

ORIGINAL ARTICLE

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Willingness to Work during Mass Casualty Incidents among Emergency Department Healthcare Workers in the Zealand Region, Denmark

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Abstract

Background: Mass casualty incidents (MCI) cause a surge in healthcare needs, requiring additional staff and the activation of disaster plans. A key question is whether healthcare workers (HCWs) are willing to respond to the call and come to work.

Aim: This study evaluates the willingness of HCWs in the Zealand region, Denmark to work during MCIs, exploring influencing factors and conditions in comparison to previously published studies.

Methods: A cross-sectional, survey was conducted in two emergency departments across three hospitals in Zealand, Denmark. Data collection utilized an online questionnaire based on the “Fight or Flight” questionnaire developed by the University of Leuven, Belgium.

Results: Out of 508 invited HCWs (nurses, doctors, and secretaries), 103 fully answered the questionnaire (response rate 20.3%). Among them, willingness to work (WTW) unconditionally was highest for influenza pandemics (68%), SARS/COVID-19 (63%), and mass shootings (53%). The lowest WTW occurred during nuclear incidents (28%) and dirty bombs (29%). Key conditions for WTW included family safety (84%) and personal protective equipment (79%). Doctors showed higher WTW than nurses, and prior disaster training significantly influenced WTW for specific scenarios ($p < 0.05$).

Conclusion: High WTW rates suggest a self-evaluated readiness among Danish HCWs in the Zealand Region, especially during pandemics. However, WTW was lower for some scenarios, such as nuclear and radiological events. We suggest, based on the results, that targeted training could enhance preparedness and WTW.

Keywords: Disaster response; Mass casualty incident; Willingness to work; Healthcare workers; Emergency department; Fight or flight

Introduction

In 2023, a total number of 399 natural disasters like earthquakes, storms and heat waves were reported worldwide, leading to over 86,000 deaths and affecting 93 million people, and the numbers are increasing (1). These events, as well as pandemics and larger accidents, would cause a surge in healthcare needs and can overwhelm the capacity of a healthcare system. Almost all hospitals worldwide have recently had to adjust to the COVID-19 pandemic, and infectious diseases remain a high-ranking threat to healthcare systems (2). Furthermore, a severe dysfunction or breakdown of essential supplies and infrastructure (e.g. water, power, sanitation, communication, digital healthcare records) affects a hospital's ability to provide its services at a normal level (3). These hazards are also identified for Denmark (4). All hospitals in Denmark are obligated to prepare for mass casualty incidents (MCIs) under national guidelines (5). MCIs are defined as an overwhelming demand for healthcare needs, that cannot be met by normal day-to-day resources (6).

The healthcare sector is suffering from a shortage of qualified staff, especially nurses also in Denmark (7). With regard to the emergency department, a major question is if all healthcare workers (HCW) will respond to the activation of the MCI plan and come to work, as activating off-duty personnel and staffing up is a key component of this activation. This positive attitude to help outside one's normal working schedule and in scenarios which include a certain risk to health and safety defines "willingness to work" in this study. Without qualified HCW available, preventable deaths can occur.

No such survey has so far been conducted in Denmark. This study was conducted as part of the European Master in Disaster Medicine (EMDM) program, an international advanced Master of Science program organized by CRIMEDIM, University of Eastern Piemonte, Italy, and REGEDIM, Free University of Brussels, Belgium, for the purpose of teaching and supporting state-of-the-art and evidence-based knowledge about disaster medicine (8).

The aim of this study is to evaluate the willingness of HCWs in two emergency departments in the Zealand region, Denmark, to work during MCIs, exploring influencing factors and conditions.

Methods

STUDY DESIGN

The study used a survey to generate a numeric representation of specific scenarios. The original survey was developed by the Center for Research and Education in Emergency Care (CREEC) of the University of Leuven, Belgium (9). The English version (10) was translated to Danish by the author by performing a back-and-forth translation using Google Translate (11).

