Disaster Medicine and Public Health Preparedness

www.cambridge.org/dmp

Knowledge, Attitude and Awareness of Oman Emergency Physicians and Residents Regarding Radiation Emergencies

Suad K. Al-Sulaimani MD[1,2,3], Hassan Al-Balushi MD[1,2,4], Aaisha AL-Balushi MD[5], Sathiya Murthi Panchatcharam Msc[6], Mohamed AL-Shamsi MD[3,5], Ziad Kazzi MD[1,2] and Badria Alhatali MD[7,*]

[1]Emory University, School of Medicine, Department of Emergency Medicine, Division of Medical Toxicology, Atlanta, GA, United States; [2]Georgia Poison Center, Atlanta, GA, United States; [3]Armed forces hospital, Department of Emergency Medicine, Oman; [4]Sohar Hospital, Sohar, Oman; [5]Oman Medical Specialty Board, Muscat, Oman; [6]Research and Studies Department, Oman Medical Specialty Board, Muscat, Oman and [7]Department of Environmental and Occupational Health, Directorate General for Disease Surveillance and Control, Ministry of Health, Oman

Original Research

Cite this article: Al-Sulaimani SK, Al-Balushi H, AL-Balushi A, *et al*. Knowledge, attitude and awareness of Oman emergency physicians and residents regarding radiation emergencies. *Disaster Med Public Health Prep*. **18**(e7), 1–5. doi: https://doi.org/10.1017/dmp.2023.191.

Keywords:
Disaster medicine; acute radiation syndrome; biological warfare

Corresponding author:
Suad K. Al-Sulaimani;
Email: Salsul2@emory.edu.

*The online version of this article has been updated since original publication. A notice detailing the change has also been published.

Abstract

Objective: Radiological emergency preparedness and response are increasingly acknowledged as vital components of both emergency readiness and public health. Previous studies have shown that medical providers feel unprepared to respond to radiation incidents. The existing level of knowledge, attitudes, and awareness held by emergency medicine residents and physicians in Oman, remain unexplored. This study aims to evaluate the knowledge, attitude, and awareness level of emergency residents and physicians in Oman regarding the management of radiation emergencies.

Methods: An electronic survey was distributed to 44 emergency residents and 57 emergency physicians.

Results: The response rate was 62.7% (N = 69/110). Notably, 62% reported no prior engagement in radiation emergency training. The majority of participants had neither employed nor received training in operating radiation detection devices. A significant gap in knowledge emerged, with the median self-reported knowledge score of 50/100. The majority of participants (59%) expressed a need for educational programs and materials.

Conclusion: Our findings underscore the imperative for enhanced training in radiological incident preparedness for emergency medicine residents and physicians in Oman. The study reveals a clear necessity to bridge the existing gaps in knowledge and attitudes to bolster the readiness of health-care professionals to respond effectively to radiation emergencies.

Radiation emergencies have a great impact on the community and surrounding environment.[1,2] Readiness for such disasters may be achieved through knowledge and training on emergency response components.[2] Variability in staff knowledge, training, and education regarding preparedness for disaster emergency incidents has been reported in several studies in the Middle East.

An essential study, a meta-analysis, undertook the crucial task of assessing the readiness of hospitals in the Middle East for disaster situations, this comprehensive study revealed that 68% of the reviewed articles consistently rated the preparedness of these hospitals as generally very poor, poor, or at best moderate. These assessments were made based on a range of factors, including staff proficiency and training in disaster management, command and control structure, and overall disaster management protocols.[2]

The risk of a catastrophic radiological or nuclear incident has increased significantly during the past 2 decades with the increased threat of terrorist groups using radioactive materials in a radiological dispersal device or the threats of nuclear warfare that has been promulgated in the media. The clinical practice of radiation emergency medicine is deficient due to the rare global occurrence of radiation emergencies.[1,2] A study done in the United States reflected a similar fact where among 114 medical toxicologists, only a quarter of the respondents had cared for a patient exposed to ionizing radiation, and 13% had cared for patients contaminated with radioactive material.[3] The results of another significant study conducted in the United States where an electronic survey was sent to 309 emergency medicine residents and physicians at 3 US academic institutions has shown insufficient knowledge and comfort in dealing with radiological emergencies. In this study, only 37% and 28% of respondents had attended radiological preparedness training in the preceding 5 y or any training in radiation detection, respectively. Responders exhibited areas where their knowledge fell short, particularly in the realm of radiological emergencies. These gaps were most noticeable in their understanding of detecting

