department are alerted as they are crucial in the preoperative management of mass casualty victims. Such swift communication within a trauma system during a disaster event is vital and can save lives, therefore preparing for mass casualty incidents is necessary, and hospitals need emergency drills to prepare its staff and resources. [17]

Natural and man-made disasters are becoming more common in recent times for the more developed world, and none of the hospitals which had to tackle these situations like hurricane Katrina, or the Madrid bombing had experience or preparation for such events. [18] The reports suggest that even medical students do not receive adequate disaster training, as they are busy in the inpatient setting of wards in urban tertiary hospitals, which emphasizes making the right diagnosis over principles of triage and emergency management. [19]

MCI guidelines are essential to establish in every trauma system because disasters and MASCAL incidents are not predictable and mostly occur without warnings. Mitigation and planning are crucial factors for an MCI response. [20] According to the literature, MCI and disaster planning have 4 phases: first mitigation, then preparation, response, and finally, we recover from the event and learn from the mistakes. [21] Experience also plays a crucial role in the preparation of any MCI or disaster response. Methods such as the queueing theory have gained popularity in measuring the effectiveness of MCI planning. The queueing network model is used to evaluate the degree of efficiency in different MCI responses. [22] Currently, MCI guidelines include the golden hour rules, damage control policies, chain of survival, and their well-known evaluation techniques called the MSI (medical severity index), PICE (Potential injury creating event), and DSS (Disaster severity scale). These policies and methods can help us prepare and respond to disasters better. However, limitations exist, such as the evaluation methods are all retrospective evaluations and cannot provide real-time assessment for practical MCI response and decision making. [23] However, most evaluation tools or measures for effectiveness during such events are still not well established. [22]

As we discussed, MCIs result from natural phenomenon’s or man-made crises; therefore, the overwhelmed trauma system can also result in enormous pressure on the local and regional resources. MCI protocols need to include strategies to improve federal and local coordination to increase the response's efficiency. [24]

Protocols are required in every MCI management guideline to revamp the communication channels between different hospital departments. Emergency physicians and surgeons are most involved in the response, and communication between them can be heavily relied upon during such incidents. Adequate training and education for an appropriate response can help organize a more robust response; however, the evidence suggests that the training is still limited. [25]

Surge capacity is a significant component of any MCI guideline because one of the major concerns during a disaster is providing care to the increased number of patients and increasing the resources available for that in a short period. [26] In some instances of MCI emergencies, the hospitals also require to be evacuated, and in such cases, proper guidelines are in place to help discharge patients and continue care in different locations if possible. [27]

Burn Mass casualty incidents are more complicated and require more planning and resources. Cases like wildfires, industrial explosions, and terrorist bomb-blasts all require different kinds of medical expertise and resources; therefore, MCI guidelines include plans for such incidents. However, the triage and preparation protocols are still alike, and hospital staff must create more

space, discharge the non-critical patients, improve the communication between departments to reduce confusion, and acquire the required medical equipment to tackle the situation and surge of patients. The preparations still vary from country to country [28]

Literature shows that well-equipped hospitals with adequate resources can provide better emergency response and recovery, especially in MCI prone areas. [29] Mass casualty episodes can happen in any community, and therefore disaster planning and clear MCI trauma guidelines are critical for every community. [30]

MCI preparedness and responses in disaster prone areas

We need to know the current situation and how trauma centers have addressed major mass casualty incidents in the recent past.

Many hospitals worldwide have contributed to the literature to understand and prepare better for disaster events. The United States has contributed about 35% in the publications and ranked first, followed by Japan and China, contributing 7.7% and 7%, respectively. However, when it comes to research, output was standardized according to GDP per capita, India, China, and the US contributed the most. UK, Canada, and Switzerland have produced the most amount of research with international authors. It is interesting to note that Sichuan university and its affiliated hospitals provided the greatest number of documents (384) in the disaster medicine journal and ranked the first in this field. [31]

Earthquakes have the most impact on mortality in low and middle-income countries (LMICs). Nevertheless, there is a paucity of literature supporting any disaster reduction activities in LMICs. The available literature suggests that preparedness of health care systems is essential to reduce the effects of an earthquake on the wellbeing of the people living in LMICs. [32]

Responses in Sichuan

Sichuan has faced many earthquakes, and, three major earthquakes were above the magnitude of 7, including the 2008 earthquake in Wenchuan, the 2013 earthquake in Lushan, and the 2017 earthquake in Jiuzhaigou. The focal point for improvement for the government and the healthcare systems is the construction of a resilient disaster prevention system in these earthquake-prone areas [33]

In response to the 2008 earthquake, the Chinese government activated the emergency medical system in less than 2 hours and mobilized around 10000 medical workers to the affected areas. [23] The response was based on a national disaster plan that followed the principle of "four concentrations," including patient concentration, expert concentration, resource concentration, and treatment concentration. Practical use of the plan was never evaluated during the response because of the lack of information; however, the team of doctors from the UK who were deployed to assist with the respondents reported that none of the hospitals were overwhelmed by the radical triage system and the benefits of a well-distributed and well-functioning national disaster plan were evident. [34] However, despite the medical staff's enormous efforts and rescue workers, two significant issues were recognized. First, the rescue efforts initially were ineffective because the medical workers were psychologically unprepared due to a lack of awareness of guidelines, which resulted in high in-hospital mortality. Secondly, the communication regarding casualty information was inadequate, which lead to inappropriate deployment of medical resources in the

affected areas. [23] Both of these problems could be solved with proper implementation of MCI guidelines and disaster response training. [35]
Wenchuan earthquake of 2008 caused the governments and healthcare systems to review and improve their disaster response. A Simple ridge and rapid treatment (START) method was designed and established. However, every hospital did not adopt the standard triage protocol, and mostly general emergency triage protocols were still used. Most doctors had not received any formal training in triage, resulting in wasting necessary resources during an MCI response. The events showed the need for proper disaster triage training and guidelines. [19]

After the 2013 earthquake in Ya'an, medical workers and nurses were asked to reflect on the quality of response, and three significant problems were highlighted, which included the challenges related to the dispatch of medical staff to the affected areas, the lack of disaster training among the medical workers and the lack of physical and psychological preparedness for such events. [36] The Wenchuan and Lushan earthquake created an opportunity to learn from the mistakes also taught many lessons for disaster and especially earthquake response. The magnitude of the earthquake is directly proportional to the number and severity of the injuries. The earthquakes also caused major transportation issues and delays in response and care. We also learned that medical and trauma centers need to be prepared for an influx of patients and ensure the availability of different surgical resources, including operation theatres for orthopedic, thoracic, and neurosurgery. [37]

Responses in the rest of China

Currently, research shows that tertiary hospitals in china are well prepared, with all of them having a disaster management plan, and most of them have simulation training with specific disaster training. However, the secondary hospitals still have some catching up to do, with only about 76% having training and simulations. [38] The impressive response to the bus fire incident in Hangzhou on July 5, 2014, demonstrated that a middle-sized city in china had the capacity and resources for a small-scale disaster response of such scale. [23] However, A study analyzing 107 responses in China found that the responders still lacked emergency communication, psychological first aid, public health, and disaster laws and ethics and media handling. [39] Interviews with nurses and healthcare workers after disaster events revealed that quality of training was low, poor disaster planning and coordination required disaster education, and most health care workers were challenged with a lack of medical equipments and unsatisfactory living conditions during disaster incidents such as earthquakes. [40]

Responses in Quebec

Quebec has been fortunate enough not to face many disasters of mass casualty incidents in the past; however, there have been a few incidents, including the railway disaster of Lac-Megantic on July 6, 2013. This accident resulted in 47 deaths due to the explosion caused by the oil tanks. (41) Quebec also faced the Dawson college shootings in Montréal. These events showed that a disaster could lead to significant communication failures with hospital phone lines collapsing and the lack of call back facility at that time. Educational surveys were mostly conducted in hospitals with trauma systems, but they should also be conducted in community hospitals as MCIs can occur at any place without warning. These experiences taught the Canadian trauma systems and local

governments the importance of disaster protocols and guidelines and contingency plans, like guidelines to help blast victims who are transiently deaf. [18]

Responses in the rest of Canada

The first example of a mass casualty incident with a coordinated medical response in Canada was from the 1917 disaster; this is still relevant to the modern MCI preparedness. [42] Since then, the rest of Canada is actively involved in disaster training and MCI response.
In 1985 in Barrie, Ontario, the major tornado caused 155 casualties and 16 cases of multiple trauma over just 5 hours. The local hospitals' quick and impressive response established the importance of a disaster plan and motivated other hospitals across Canada to design MCI guidelines and protocols. [43] In 2010 for the G8 summit preparation, the Royal Victoria hospital in Ontario organized drills to prepare for a chemical, biological, radiological, or nuclear attack. These drills emphasized the importance of communication and the involvement of community hospitals. However, the surgeons were not involved. [18] In an evaluation of preparedness among Canada's medical workers, it was revealed that the preparedness varied among the staff and was the worst for CBRN incidents (chemical, biological radiological, and nuclear). Factors such as gender, previous experience, and region of employment played an important role. However, nurses responded with a low level of confidence and access to resources, and interestingly 40% of the respondents did not know the existence of a disaster or MCI plan of their hospital. [44]

Different responses to MCIs around the world

In other parts of the world, such as Indonesia, a well-known disaster-prone country has experienced enormous sufferings and damages caused by MCIs. It is calculated that between 1984 and 2013, Indonesia experienced 325 natural disasters which resulted in 190,794 deaths. These events' findings showed that Indonesia has a moderate level of trauma and MCI preparedness, and the previous experience and disaster training has positively impacted their subsequent responses. [45] Iran is also a natural disaster-prone area and has a class of 8 out of 10. They have been facing many MCIs, which has caused more than 109,000 deaths. These deaths include the 31000 killed in the Bam's earthquake. The state is in serious need of a disaster plan. [46]

The United States has also seen a fair share of disasters, including a few deadly hurricanes like Hugo, the worst storm in Charleston's history. It resulted in a total odd 35 deaths associated directly with the hurricane and about 2100 hospital visits in the two weeks post the storm. This storm caused damages over 6 billion dollars [47]
The medical response exposed significant themes. The research demonstrated a lack of awareness of disaster protocols among the hospital staff and decision-makers regarding environmental and climate hazards. It also showed the reliance on old and outdated resources to assess floods. Even though the increasing number of flood-related disasters have resulted in more significant damages, the gaps are still evident in understanding and preparedness for such events. [47] The 2017 Las Vegas attack proved to be very educational for hospitals in the United States. It made every hospital realize that such events as terrorist attacks and natural disasters are unpredictable, and any hospital can become the primary caregiver for managing an MCI. [17] The 2003 electrical power failure tested New York City's surge capacity and functionality in cases of power outages. MCIs with power outages are common, especially during natural disasters. They found out that the

hospitals were quickly overwhelmed by the prolonged electrical failure. Critical medical devices such as respirators failed to function, and power backup systems were outdated. [48] The blackout of 2003 demonstrated significant holes in the MCI preparedness of hospitals in New York City. This included backup power supply issues, water and food supply shortages, communications problems, emergency medical devices such as X-rays were immobile, ventilation issues, and overall lack of preparedness among hospital staff. [49]

The Black Saturday disaster or the infamous Australian bushfires claimed 173 lives and cost about 4 billion AUDs in damages. The MCI demonstrated the difference between handling an individual burn and trauma case versus a collective system-based disaster response. Australia has since formulated a plan to help patients from smaller populations over a larger area. [50] The bush fires, cyclones, floods, and heatwaves have significantly questioned the disaster preparedness and surge capacity of hospitals across Australia. [51]

The Rwandan disaster plan is managed by the ministry of disaster management and refugee affairs. The disaster plan has been in effect; however, most districts are still not integrated with adequate resources to respond to any MCI. The reports suggest that the disaster committees lack training, and they need to build capacity for practical disaster response. [52]