After face-validation the questionnaire's content validity was reviewed by a panel consisting of two nurses and one specialist doctor in emergency medicine, who represented the target groups. All three participants of the panel were native speakers of Danish, working at the same department as the author and were involved in the disaster training in the department. They were given the opportunity to rephrase the questionnaire when there were doubts about the validity and understandability of the translation from a cultural perspective. For conditions necessary to come to work, one or more answers were possible. Individual knowledge of the scenario was covered by a question regarding previous training. The responses to the questionnaire were voluntary and anonymous. By participating in the questionnaire, the participants consented to the use of the submitted data.

FIGHT OR FLIGHT-QUESTIONNAIRE

The fight or flight-questionnaire (9) has been used in several previous studies from Norway (12), Saudi Arabia (10), Belgium (9, 13) and the Netherlands (14). The healthcare systems in Norway, Belgium and the Netherlands are generally considered comparable to the Danish healthcare system (15, 16). The healthcare system of Saudi Arabia consists of a larger private sector, and the workforce is to a considerable extent recruited from abroad (17). Despite these differences, the results for

WTW in the previous studies were consistent regarding different WTW for doctors and nurses, female vs. male.

DATA COLLECTION

The “Survey Xact” internet-based platform (Xact by Ramboll, DK-8200 Aarhus) was used to collect data. All data were stored on an encrypted and password-protected server of the Zealand region. A link to the electronic questionnaire was distributed via e-mail to all 508 employees of two emergency departments (ED) of Zealand University Hospital, covering the hospitals at Roskilde, Køge and Nykøbing Falster on November 1st, 2024.

The distribution was facilitated by the leadership of the two departments, who sent the link and information about the study in a weekly newsletter. Nurses, medical doctors and secretaries were included, medical students, nursing students and other professions were excluded and not invited to answer the questionnaire. Only employees with contractual relations to the departments were included. One week after the initial distribution of the link, a reminder was distributed, after another week a personal invitation was sent to the work email of the employees by the heads of the department. The data-collection was terminated by December 1st. No time limit was predefined to complete the questionnaire. The two departments were chosen, as they represent an urban academic hospital (at the sites in Køge and Roskilde) and a rural ED in Nykøbing Falster. As both departments are organized under Zealand University Hospital and located within the same healthcare-region, sampling bias is possible.

The questionnaire used is included in Appendix 1.

ETHICAL CONSIDERATIONS

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was not required under Danish legislation, as the study involved voluntary participation in an anonymous survey without the collection of sensitive personal data or medical information (18). All data were collected and stored securely using a password-protected online

platform. No personally identifiable information was collected, ensuring complete anonymity. Data processing complied with General Data Protection Regulation (GDPR, EU 2016/679) standards to protect privacy and confidentiality.

Participants were informed that the participation in the questionnaire was voluntary and that they consented by actively following the link and completing the survey. As the data were collected anonymously, a later withdrawal of consent was not possible.

STATISTICS

Cronbach's alpha was calculated (19), and Fisher's exact test (p-value) was performed (20), using SPSS (IBM). Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. Fisher's exact test is a statistical hypothesis test used to assess the association between two binary variables in a contingency table and is particularly useful when working with small-sized samples. Data presented with mean and standard deviation were calculated with Microsoft Excel. Human Resources provided the information that a total of 508 HCWs are employed in the two emergency departments of choice. The sample size was set at 250 healthcare practitioners based on a power calculation (Raosoft Inc., USA) (21), assuming 4.5% precision with 50% prevalence and a population size of 508 with a 95% confidence interval and specified limits. As only fully completed questionnaires were analysed, there were no missing data.

Results

A total of 103 fully answered questionnaires were collected and further processed. 12 incomplete questionnaires were excluded from further analysis. The percentage of fully answered questionnaires was 20.3%. Demographics are shown in Table 1. It shows that most of the respondents were female (N=78). 34 of the responders were doctors, 54 nurses, and 15 were secretaries (others). Of the 34 doctors, 22 were junior doctors, and 12 consultants. Nine of the responders had leadership roles, and 10

were without patient contact (with overlap of these groups). 75 of the responders were living with a partner, 74 had children, and 44 had children in the same home.

Table 1. Summary of demographics of included study participants, totals and percent, w/o: without.