SDMPH
SOCIETY FOR DISASTER MEDICINE & PUBLIC HEALTH

radiological contamination, handling radiation decontamination (both indications and procedures), and managing patients, which also extended to specific pharmacological aspects.[4]

Efforts to enhance disaster preparedness education and awareness among medical students, emergency medicine residents, and physicians have grown over the past decade. Additionally, the core content for emergency medicine residency training in the Sultanate of Oman does include chemical, biological, and radiological emergency preparedness. Classroom teaching at the workplace and prepackaged educational materials were most frequently rated as the preferred educational method for radiation preparedness training from previous study in the United States.[3]

Despite these efforts, existing evidence from recent research in the United States has shown that medical students do not feel prepared to respond to a public health emergency.[3] This may be due to the lack of such expertise and scope of practice within existing medical subspecialties. A cross-sectional survey done in southwest Saudi Arabia in 2015, showed a lack of sufficient knowledge and comfort dealing with radiation emergencies. Participants were found to have poor knowledge of using PPE, decontamination, diagnosis, and treatment with chelating agents.[5] In this study, training courses, which were provided, improved emergency physicians' knowledge but did not change their attitude toward attending and caring for radiation victims.[5]

However, it has been shown that medical toxicologists in the United State who had a willingness to participate in radiological or nuclear emergencies or who had taken care of patients contaminated with radioactive material were more likely to perform well on the knowledge assessment.[3]

To the best of our knowledge, there is no existing literature available assessing the knowledge and attitude of health care professionals toward radiological emergencies in the Sultanate of Oman. The results of this study will support the role of emergency medicine residents and physicians during a radiation emergency. It also helps fill the gap in their current knowledge of caring for patients with radiation injuries.

Methods

The study consisted of an electronic cross-sectional survey of a convenience sample of emergency medicine residents and board-certified emergency physicians to determine if radiological preparedness training improves self-reported knowledge and attitudes. The survey questions were reviewed and validated by 6 emergency medicine and medical toxicology experts. The validation index ratio and score were calculated for all questions and found to be 0.8. The questionnaire contained 26 questions and comprised questions designed to assess knowledge, attitude, and awareness toward radiation emergencies. Ethical approval from the Oman Medical Specialty Board (OMSB) was obtained before initiation of this study.

The survey was emailed to 110 individuals (44 emergency medicine residents and 57 board-certified emergency physicians), from the period of April 24 to May 29, 2022. The survey was conducted using Google Survey form as the platform. Reminder emails were sent to complete the survey.

In addition to demographic variables, the survey collected data related to the attitude, knowledge, and comfort level of respondents toward radiation emergencies. Additionally, the survey collected data on the preferred educational methods for radiation preparedness training according to the respondents. All responses were anonymous. The results from the knowledge tests were analyzed with descriptive analysis and frequency distribution. Descriptive statistical analysis was used to extract the distributions of each variable. The correlation between the level of comfort and the level of knowledge was assessed. The data were analyzed using IBM SPSS Statistics version 27 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. IBM Corp; Armonk, NY). For the descriptive analysis, categorical variables were presented with frequency and percentages. For the knowledge items, the total score was calculated and presented with median, standard, and interquartile range (IQR) scores. The knowledge score was compared between the trained and untrained physicians. A P value of <0.05 was considered as statistical significance.

Table 1. Descriptive analysis of survey respondents and training on radiation emergencies

Variables	*N*	%
1. Which of the following describes you?		
I am an emergency medicine resident	35	50.7
I am a practicing emergency medicine physician	34	49.3
2. If you are a resident, which year of training are you in?		
1st	13	37.1
2nd	5	14.3
3rd	7	20.0
4th	5	14.3
5th	5	14.3
3. If you are practicing physician, how many years of experience do you have since graduation from your residency program?		
Less than 1 year	4	11.8
1 to 3 years	5	14.7
4 to 5 years	6	17.6
6 to 10 years	5	14.7
Greater than 10 years	14	41.2
4. In the past 5 years, have you attended any training in radiological emergency preparedness or response?		
Yes	26	37.7
No	43	62.3
5. Have you ever used or been trained in using a handheld radiation detector?		
Yes	11	15.9
No	58	84.1

Abbreviation: *N*, number.