The Japanese trauma response to the 2011 earthquake is quite commendable as they acquired complete recovery of the health care system in under three months by transporting large amounts of medical supplies, establishing multi-organizational communication channels, and providing medical assistance to the survivors. The earthquake caused significant damage, including a nuclear accident that created panic in the community. The JMA showed extreme resilience and put all their efforts to assist survivors and attends in the disaster affected areas; they implemented their MCI guidelines to achieve a fantastic response. However, there are always areas to learn from and improve. [53] Reports showed that the 2011 earthquake caused the most damage since world war 2; although the disaster was catastrophic, MCI guidelines and protocols with adequate preparedness helped alleviate the damage. [54] The academics have tried to compare the response of the east japan earthquake and the Sichuan earthquake; however, the difference in magnitude and population densities made the comparison very difficult. [55]

Limitation of current MCI protocols

There is a paucity of literature in evidence for improved disaster preparedness and disaster training or interventions. [56] Despite all the efforts in improving Canadian healthcare, the studies by the hospital emergency readiness revealed gaps in the readiness for disasters, especially with contaminated patients. The lack of standard assessment for CBRN (chemical, biological, radiological and nuclear) incident preparedness is highlighted, and the need for more guidelines is stressed. [57] Fortunately, Canada is not considered a major target for any terrorist attack, and natural disasters are also not very common. However, the medical staff, including nurses, admitted that Canadian hospitals are underprepared for a large-scale disaster. The Canadian disaster database emphasized the need for a standardized all-hazards plan or disaster guidelines to deal with such MCIs if required. [14] [44] Virtual live exercise performed in Canada helped identify various shortcomings in the current MCI guidelines and protocols, including under triaging, inadequate quality of care, lack of communication and behavioral issues among the staff. Most

participants accepted that such training programs are helpful in understanding and highlighting the gaps in their systems. Disaster planners need to continue to develop better guidelines and partner with public health agencies to address the gaps that exist in the current system [58][59]

It is evident that China has made significant progress and has undertaken successful responses to various disasters in the past. There are still particular challenges to overcome in their trauma management for MCIs, including better coordination between hospitals, better portable diagnostic resources, and a more specific disaster plan with a developed triage and surge capacity system. [19] Current protocols and guidelines do not ensure the correct allocation of medical resources like beds and monitors, functioning communication facilities, plans to increase staff in case of a surge and essential medical equipments and pharmaceuticals. The current MCI guidelines rarely include training and education of staff for a safe and effective MCI response. [60] Inadequate preparedness leads to delayed patient care and undesirable outcomes. The few MCI guidelines with training and education are restricted to only the emergency or trauma department physicians. Although the first responders mostly include the Emergency Department staff, the increasing demand in the surgical intervention should motivate other departments like anesthesiology to be more familiar with the disaster plan. [17] In the past, surveys have shown that very few residency programs provided disaster education among anesthesiologists. It also revealed that most anesthesiologists desire to know more about their hospital's disaster management plans. It is critical to keep the anesthesiologist aware of the medical resources during disasters that require surgical interventions. [17] Hospitals currently rarely have guidelines for emergency surge and supply of medical equipments in the affected and disaster-prone areas. Research has demonstrated that the increase in knowledge and awareness about disaster preparedness guidelines improves the response quality. [46] The literature suggests major gaps in American healthcare centers' capabilities to respond to an MCI. These include limited research, lack of standardized evaluation of the preparedness, and the overall program administration's incompetence for disaster response. [61] Various surveys have been conducted to assess nurses' preparedness for any upcoming disaster or mass casualty incident, and all the results suggest a lack of preparedness and knowledge or awareness of their role in hospital's MCI guidelines. [62] Most health care systems show no integration of disaster planning and preparedness with the actual response. [24]

Experience has indicated that most hospital staff plan not to report to work in case of MCI. We also know that health care workers prefer to report for a natural disaster than for epidemics or CBRN incidents. New protocols and guidelines are required to organize the staffing models during MCIs and ensure the staff's personal protection who report for work during these situations. [63] Research from recent incidents also shows that the current protocols are not enough to tackle casualties in disaster settings; better regional, national and international partnerships help build a better disaster response. [64]

The most critical factor in any MCI guideline is to ensure that medical staff is prepared and educated to respond to a disaster event. Cross-sectional studies done with 757 hospitals worldwide evaluated that the doctors and medical staff have a low-moderate level of MCI knowledge, skill, and preparedness. These data were not linked to any specific country or hospital. [65] Studies done in Iran show the inadequate preparedness among the local hospitals in disaster-prone areas like Bandar Abbas. The operating rooms, laboratories and surge capacity are still at a rudimentary level and require urgent improvements. The researchers emphasize that by developing better systems and protocols for disaster response with adequate supplies and communication facilities, the hospitals can perform much better in the future. [28][66] Emergency preparedness training programs in North and South Carolina demonstrated the low level of preparedness among the emergency

patient care providers. Most of the emergency department directors revealed in the surveys conducted that they feared that most healthcare workers would fail to provide adequate care in an MCI. More than half of the medical staff participating admitted to having very little to no disaster training. This led to the conclusion that current protocols and guidelines in these states were not enough to respond to a disaster. [67] Hospitals in countries like South Africa mostly have a disaster plan; however, the current plans still need improvements, including specific plans for more vulnerable communities, better communication channels during disasters, more collaborative partnerships between different trauma centers, and increased quality of training simulations for disaster responses. [20]

Studies showed that only 47% of the medical students receive formal disaster or MCI training, and out of this, only 64% is a simulation training. Such studies demonstrated the need for disaster and MCI planning in the fundamental training of medical students. The current protocols do not include medical school curriculums to train for such disasters. [68]

Evaluations of disaster/MCI preparedness

Proper functioning of hospitals is critical in any disaster response, and therefore evaluation of the hospitals' s preparedness is critical. However, we still do not have any comprehensive, standardized model to follow for such evaluations. The existing evaluation tools do not cover all the dimensions essential for a proper response. [69] The optimal disaster and MCI preparedness tool need to measure the knowledge, skill and post-disaster management skills. [70] Evaluation of disaster preparedness is a debatable topic, and studies have been done using benchmarks to assess and improve hospitals' performance. Literature demonstrated that the use of simulations could derive objective benchmarks of a hospital's surge capacity. [35] A particular study had participating hospitals with experienced MCIs in the past and hospitals without experience. It demonstrated that hospitals could prepare for MCIs using the present benchmarks and reach a higher standard. The methods used showed significant improvement, especially in the training category. [71]

Most hospitals perform simulation exercises and after-action reports to learn and understand from past experiences. However, no such simulation is analyzed enough to provide overall effective preparedness. It is also not evident that AARs can help and complement disaster preparedness. [72]

Surveys are recognized as a useful tool to assess the preparedness of the medical staff, including surgeons. Various surveys have been done in the past, and the literature suggests that these surveys should be done among doctors of different experience levels for optimal results. [13] Studies support the use of questionnaires and charts to evaluate disaster preparations. However, these tools are unable to assess the quality of care and patient flows. Compliance is also a significant limitation of survey tools and can determine and influence the results. [73] Previous surveys in Italy showed that 12 out of 15 hospitals were considered to be underprepared for any MCI. The average level of preparedness was lower than the recommended checklist by WHO. It revealed that communication systems, surge capacity and safety were inadequately executed. The survey also emphasized the need for standard federal guidelines to support the hospital get prepared. [74] Jordan is another country plagued with conflict and war. Surveys and evaluations conducted in Jordan showed moderate to weak knowledge and skills among doctors to respond to an MCI. The perception of preparedness varied considerably according to their experience, sex and specialty. The study suggested that better education and training improve the situation. [75]

In Iran, the researchers suggested the need for new tools based on scientific evidence to predict and evaluate hospital preparedness before any MCI. [76]. The evaluation of hospital preparedness

for disasters and MCIs is an effective way to reveal the system's gaps and weaknesses and possibly improve the response. Pilot studies showed the possibility of standardized evaluation techniques to understand the relationship between better preparedness in the trauma centers and an enhanced response to an MCI. [77] It is established in the literature that disaster and MCI planning is directly related to better disaster response. However, no standardized tool or method is still considered to evaluate hospital systems' disaster preparedness and planning. Various evaluation tools have been considered optimal, including a three-part tool involving triage, medical maneuvers and radio usage. This tool needs to be used with more observation as such tools can be reproduced internationally as an evaluation tool for disaster management drills. [78]

Aims and objectives

- The proposed study is expected to access the trauma preparedness and techniques of WCSM
- The Study is also expected to assess the awareness and preparedness of the doctors in the trauma centers
- It aims to show that Frequent Simulation training can Help prepare for MCIs better
- The study is expected to analyze if a more experienced system is superior to a more advanced system
- The study is also expected to find the gaps between the systems around the world

Research questions

- What is the level of trauma and surgical preparedness in both the systems?
- How are the different trauma systems around the world prepare and evaluate their MCI preparedness?

Hypothesis

There are significant gaps between the optimal trauma preparedness guidelines and requirements worldwide and the current methods and approaches used to tackle such mass casualty events.

Methodology and Work Plan

Study design

This is a descriptive qualitative study.

Background Study of the Literature available.

Library research and literature review about the best and optimal trauma preparedness guidelines present and published around the world using PubMed/Medline, Embase and Cochrane and other

databases available. This is a major part of the research and the initial step towards shaping the whole thesis. The search strategy is found in appendix

Questionnaire

We conducted a survey of the surgeons and physicians working at the West China School of medicine, to characterize their existing disaster-response plans and to identify areas where preparedness could be improved. A part of the survey is directed to the leadership of the department, the survey includes questions about the major aspects including:

- Training guidelines.
- Stratification of hospitals and Surge protocols.
- Triage and transfer protocols.
- quality control and follow up of patients
- Hospital infrastructure and systems.

Detailed draft of the questionnaire can be seen in Appendix 1

Inclusion Criteria and Sampling

- A list of potential doctors was extracted from the database of West China school of medicine.
- Target population of this study are the doctors who will be potentially involved in case of an MCI in the two-target hospitals/trauma centers. It was estimated to find at least 25 doctors from each hospital. The response rate is predicted to be 80% therefore making the number of at least participants 20 from each hospital.

Recruitment

After receiving ethics Institutional Review Board approval from the Research Ethics Board at McGill University, the roster managers of the organizations participating in this study were sent an email to the doctors in their database. The roster managers were notified, that the main researcher will be contacting them for this research, and they will have the option to let their manager know if they do not want to be contacted. The roster managers signed a confidentiality agreement to ensure that the names of those who refused to participate is confidential and that they were not penalized in anyway by opting out from this study. The investigators then contacted the doctor that did not refuse to be contacted with an email which contains an introduction and overview to the research, the consent form and the link to an online survey. The online survey was done using an online survey tool (SurveyMonkey, Inc, Palo Alto, CA, WeChat). Participants who agreed to participate in the study could access the link directly. The survey included a section with a consent form that had to be signed before completing the questionnaire. The roster managers did not have access to the names of who answered the survey and who did not. That information is only accessible by the investigator. A reminder was sent to the potential participants every two weeks by the recruiters.

Informed consent and consent withdrawal

Participation in this study was completely voluntary and will take into consideration the well-being, free-will and respect of the participants, including respect of privacy. Informed consent form is shown in Appendix 2, containing information and assurances that allow individuals to understand the implications of participation and reach a fully informed and freely given decision about whether to do so, without the exercise of any pressure or coercion. Participants could withdraw from the study if they do not feel comfortable. Participants may also withdraw from the study at any time, for any reason.

Analysis of the data collected using different tools

- A descriptive analysis of the data was used to evaluate if there is a consensus on the lack of awareness about the protocols and guidelines regarding MCIs.
- Assessment of the current situation about how the different trauma systems are tackling and dealing with such mass casualty events. The studies were considered based on review of similar disasters all around the world and the level of repose in those disasters. Primary source materials available were also collected.
- Analysis of the major events in two parts of the world, including the Sichuan earthquakes, the Quebec floods and other similar events such as the Lac-Megantic train derailments [(38)]. Using tools of data collection, the study would keep it open enough to adopt various tool
- Development of improved and more advanced methods and guidelines for trauma preparedness can be formulated using interviews and personal observations. relevant information was gathered from various medical reports, books, journals, research papers, news reports from print and visual media etc.in both Chinese and English languages. Hospital officials, doctors were contacted to collect valuable inputs and suggestions. Though considerable quantitative data were gathered the essential thrust of the research was made through the qualitative technique and methodology adopted will be comparative and analytical in nature.