	Total = 103	%		%
Profession	34 doctors in total	33.01		
	22 junior doctors/residents	21.36		
	12 consultants	11.65		
	54 nurses	52.43		
	15 others	14.56		
Gender	78 female	75.73	25 male	24.27
Leadership role	94 employees	91.26	9 managers	8.74
Patient contact	93 regular	90.29	10 w/o	9.71
Partner	75 living with partner	72.82	28 w/o	27.18
Children	74 with children	71.84	29 w/o	28.16
Children at home	44 with children at home	42.72	59 w/o	57.28

Regarding their WTW, four categories could be chosen from in relation to 12 different scenarios. The Cronbach's Alpha for the WTW-questions was 0.915, which indicates a very high reliability of consistency.

The categories "Yes unconditionally" and "Yes under certain conditions" were considered positive/high, while "probably not" and "certainly not" were considered negative/low in the further analysis, where they were not referred to individually.

Conditions to come to work were only obtained from the responders who answered "Yes, under certain conditions" (N=29-61, see Figure 1). The result of the individual conditions is shown as sum in Figure 2 for all scenarios. That was considered useful and necessary due to the small numbers but can influence the generalizability of the results for some conditions, e.g., PPE and vaccination for scenarios without an infection hazard.

The scenarios with the highest rates for WTW unconditionally or under certain conditions were influenza, pandemic with special influence like bird flu, SARS/COVID-19 and mass shooting. The lowest WTW was observed for nuclear incidents and dirty bombs. In these scenarios, as well as in natural disasters, bomb threats and mass shootings, the majority would attend under certain conditions. The rate of not attending work or having serious doubts was generally very low. See Figure 1.

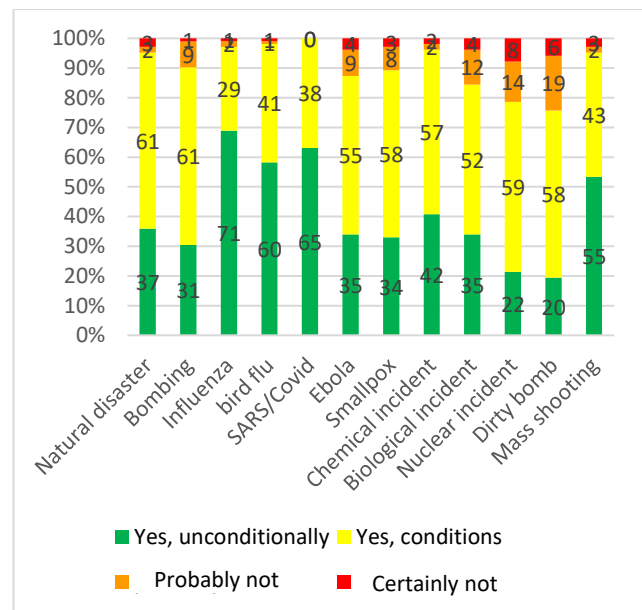


Figure 1. WTW in percent for all responders (Y-axis: colours). Number in column: totals of individuals = (n).

Doctors showed a higher WTW unconditionally than nurses, males higher than females, HCWs without a partner, children or children at home higher than HCWs with a partner, children or children at home. In some scenarios we did find a significant p-value despite the overall low numbers. The following combinations showed significant influence: Profession (doctors with a higher WTW than nurses) for Ebola-outbreak, chemical incident, biological incident and dirty bomb; Gender (male with higher WTW than female) for natural disaster, bomb threat, chemical incident, nuclear incident, and dirty bomb. Responders living with a partner were less likely to respond unconditionally to influenza, bird flu, Ebola, biological incidences, and shootings. Responders with children were less likely to respond unconditionally to natural disasters, influenza-pandemic, bird-

flu, chemical incidences and biological incidences. Children at home had a significant influence on the response to natural disaster, bomb threat, Ebola, chemical incidents and mass shooting. For p -values see Table 2.

