Preparedness for chemical, radiologic and nuclear incidents among a sample of emergency physicians' and general practitioners'—a qualitative study

Received 11 July 2022
Revised 16 September 2022
4 November 2022
15 December 2022
Accepted 30 December 2022

Lina Gyllencreutz
Department of Nursing, Umeå University, Umeå, Sweden and
Department of Surgical and Perioperative Sciences, Surgery, Center of Disaster Medicine, Umeå University, Umeå, Sweden
Carl-Pontus Carlsson
Emergency Department, Region Vasterbotten, Umeå, Sweden and
Department of Surgical and Perioperative Sciences, Surgery, Center of Disaster Medicine, Umeå University, Umeå, Sweden
Sofia Karlsson
Department of Surgical and Perioperative Sciences, Surgery, Center of Disaster Medicine, Umeå University, Umeå, Sweden, and
Pia Hedberg
Department of Nursing, Umeå University, Umeå, Sweden and
Department of Surgical and Perioperative Sciences, Surgery, Center of Disaster Medicine, Umeå University, Umeå, Sweden

Abstract

Purpose – This study describes preparedness of emergency physicians and general practitioners following chemical, radiological and nuclear incidents.

Design/methodology/approach – Five emergency physicians and six general practitioners were interviewed individually, and data was analysed using qualitative content analysis.

Findings – The study results showed that physicians' preparedness for chemical, radiological and nuclear incidents is linked to one main category: to be an expert and to seek expertise and two categories: preparations before receiving CRN patients, and physical examination and treatment of CRN patients with subcategories.

Research limitations/implications – The results have implications for further research on the complexity of generalist vs specialist competence and knowledge when responding to chemical, radiological and nuclear incidents.

The authors thank the medical secretary at the Region Västerbotten, Sweden, for transcribing the interviews. The authors also thank Anders Bucht, Professor and Research Director at the Swedish Defence Research Agency for his CBRN expertise.

International Journal of Emergency Services
Vol. 12 No. 2, 2023
pp. 161-170
Emerald Publishing Limited
2047-0894
DOI 10.1108/IJES-07-2022-0032

Originality/value – This study provides insights regarding chemical, radiological and nuclear preparedness among physicians at emergency departments and primary healthcare centres.

Keywords CBRNe, Disaster preparedness, Emergency care, Emergency management, Accident and emergency department, Primary care

Paper type Research paper

Introduction and background

The potential threat of chemical (C), biological (B), radiological (R), nuclear (N) and explosive (CBRNE) weapons is unlikely but has been increasingly worrisome since Russia invaded Ukraine in February 2022. Since CBRNE incidents affect large numbers of people, emergency departments (EDs) and primary healthcare centres (PHCCs) will both be affected and the personnel must therefore be prepared, trained and well-educated in handling these incidents. Previous published research showed that personnel at emergency medical services (EMS) and EDs are not adequately prepared to respond to disasters such as emergencies, mass causality incidents, weapons of mass destruction, CBRNE and terrorist incidents, etc. (Hsu *et al.*, 2004; Furbee *et al.*, 2006; Beyramijam *et al.*, 2021). Physicians and nurses have shown a lack of preparedness for CBRNE incidents (DeBacker, 2003; Moore *et al.*, 2015). SteelFisher *et al.*, (2015) showed significant gaps in physicians' preparedness for emergencies, even though they have implemented a physician disaster medicine residency training program. Just one-third of participating physicians felt prepared to handle a CBRNE incident (SteelFisher *et al.*, 2015). Azeem *et al.* (2019) studied the perception of preparedness among 200 nurses and doctors and demonstrated that overall, participants were not adequately prepared for a CBRNE incident.

Previously collected data from hospitals in Europe describe a poor level of education about and preparedness for CBRNE incidents (Williams *et al.*, 2007; Mortelmans *et al.*, 2014). Even in countries rich in petrochemical and nuclear power installations formal disaster plans with incorporated CBRNE incident response plans are lacking (c.f. Mortelmans *et al.*, 2014). In the United States, the September 11th attack resulted in a dramatic increase in the perceived risk of bioterrorism. However, 57% (n = 3,074) of responders from local public health departments believed that another attack was unlikely to occur within their own community. The public health professionals perceived their own communities to be at low risk for a bioterrorism incident (Shadel *et al.*, 2004).