Data dissemination

Data was used for this research only. It will be stored for 10 years then will be deleted permanently. Data will be used to create an article for publication and the master's thesis project

Ethics

Study will be conducted according to ethical principles stated in the Declaration of Helsinki (2013), ethics approval will be obtained before initiating study, consent forms will take into consideration the well-being, free-will and respect of the participants, including respect of privacy.

Implications

The proposed study has the full potential to unleash new information and perspectives. The study's empirical and objective findings will provide impetus to various stakeholders involved in the process of trauma management. Thus, besides contributing to academic knowledge, this research aims to provide inputs into the medical decision-making process during natural disasters and trauma management.

Results

Demographics

44 Doctors participated in the survey, 25 were male, and 19 were female with an average age of 35. The participants are all part of the emergency department of the West China School of medicine. The average years of experience of the participants are 8.63 years, and the responses are plotted on Chart 1.1

Of the 44 participants, 20 were resident doctors, 19 were attending doctors, 4 were associate doctors, and 1 was the chief of the emergency department in WCSM. Of those, 68% said it is very likely that their Hospital will be required to respond to a mass casualty incident in the next five years, 27% said maybe, and only 5% said it is not likely; the data is also displayed in Chart 1.2. The respondents were also asked what kind of MCI they were expecting; the results are shown in Chart 1.3. Most doctors think that their Hospital will most likely respond to MCIs like an earthquake, landslides, road traffic accidents, and fires. The results also showed that the respondents felt that they are not likely to respond to gunshots, violence, floods or CBRN.

Chart 1.1

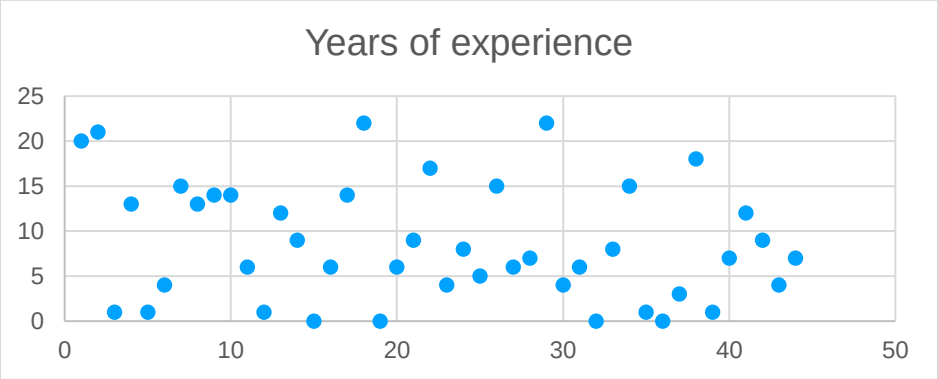


Chart 1.2

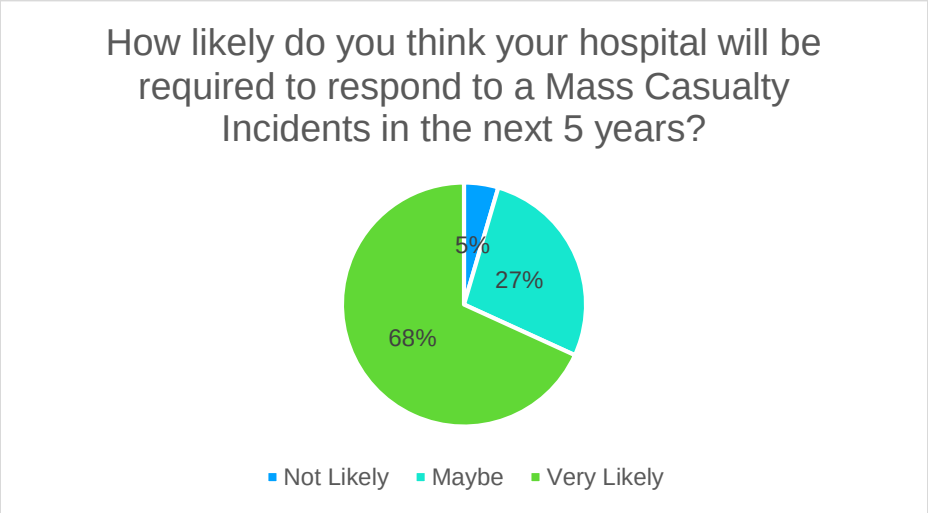
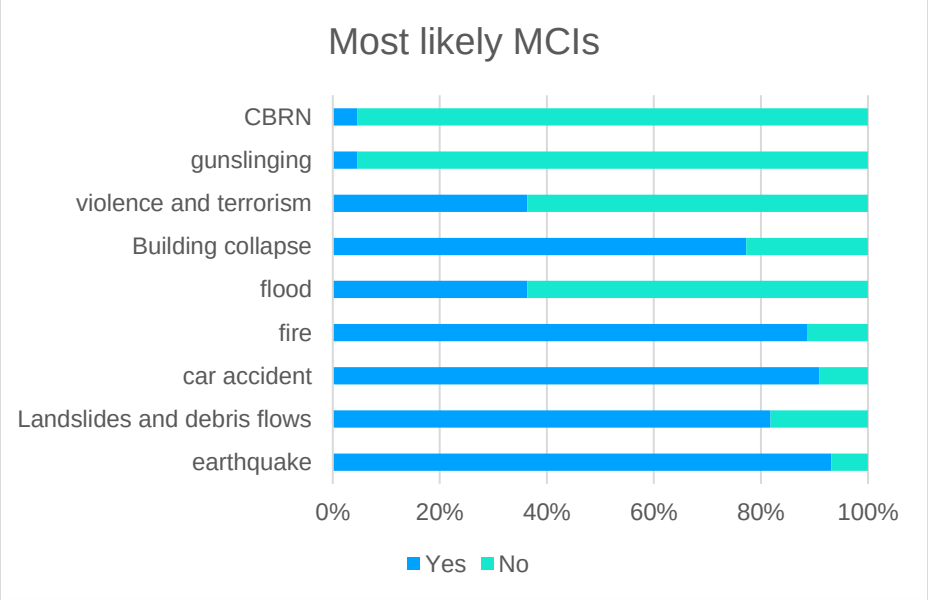


Chart1.3



Training

In this section, the participants were asked questions about their certification and post graduate training status. They were also asked about their Hospital's training guidelines. The training section helps assess the and awareness level of training.

The responders were asked if they were offered regular training for MCI and disaster preparedness. The hospital protocols of WCSM showed no guidelines for regular training; however, interestingly, 23% of the participants were not aware and answered yes; the data can be found in chart 2.1.

The participants were asked about their current BLS, ACLS, ATLS and other postgraduate certification statuses. The majority of the respondents had a valid BLS certification; 50% of the responders had valid ACLS certification. However, very few participants had ATLS or a postgraduate or certificate training in MCI or disaster management. The data is presented in Chart 2.2

Most participants received BLS training within the last five years; however, many doctors never received an ACLS or ATLS training. The results are shown in Chart 2.3

Chart 2.4 showed the different postgraduate certifications received by the participants at the West china school of medicine.

Chart 2.1

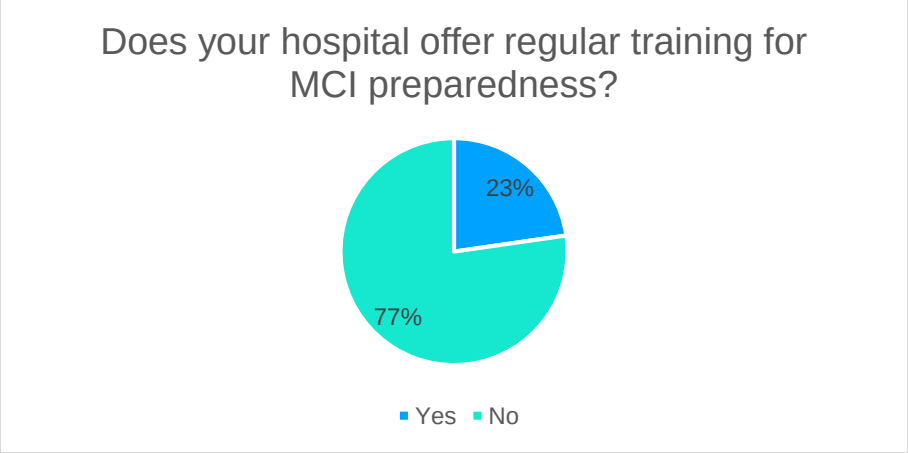


Chart 2.2

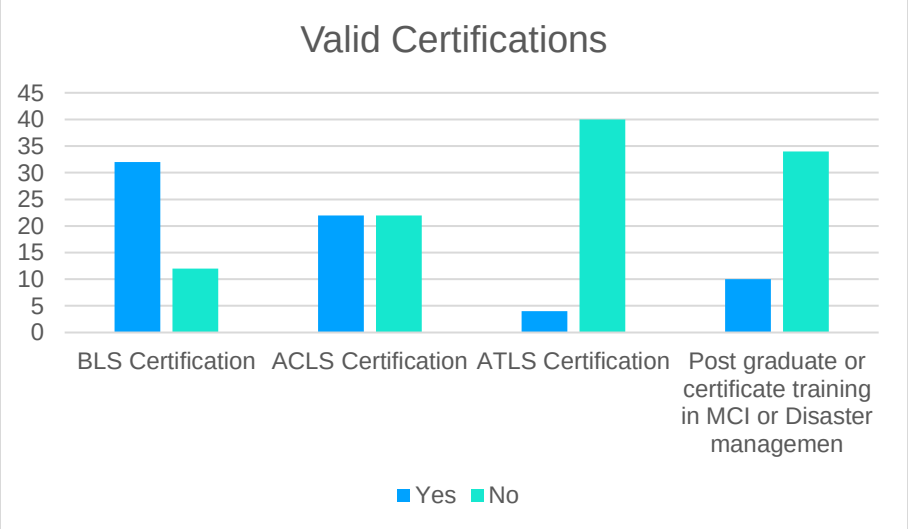


Chart 2.3

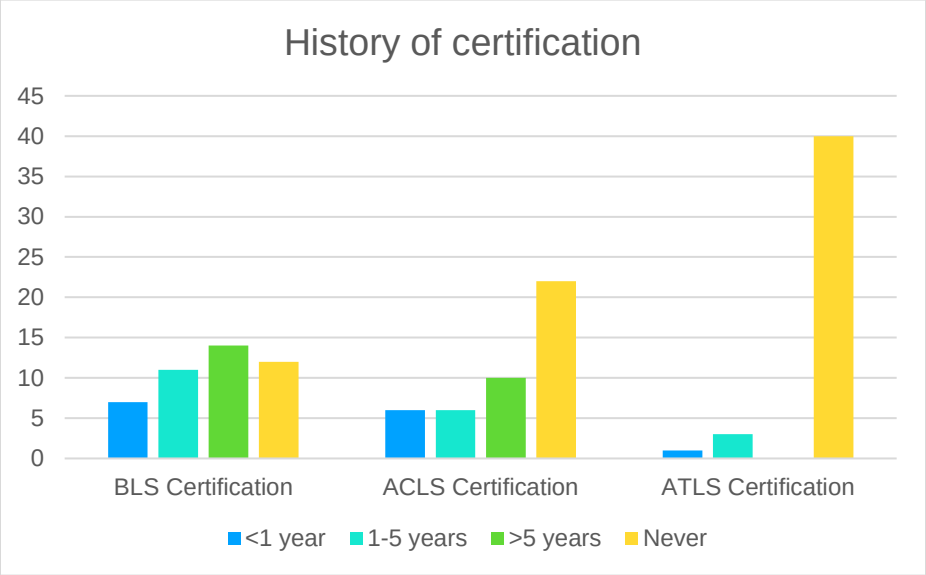
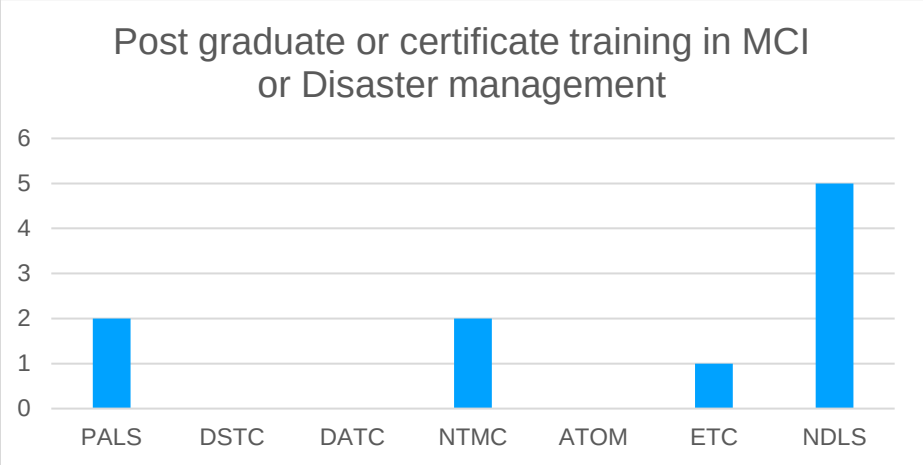


Chart 2.4



Triage

In this section, the participants were asked questions about their Hospital's triage guidelines and protocols. The triage section helps assess the level of awareness among the participants about their Hospital's triage procedures.