	Natural d.	Bombing	Influenza	Bird flu	SARS	Ebola	Smallpox	Chem. Inc.	Bio. Inc.	Nuc.inc.	Dirty bomb	Shooting
Profession (doctors higher rate of WTW unconditionally)	n.s.	n.s.	n.s.	n.s.	n.s.	0.002	n.s.	0.019	<0.001	n.s.	0.028	n.s.
Gender(male higher rate of WTW u.)	0.018	0.019	n.s.	n.s.	n.s.	n.s.	n.s.	0.016	n.s.	<0.01	0.019	n.s.
With partner lower rate of WTW u.	n.s.	n.s.	0.02	0.011	n.s.	0.044	n.s.	n.s.	0.032	n.s.	n.s.	0.019
With children lower rate of WTW u.	0,03	n.s.	0.045	0.021	n.s.	n.s.	n.s.	0.004	0.018	n.s.	n.s.	n.s.
With children at home lower rate of WTW u.	<0.001	<0.001	n.s.	n.s.	n.s.	0.006	n.s.	0.001	n.s.	n.s.	n.s.	0.002
Training in disaster managment												
Higher rate of WTW u.	0.023	n.s.	n.s.	n.s.	n.s.	n.s.	0.019	n.s.	n.s.	9	n.s.	n.s.
Training in epidemics	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Training in chem. inc.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Training in nuclear inc.												
Higher rate of WTW u.	0.046	n.s.	n.s.	n.s.	n.s.	0.034	0,04	n.s.	n.s.	0.004	0.016	n.s.
Training in mass casualty												
Higher rate of WTW u.	n.s.	0.018	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Table 2. The influence of demographics and previous training on WTW in different scenarios. p -values (yellow when $p < 0.05$ and red when $p < 0.01$) for demographics and training-status regarding the different scenarios. d: disaster, Chem.Inc.: chemical incident, Bio.Inc.: biological incident, Nuc.inc.: nuclear incident, n.s.: not significant ($p \geq 0.05$), u: unconditionally.

Previous training had a significant influence on the WTW in some scenarios.

Training in disaster management had a significant positive influence on the WTW in natural disaster, smallpox and nuclear incidences. Training in epidemics and chemical incidences had no significant influence. Mass casualty training had an influence on bomb threats, whereas responders trained in nuclear incidences had higher WTW unconditionally in natural disasters, Ebola, smallpox, nuclear incidents and dirty bombs. See also Table 2.

Asked about conditions to attend work, the responders could choose between 10 different conditions. The most important condition was identified as safety for their family, followed by availability of personal protective equipment (PPE), proper education and training, the possibility for contact with their family and a high level of information about the development of the MCI situation. All other conditions, such as extra salary, free antidots, vaccines only seemed to play a minor role. See Figure 2.

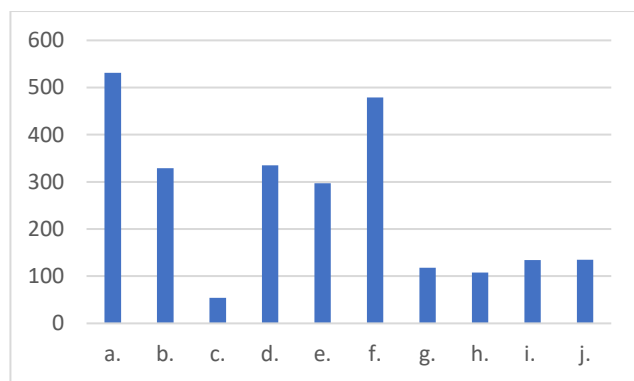


Figure 2. Conditions for coming to work, as sum for conditions from all scenarios. a. if my family is safe and taken care of, b. if I can be sure to come in contact with my family, c. if my boss is coming to work too, d. if I get sufficient training, e. if I get updates about the development, f. if necessary PPE is provided, g. if I get extra salary, h. if I get antiviral drugs for free, i. if free antidote is provided, j. if free vaccines are provided. Shown as sum of all 12 scenarios where “yes, under certain conditions” as chosen.