There is a consensus as to the need for and the positive impacts of disaster preparedness, as it provides the necessary education and training for improving preparedness among hospital staff (Maguire *et al.*, 2007). Chen *et al.* (2002) found that response training was associated with preparedness among family physicians (comparable to GPs). However, recent research shows that there is little-to-no experience or training targeted at CBRNE-related incidents among, e.g. non-urban physicians (Hus *et al.*, 2005) and family physicians (Chen *et al.*, 2002). However, in another study, almost 70% of physicians stated that they had received CBRNE training (Hung *et al.*, 2013). Still, among those who received training almost all (93%) indicated their wish to obtain more training. In line with that result, Alexander *et al.* (2003) found that 80% of responding physicians were willing to respond to bioterrorist incidents but only 20% of them were confident in handling such an event.

An example from Sweden of an industrial incident (unintentional/accidental) is the release of massive amounts of ammonia in the city Helsingborg in 2010, resulting in the hospitalization of twelve people (Björnstig *et al.*, 2020). The Swedish National Board of Health and Welfare states that healthcare personnel, who are supposed to work with serious occurrences in a mass injury event, should be educated and regularly trained in CBRNE response. Additionally, it is mandatory in Sweden to have a disaster preparedness plan for different levels of society (The National Board of Health and Welfare, 2020).

Investigating the current state of disaster preparedness and the capabilities of physicians at EDs and healthcare centres to respond to emergencies and disasters could be a major step towards enhancing the outcome and recovery from major incidents like CBRNE. As far as we have seen there seem to be few publications on *how* EPs and GPs perceive their work procedures and competence related to CBRNE incident response. In this study we only include chemical, radiological and nuclear (CRN) incidents. Finding out experiences among physicians is assumed to be of value in increasing preparedness and optimizing multi-professional performance for the benefit of patients when faced with a CRN incident.

Aim

To describe Swedish emergency physicians' and general practitioners' preparedness (work procedures and competence) regarding response to chemical, radiological and nuclear incidents.

Method

We conducted a qualitative descriptive study using semi-structured individual interviews based on vignettes. Vignettes are short stories, hypothetical scenarios or descriptions of incidents. Vignettes are used as a stimulus to generate a reaction, discussion or opinion from participants and should resemble realistic situations (Schoenberg *et al.*, 2000). The three vignettes that we used highlighted chemical (C), radiological (R) and nuclear (N) incidents (Table 1).

Participants

Participants were enrolled in the study via a convenience sample through personal knowledge and geographical closeness. To obtain the perspectives of both emergency care and primary healthcare practitioners, five EPs and six GPs were included in the sample.

To become a specialized physician in emergency medicine (EP) or general medicine (GP) it requires an education of twelve years. Primary healthcare centres are staffed by GPs and form the basis of Swedish healthcare. All diseases that is not urgent or life-threatening is handled by GPs. If needed, the GP send a reference to a specific clinic, for example to surgical procedure. The ED are staffed by EPs and are responsible for urgent and life-threatening conditions. The EP assess and stabilize the patient. After that they report the patient to the relevant clinic, a PHCC or send them back home if cured.

The triage nurse will contact you since you are the physician on call. A woman in her 40s has been rushed into the emergency room, screaming, and loudly coughing. She is soaked even though it is sunny outside and has a lot of pain in her eyes. The woman smells strong. When the triage nurse tries to ask what has happened, the woman seems confused. The waiting room is crowded with other patients. How will you respond?
You will be contacted by a medically responsible nurse who has recently arrived at the scene of the injury together with emergency services. The medical officer asks for advice on how to handle the injury. This is an incident involving four railway workers who discovered during their work that a train carrying nuclear waste had damage to its structure. The four track workers may potentially have been exposed to radiation and one of them feels sick and dizzy. How will you respond?
As a physician on call, you are contacted by the region's emergency official regarding an ongoing fire in an industrial building known to handle chemicals. The region's emergency official announces that there are 50 injured persons; about a third of which are estimated to arrive at your hospital. Patients are expected to arrive every 10 min and you are advised to get ready to receive two critical patients shortly. These two have only been prepped with lifesaving decontamination. How will you act?