Among the 44 participants, 28 of them were aware that their Hospital had set guidelines and protocols for triage during a disaster and MCI. (Chart 3.1)

However, Chart 3.2 shows that 57% of the responders were not familiar with the Hospital's MCI triage protocols, and only 43% were familiar or very familiar with them.

The participants were first asked if they think there is a need for a better triage system and protocols, and 100% of the responders agreed that superior triage protocols are required to better respond to an MCI. As Operation room triage protocols are very sensitive and essential during a disaster, the participants were specifically asked if they were aware of them, and the results are displayed in Chart 3.3

Chart 3.1

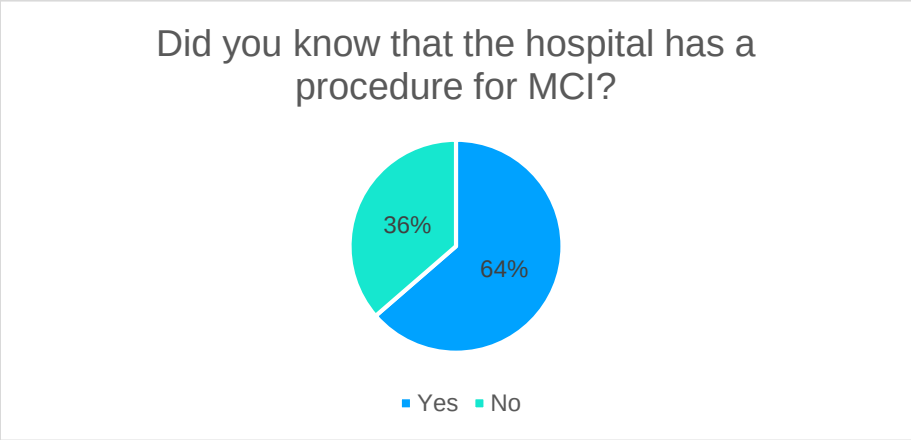


Chart 3.2

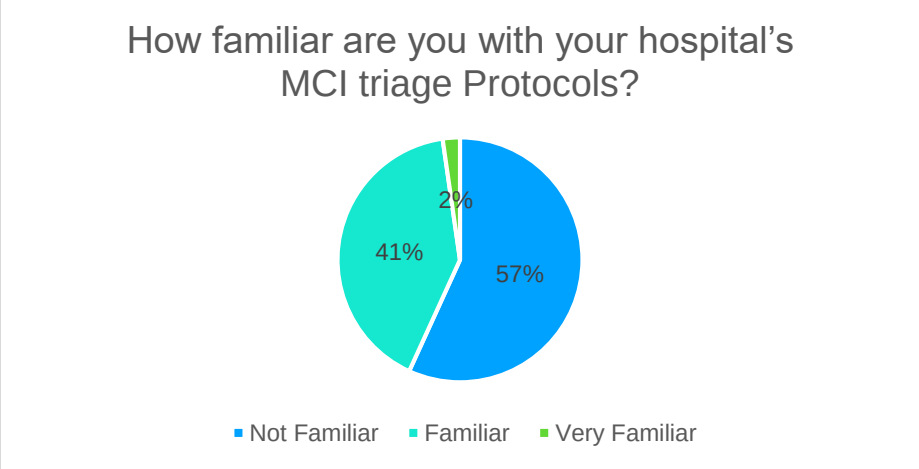
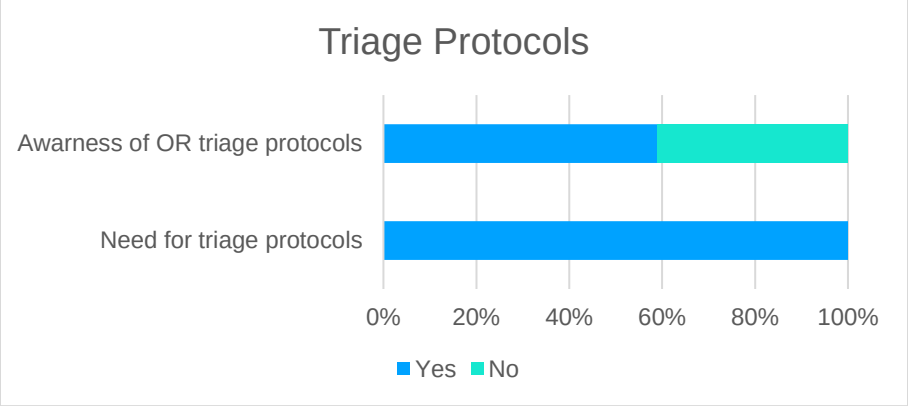


Chart 3.3



Surge and Stratification of hospitals

In this section, the participants were asked questions about their Hospital's surge and stratification guidelines. The Surge section helps assess the level of awareness among the participants about their Hospital's surge capacity. This section also tries to gauge the participant's perception of the efficiency of the Hospital's existing surge and stratification policies.

30 participants out of the 44 responders did not know about the surge guidelines of their hospitals. Chart 4.1 also shows their perception of how well the protocols work.

Similarly, only 14 participants were aware of local policies or guidelines to redirect non-MCI patients to different hospitals. Chart 4.2 shows how well the current system works according to the doctors of WCSM.

In contrast to the above results, 75% of the participants were aware of the protocols in WCSM for transferring existing patients and to create capacity for MCI patients before their arrival. Chart 4.3 shows that most responders felt the existing protocols works.

WCSM performs simulation drills for surge capacity; however, more than 50% of the participants were not aware of the drills. Chart 4.4 shows how efficiently the simulation drills work according to the participants.

