Nurses' Perception of Readiness for Mass Casualty Events Involving Children

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Author Note:

No funding was received for this work. The authors have no financial or other conflicts of interest.

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Abstract

Background: During mass casualty events, hospitals must be ready to receive and provide patient care for both children and adults. However, many studies have shown that due to a lack of funding, resources, training, and time, nurses consistently report feeling unprepared to care for children during mass casualty events.

Methods: To improve understanding of how prepared pediatric-trained nurses are to respond to mass casualty events involving children, Registered Nurses (RN) completed a survey with questions that included four domains: professional demographics and employment history, experience working as an RN in a mass casualty event, knowledge questions related to current organizational mass casualty procedures, and perceptions on professional preparedness.

Results: Seventy-four percent of participants agree that a mass casualty event primarily involving children, requiring what is known as a Code Orange activation, will occur at some point during their career. Nurse participants do not currently receive regular training related to a Code Orange activation, and are overall dissatisfied with the little training provided. Nurses believe emergency preparedness is important to their professional development.

Discussion: Increasing nurses' preparedness to respond to a mass casualty event involving children is important and may require additional training across nurses' career trajectory.

Keywords: Children, Code Orange, Hospital Preparedness, Mass Casualty, Perception of Preparedness, Registered Nurses, Training

Introduction

Nurses are the largest group of health-care providers and have always played an important role in a hospital's response to disasters (Labrague et al., 2017; Al Khalaileh et al., 2009; O'Sullivan et al., 2008; Yousefi et al., 2016). As disasters and mass casualty events increase in frequency and severity, nurses' preparedness to respond is of critical importance in reducing negative health consequences amongst affected populations (Labrague et al., 2017). In particular, children are of important consideration as they experience higher morbidity and mortality rates than their proportional population representation in disasters, due to their unique vulnerabilities and health requirements (Burke et al., 2010; Mason & Anderson, 2009).

The ability for hospitals to respond to mass casualty events reflects a nation's overall level of emergency preparedness (Ferrier, n.d.). Historically, emergency management has military roots in civil protection and defense. Over time, there has been an evolution towards an all-hazard approach, including public health emergencies (Quarantelli, 2000). In terms of meeting medical needs during times of disaster, few preparedness efforts were focused on acute care in hospitals. Today, there are no national hospital emergency preparedness standards in Canada. While health care in Canada is provincially administered, a limited number of studies have demonstrated that education through a national hospital preparedness *program* increased nurses' knowledge, attitude, and performance in real incidents (Yousefi et al., 2016).

A National Assessment of Emergency Planning in Canada's General Hospitals was conducted between October 2000 and February 2001. Ferrier (n.d.) found that hospitals across the country reported a general lack of understanding in emergency management principles, and concluded that despite having an emergency plan in place, hospitals were unable to make the connection between hazard and risk identification. Furthermore, Ferrier (n.d.) also concluded that hospitals made assumptions about evacuations, communication, and patient care without exercising or testing processes. Without an understanding of basic emergency management concepts, including plans that address a variety of emergency scenarios, hospitals likely do not have the capacity to operate successfully during an emergency (VanVactor, 2012). In addition, plans were written without consultation or collaboration with partners, which led to agencies making assumptions about expectations and further creating logistical and operational gaps (Ferrier, n.d.).

While Registered Nurses (RNs) have been recognized as making positive impacts on many aspects of both patient care and the health-care system, little is known about their preparedness for responding to mass casualty events involving children (Canadian Nurses Association, 2013).

Education through a national hospital preparedness program can increase nurses' knowledge, attitude, and performance in real incidents, increasing their ability to respond to events (Yousefi et al., 2016). In addition, federal programs with funding models and national standards for hospitals can also provide consistency for all hospitals across the country while bringing together public health care and hospitals for a coordinated response, improving a country's overall preparedness (Taschner et al., 2017; Watson et al., 2017). When national programs invest in frontline staff, there are clear positive outcomes for patients, the health-care system, and the nation overall.

On a daily basis, hospitals in Canada operate over-capacity, with patients on stretchers in hallways becoming a norm. Chronic nursing staff shortages are predicted to worsen in the next decades (Dauphinee, 2009; Gausche-Hill, 2009; Goodhue et al., 2013). Without extra staff to call in to respond to pediatric mass casualty events, hospitals will quickly become overwhelmed. Furthermore, training for preparedness also becomes more difficult without additional staff to cover patient care during exercises and drills, when staff can barely cope with normal volumes of patients on a daily basis (Goodhue et al., 2013).