Table 1.
Vignettes used in the interviews

The five EP participants were recruited from northern Sweden's coastal area but had work experiences in various regions within Sweden and from Poland, Argentina, Spain and Ethiopia. The six GPs were recruited from Sweden's mountain region, but they had work experience from other regions in Sweden; e.g. Stockholm city, Stockholm archipelago and Gothenburg, and also from Tanzania and Denmark. This means that together they had experiences working from big cities to small villages in sparsely-populated areas, and from different countries and different regions around Sweden.

The participants, 11 in total, were 37–61 years old. They had between 8 and 35 years of work experience as a physician, with an overall average of 17 years. Five were women and six were men. All participants had specialized in either emergency medicine or general medicine, and all could be assigned the role of physician on call. Participants were asked if they had taken care of a patient who were exposed to a CRN accident, and some of the participants had experiences with minor incidences regarding chemical agents but the majority of participants answered "no" to that specific question.

Data collection

The three vignettes were created by the authors. During construction of the vignettes the authors also sought input from an expert at the Swedish Defence Research Agency.

The vignettes were presented to the participants one by one, and the following questions were asked following all three vignettes: What information do you need? How do you prepare for the patients' arrival? What do you think about safety? Participants were interviewed live on the digital platform Zoom via video camera. Following the first interview, the authors met to discuss the interview, and ideas and questions were clarified for the ten interviews to follow. Interviews lasted 35–45 min and were recorded and transcribed verbatim.

Analysis

A qualitative content analysis inspired by Graneheim and Lundman (2004) was used to analyse the interview data. The main focus lay on the manifest content of the interviews, which includes the visible and obvious components of the text. First, the interviews were read through several times by one of the authors (C-P C). Interview texts were then divided into meaning units before being further divided into condensed meaning units and afterwards labelled as codes. All codes were then grouped and one overarching main category was constructed and divided into two categories and five subcategories (Table 2). Excerpts from the interviews are presented as quotations in the results to confirm internal validity. All the steps of the analysis were reviewed and adjusted by the remaining authors, who also had read the interviews.

Ethical consideration

This project has been performed in accordance with the Helsinki Declaration (WHO, 2013). The study participants are professionals and not patients, and thereby not regulated by The

Table 2.
Main category, categories, and sub-categories

Main category	Categories	Sub-categories
To be an expert and to seek expertise	Preparations before receiving CRN patients	Information needs Resource needs
	Physical examination and treatment of CRN patients	Managing a contaminated patient Initial assessment and stabilization of the patient Treatment of the patient

Act concerning the Ethical Review of Research Involving Humans. We received approval from participants' line managers. Participants were thoroughly informed about the aim of the study, their rights to withdraw their contribution, and about confidential handling of data and that participants' identities cannot be determined based on the quotes used in the study results. Participants then gave written informed consent.

Findings and results

The findings present participant's work procedures and competence regarding management of chemical, radiological and nuclear incidents. Their experience and competence were covered by the overarching main category "to be an expert and to seek expertise." This main category illustrated a general competence among the participants in handling emergencies, although they lacked expertise in the management of rare CRN events. To be an expert and to seek expertise also covered the need for education and training such as lectures, scenario training and reviews on, e.g. antidotes and decontamination areas. However, the main category also highlights a conflict between having specialist expert knowledge in rare CRN incidents or on relying on their own general competence in the primary survey of affected patients.

Preparations before receiving CRN patients

The first category describes how the participants prepare and plan to take care of patients exposed to chemical, radiological or nuclear incidents. The category involves two subcategories; *information needs* and *resource needs*.

Information needs. When the participants receive information that a CRN incident has happened they contact the region's emergency official at the hospital to activate the hospital emergency disaster plan. After this, they use action plans in order to know step by step what to do and whom to contact. However, these plans are not specific to CRN incidents but are generalized for all types of major incidents. Regarding CRN specific incidents, participants stressed the importance of gaining information about the overall situation before receiving the exposed patients. They requested information about where the incident has happened, how many persons were affected, for how long a time they had been exposed and how the patients are doing. Depending on whether it is a chemical, radiological or nuclear incident, participants also required further information relating specifically to the hazardous substance. When it came to chemical incidents, they needed to know to which chemicals the patients had been exposed, and in the case of radiological incidents, they needed information about the amount of radiation the patients have been exposed to and how far from the radiation source the patients had been, as well as what kind of transport they took and if the waste is visible.