Chart 4.1

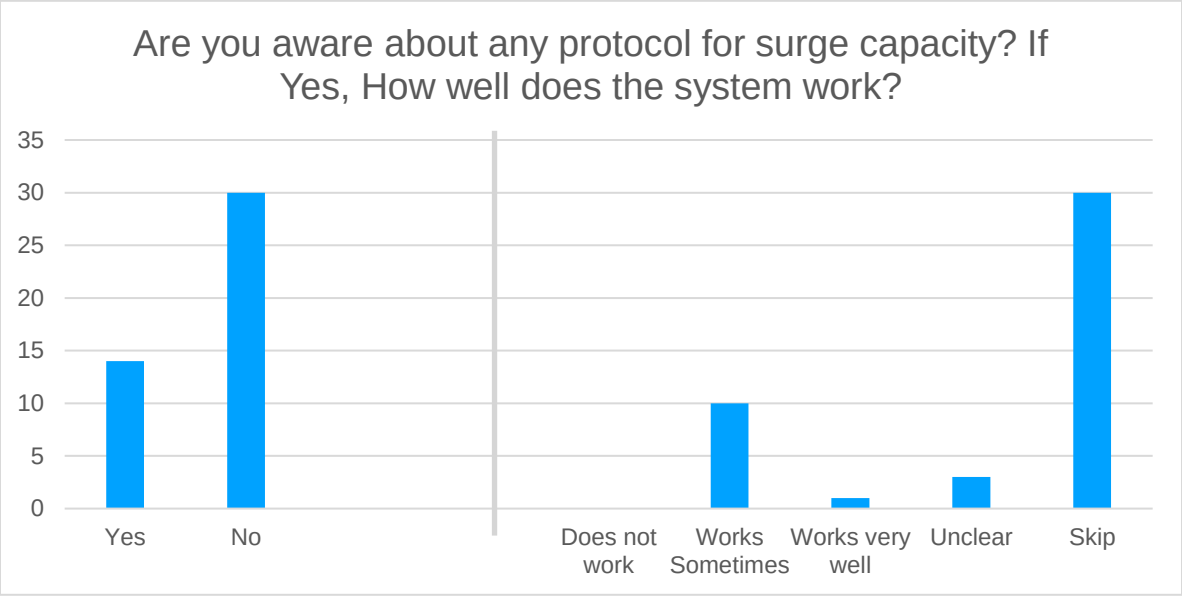


Chart 4.2

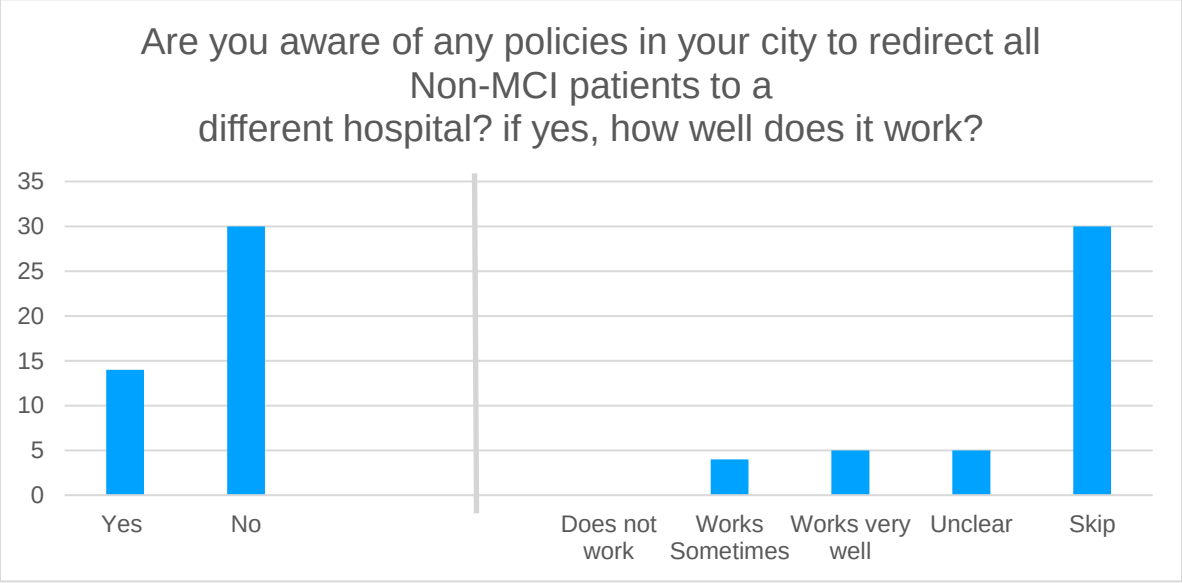


Chart 4.3

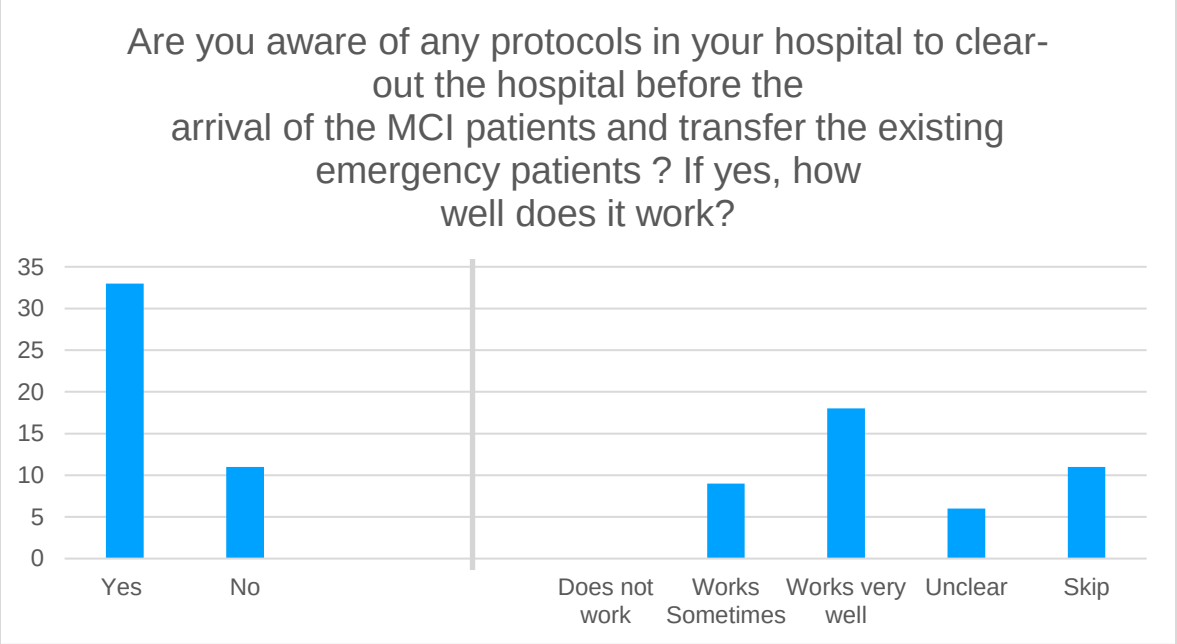
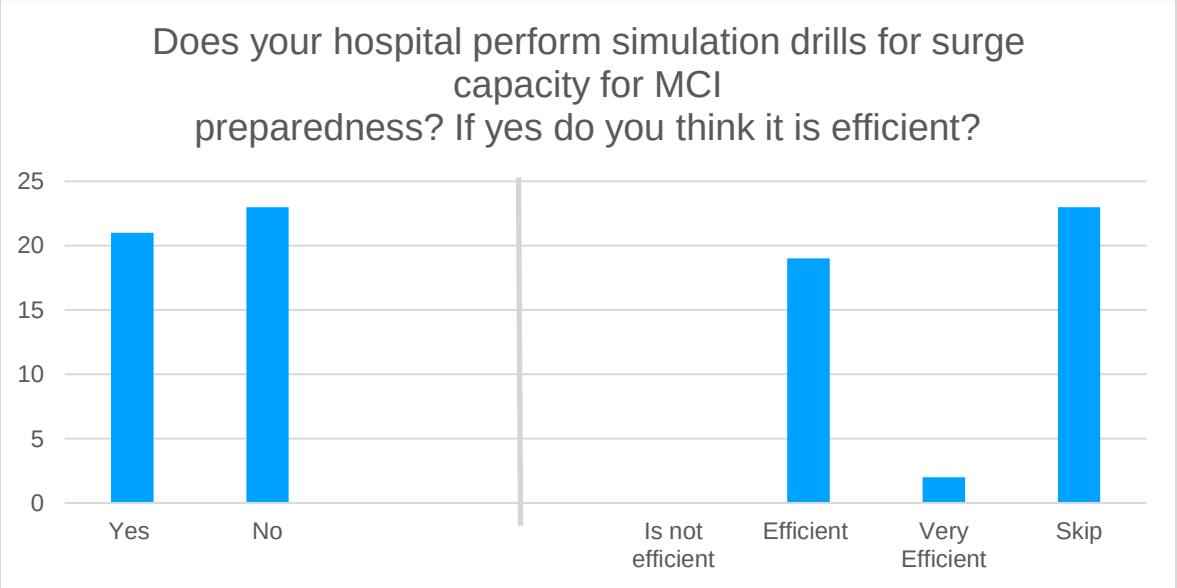


Chart 4.4



Quality of care

In this section, the participants were asked questions about their Hospital's quality control methods and techniques. This section's questions help assess the participant's comfortability and familiarity with their Hospital's quality control protocols. This section also tries to gauge the participant's perception of the efficiency of the Hospital's existing guidelines related to patient follow-up during an MCI.

82% of the responders were either comfortable or very comfortable with their role in the Hospital's code orange or MCI protocols. However, 18% of the participants were still not comfortable with the Hospital's MCI protocols. The data is depicted in chart 5.1

Penetrating wounds and gunshot wounds are prevalent during most MCIs. The participants were asked about their familiarity with deep penetrating wounds and gunshot wounds, and the results in chart 5.2 showed more than half of the responders were not familiar with the care of penetrating wounds.

Of the 44 participants, only six were aware of the specific protocols in the WCSM to follow up on the patients who are admitted in case of a disaster event. Chart 5.3 shows that the doctors aware of the protocols agree that it works efficiently.

When asked about patient data collection during an MCI, 23 participants knew about the Hospital's guidelines. Chart 5.4 shows that most responders who are aware of their Hospital's protocols think it works very well.

Chart 5.1

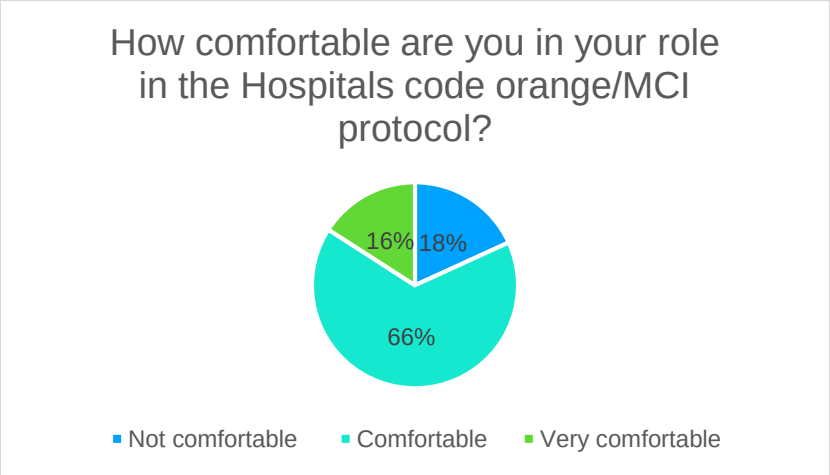


Chart 5.2

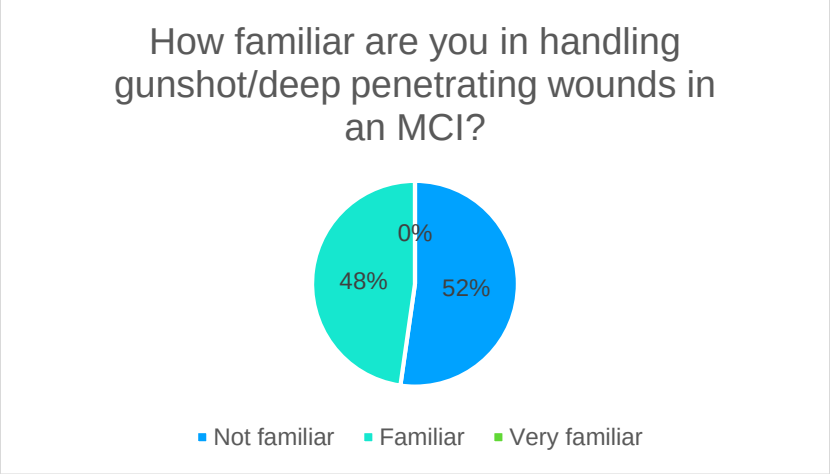


Chart 5.3

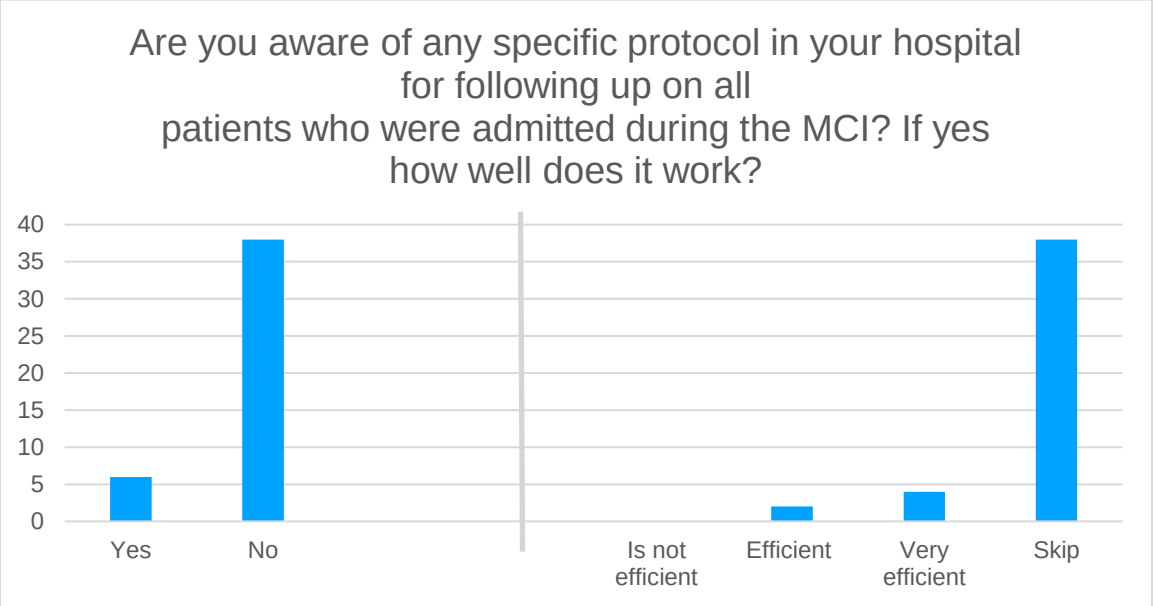
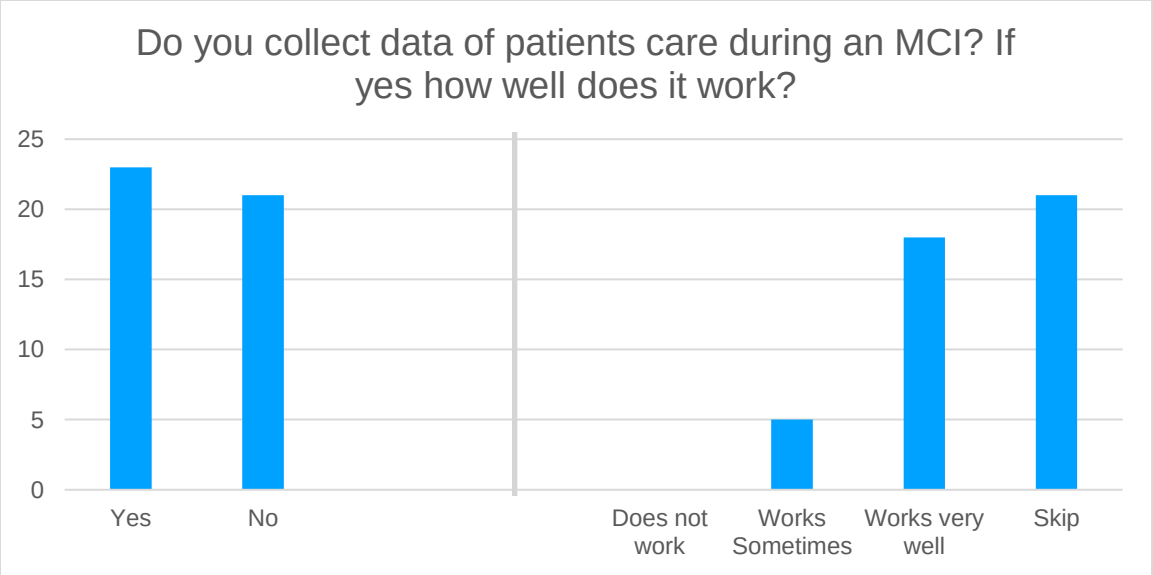


Chart 5.4



Hospital system and infrastructure

This section is divided into two parts. In the first part, all the participants were asked questions about their Hospital's system and infrastructure related to MCIs. In the second part of this section, we asked the chief of the emergency department of WCSM about specific protocols and guidelines of the Hospital. The section helps assess the level of awareness among the participants about their Hospital's MCI system and gives an insight into the existing protocols related to MCI management

and preparedness, specifically in West Chia School of Medicine. The questions help understand the current guidelines used by WCSM to handle disaster events.

In the first part, all participants were asked if they are aware of the designated triage officer and a designated triage area in their Hospital. Chart 6.1 and chart 6.2 show that 91% of the participants had knowledge about triage officers and triage areas.