Children have unique developmental needs compared to their adult counterparts (Gaushe-Hill, 2009; Ginter et al., 2006). However, there is an assumption that when resources are limited, patient care that is appropriate for adults is also suitable for children (Burke et al., 2010; Fox & Timm, 2008; Ginter et al., 2006). This can result in severe negative outcomes for pediatric patients, who are not simply "smaller versions" of adults. Infants and toddlers are, for the most part, non-communicative, and young children may have difficulties articulating their needs and emotions in an emergency, relying on caregivers to provide and advocate for them (Gaushe-Hill, 2009; Ginter et al., 2006). During a mass casualty event, caregivers may be separated from their children, and healthcare providers may need to provide care for children who are afraid and separated from those who know them best. Barthel et al. (2013) explains that children who are impacted by a disaster fare better the earlier they are reunited with their caregivers. Ginter et al. (2006) discuss how children need support to understand their experience and work through their emotions after a disaster, which is often overlooked in disaster preparedness planning. For example, several studies indicate that children not given the opportunity to work through the traumas of a disaster experience are at an increased risk of developing symptoms of post-traumatic stress disorder and other psychological concerns later in life (Fox & Timm, 2008; Gausche-Hill, 2009; Peek, 2008). Hospitals' emergency preparedness must include staff with the capability and competency to provide developmentally appropriate care for both children and adults who present to the Emergency Department during mass casualty events.

Gaps in the system persist as few programs address the unique circumstances that come with responding to a mass casualty event where children are involved (Fox & Timm, 2008). Hospitals across Canada are left on their own to develop hospital-wide emergency preparedness programs, including self-funding preparedness. This often pushes emergency preparedness to a low priority, delegated as an afterthought assignment to whomever is able in the organization.

In a study by Kaji & Lewis (2006) on hospital preparedness, researchers surveyed hospital personnel and found that due to a lack of multi-agency collaboration to develop mutual aid agreements, as well as a limited surge capacity, hospital preparedness is perceived as minimal (Kaji & Lewis, 2006). In another study by Rassin et al. (2007), Emergency Department physicians and nurses were surveyed to measure perceptions of their hospital's preparedness for mass casualty events involving children, and mass casualty events involving only adults. Respondents reported lower levels of preparedness for mass casualty events involving children compared to mass casualty events with only adult patients. They also reported feeling unprepared to cope emotionally with children impacted by disasters, to such an extent that they may not respond to the hospital's calls for help during a disaster (Rassin et al., 2007). A significant positive correlation was found between professional seniority and the ability to cope with pediatric mass casualty events in terms of knowledge and skill, but not in nurses' perception of their ability to cope with mass casualty events involving children (Rassin et al., 2007). An Israeli evaluation of the role of nurses during mass casualty events pointed to their significant roles in both clinical and managerial leadership (Admi et al., 2011). Labrague et al. (2017) conducted a systematic review of peer-reviewed publications between 2006 and 2016 that measured nurses' preparedness for disaster response. Only one study in the review included Canadian nurses, and only one study included pediatric nurses. O'Sullivan et al. (2008)'s work studied French- and English-speaking nurses across Canada using a web-based survey. Less than half of the respondents indicated that their hospitals had an emergency plan, with almost 40% of respondents either reporting that they did not know or leaving the question unanswered (O'Sullivan et al., 2008). Overall, nurses reported low confidence toward the preparedness of Canadian healthcare institutions, with nurses from Ontario and Quebec reporting the highest levels of confidence (O'Sullivan et al., 2008).

This research study seeks to understand nurses' perceptions of emergency preparedness regarding mass casualty events involving children, and to consider how empowerment related to preparedness may be positively correlated with knowledge and skill (Kuokkkanen & Leino-Kilpi, 2000; Wong & Laschinger, 2012). Under the structural empowerment theory, we use nurses'

perceptions of preparedness to inform us of the education and training initiatives required to prepare nurses for such events. Several previous studies focused on nurses working in one department, such as the Emergency Department or an Intensive Care Unit, where both children and adults are seen. This study is unique, however, in that it examines the perception of readiness of pediatric-trained nurses in one organization across different in-patient and out-patient departments. Results will inform current training and practices for Code Orange type situations, including mass casualty events involving children in Canadian hospitals, in addition to addressing education gaps among nurses in order to meet the needs of children and their families during a mass casualty event.

Methods

A survey was developed in 2019 to assess the attitudes and opinions of pediatric nurses working at Children's Hospital at London Health Sciences Centre (LHSC) in London, Ontario. The survey focused on readiness to respond to multiple and mass casualty events involving children, and also aimed at testing potential associations between reported attitudes, opinions, and perceptions of readiness. By seeking to understand nurses' perception, the study recognizes both the need to assess and understand current readiness levels, as well as the integral role nurses play to empower change and improve patient outcomes in the context of emergency preparedness. The survey was accessed by RNs currently employed at Children's Hospital at LHSC using the online platform REDCap. The full survey is available in Supplemental Document 1.