> What does the patient look like, what kind of injuries does she have, does she have chemical burn injuries/burn injuries on her skin, does she have stable vitals? Are we able to calm her down? What kind of substance has she been exposed to? How long has she been exposed and so on.

"Information needs" also covers the need to give information and advice to emergency medical services (EMS) and the public—including schools near the incident site—about what to do and actions they can take to protect themselves.

Participants became startled when asked to give advice to EMS personnel about how to act during a radiological incident. They stressed the importance of EMS personnel keeping a safe distance away from the radiation source, and in considering wind direction, because participants assumed EMS personnel lack the proper equipment necessary to handle radiological incidents. However, they do not know how long the distance needs to be to be

safe. They also suggested that EMS personnel should triage patients from a distance with the help for example from electronic equipment when facing a radiological accident.

> I have no idea! Yes, perhaps I have. What in the world should I advise them on? Let's see, nuclear waste, damaged construction, it could potentially leak radiation. It will be a bit like working during Chernobyl, then.

> This means that all four patients in the vignette must be triaged. They [EMS personnel] can try to look at them from a distance or throw some kind of radio or telephone to them in order to communicate with the patients about potential injuries.

Resource needs. Participants stated that resource inventory and planning is important, because the management of chemical, radiological and nuclear incidents requires extensive resources. To prepare for a surge of patients, participants described that they would empty the healthcare facility and make personal and transport resources available. How much resources are needed depends on the number of patients and the injury panorama. At EDs there is a routine for managing all types of disasters, where the back-up surgeon is responsible for resource availability and distribution. At the PHCC, participants were not sure whether there were any such routines in place. However, they stated that PHCC in sparsely-populated areas far away from hospitals should be more prepared than they are today and have access to more resources, so as to be better at managing CRN incidents.

Furthermore, participants described that cooperation within their own organizations and between different actors such as dispatch centres, regional emergency officials and the Swedish Poison Information Centre is fundamental to be able to successfully handle chemical, radiological and nuclear incidents.

The participants expressed the urgent need to seek expertise if faced with a chemical, radiological or nuclear incident. They would contact radiological competence for advice regarding management of radiological exposure, and some participants stated they would contact hospital physicists and the Swedish Civil Contingencies Agency, and some were unsure who to contact. They would also seek support from anaesthetists, intensive care physicians, surgeons and medical physicians, depending on the present situation and the patient's status.

> And at the same time, contact the Swedish Poison Information Centre regarding whether iodine or another substance can be administered. I do not know, is it possible to treat patients with iodine, magnesium, or potassium preventively?

Physical examination and treatment of CRN patients

This category describes the work procedures and competence regarding how to manage contaminated patients and how to reduce the exposure for patients, themselves, and other people. This category is also about the initial assessment and stabilization of the patient and their subsequent treatment. The category involves three subcategories; *managing a contaminated patient*, *initial assessment and stabilization of the patient* and *treatment of the patient.*

Managing a contaminated patient. The participants shared knowledge about how to reduce patient exposure and stated the importance that the patient should leave the contaminated area, undress, and wash with soap and water as soon as possible in a decontamination chain, either onsite at the incident or at the hospital. They specified that patients should be decontaminated before medical treatment but are not sure how and or where this should be done. When it comes to limiting the exposure others who had not yet been exposed, e.g. other patients, participants knew that patients suspected of contamination should be separated and isolated from others and that their clothes should be taken care of in sanitizing vessels. How this separation should be arranged was not clearly described by participants. In order to protect healthcare personnel, participants described that they should

use protective equipment such as gloves, goggles, clothes and filter masks, and be aware of safe distances from radiation sources. Participants state that current protective equipment capacity is good, due to the COVID-19 pandemic. However, when it comes to chemical and radiological incidents, decontamination, protective equipment and treatment of patients, participants describe an overall lack of competence regarding protective gear.

Participants who work in urban PHCC described that they lack both equipment and competence regarding the management and treatment of contaminated patients in chemical and radiological incidents. They further stated that the need for this is low because they are situated close to major hospitals, which means (according to participants) that patients would be transported directly to the hospital.

Initial assessment and stabilization of the patient. The participants described faith in their general experience in emergency care when assessing and stabilizing exposed patients. They use their basic competence in primary surveys due to the advanced trauma life support (ATLS) concept. Participants describe that they will apply structured assessment and stabilization of the patients in accordance with ATLS; airway (A), breathing (B), circulation (C), disability (D) and exposure (E). When patients are stabilized participants will look for less-acute states like eye injuries, medical histories and hypothermia prevention. It was also stated that, depending on the general condition of the patient, participants may accept the risk of exposing themselves to the CRN agent during the assessment and stabilization of the patient depending on the availability of protective equipment.