Asked about the risk/probability of a scenario happening, Influenza pandemic, SARS/COVID-19, natural disasters and chemical incidences are perceived to be the most likely, whereas for Ebola, smallpox, dirty bombs, biological and nuclear incidences the likelihood is perceived as low. Regarding how dangerous a scenario was perceived, nuclear incidences, dirty bombs, bomb threats, and Ebola were the top scorer. The scenarios perceived as least dangerous were influenza, special influenza and SARS/COVID-19. See Figure 3. For both probability and danger, the range of answers was 0-100%; for standard deviations see Table 3.

Scenario	Risk/Probability	Danger	St.dev. Risk	St.dev. Danger
Natural disaster	49	46	28.73	25.12
Bombing	45	64	29.20	32.00
Influenza	68	41	27.00	23.17
bird flu	50	43	28.23	23.69
SARS/Covid	63	41	29.68	25.61
Ebola	27	60	25.34	32.21
Smallpox	28	51	23.15	31.88
Chemical incident	48	54	29.30	28.76
Biological incident	30	57	23.45	34.39

Nuclear incident	28	65	25.38	37.15
Dirty bomb	29	66	24.60	35.24
Mass shooting	45	52	30.45	31.38

Table 3. Risk/probability for a scenario to occur and the perceived danger to the HCW, as mean % and standard deviation (St.dev.)

Asked about previous training in disaster-related topics, 56 (54%) reported previous training in disaster management, 48 (47%) in epidemics/pandemics, 44 (43%) in chemical incidents, 22 (21%) in nuclear incidents and 60 (58%) in mass casualty situations.

Discussion

A study of the WTW in HCWs can help to identify demographic patterns and conditions which can have a great influence on the number of staff available in case of MCIs. Even within the limitation of this rather small questionnaire, the results seem to be consistent with previous studies and can support decisionmakers with ideas and priorities. The main findings of the study are a generally positive attitude regarding WTW, but many respondents had conditions. There were important conditions identified outside the hospital, such as e.g. the safety of one's family and inside the hospital as e.g. training and PPE.

The most positive rates for WTW were seen in pandemic scenarios, as shown in Fig. 1. This can be related to the fact that the COVID-19 pandemic from 2020 to 2023 (22) is still in memory, and an influenza epidemic is handled every year (23). Denmark did well during the COVID-19 pandemic, e.g. regarding the rate of excess monthly mortality from 2020 to 2023 in a European comparison (24). Danish HCWs have very limited experience with shootings, only in the greater Copenhagen area do they have some experience (25, 26), but other MCIs are rare in the past (27). Some of the scenarios might be unknown and at best based on theoretical knowledge, which is a further limitation.

The observed differences in WTW regarding education and gender can be connected, with nurses more often living in a partnership and having children at home. The safety of one's family and the provision of PPE seem to be the most important conditions, as shown in Figure 2. The lowest WTW with serious doubts or not willing to work at all was observed for dirty bombs and nuclear incidents. These scenarios are also perceived as unlikely but very dangerous as showed in Figure 3, even though no large numbers of casualties have been seen in the last decades (28).

In this survey, as well as in previous studies with the “fight or flight”-questionnaire from the Netherlands (14) and Saudi Arabia (10), there was not a scenario where all HCWs would attend to work unconditionally. The most recent study from Norway, which included police, fire, and rescue-personnel, and NGO-employees alongside HCWs, also showed similar findings (12). Our rates of WTW unconditionally were similar for most scenarios in comparison to the Netherlands but seem to be lower for dirty bombs and nuclear incidents. The low WTW in nuclear and radiological incidences can be associated with a very low level of training in these scenarios. A fear of the unknown might be a further explanation of this finding.