The survey included questions covering four domains: professional demographics and employment history; experience working as an RN in a mass casualty event; knowledge questions related to current organizational mass casualty procedures; and perceptions on professional preparedness. The professional demographics portion of the survey included questions on whether nurses hold a diploma in nursing or a nursing degree (Yes / No), the number of years of nursing practice (continuous), and whether nurses had any critical care or emergency nursing experience (Yes / No). Furthermore, respondents were asked whether they have experience responding to mass casualty events (Yes/No), whether a Code Orange was activated during that mass casualty event (Yes/No), and the level of involvement the nurse had in previous mass casualty events (none, minimal, some, a lot, extensive). The survey also collected data on any additional training and certifications the responding nurse may have received, such as trauma training courses and advanced life support certifications, using a checklist and an open response for nurses to list any additional certifications. Finally, the perception section of the survey utilized Likert Scales (1 = Strongly

Disagree and 5 = Strongly Agree) to ask respondents how confident they feel in coping with a mass casualty event and using the knowledge and skills they currently possess to respond to an event. Prior to dissemination, the survey questionnaire was validated based on feedback from pilot testers, who were group representatives of the target audience, but who were not included in the survey. The survey and all other documents related to this research were reviewed and approved by the Royal Roads University (RRU) Research Ethics Board (REB), Lawson Health Research Institute (ReDA ID #7694), and the Western University Health Science Research Ethics Board (HSREB) (Project ID #114080).

Counts and frequencies were calculated for all variables, as well as the number of missing responses for each question. Responses were coded using 0, 1, and 2 for analysis purposes. Means of Likert scale responses were calculated to summarize each perception question and presented with standard deviations. Correlation coefficients were calculated between "years of nursing and knowledge" scores and "perception" scores to determine the strength of any relationship between the two variables. Chi square tests were conducted to determine relationships between RN education, years of experience, specialty experience, additional training, knowledge scores, experience responding to previous Code Orange, and perceptions.

Results

Thirty-four of RN staff (12.6%) at the Children's Hospital completed the survey. Seventy percent (24 of 34) of respondents reported having a Bachelor of Science in Nursing degree, and the remainder of respondents (10 of 34) reported having a college diploma in Nursing (Table 1). In addition to their formal education, 21 of 34 (62%) of nurses reported having either an expired or current Neonatal Resuscitation Program (NRP) certification, while 24 of 34 (71%) nurses reported having either an expired or current Pediatric Advanced Life Support (PALS) certification. The survey results also showed that nearly half of all respondents (15 of 34; 44%) have at least 10 years of nursing experience.

Table 1: Demographic characteristics of survey respondents

	College Diploma RN (n=10)		BScN RN (n=24)		Total (n=34)	
Characteristics	n	%	n	%	n	%
Additional education to nursing						
College diploma	3	30%	2	8.3%	5	15%
Graduate college certificate	1	10%	1	4.2%	2	6%
Bachelors degree	0	0%	7	29.2%	7	21%
Masters degree	0	0%	3	12.5%	3	9%
Post-doctorate degree	0	0%	0	0%	0	0%
No additional education to nursing	4	40%	11	45.8%	15	44%
Nursing experience						
0-5 years	0	0%	11	45.8%	11	32%
6-10 years	0	0%	8	33.3%	8	24%
11-15 years	0	0%	4	16.7%	4	12%
16-20 years	2	20%	0	0%	2	6%
21 and more years	8	80%	1	4.2%	9	27%
Clinical specialty experience						
Emergency care only	1	10%	6	25%	7	21%
Critical care only	6	60%	4	16.7%	10	29%
Both emergency care and critical care	3	30%	5	20.8%	8	24%
Neither	0	0%	9	37.5%	9	27%
Additional Courses or Certificates						
Advanced Cardiovascular Life Support (ACLS)	3	30%	6	25%	9	27%
Certified Nurse in Critical Care (C)anada (CNCC(C))	3	30%	1	4.2%	4	12%
Emergency Nurse Certified (C)anada (ENC (C))	1	10%	1	4.2%	2	6%
Emergency Nursing Pediatric Course (ENPC)	2	20%	4	16.7%	6	18%
Federal Emergency Management Agency (FEMA) Independent Study (IS) courses	0	0%	0	0%	0	0%
Incident Management System (IMS)/Incident Command System (ICS) courses	0	0%	1	4.2%	1	3%
Neonatal Resuscitation Program (NRP)	8	80%	13	54.2%	21	62%
Pediatric Advanced Life Support (PALS)	8	80%	16	66.7%	24	71%
Trauma Nursing Core Course (TNCC)	3	30%	2	8.3%	5	15%
Other	1	10%	2	8.3%	3	9%
No additional courses or certificates	0	0%	4	16.7%	4	12%
Experience responding to multiple or mass casualty event						
Yes	2	20%	7	29.2%	9	27%
No	8	80%	17	70.8%	25	74%

Emergency and Critical Care Experience and Training

With regard to emergency and critical care experience, nearly all respondents reported having either current or previous emergency care (15 of 34; 44%) or critical care (18 of 34; 53%) experience with adults or pediatric patients. Eight respondents (24%) reported having both emergency care and critical care experience, and nine respondents (26%) reported having neither emergency care nor critical care experience. However, few nurses had training specifically geared towards emergency response. Two nurses (6%) reported having an expired or current Emergency Nurse Certified (C)anada (ENC(C)) certification. Six (18%) reported taking the Emergency Nursing Pediatric Course (ENPC), and five (15%) took a Trauma Nursing Core Course (TNCC). Only one respondent (3%) reported taking a course in Incident Management System (IMS)/Incident Command Systems (ICS), and no nurses reported taking courses from the U.S. Federal Emergency Management Agency (FEMA). Four additional courses were reported by respondents, including Association of Pediatric Hematology/Oncology Nurses (APHON) certification (N=1), Acute Care of at-Risk Newborns (ACORN) (N=1), Stop the Bleed (N=1), and Narcan community administration (N=1).