The overall experience and competence of primary patient surveys was described as the ability for participants to be able to remain calm, even in a stressful CRN situation. However, they expressed that they prefer not to be in charge if an CRN incident did occur.

> But the perception due to the experience I have of working for such a long time is that I can be calm and know that it is just to check what competence there is on-site, what we need to look up, call the right people, call the personnel who need to be summoned—and that is important, to know who to call for help.

Treatment of the patient. If faced with chemical or radiological incidents, participants indicated that they can deduce what kind of injuries to expect. In chemical incidents, participants for example expect that there would be chemical burn injuries, and during fires they suspected poisoning and also inhalation injuries to the airways.

When the participants suspect radiation injuries, they expected to see nausea, dizziness, headache, vomiting, diarrhoea, skin damage and changes to blood profiles as signs and symptoms.

After primary survey and initial stabilization of patients, participants stated that they would continue by treating their injuries. They would treat burn injuries by cooling the burn site, and through analgesics and ointments. They would rinse chemically-injured eyes, which means that in some situations reducing patient exposure and treating the patient is one and the same. They would treat affected airways with inhalation and use drugs, like antidotes, depending on the patients' condition. However, not all participants had experience with inhalation injuries. If the patient is suspected to be exposed to radiation, the thyroid will be protected with iodine, and if the patient is nauseous they will be prescribed antiemetics.

Participants also described that they would need to seek expertise regarding how to treat patients. For example, if a patient has severe burn injuries, the special wards charged with taking care of such patients will be contacted. The also stated that they would contact the Swedish Poison Information Centre for advice about how to treat exposure from different substances and radiation.

After initial treatment the participants would decide on the level of care based on the patient's medical history, what the patient has been exposed to, and on their condition.

Participants would also seek expertise for psychological and social management of relatives after the acute phase.

Discussion

The aim of this project was to investigate the preparedness regarding response to CRN incidents among Swedish EPs and GPs through examining work procedures and competence.

The results show that participants are confident in their ability to take care of patients in general, and perceived that they have general knowledge in primary patient surveys. They described how to seek expertise, although specific knowledge regarding chemical, radiological and nuclear incidents is considered to be low and a need for education and training was expressed by the physicians in the study.

Some of the participants in our study had some experience with minor chemical incidents, but they lacked expe-rience with extensive chemical incidents and radiological incidents. Competence, i.e. experience and knowledge, is assumed to be fundamental in order to be prepared for and capable of handling these situations. In accordance with our results, Kotora (2015) also stated that emergency care providers are inadequately prepared to manage CBRNE incidents. The suggestions were that new efforts with a focus on collaboration between public health institutions and the effective use of online resources to bring more physicians on board in developing relevant tools are suitable to address the challenge.

As a consequence of the rarity of CRN events, CRN-specific competence, at least in the confines of this study, seems to be limited. Emergency physicians and GPs seem to react differently to this relatively low competence. Emergency physicians requested specialist CRN knowledge and training to improve capability, while the GPs expressed the need for training but were quite comfortable in not having this specific competence, and if necessary, would ask for help and would hand patients over to a hospital. This also impacts how they plan to handle initial patient stabilization, where EPs were more specific about what and how they will act, for example, by using the ATLS concept, while the GPs are more general in their descriptions of what to do. One explanation could be that GPs more often lack specific procedures, facilities and equipment in comparison with EPs who work at hospitals.

The results from our study showed that to be able to strengthen the ability of EPs and GPs to respond adequately to a CRN incident several aspects have to be considered. These are, namely, preparedness, response, decontamination and personal protective equipment (PPE). A system-based approach suggested by Razak *et al.* (2018) describes three levels: *organizational (*policies and procedures*), technological* (decontamination, communication, security, clinical care and treatment) and *individual* (willingness to respond, PPE, knowledge and competence). In the meantime, until such a system is in place, it can be valuable to offer lectures held by various experts and to carry out small relevant training exercises. The results from our study show that both EPs and GPs discussed safety and the importance of protecting oneself, the patient and others. There is no doubt that safety is crucial but the talk about safety can also be an expression of uncertainty due to lack of competence regarding CRN incidents. Balicer *et al.* (2011) performed an online survey with all employees at John Hopkins hospital in Baltimore, which showed that personal safety issues were important parameters associated with a willingness to respond to radiological events.