39 responders out of 44 were aware of the medical staff activation process for MCIs at their Hospital, and most of the people who responded think that the process works efficiently or very efficiently. (Chart 6.3)

In the second part of the section, the emergency department chief acknowledged that WCSM had dedicated staff for public communication during an MCI. They have special guidelines for patient registration and tracking in cases of surge due to an MCI, along with the Hospital's trauma registry dedicated to all kinds of disasters.

According to the chief of the emergency department at WCSM, they offer MCI preparedness training; these simulation drills are performed less than five times every year. However, they do not offer any specialized trauma courses. He also highlighted in his response that the hospital staff are offered BLS and ACLS, but they have not offered ATLS training yet.

WCSM has responded to 14 different MCIs in the last 15 years alone, including the major earthquakes of Wenchuan, Ya'an and Jiuzhaiguo in the Sichuan province of China. The list of the 14 MCIs is shown in Table 6.4. the table depicts that WCSM medicine has responded to various types of MCIs, like forest fires, explosions, earthquakes, floods and road traffic accidents. According to the Hospital, the MCI management for the disasters listed included Land and transfers to hospitals, onsite treatment and first aid of critical patients, resource mobilization of deployment to different hospitals in need, collection of important information related to patient management and rehabilitation of the affected patients.

In his response, he admitted the lack of different protocols for tackling different kinds of MCIs. WCSM does not have specific protocols to follow up on all the admitted patients during an MCI. The Hospital also does not undergo regular All hazards risk assessments or evaluations. Nevertheless, the Hospital is involved in disaster preparedness and response planning at the municipal, regional and national levels. Therefore, there is hope for improvement in the future.

Chart6.1

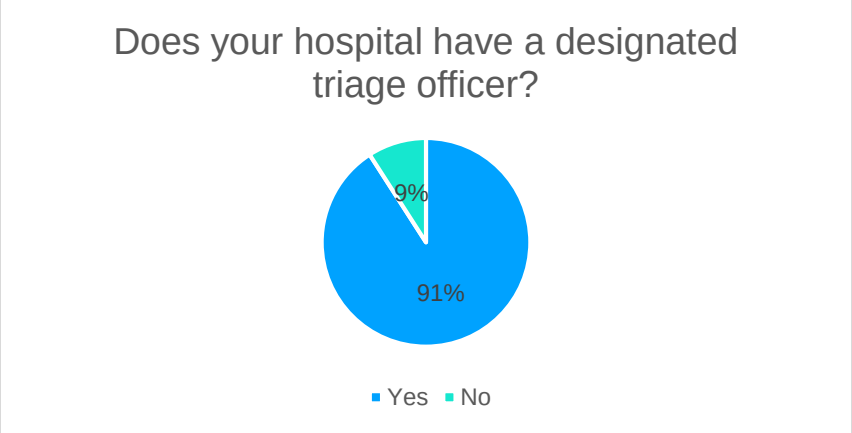


Chart 6.2

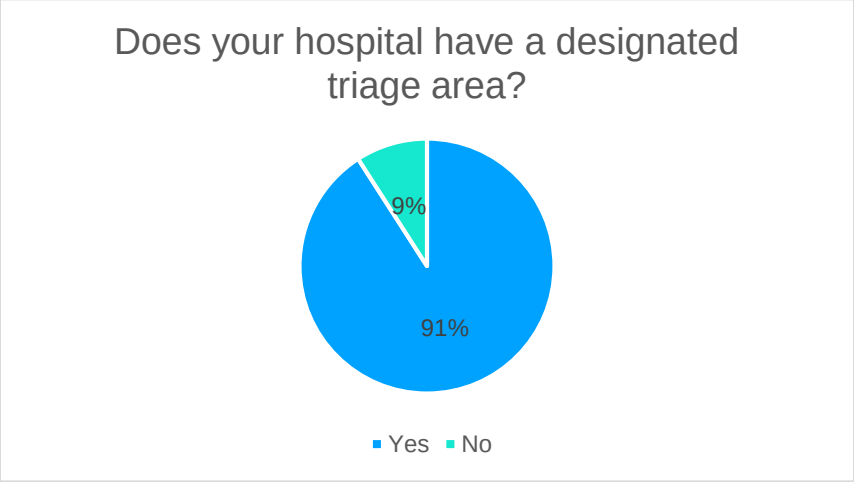


Chart 5.3

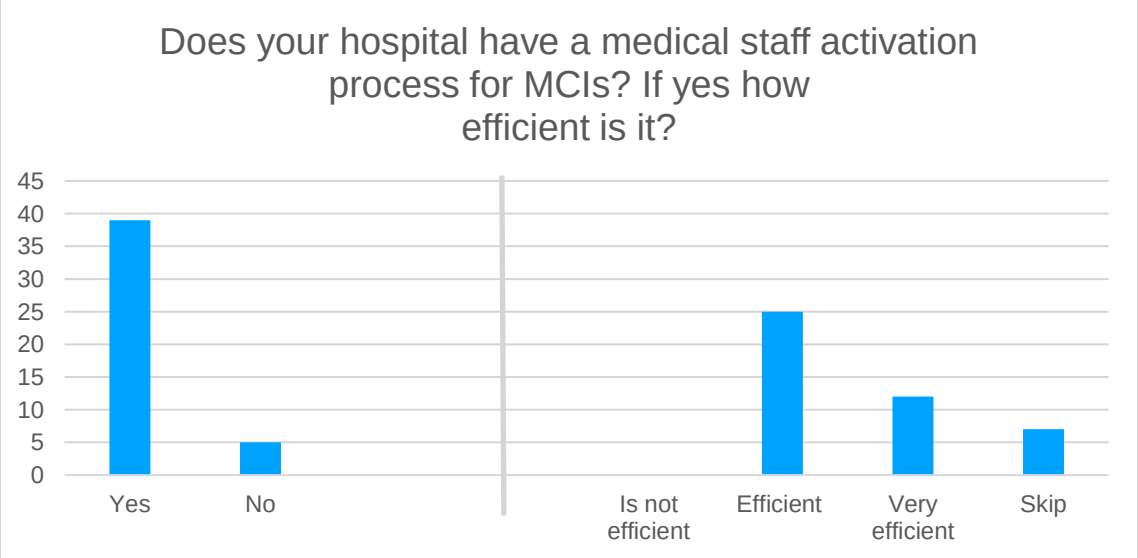


Table 6.4

List of MCI responses by WCSM in the last 15 years	
Dates	**Mass casualty event**
2008.5.12	Wenchuan Earthquake
2010.4.14	Qinghai Yushu Earthquake
2012.4.29	Multiple car accident rescue work
2012.9.7	Earthquake in Zhaotong City, Yunnan
2013.4·20	Ya'an Lushan Earthquake
2014.3.19	Xichang Forest Fire
2014.8.2	Explosion at the Kunshan factory in Jiangsu
2014.8.3	Yunnan Zhaotong Earthquake
2015.8.16	Nanchong flood disaster
2015.12.12	Baomao Expressway Accident Rescue
2017.6.24	Large landslide in Maoxian County, Sichuan
2017.8.8	Jiuzhaigou earthquake
2019.4.2	Deep forest fire in Liangshan, Sichuan
2019.8.2	Mabian flood disaster

Discussion

The survey participants had a wide range of levels of experience; nevertheless, most of the responders agreed that MCIs are likely to happen in the near future. This emphasizes the importance of MCI training and preparedness. The literature suggests that the field of disaster preparedness is rapidly growing; however, there is still a need for more international collaborations. Global collaborations in this field will help enhance the response to natural and man-made disasters worldwide. [(31)]

A significant number of participants were aware that the West China school of medicine had specific protocols for an MCI. There are various studies done to develop better trauma protocols and guidelines specific to MCI response. It is very promising that most participants had a valid BLS certification; however, it should be noted that only half of the responders had an ACLS certification, and a tiny percentage had an ATLS certification, which is critical in any trauma response. It is also alarming that most participants agreed that their Hospital does not offer regular training for MCI preparedness. Researchers have demonstrated the need for inter-professional training among hospital staff. Especially since surgeons are mostly involved in disaster responses, they need to be trained in non-technical skills to achieve better performance during a response, like leadership, teamwork, and conflict resolution. [(79)] It is interesting to note that less than 60% of the participants were aware of the triage protocols for patients going directly to the operation rooms, emphasizing the importance of MCI training among surgeons. Most triage skills are taught in training and disaster preparation courses. It is also troubling that a significant number of the participants got their certifications more than five years ago. A very small number of participants have post graduate training for disaster response. Medical staff with previous experience and disaster preparation education are proven to be more efficient during disaster responses. [(65)]

Every Hospital should have plans for surge capacity to improve trauma response. Surge techniques should be part of every guideline to support and estimates surge capacity during a response. [80] Hospitals need strategies for evacuation and relocation of existing patients to create surge capacity. This needs to be executed safely and efficiently to maintain the quality of care in a disaster. [81] It is alarming that most of the participants were not aware of West china school medicine's surge protocols and guidelines; however, when asked if they are aware of guidelines to evacuate the Hospital for MCI patients, most of the participants were aware of the protocols and also admitted that it works well. Training exercises should be conducted often, and the flaws identified from the assessments should be implemented for better real-time applications. However, the results from the survey showed that less than 50% of the participants were aware of their Hospital's surge simulation drills, and most of the doctors who were aware agreed that the training exercises do not work very well but works sometimes. The evaluation of training sessions is an effective method to enhance preparedness. [82][83] Protocols for MCI can use guidelines from planned evacuations, and these plans, when implemented during regular and frequent disaster drills, can make the hospital staff more aware of the guidelines and help actual MCI evacuation seamless. [81] Such innovation and analytic framework can help collect data for a more methodological approach to unpredictable surge demands during an MCI. More research in this area needs to be done to design a better system. [84]

More than half of the participants were not familiar with their Hospital's triage protocols and infrastructure, which is a very troubling fact. However, most of the responders agreed that specific triage protocols are required for MCIs, which shows the interest of the participants to train and learn the triage guidelines.
Every Hospital needs the infrastructure for decontamination areas with showers and ventilation and train responders for this process. The chief of the emergency department highlighted in his response that WCSM has a designated triage area and a designated triage officer to maintain the triage protocols guidelines during an MCI. Hospitals also need to plan for protocols for acquiring antidotes for major toxins. The MCI planning committees need to evaluate the strategic nation stockpiles before delegating responsibility to them. [21] The research suggests that delayed response and care during an MCI can lead to infections in seriously injured patients. The availability of antibiotic therapy is critical in the case of an MCI; studies show that it increases the efficiency and quality of care. Early effective antibiotic therapy prevents long term complications of severe Trauma. [29] Web-based models provide methods to keep the hospital capacity updated and also help during simulations of complex MCIs for preparedness and response. [85]

We saw promising results as most participants were comfortable or very comfortable with their role in the Hospital's code orange or MCI guidelines. This indicates that the doctors are confident and likely to respond to MCIs better. The literature emphasizes the lack of psychological support for the medical staff during and after an MCI. Hospital MCI protocols should consider the confidence of their medical staff to attend to a disaster situation. However, 52 % of the doctors confirmed that they are not familiar with attending to gunshot wounds or penetrating wounds during an MCI. Core-competency based training can help emergency department doctors to improve confidence and increase willingness to respond better [39]. Courses should be designed for medical trainees and emergency physicians without formal disaster training. A critical factor in improving the quality of care in the future is to collect patient data, and WCSM has well-prepared protocols for data collection, which works very well according to most participants. Following up

with patients admitted during an MCI is vital to maintain a good quality of care; however, when the participants were asked, more than 85% of the participants did not know about the protocols related to following up with their patients. The ideal course should contain both clinical and non-clinical disaster response factors and make the trainees aware of their hospitals' existing protocols. Smartphones are becoming part of the medical field, and apps can be used to facilitate such training courses [86][87]. PEDS is one of the well-known courses designed by the American Academy of Pediatrics, which delivers disaster preparedness and response training to pediatricians worldwide. PEDS focuses on the emotional impacts, planning and triage, and the nutritional needs required during an MCI, including pediatric patients. Such courses can help responders understand the importance of emotional care during a response. [88]
MCI protocols and guidelines for triage, adequate staffing, adequate resources and protection of patients and staff are necessary to enhance the quality of response.[89][90][91][92] WCSM has an excellent staff activation process for MCIs, and according to survey results, it works very efficiently. A study in Sichuan, China, used four teaching techniques: action-based learning, problem-based learning and skill training and lectures. These methods were used to complete planned activities for two weeks. The study demonstrated a significant increase in the willingness and competency among students regarding disaster response. There was a significant increase in skills and knowledge after the completion of the course [93]. Pilot studies have shown that training programs conducted regularly throughout the year improved emergency physicians' cognitive competency. Such disaster training programs prove to have significant results to improve emergency response and should be applied in real-life MCI protocols.[94] According to the WCSM, the MCI management for the disasters responded in the last 15 years included Land and transfers to hospitals, onsite treatment and first aid of critical patients, resource mobilization of deployment to different hospitals in need, collection of important information related to patient management and rehabilitation of the affected patients. The wide variety in any MCI response puts immense pressure on the Hospital's trauma system. Computer-based simulations (SIMS) are used to demonstrate the impact of an MCI on the Hospital's trauma system. However, this cannot replace the live participation of medical staff. Virtual live exercises (VLE) help disaster plan evaluation, as they help participants come up with new and creative ideas to help during an MCI response. These exercises also help the Hospital evaluate the limitations of their response plans. Frequent use of such exercises can help establish benchmarks for disaster preparedness. Both VLE and SIMS are useful and complement each other [58][95]