In terms of participation in an emergency or mass casualty event, only nine respondents (26%) reported experience responding to a multiple or mass casualty event in a hospital setting, while 25 (74%) reported no experience with a multiple or mass casualty event in a hospital setting. Of the nine respondents with experience in a multiple or mass casualty event, only one (11%) reported that the hospital activated a Code Orange during the event. However, seven among the nine (78%) of those who responded to a multiple or mass casualty event reported either substantial (N=3) or extensive (N=4) patient care. All nine reported that they were working on shift in the hospital at the time they received the first notification of the multiple or mass casualty event.

Knowledge of Emergency Events Impacting the Hospital

Based on their general knowledge, nurse respondents' definition of multiple or mass casualty events differed widely. While nearly all respondents (29 of 33; 88%) considered an incident activating a Code Orange to be this type of event, 17 of 33 (52%) considered that a pandemic situation similar to SARS in 2003 would qualify. 11 (33%) felt that a trauma incident involving two or more patients admitted to hospital constituted a multiple or mass casualty event, while 6 of 33 (18%) indicated that a multiple or mass casualty event is when the inpatient units are full and patients admitted to hospital spend over 24 hours in the Emergency Department. Nearly all respondents (33 of 34; 97%) were able to correctly define a Code Orange as an incident that occurs outside the hospital, resulting in a number of casualties that will overwhelm the hospital. When

asked about another emergency code colour used in the hospital, knowledge amongst the nurses varied, with 28 nurses (82%) correctly identifying the definition of another hospital colour code.

In the case of a Code Orange activation, nearly half of the respondents (14 of 34; 41%) could not identify the triage system used in the ER during a Code Orange. Forty-five percent (15 of 33) of respondents reported that their first action upon hearing a Code Orange would be paging their coordinator for instructions, while 11 of 33 respondents (33%) reported that the first action would be to send the Charge Nurse to the Emergency Department for a debrief. About one-third of respondents (11 of 34; 32%) did not know which department leaders would be identified during a Code Orange while 11 (32%) correctly identified the departmental leadership during a Code Orange, which would include Physician Lead, Clinical Operations Lead, Logistics Lead, and Incident Commander.

Likert Scale Responses Related to Likelihood of Mass Casualty Event Involving Children and Adults

A series of questions asked the nurse respondents to provide their opinions about the likelihood of mass casualty events. Twenty-five respondents (74%) either somewhat or strongly agreed that a mass casualty event involving primarily children and requiring a Code Orange activation will occur at some point during their career as an RN at Children's Hospital at LHSC (mean=3.8; SD=1.1). Slightly more respondents (28 of 34; 82%) either somewhat or strongly agreed that a mass casualty event involving a mix of children and adults, and requiring a Code Orange activation, will occur at some point during their career as an RN at Children's Hospital at LHSC (mean=4.0; SD=0.94). About the same (27 of 34; 79%) number of respondents expected an event involving primarily adults during their career (mean=4.0; SD=0.97).

Likert Scale Responses Related to Perceptions of Professional and Facility Preparedness

Sixteen respondents (47%) somewhat or strongly agreed with the statement that as an RN, they have the skill and knowledge to respond to a multiple/mass casualty event at Children's Hospital at LHSC (mean=3.3; SD=0.94). Twenty-five respondents (74%) somewhat or strongly agreed with the statement that as an RN, they have the emotional and mental ability to cope and care for children impacted by a multiple or mass casualty event presenting at Children's Hospital (mean=3.9; SD=1.0). Although the nurse respondents assess their skills, knowledge, and emotional and mental ability to respond positively, the majority of respondents (25 of 34; 74%) either somewhat or strongly disagreed that they receive regular training and education that help them care

for patients during a multiple/mass casualty event at Children's Hospital at LHSC (mean=2.0; SD=1.0). Similarly, 26 of 34 respondents (76%) reported that they either somewhat or strongly disagreed with the statement that they are satisfied with the training they receive to prepare for a multiple/mass casualty event at Children's Hospital at LHSC (mean=1.9; SD=1.0).