Our study shows that depending on the general condition of the patient, EPs and GPs may accept the risk of exposing themselves during the primary survey and stabilization of the patient, depending on the availability of protective equipment. This result highlights the importance of more education and training, and on evaluating the ability to handle rare CRN events on all three levels; organizational, technological and individual.

Methodological consideration

When dealing with qualitative content analysis, both the manifest and latent content of a text are used. This study focuses mainly on the manifest content; that is *what the text says* and resulted in an overarching main category with categories and sub-categories (Graneheim and Lundman, 2004).

Another central concept in qualitative studies is trustworthiness, which is a summary of the different aspects of credibility, dependability and transferability (Graneheim *et al.*, 2017).

The fact that several researchers participated in the construction of the vignettes and throughout the analysis process strengthened the trustworthiness of this study.

Participant selection is another aspect of trustworthiness. Our participants were recruited via a convenience sample and everyone that was asked to participate and accepted the invitation was included in the study. The sample consists of both GPs and EPs, and includes both men and women of different ages. Even if the sample size of the participants is rather small, and transferability need to be done carefully, the interviews contained extensive stories regarding what the participants expected they would do during CRN incident, according to the vignettes. However, the interview guide could also have included questions related to the participants awareness of their feelings related to such incidents. That was something the authors thought would arise spontaneously from participants, but only a few participants revealed uncertainties as to this type of incidents. More research including not only knowledge about what to do, but also emotional responses connected to the topic would be of value.

Conclusion

Although this is a rather small sample of physicians, confirming previous research regarding low preparedness for CRN incident response, it also emphasizes the importance of knowledge on general primary surveys and how best to seek support.

However, in the current healthcare system, which is stressed by a high workload during the COVID-19 pandemic, and by difficulties in recruiting competent personnel and large personnel turnover, it might not be realistic to raise all physicians preparedness for rare incidents to the expert level. What level of expertise physicians at various healthcare departments should hold to be prepared to respond to CRN incidents merits further investigation.

References

Alexander, G.C. and Wynia, M.K. (2003), "Ready and willing? Physicians' sense of preparedness for bioterrorism", *Health Affaires*, Vol. 22 No. 5, pp. 189-196.

Azeem, A.R., Sharif, M.W., Akhtar, A., Sohail, C.S., Dar, A.A., Khan, M. and Aleem, M. (2019), "Perception of preparedness of health care professionals in case of a nuclear, chemical, biological attack/emergency in a tertiary care hospital", *Cureus*, Vol. 11 No. 5, pp. 2-7.

Balicer, R.D., Catlett, C.L., Barnett, D.J., Thompson, C.B, Hsu, E.B., Morton, M.J. and Links, J.M. (2011), "Characterizing hospital workers' willingness to respond to a radiological event", *PLoS*, Vol. 6 No. 10, e25327.

Beyramijam, M., Farrokhi, M., Ebad, A., Masoumi, G. and Khankeh, H.R. (2021), "Disaster preparedness in emergency service agencies: a systematic review", *Journal of Education and Health Promotion*, Vol. 10, p. 1.

Björnstig, J., Westman, A., Saveman, B.I. and Björnstig, U. (2020), "The 'Chemical ambulance'", *Perstorp - Valuable Expertise in CBRNE Events, Report from the Knowledge Centre for Disaster Medicine*, Umeå University, Umeå.

Chen, R.M., Hickner, J., Fink, K., Galliher, J.M. and Burstin, H. (2002), "On the front lines: family physicians' preparedness for bioterrorism", *The Journal of Family Practice*, Vol. 51 No. 9, pp. 745-750.

DeBacker, M. (2003), "Hospital preparedness for incidents with chemical agents", *International Journal of Disaster Medicine*, Vol. 1 No. 1, pp. 42-50.

Furbee, P.M., Coben, J.H., Smyth, S.K., Manley, W.G., Summers, D.E., Sanddal, N.D., Sanddal, T.L., Helmkamp, J.C., Kimble, R.L., Althouse, R.C. and Kocsis, A.T. (2006), "Realities of rural emergency medical services disaster preparedness", *Prehospital and Disaster Medicine*, Vol. 21 No. 2, pp. 64-70.