According to the responses, WCSM has specific protocols or guidelines to assign dedicated staff for public communication. WCSM also has special guidelines for patient registration and tracking in cases of surge during an MCI. Implementation of Trauma and MCI guidelines are vital for the normal functioning of a hospital. Every Hospital needs to formulate an effective disaster and MCI management plan, which resonates with multiple levels, including the local and national disaster strategy. The hospitals should also prioritize regular disaster drills and revision of MCI plans according to the hospital staff's preparedness. [38][19] Hospitals also need to develop educational programs to improve their hospital staff's knowledge and skills. This will ensure the active participation of healthcare workers during any MCI. Infrastructure also plays a significant role in response to a disaster, and the hospitals need to re-evaluate the safety and evacuation plans as part of their disaster preparations. Research also emphasized the importance of evaluating emergency operation centers to ensure adequate resources and safe functioning. [96]

It was interesting to note that most participants think an earthquake, fires, road traffic accidents, and landslides are most likely disaster to which they will respond, which can be alarming as MCIs like gun violence or CBRN disasters require different training and can be ignored by most staff. However, the survey results showed that WCSM has responded to a wide variety of disasters and MCIs in the last 15 years. Despite this fact, WCSM still does not have specific protocols for different MCIs. MCI preparedness is crucial for every disaster response, and hospitals should have flexible plans between all-hazard preparedness and hazard-specific preparedness (e.g. CBRN disasters). It is encouraging that WCSM offers training for MCI preparedness, and they perform disaster drills around five times every year. The MCI plans should be guided by evaluations and benchmarks of disaster simulations and MCI drills. Most hospitals channel their funds towards the routine clinical budget; however, the literature suggests that an upfront expenditure towards disaster preparation resources can lead to a more efficient and smooth response in a disaster. [83] Studies have clearly demonstrated the need and the importance of developing a disaster preparedness evaluation tool. Such tools can help hospitals make informed decisions regarding resource allocation to improve the efficiency of disaster response. These tools can also help identify a trauma response's weakness and reinforce the best practices by setting benchmarks. [97] the questionnaire results showed that WCSM has medical information system or a trauma registry dedicated to any MCI in the Hospital. Pre-incident planning and preparedness can help coordinate severely injured patients' care by distributing the patient load to regional care facilities. These plans can be implemented using after-action reports from simulation training organized by hospitals regularly. AARs are essential to identify the strengths and the gaps in the effective response to an MCI. [15] MCI preparedness plans should also factor in the care required to patients that are not directly related to the event, including mental health support, as patients and staff both are likely to need it during and after a disaster response. Communication strategies also need to be addressed as patients, families, and the media will be involved during such events. [21]

Unfortunately, according to the survey response, WCSM does not have an All Hazards Risk Assessment done regularly. As part of the national strategy for disaster response, accreditation and assessment for the hospitals will motivate hospitals to invest more money and time to improve disaster preparedness and mitigation plans for MCIs. Regular implementation of disaster plans has demonstrated better response to disasters in the past. [46]

Implementing module-based simulation training for medical residents and emergency physicians has demonstrated preferable results for the trainees. The participants have reported desirable lengths with extended training modules, which helped them feel more confident in managing MCIs on both individual and departmental levels. [98]

The survey results response suggests that WCSM is involved in disaster preparedness and response planning at the national, regional and also municipal levels. The literature suggests that standardized national MCI plans lead to improvement of regional response and implementing strategies for better communication with stockpiling of medical resources can lead to a better response for MCIs from trauma centers and avoid any unwanted functional collapse. [14] Other areas for better implementation of MCI protocols include intense reviewing of the triage teams and its functions, communication systems and availability and judicious use of medical resources. [30]

Looking at the MCI preparedness guidelines and protocols in the world and the MCI protocol awareness of West China School of medicine, heterogeneity is evident. Lack of awareness among doctors about their disaster and MCI protocols increases the variability of the quality of response for MCIs and creates this disparity in access to care during MCIs. Therefore, standardized MCI

preparedness and education becomes a critical factor in improving the quality of care in disaster settings

This study presented limitations that should be explored here. The main limitation of the study design was its limited sample size, which restricted its power. It was a self-reported online survey that limited our ability to validate credentials and experiences and be prone to recall bias. The already discussed analysis could have been expanded to include a comparison between different variables by using ANOVA testing. The comparison could have been made between the doctors of different trauma systems to understand the differences and highlight the similarities which are proven to work. Furthermore, The inclusion criteria restricted us to only doctors and physicians; this choice was established during the methodology phase as a study design decision since the objective of this study was to assess the awareness of MCI protocols and guidelines only among the physicians involved in MCI response. Additionally, nurses and other hospital staff were not included, which limited its capabilities to expand interventions, which may have given a broader understanding. Nonetheless, various studies can be found in the literature that focuses only on nurses' preparedness for MCIs, and this study tried to do only among physicians similarly.

Conclusion

The study helps identify the hospital's Preparedness and weaknesses before an actual disaster occurs to ensure the quality of care during an unexpected occurrence of an MCI. [96] This shows the importance of doctors who participate in these MCI responses to have broad-based training that includes the most encountered issues in disaster settings.
This research provides better-informed capabilities and awareness of the doctors expected to be involved in an MCI and enhance hospitals' collaborations during disaster events. The information from this research can be used to improve the hospital staff's preparedness and skills for future MCIs. This study can also add to the literature to address the gaps in the field of disaster preparedness and guidelines. [51] The study helps hospital management realize their staff's awareness and level of preparedness for reporting to a disaster event. It also emphasizes the importance of developing a standardized disaster training program to support and enhance response to an actual MCI. [99][70] We focused on the doctors' perception of preparedness as research shows that perceptions are dynamic and may change with different events' experience. Tracking the changing preparedness among hospital staff is vital for modern emergency disaster response. [44]

Physicians are one of the most crucial factors of any disaster response; however, very few are involved in disaster response planning. Therefore, some doctors cannot realize their role and are unaware of the existing guidelines and protocols during an MCI. This research tries to bring awareness about the existing systems and infrastructure required during an MCI among the hospital staff. This study also focused on informing the hospitals about the different MCI protocols and guidelines existing in different parts of the world to facilitate the formulation of the Hospital's optimal disaster plan. It is hoped that exposing the hospital staff to the different disaster principles and practices will motivate them to get involved in administrative and planning components at the local or federal level. Acquiring the skills for these life-saving incidents before being deployed will improve the mortality and morbidity outcomes during any MCI and create an ethical space where doctors have been adequately trained according to a standardized protocol. The physicians

must be aware of the protocols and guidelines, so they are prepared to respond to any MCI, should it occur. [(100)]

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Questions for the Questionnaire

DEMOGRAPHICS

Age: _____

Gender: _____

Employment rate: *Part-time*☐ *Full-time*☐

Years of experience in the Emergency Department: _____

Department: _____

Role: *Resident*☐ *Attending*☐ *Chief*☐

How likely do you think your hospital will be required to respond to a Mass Casualty Incidents in the next 5 years? And please specify what kind of MCI do you think it will be?(E.g. Earthquake, Fire, Shooting etc.)

Not Likely☐ *Maybe*☐ *Very Likely*☐

TRAINING

1. Do you currently have a valid BLS certification? If "No" have you ever received this certification in the past?

Yes ☐ *No*☐

Never☐ *1-5 years ago*☐ *>5years ago*☐

2. Do you currently have a valid ATLS certification? If "No" have you ever received this certification in the past?

Yes☐ *No*☐

Never☐ *1-5 years ago*☐ *>5years ago*☐

3. Do you currently have a valid ACLS certification ? If "No" have you ever received this certification in the past and how long ago did you receive it?

Yes☐ *No*☐

Never ☐ *1-5 years ago* ☐ *>5years ago* ☐

4. Do you have any Post graduate or certificate training in MCI or Disaster management? If yes, please specify (E.g. PALS, DSTC etc.)

Yes ☐ *No* ☐ _____

5. Does your hospital offer regular training for MCI preparedness?

Yes ☐ *No* ☐

TRIAGE

6. How familiar are you with your hospital's MCI triage Protocols?

Not familiar ☐ *Familiar* ☐ *Very familiar* ☐

7. Do you think we need a triage system specifically for MCI trauma patients?

Yes ☐ *No* ☐

8. Are you aware of the protocols for triaging cases going to the OR during an MCI?

Yes ☐ *No* ☐

STRATIFICATION OF HOSPITALS

9. Are you aware about any protocol for surge capacity or managing the Non- MCI patients and MCI cases at the same time?

Yes ☐ *No* ☐

Does not Work ☐ *Works Sometimes* ☐ *Works very well* ☐

10. Are you aware of any policies in your city to redirect all Non-MCI patients to a different hospital? If yes how well does it work?

Yes ☐ *No* ☐

Does not work ☐ *Works Sometimes* ☐ *Works very well* ☐

11. Are you aware of any protocols in your hospital to clear-out the hospital before the arrival of the MCI patients and transfer the existing emergency patients ? If yes how well does it work?

Yes ☐ *No* ☐

Does not Work ☐ *Works Sometimes* ☐ *Works very well* ☐

12. Does your hospital perform simulation drills for surge capacity for MCI preparedness? If yes do you think it is efficient?

Yes ☐ *No* ☐

Is not efficient ☐ *Efficient* ☐ *Very efficient* ☐

QUALITY CONTROL

13. How comfortable are you in your role in the Hospitals code orange/MCI protocol?

Not Comfortable ☐ Comfortable ☐ Very comfortable ☐

14. How familiar are you in handling gunshot/deep penetrating wounds in an MCI?

Not Familiar ☐ *Familiar* ☐ *Very Familiar* ☐

15. Are you aware of any specific protocol in your hospital for following up on all patients who were admitted during the MCI? If yes how well does it work?

Yes ☐ *No* ☐

Does not Work ☐ *Works Sometimes* ☐ *Works very well* ☐

16. Do you collect data of patients care during an MCI? If yes how well does it work?

Yes ☐ *No* ☐

Does not Work ☐ *Works Sometimes* ☐ *Works very well* ☐

HOSPITAL TRAINING, TEAMWORK AND SYSTEMS

1) Does your hospital have a designated triage officer?

Yes ☐ *No* ☐

2) Does your hospital have a designated triage area?

Yes ☐ *No* ☐

3) Does your hospital have a medical staff activation process for MCIs? If yes how efficient is it?

Yes ☐ *No* ☐

Is not efficient ☐ *Efficient* ☐ *Very efficient* ☐

4) Does you hospital have protocols or guidelines to assign dedicated staff for public communication?

Yes ☐ *No* ☐

5) Does your hospital have special guidelines for patient registration and tracking in case of an surge capacity due to a MCI?

Yes ☐ *No* ☐

6) Is there a medical information system or a trauma registry dedicated for any MCI in the hospital?

Yes ☐ *No* ☐

7) Does your hospital offer training in MCI preparedness? If yes, can you explain it briefly?