Nurse respondents' assessment of hospital preparedness was different than their assessment of their personal preparedness. Half of all respondents (17 of 34; 50%) either somewhat or strongly disagreed with the statement that Children's Hospital at LHSC has enough equipment and supplies, or the means to procure the required supplies and equipment, to respond to a multiple/mass casualty event (mean=2.6; SD=1.1). Half the respondents (17 of 34; 50%) also somewhat or strongly disagreed with the statement that Children's Hospital at LHSC is prepared to respond to a mass casualty event involving children (mean=2.7; SD=0.91). One specific area where concerns about preparedness were identified was with the statement that Children's Hospital at LHSC has enough equipment and supplies, or the means to procure the required supplies and equipment, to respond to a multiple/mass casualty event. No nurses strongly agreed with this statement (5 strongly disagreed; 12 somewhat disagreed; 7 neutral; and 10 somewhat agreed). Overall, weighed against other priorities, 27 nurses (79%) either somewhat or strongly agreed that Code Orange preparedness is important to their professional development (mean=4.1; SD=0.90).

Factors Influencing Perceptions of Readiness

Two-by-two tables were constructed and chi square tests calculated for subsets of variables. There were no statistically significant differences between RNs with a college diploma in Nursing and RNs with Bachelor of Science in Nursing (BScN) degrees in terms of perceptions of their skills and knowledge to care for children impacted during a mass casualty event ($p=0.13$) or perceptions of emotional ability to cope through a mass casualty event involving children ($p=0.58$). When comparing nurses with more than ten years of nursing experience to less experienced nurses, there were no statistically significant differences in their perception of their skills and knowledge ($p=0.41$) or emotional ability ($p=0.33$).

Nurses with emergency care or critical care experience were more likely to report a higher likelihood of a mass casualty event occurring that involves primarily children ($p<0.01$). Nurses with specialty experience did not differ from other nurses in terms of their perceptions of receiving regular training ($p=0.45$) or satisfaction with training received ($p=0.94$). There was no statistical difference when comparing knowledge scores and perceptions of knowledge and skill to respond to a mass casualty event involving children ($p=0.61$), perceptions of regular training ($p=0.084$), and

perceptions of overall readiness (p=0.32). Lastly, there were no statistically significant differences when comparing nurses with past Code Orange experience and perceptions of skills and knowledge to respond to a mass casualty event involving children (p=0.48), emotional ability to cope during a mass casualty event involving children (p=0.74), perceptions of satisfaction with training (p=0.26), and perceptions of overall hospital readiness (p=0.42). While p-values were calculated, given the relatively small sample size, substantive differences in these results can still inform future hospital priorities around emergency preparedness.

Discussion

The majority of nurses agreed that mass casualty events involving either a mix of adults and children or primarily children will occur at some point during their career; however, many nurses in this study do not feel prepared to respond to such mass casualty events. This finding aligns with the published research, which finds that nurses are inadequately prepared (Labrague et al., 2017). This is increasingly important as the prevalence and severity of disasters have increased over the last decade (Baack & Alfred, 2013). Within the Canadian context, there has been an increase in events, with 321 disasters reported in the Canadian Disaster Database from 2001-2019, compared to 608 disasters reported between 1951-2000 (Public Safety Canada, 2013). In addition to the increase in mass casualty events, nurses working in pediatric tertiary care centres must remember that due to their unique vulnerabilities and health requirements, along with the way children are socialized, children are often impacted by disasters in numbers larger than their proportional representation in the overall population (Mason & Anderson, 2009). Furthermore, nurses working in pediatric tertiary care centres will respond to events beyond their municipal borders, with the most critical patients transported to their facility during a mass casualty event to receive specialized care. Because of this, nurses working in pediatric tertiary care centres have a greater need for education and training to ensure readiness in response to mass casualty events involving children.

In a mass casualty event involving children, the number of pediatric patients presenting to the hospital will quickly overwhelm resources, leading to the need to make difficult medical and ethical decisions. This shifts triage from caring for the most ill first to "doing the greatest good for the greatest number of patients" during a mass casualty event (Kaji et al., 2006; Markovitz, 2009). Resources that will be of greatest shortage during a disaster are known as the 3S: stuff, staff, and space (Corcoran et al., 2012). Specifically, most hospitals cannot afford to stockpile ventilators, as

they are expensive to purchase and maintain, and therefore will quickly be in shortage in a mass casualty response (Corcoran et al., 2012). Lack of space will be a challenge for most hospital organizations, as critical care interventions and patient care can only be conducted in locations with access to electrical outlets, oxygen, and monitoring equipment (Corcoran et al., 2012). However, these designated areas for patient care will quickly become overcrowded with the number of staff and patients in the space. Staff may find these spaces unable to accommodate the same number of patients during a mass casualty event as during normal hospital operations.