Graneheim, U.H. and Lundman, B. (2004), "Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness", *Nurse Education Today*, Vol. 24 No. 2, pp. 105-112.

Graneheim, U.H., Lindgren, B.M. and Lundman, B. (2017), "Methodological challenges in qualitative content analysis: a discussion paper", *Nurse Education Today*, Vol. 56, pp. 29-34.

Hsu, E., Jenckes, M.W., Catlett, C.L., Robinson, K.A., Feuerstein, C., Cosgrove, S.E., Green, G.B. and Bass, E.B. (2004), "Effectiveness of hospital staff mass-casualty incident training methods: a systematic literature review", *Prehospital Disaster Medicine*, Vol. 19 No. 3, pp. 191-199.

Hsu, E., Mas, F.S., Jacobson, H., Papenfuss, R., Nkhoma, E.T. and Zoretic, J. (2005), "Assessing the readiness and training needs of non-urban physicians in public health emergency and response", *Disaster Management & Response*, Vol. 3 No. 4, pp. 106-111.

Hung, K., Lam, E., Wong, M., Wong, T., Chan, E. and Graham, C. (2013), "Emergency physicians' preparedness for CBRNE incidents in Hong Kong", *Hong Kong Journal of Emergency Medicine*, Vol. 20 No. 2, pp. 90-97.

Kotora, J.G. (2015), "An assessment of chemical, biological, radiologic, nuclear, and explosive preparedness among emergency department healthcare providers in an inner city emergency department", *Journal of Emergency Management*, Vol. 13 No. 5, pp. 431-446.

Maguire, B.J., Dean, S., Bisell, R.A., Walz, B.J. and Bumbak, A.K. (2007), "Epidemic and bioterrorism preparation among emergency medical services systems", *Prehospital and Disaster Medicine*, Vol. 22 No. 3, pp. 237-242.

Moore, B.L., Geller, R.J. and Clark, C. (2015), "Hospital preparedness for chemical and radiological disasters", *Emergency Medicine Clinic of North America*, Vol. 33 No. 1, pp. 37-49.

Mortelmans, L., Van Boxstael, S, De Cauwer, H. and Sabbe, M. (2014), "Preparedness of Belgian civil hospitals for chemical, biological, radiation, and nuclear incidents are we there yet?", *European Journal of Emergency Medicine*, Vol. 21 No. 4, pp. 296-300.

Razak, S., Hignett, S. and Barnes, J. (2018), "Emergency department response to chemical, biological, radiological, nuclear, and explosive events: a systematic review", *Prehospital and Disaster Medicine*, Vol. 33 No. 5, pp. 543-549.

Schoenberg, N.E. and Racdal, H. (2000), "Using vignettes in awareness and attitudinal research", *International Journal of Social Research Methodology*, Vol. 3 No. 1, pp. 63-74.

Shadel, B.N., Chen, J.J., Newkirk, R.W., Lawrence, S.J., Clements, B. and Evans, R.G. (2004), "Bioterrorism risk perceptions and educational needs of public health professionals before and after september 11, 2001: a national needs assessment survey", *Journal of Public Health Management and Practice*, Vol. 10 No. 4, pp. 282-289.

SteelFisher, G.K., Blendon, R.J., Brulé, A.S., Lubell, K.M., Jackson Brown, L., Batts, D. and Ben-Porath, E. (2015), "Physician emergency preparedness: a national poll of physicians", *Disaster Medicine and Public Health Preparedness*, Vol. 9 No. 6, pp. 666-680.

The National Board of Health and Welfare (2020), "(SOSFS 2013:22), Regulations on amendments to the regulations and general advice on disaster medical preparedness", *HSLF-FS*, p. 60.

Williams, J., Walter, D. and Challen, K. (2007), "Preparedness of emergency departments in northwest England for managing chemical incidents: a structured interview survey", *BMC Emergency Medicine*, Vol. 20 No. 7, pp. 1-5.

World Medical Association Declaration of Helsinki (2013), "Ethical principles for medical research involving human subjects", available at: https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/ (accessed 6 September 2022).

Corresponding author
Lina Gyllencreutz can be contacted at: lina.gyllencreutz@umu.se