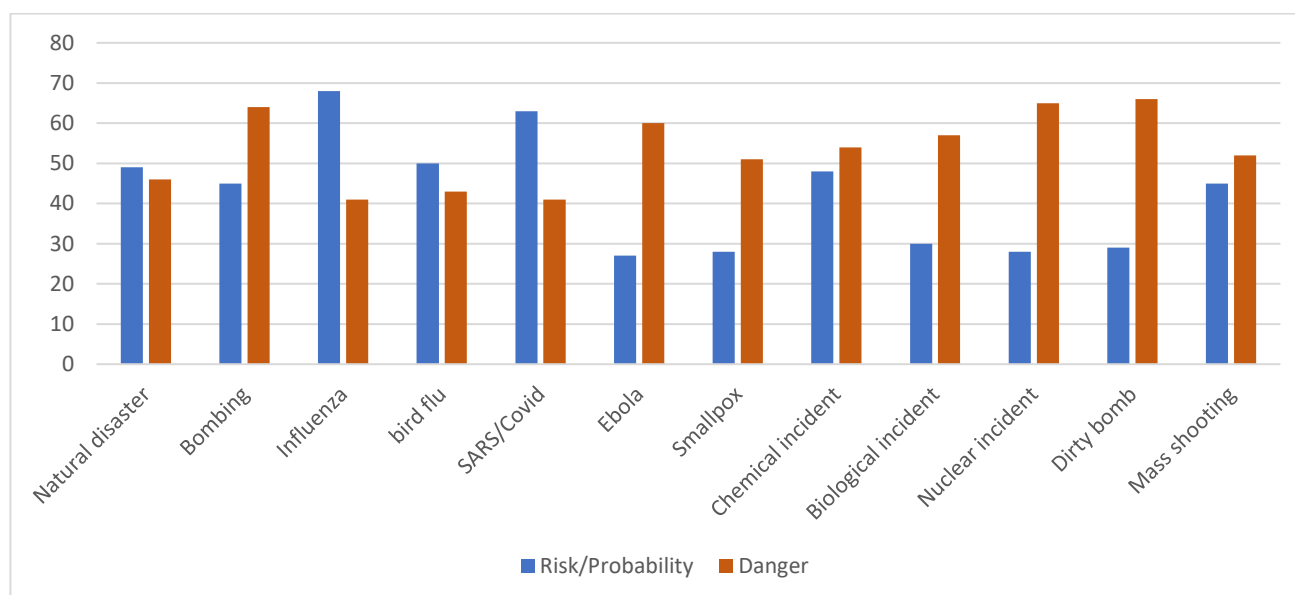


Figure 3. Risk/probability for a scenario to occur and the perceived danger to the HCW, as mean %

In comparison to Saudi Arabia, the Danish cohort seems less willing to work unconditionally in case of natural disasters. There were no natural disasters leading to an MCI in the last couple of years in Denmark, whereas Saudi Arabia has experienced natural disasters (29).

Previous training seems to have a positive correlation with WTW and could support further development of disaster training programs as one of the main interventions to improve WTW, as noted in a literature study from 2021 (29).

A major limitation of this study is the low number of participants and low response rate, which was underpowered regarding the power-calculation and compared to previous studies from the Netherlands and Saudi-Arabia. There can be numerous differences between responders and non-responders, but further analysis could not be performed. Data were only collected from two EDs within the same healthcare region, which makes the study vulnerable to local factors and limits the generalizability, but the EDs are independent from each other and had used different MCI-plans and training protocols

at the time of the study. 12 incomplete questionnaires were excluded from the analysis. Self-reporting bias can mislead descriptive statistics and causal inferences. The translation was not using the standard COSMIN (30), ISPOR (31) or EORTC (32) procedure, which can compromise the validity of the study. More focus on validation of the questionnaire after translation regarding content validity, construct validity and face validity would have improved the study. The questionnaire used did not focus on other relevant factors of WTW, such as religious values, group dynamics or mental toolkits, as identified in other publications (28).

Conclusion

This study suggests a high self-reported WTW in 12 different MCI scenarios. Many responders indicated that they would only come to work, if certain conditions were fulfilled. Based on the results, the following suggestions seem reasonable: A family support system, ensuring the safety of the healthcare workers' family should be integrated into disaster plans. The availability of relevant PPE should be ensured and communicated. Disaster training, also for rare scenarios, seems to be correlated with a higher WTW. Possible scenarios and conditions for work should be revised regularly, as new aspects may emerge.

Conflicts of Interest

The authors declare no conflicts of interest.

Funding

None.

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