Historically, disaster events leading to Code Orange activations have been rare. Only one nurse in this study reported experience responding to a Code Orange in the past. Few hospitals in Canada have experienced a mass casualty event requiring the activation of Code Orange; therefore, most hospital and departmental emergency preparedness plans have never been operationalized (Kaji & Lewis, 2006). Most nurses agree that Children's Hospital is not prepared to respond to a mass casualty event involving children. Hospital readiness encompasses not only the 3S, but also coordination and communication with local and regional agencies and resources. For example, only 33.4% of Canadian hospitals have previously tested evacuation plans, and only 8.6% have tested their organization's ability to accept patients from other sites (Ferrier, n.d.). Beyond the presence and familiarity of a disaster plan, a successful disaster response requires strategic navigation through the healthcare system, which is complex and highly integrated (Labrague et al., 2017). The majority of hospitals report that there are no plans to share resources, and if plans exist, they have not been formalized (Ferrier, n.d.). With a lack of awareness and understanding of organizational plans, in addition to a lack of access to continuing education and training opportunities, nurses have little potential to empower themselves with the skills, knowledge, and confidence to respond to mass casualty events involving children. This translates into an overall lower level of preparedness for the hospital organization.

Nurses need to have accurate risk perception of the potential hazards they may face to understand and anticipate the types of injuries children may have during a mass casualty event. Based on the findings of this research, nurses agreed that Code Orange readiness is a high priority, and many are dissatisfied with the current training they receive, with many reporting that they did not receive regular training. Researchers have long accepted workforce training and education as critical components of organizational preparedness (Chapman & Arbon, 2008). Training and exercising provide nurses with experience in responding to simulated mass casualty events while creating a safe space for learning and inquiry. Based on studies reviewed, training has increased

perceptions of preparedness in nurses, including improving confidence in disaster response and understanding of disaster plans and equipment (Chapman & Arbon, 2008; Grove, 2017; Labrague et al., 2017; Rassin et al., 2007). Baack & Alfred (2013) observed that nurses with more confidence also scored higher on the Emergency Preparedness Information Questionnaire (EPIQ), which suggests a positive relationship with consistent training. Williams et al. (2008) concluded that participation in disaster response improved nurses' perception of competence, and therefore hands-on education opportunities can also help increase perceptions of readiness and skill.

Training allows nurses to focus on specific skills to address unique considerations that may be involved with caring for children during mass casualty events, to ensure care is developmentally appropriated for the pediatric patients. Because of their integral role with direct patient contact and engagement, frontline nurses need to be empowered with knowledge and additional skills through training to ensure positive patient outcomes. Dissatisfaction can lead to nurses feeling disengaged and powerless, which leads to ineffective caregivers at the bedside (Bradbury-Jones et al., 2008).

In Canadian nursing schools, there are few education or training programs for caregivers related to coping with mass casualty events involving children. Nursing schools do not typically include disaster education in their curriculum, so new graduate nurses begin their career with no experience in disaster response. Once working with an RN license, there are few opportunities for training, because hospitals with already limited resources may not prioritize disaster preparedness efforts (Ferrier, n.d.). Barriers to training at the organizational level include the practicality of running mock disasters without interrupting the daily functions of a hospital department or compromising the quality of patient care. However, research has found that disaster drills typically have no impact on the timeliness of actual patients receiving care, despite the extra workload put on staff (Timm & Kennebeck, 2008; Charney et al., 2011).

Limitations

This study has several limitations. The sample size of this study was small and participation was limited to RNs at a single pediatric tertiary care centre. Therefore, this study may be missing broader perspectives and opinions from others whose roles may be related to hospital preparedness for a mass casualty event overall, which would be needed to generate a comprehensive and accurate description of staff and facility preparedness. This is particularly important, since the best patient outcomes during a mass casualty event likely derive from a multidisciplinary approach, with all care

providers working collaboratively (Sierchio, 2003). Similarly, future research should survey nurses working in pediatric tertiary care centres across Canada, rather than sampling nurses from one organization. Since the study was administered by Unit Coordinators, there is a chance that social desirability bias influenced responses. While the information letter provided with the survey ensured respondent anonymity, there remains a chance that some respondents completed the survey with a desire to ensure it reflected positively on the participant or their department. The survey distributed to nursing staff was only available online using REDCap, meaning that nurses had to log onto their work email to access the survey link. This may have hindered the participation of some nurses with lower computer literacy. However, since most diagnostic and clinical documentation is online, and all nurses are assigned to a dedicated computer during their shift, it is unlikely that nurses felt uncomfortable completing an online survey. Despite these limitations, the study still highlights an area within nursing research that seldom receives focus. This research study increases the awareness of nurses as frontline resources during mass casualty events, and of pediatric mass casualty events. Nurses' ability to effectively respond to these events and cope with the aftermath is directly linked to the overall success of a mass casualty event response.