Yes ☐ *No* ☐

8) How many simulation disaster drills do you participate in every year?

<5 ☐ *5-15* ☐ *>16* ☐

9) Does your hospital offer specialized Trauma courses? If yes, please specify

Yes ☐ *No* ☐

10) Does your hospital offer BLS training to all staff?

Yes☐ *No*☐

11) Does your hospital offer ALS training to all staff?

Yes☐ *No*☐

12) Does your hospital offer ATLS training to all doctors?

Yes☐ *No*☐

13) Does your hospital offer ACLS training to all doctors?

Yes☐ *No*☐

14) How many MCIs has your hospital responded to in the last 15 years? Could you please briefly describe how did they respond to them?

<5☐ *5-15*☐ *>16*☐

15) Does your hospital have different protocol for tackling different MCIs? If yes, please briefly describe each of them.

Yes☐ *No*☐

16) Is your Hospital involved in disaster preparedness and response planning at the different levels?

National☐ *Regional*☐ *Municipal*☐

17) Does your hospital have a specific protocol in place for following up on all patients who were admitted during the MCI? If yes how well does it work?

Yes☐ *No*☐

18) Is there a procedure in your city to redirect all Non-MCI patients to a different hospital? If yes how well does it work?

Yes☐ *No*☐

19) Does you Hospital have an All Hazards Risk Assessment done regularly?

Yes☐ *No*☐

Appendix 2

PARTICIPANT CONSENT FORM

Trauma Management and Preparedness in Quebec's and Sichuan's Trauma Centers for mass casualty Incidents: A Comparative study and Analysis

Researcher: Dr. Shreenik Kundu
Msc Experimental Surgery, McGill University
Telephone: +1 (647) 607 7591
Email: shreenik.kundu@mail.mcgill.ca

Supervisor: Dr. Tarek Razek
Department of Experimental Surgery, McGill University
Email: tarek.razek@mcgill.ca

Introduction
You have been invited to participate in an online survey that aims to examine the level of preparedness in the target trauma centers to deal with mass casualty events.
You have been selected based on your previous experience or potential role in response to mass casualty incident. The objective of this research is to identify the gaps in mass casualty incident training and common protocols to respond in the future. This will help in the creation of a framework with the necessary skills general surgeons need to master to work efficiently in a disaster setting. This framework of an optimal trauma center and response in the future to ensure they can provide proper medical care and are fully prepared to the wide scope of practices they can encounter during a mass casualty incident.

Study procedure:
If you agree to participate in this study, please answer the survey attached to this email. The first section of the survey contains the consent form that you have to sign in order to have access to the questionnaire. The questionnaire has questions on demographics, awareness of current protocols regarding MCI response and main barriers to trauma response in disaster settings. The length of this survey is 20-30 minutes and is in English and Mandarin.

Potential Risk:
There are no anticipated physical risks to you by entering in this research, the questions are about your awareness about the MCI protocols only and not your personal experience in these settings.

Potential Benefits:

Participating in the study might not benefit you, but we hope to learn how to enhance the trauma response to any mass casualty incident in the future by improving the outcomes regarding delivery of medical response.

Confidentiality:
No personal identifying information will be collected, and you will remain completely anonymous. None of the information you provide will be linked to your history. Stating your gender, and clinical skills will not be linked to your personal data. All data will be collected in a password-protected digital database. Participant information will remain confidential and access to the database will be the research team.

Voluntary participation:
Your participation in this study is voluntary, and anonymous. You may refuse to participate, may decline to answer any question, and may withdraw from the study at any time, for any reason. If you choose not to participate or to withdraw, all available information you had offered will be erased.

Questions:
In case of any questions or comments related to the study, please contact the main researcher as above listed. If you have any ethical concerns or complaints about your participation in this study and you want to speak with someone not on the research team, please contact the McGill Ethics Manager at +1 (514)-398-6831 or lynda.mcneil@mcgill.ca.
Please sign below if you agree with this statement: "I have read the above information, the study has been fully explained to me and all questions have been answered to my satisfaction. I agree to participate in this study. I do not waive any of my rights or release the researchers from their responsibilities by signing".

_____ _____

Participant Signature Date

四川大学华西医院
West China Hospital, Sichuan University
No.37 Guo XueXiang, Chengdu, Sichuan, 610041, P.R. China Tel: +86 28 85553558 FAX: +86 28 85582944

LETTER OF AGREEMENT

I accept the researcher Shreenik Kundu from the Department of Experimental Surgery, Faculty of medicine of McGill University to develop his research entitled "Trauma Management and Preparedness in Quebec's and Sichuan's Trauma Centres for mass casualty Incidents: A Comparative study and Analysis" under the supervision of Dr. Tarek Razek in collaboration with department of Emergency Medicine of the West China School of Medicine in Chengdu, China

The collaboration between McGill University and the West China School of Medicine will help development of the research through the following:

1. Approval to Assess the trauma preparedness and techniques in MUHC and WCSM for any Mass casualty incident.
2. Approval to contact the doctors in the Huaxi hospital, Chengdu to Assess the awareness and preparedness of the doctors in the two Hospitals using a Survey.
3. Approval to analyse the trauma protocols and guidelines used by the West China school of medicine.

I am aware of the objectives, methods and techniques that will be used in this research, I agree to provide all the subsidies for its development, considering that the following is assured:

1. The agreement and compliance with Chinese ethical board
2. The guarantee of requesting and receiving clarification before, during and after the development of the research
3. In case of non-compliance with above items, the freedom to withdraw my consent at any time of the research

Student: Shreenik Kundu
Department: Experimental Surgery
University: McGill University

Dr. Nie Hu
Chief of Emergency Medicine
West China School of Medicine
Chengdu, China
Signature and stamp

McGill

Faculty of Medicine
3655 Promenade Sir William Osler #633
Montreal, QC, H3G 1Y6

Faculté de médecine
3655, promenade Sir William Osler #633
Montréal, QC H3G 1Y6

Fax/Télécopieur:
(514) 398-3870
Tél/Tel: (514) 398-3124

April 20, 2020

Dr. Tarek Razek
Department of Experimental Surgery
Montreal General Hospital
1650 Cedar Avenue
Montreal, Quebec H3G 1A4

RE: IRB Review Number: A04-E27-20B (20-04-067)

Trauma Management and Preparedness in Quebec's and Sichuan's Trauma Centers for mass casualty Incidents: A Comparative study and Analysis

Dear Dr. Razek,

Thank you for submitting the above-referenced study for an ethics review, on behalf of your student Shreenik Kundu.

As this study involves no more than minimal risk, and in accordance with Articles 2.9 and 6.12 of the 2nd Edition of the Canadian Tri-Council Policy Statement of Ethical Conduct for Research Involving Humans (TCPS 2 2018) and U.S. Title 45 CFR 46, Section 110 (b), paragraph (1), we are pleased to inform you that approval for the study and consent form (IRB dated April 8, 2020) was provided by an expedited/delegated review on 20-Apr-2020, valid until **19-Apr-2021**. The study proposal will be presented for corroborative approval at the next meeting of the Committee.

Prior to initiating the study, please modify the contact information in the consent form to "McGill Ethics Officer at +1 (514)-398-8302 or ilde.lepore@mcgill.ca ".

The Faculty of Medicine Institutional Review Board (IRB) is a registered University IRB working under the published guidelines of the Tri-Council Policy Statement 2, in compliance with the Plan d'action ministériel en éthique de la recherche et en intégrité scientifique (MSSS, 1998), and the Food and Drugs Act (17 June 2001); and acts in accordance with the U.S. Code of Federal Regulations that govern research on human subjects (**FWA 00004545**). The IRB working procedures are consistent with internationally accepted principles of good clinical practice.

The Principal Investigator is required to immediately notify the Institutional Review Board Office, via amendment or progress report, of:

- Any significant changes to the research project and the reason for that change, including an indication of ethical implications (if any);
- Serious Adverse Effects experienced by participants and the action taken to address those effects;
- Any other unforeseen events or unanticipated developments that merit notification;

- The inability of the Principal Investigator to continue in her/his role, or any other change in research personnel involved in the project;
- A delay of more than 12 months in the commencement of the research project, and;
- Termination or closure of the research project.

The Principal Investigator is required to submit an annual progress report (continuing review application) on the anniversary of the date of the initial approval (or see the date of expiration).

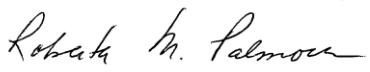
The Faculty of Medicine IRB may conduct an audit of the research project at any time.

If the research project involves multiple study sites, the Principal Investigator is required to report all IRB approvals and approved study documents to the appropriate Research Ethics Office (REO) or delegated authority for the participating study sites. Appropriate authorization from each study site must be obtained before the study recruitment and/or testing can begin at that site. Research funds linked to this research project may be withheld and/or the study data may be revoked if the Principal Investigator fails to comply with this requirement. A copy of the study site authorization should be submitted the IRB Office.

It is the Principal Investigator's responsibility to ensure that all researchers associated with this project are aware of the conditions of approval and which documents have been approved.

The McGill IRB wishes you and your colleagues every success in your research.

Sincerely,



Roberta Palmour, PhD
Chair
Institutional Review Board

cc: Shreenik Kundu
Dr. S. Baillet, Associate Dean, Research
A04-E27-20B (20-04-067)

Databases Searched / Search Strategy

Medline [Ovid] – February 14, 2020

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to February 13, 2020>		
#	Searches	Results
1	Disaster Planning/ or Disasters/ or Mass Casualty Incidents/	30346
2	exp Emergency Service, Hospital/ or exp Hospitals/ or Surge Capacity/	336723
3	((disaster* or earthquake* or flood* or hurrican* or mass*-casualt* or tornado* or tsunami* or wildfire* or wild-fire* or crisis) adj3 (prepar* or plan or planning or ready or readiness)).tw,kf.	4140
4	((((hospital* or ED) adj3 (prepar* or ready or readiness)) or (surge adj2 capacit*)) and (disaster* or mass*-casualt* or crisis)).tw,kf.	612
5	(1 or 2) and (3 or 4)	3239
6	exp China/ or (china or chinese).tw,kf.	394977
7	(Sichuan or Chengdu or Zigong or Panzhihua or Luzhou or Deyang or Mianyang or Guangyuan or Suining or Neijiang or Leshan or Nanchong or Meishan or Yibin or Guang'an or Dazhou or Ya'an or Bazhong or Ziyang).tw,kf,in.	79643
8	or/6-7	457120
9	5 and 8	57
10	(Canada* or Canadi* or Alberta* or Calgary* or Edmonton* or "British Columbia*" or Vancouver* or Victoria* or Manitoba* or Winnipeg* or "New Brunswick*" or Fredericton* or Moncton* or Newfoundland* or "New Foundland*" or Labrador* or "St John*" or "Saint John*" or "Northwest Territor*" or Yellowknife* or "Nova Scotia*" or Halifax* or Dalhousie* or Nunavut* or Igaluit* or Ontario* or Ontarian* or Toronto* or Ottawa* or Hamilton or Queen's or McMaster* or Kingston* or Sudbury* or "Prince Edward Island*" or Charlottetown* or Quebec* or Montreal* or McGill* or Laval* or Sherbrooke* or Nunavik* or Kuujjuaq* or Inukjuak* or Puvirnituq* or Saskatchewan* or Saskatoon* or Yukon* or Whitehorse*).ti,ab. or exp Canada/	287593
11	5 and 10	78
12	Checklist/	6080
13	((Assess* or measure* or apprais* or evaluat*) adj3 (survey* or questionnaire* or checklist* or check-list* or tool*)).tw,kf.	167604
14	or/12-13	172790
15	5 and 14	109
16	limit 5 to (guideline or meta analysis or "review" or "systematic review" or systematic reviews as topic)	372
17	limit 15 to (yr="2010 - 2020" and english)	84
18	limit 16 to (yr="2010 - 2020" and english)	180
19	18 not (17 or 11 or 9)	169
20	((exp child/ or exp infant/ or adolescent/) not exp adult/) or (newborn* or new-born* or neonat* or neo-nat* or infan* or child* or adolesc* or paediatr* or pediatr* or baby* or babies* or toddler* or kid or kids or boy* or girl* or juvenile* or teen* or youth* or pubescen* or preadolesc* or prepubesc* or preteen or tween).ti,jw.	2456615
21	19 not 20	147