Conclusion

Nurses with previous experience in disaster response are better prepared in general (Labrague et al., 2017). Due to the frequency of disasters and mass casualty events, training has long been accepted as the gold standard that exposes nurses to disaster settings in order to supplement experience opportunities and improve emergency preparedness (Baack & Alfred, 2013; Fox & Timm, 2008; Grove, 2017; Labrague et al., 2017; O'Sullivan et al., 2008; Skryabina et al., 2017). Therefore, education on emergency preparedness, with a focus on pediatric considerations, should begin in nursing schools and be supplemented with regular training throughout a nurse's career. In addition, a federal hospital emergency preparedness program with national standards is needed, so that hospitals can use pre-existing health networks, and health systems can maximize resources to support regular training, especially for specialized care such as pediatrics. A national-level emergency preparedness program would not only increase the nation's overall emergency preparedness, but could also provide nurses with essential skills that are necessary to increase confidence in emotional preparedness and the ability to cope during these high-stress events. As leaders in the community, there is an expectation that hospitals will be ready to respond to mass casualty events, caring for all who are injured. Mass casualty events require nurses to respond to high-stress high-risk situations,

making quick and effective decisions while protecting resources (Chapman & Arbon, 2008). In turn, there is an expectation from hospitals that nurses working will be ready to receive and care for children for sustained periods of time during mass casualty events, regardless of challenges and barriers they may face, including a finite amount of resources. Only regular training can ensure frontline staff such as nurses remain prepared to respond to disasters and mass casualty events involving children.

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Supplement Document 1

SURVEY TO PARTICIPANTS

Nurses' Perception on Readiness for Mass Casualty Events Involving Children

Dear Participant,

Thank you for deciding to participate and providing consent to this research study which focuses on nurses' perception on hospital preparedness in mass casualty events involving children. Your participation in this research study will help the researcher understand nurses' perception of hospital preparedness, and the results will inform current practice and training for mass casualty events.

The following survey will take you approximately 10 minutes to complete and has four components asking questions on the following topics:

(1) professional demographics and employment history

(2) experience working as a Registered Nurse (RN) in a mass casualty event

(3) knowledge questions related to current mass casualty procedures at Children's Hospital at London Health Sciences Centre (LHSC)

(4) perceptions on professional preparedness.

Please note that responses to the survey are anonymous, confidential, and will be used solely for the purposes of this research study. You may wish to refrain from answering any questions in the survey, without any consequence. You may wish to withdraw from this survey at any time by closing the survey, however your responses will not be saved. By submitting the survey, you will be providing consent to participate in the survey. After submitting the survey, you will no longer be able to withdraw due to the anonymity of each survey.

Thank you again for your participation to this research study!

The following questions ask about your education and experience as a Registered Nurse.

1) Please select the option which is most applicable:

   I am a Registered Nurse (RN) with a

   - o College Nursing Diploma.
   - o Bachelors of Science in Nursing Degree (BScN).
   - o Post Diploma-Bachelors of Science in Nursing Degree (BScN).

2) Please select any education in addition to your education you may have:

   - ☐ College Diploma
   - ☐ Graduate College Certificate
   - ☐ Bachelors Degree
   - ☐ Masters Degree
   - ☐ Postdoctorate Degree
   - ☐ None of the Above

3) I have been a Registered Nurse (RN) for __ years.

   _____

4) Please check the following clinical areas you have experience working as a Registered Nurse (RN), currently or previously; including with adults or paediatrics.

   - ☐ Emergency Care
   - ☐ Critical Care
   - ☐ None of the Above

5) Please check the following courses or certifications you have completed (current or expired):

   - ☐ Advanced Cardiovascular Life Support (ACLS)
   - ☐ Certified Nurse in Critical Care (C)anada (CNCC(C))
   - ☐ Emergency Nurse Certified (C)anada (ENC(C))

- ☐ Emergency Nursing Pediatric Course (ENPC)
- ☐ Federal Emergency Management Agency (FEMA) Independent Study (IS) courses
- ☐ Incident Management System (IMS)/Incident Command System (ICS) courses
- ☐ Neonatal Resuscitation Program (NRP)
- ☐ Pediatric Advanced Life Support (PALS)
- ☐ Trauma Nursing Core Course (TNCC)
- ☐ Other None of the Above

5i) If applicable, please list any Federal Emergency Management Agency (FEMA) Independent Study (IS) courses you have completed.

_____

5ii) Please list all IMS/ICS courses you have completed.

_____

5iii) Please list any courses or certifications relevant to your nursing career that you have completed and are not listed in the above list.

_____

The following questions ask about your experience working as a Registered Nurse (RN) during a multiple or mass casualty event.

6) Have you responded to a multiple or mass casualty event in a hospital setting?
   - o Yes If 'yes', please answer Question 7, 8, 9.
   - o No If 'no', please skip to Question 10.

7) Did the hospital activate a 'Code Orange'?
   - o Yes
   - o No

8) How would you report your level of involvement as a Registered Nurse (RN) in the multiple or mass casualty event that you responded to?

- o Minimal patient care, with mostly non-patient care tasks carried out
- o Some patient care, with some non-patient care tasks carried out
- o Substantial patient care, with some non-patient care tasks carried out
- o Extensive patient care, with minimal non-patient care tasks carried out

9) Where were you when you first received notification of the multiple or mass casualty event?

- o I was off-shift, away from the hospital at the time
- o I was off-shift but at the hospital at the time
- o I was on-shift, working at the hospital at the time
- o I was on-shift but away from the hospital at the time

The following questions ask about your knowledge related to current mass casualty procedures at Children's Hospital at London Health Sciences Centre (LHSC).

10) Based on your experience, what events do you consider a multiple or mass casualty event in a hospital? (check all that apply)

- ☐ A trauma incident involving 2 or more patients admitted to hospital
- ☐ When the inpatient units are full and patients admitted to hospital spend over 24 hours in the Emergency Department
- ☐ An incident activating a 'Code Orange' at the hospital
- ☐ A pandemic situation, similar to SARS in 2003
- ☐ I do not know

11) Select the best answer describing the following statement.

A 'Code Orange' at Children's Hospital at London Health Sciences Centre (LHSC) is:

- An incident that occurs in the Emergency Department resulting in its closure, and patients are now diverted to an Emergency Department at a different hospital.
- An incident that occurs outside the hospital, resulting in a number of casualties that will overwhelm the hospital.
- A severe weather incident occurs, and the hospital is on standby in case casualties present to the Emergency Department.
- An incoming Ornge helicopter is awaiting landing on the hospital helipad.
- I do not know

12) Select the best answer describing the following statement.

A 'Code Purple' incident is:

- A robbery incident occurring in the hospital
- An active shooter incident occurring in the hospital
- A hostage incident occurring in the hospital
- A violent behavior incident occurring in the hospital
- I do not know

13) Select the single best answer describing the following statement.

The triage system used in the Emergency Department during a 'Code Orange' at LHSC is called:

- CTAS
- SALT
- JumpSTART
- Military Triage
- I do not know

14) Select the single best answer describing the following statement.

After hearing a 'Code Orange' overhead activation, what should be the first actions from your department?

- Call all your staff in to work
- Page your Coordinator for instructions
- Vertically evacuate all patients and family in your department two floors down
- Send the Charge Nurse/In-Charge Person (ICP) down to the Emergency Department for a debrief meeting
- I do not know

15) Select the best answer describing the following statement.

Departmental Leaders will be identified throughout Children's Hospital during a 'Code Orange'. They are:

- Incident Commander, Planning Lead, Finance Lead, Clinical Operations Lead
- Physician Lead, Clinical Operations Lead, Logistics Lead, Incident Commander
- Charge Nurse, Coordinator, Educator, Physician, Support Services
- Clinical Operations Lead, Educator Lead, Equipment and Supply Lead, Physician Lead
- I do not know

The following questions ask about your perceptions on professional preparedness regarding a mass casualty event at Children's Hospital at London Health Sciences Centre (LHSC).

16) A mass casualty event involving PRIMARILY CHILDREN and requiring a 'Code Orange' activation will occur at some point during my career as a Registered Nurse (RN) at Children's Hospital at London Health Sciences Centre (LHSC).

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

17) A mass casualty event involving a MIX OF CHILDREN AND ADULTS, and requiring a 'Code Orange' activation will occur at some point during my career as a

Registered Nurse (RN) at Children's Hospital at London Health Sciences Centre (LHSC).

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

18) A mass casualty event involving PRIMARILY ADULTS, and requiring a 'Code Orange' activation will occur at some point during my career as a Registered Nurse (RN) working at Children's Hospital at London Health Sciences Centre (LHSC).

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

19) As a Registered Nurse (RN), I have the skill and knowledge to respond to a multiple/mass casualty event at Children's Hospital at London Health Sciences Centre (LHSC)

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

20) As a Registered Nurse, I have the emotional and mental ability to cope, and care for children who are impacted by a mass casualty event, presenting at Children's Hospital.

- Strongly Disagree
- Somewhat Disagree

- Neutral
- Somewhat Agree
- Strongly Agree

21) Children's Hospital at London Health Sciences Centre (LHSC) has enough equipment and supplies, or means to procure the required supplies and equipment, to respond to a multiple/mass casualty event.

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

22) As a Registered Nurse (RN), I receive regular training and education that help me care for patients during a multiple/mass casualty event at Children's Hospital at London Health Sciences Centre (LHSC).

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

23) I am satisfied with the training I receive to prepare me for a multiple/mass casualty event at Children's Hospital at London Health Sciences Centre (LHSC).

- Strongly Disagree
- Somewhat Disagree
- Neutral
- Somewhat Agree
- Strongly Agree

24) Children's Hospital is prepared to respond to a mass casualty event involving children.
    - Strongly Disagree
    - Somewhat Disagree
    - Neutral
    - Somewhat Agree
    - Strongly Agree

25) Weighing against other priorities, how important is 'Code Orange' preparedness to your professional development?
    - Strongly Disagree
    - Somewhat Disagree
    - Neutral
    - Somewhat Agree
    - Strongly Agree