Results

The cross-sectional survey was completed by 34 EM residents and 35 EM physicians. The response rate was 62.7% ($N = 69/110$). The survey included a wide spectrum of respondents in terms of their training level (37.1% of residents were in their first year of training out of the total 5 y of residency training) and physician work experience (41.2% greater than 10 y) (Table 1).

Training

With regard to training, 62% ($N = 43/69$) of the responders had not attended any training in radiation emergencies preparedness. Eighty-four percent ($N = 58/69$) had never used, nor attended training on operating radiation detection devices. There was no

https://doi.org/10.1017/dmp.2023.191 Published online by Cambridge University Press

Table 2. Self-reported attitude differences toward radiological emergencies among responders

	N	%
1. In the event of a radiological dispersal device incident (dirty bomb) in your city, how would you rate your likelihood of going to work if requested by your employer?		
Very likely	9	13.0
Likely	17	24.6
Neutral	16	23.2
Unlikely	13	18.8
Very unlikely	14	20.3
2. In the event of a radiological emergency (radiological dispersal device or nuclear weapon detonation), how do you rate your level of comfort in caring for victims in your emergency department?		
Very comfortable	2	2.9
Comfortable	3	4.3
Neutral	15	21.7
Uncomfortable	32	46.4
Very uncomfortable	17	24.6
3. In the event of a radiological emergency (radiological dispersal device or nuclear weapon detonation), how do you rate your level of comfort in performing decontamination of victims in your emergency department?		
Very comfortable	1	1.4
Comfortable	9	13.0
Neutral	22	31.9
Uncomfortable	29	42.0
Very uncomfortable	8	11.6
4. In the event of a radiological emergency (radiological dispersal device or nuclear weapon detonation), how do you rate your level of comfort in surveying your patients for external contamination with radioactive material using a radiation detector in your emergency department?		
Very comfortable	1	1.4
Comfortable	7	10.1
Neutral	19	27.5
Uncomfortable	34	49.3
Very uncomfortable	8	11.6
5. In the event of a radiological emergency (radiological dispersal device or nuclear weapon detonation), how do you rate your level of comfort in diagnosing acute radiation syndrome (ARS) in your emergency department patients?		
Very comfortable	1	1.4
Comfortable	15	21.7
Neutral	22	31.8
Uncomfortable	23	33.3
Very uncomfortable	8	11.5
6. In the event of a radiological emergency (radiological dispersal device or nuclear weapon detonation), how do you rate your level of comfort in diagnosing internal contamination with radioactive materials in your emergency department patients?		
Very comfortable	1	1.4
Comfortable	3	4.3
Neutral	17	24.6
Uncomfortable	41	59.4
Very uncomfortable	7	10.1
7. Response to a radiological incidence is the responsibility of the CDAA (Civil Defense and Ambulance Authority):		
True	50	72.5
False	13	18.8
Other	6	8.7
8. Does the institute you are currently working at have a protocol on emergency department response to radiological emergencies?		
Yes	9	13.0
No	22	31.9
I don't know	38	55.1
9. On a scale from 1 to 5 (1 means strongly not needed and 5 means extremely needed), how do you rate your need for educational materials that will help you in caring for victims injured in a radiological incident?		
1	–	–
2	1	1.4
3	10	14.5
4	17	24.6
5	41	59.4
10. What is your preferred method of education on this subject?		
In person	50	72.5
Workshop	13	18.8
Courses	2	2.9
Lectures	3	4.3
Online webinars	1	1.4
Other		

Abbreviation: *N*, number; SD, standard deviation.

significant difference between junior or senior residents or years of experience between physicians (Table 1).

Attitude

Thirty-seven percent of the participants ($N = 26/69$) responded that they are likely or very likely to go to work if requested in events of a radiation emergency, 65.3% of them were residents ($N = 17/26$). However, 73%, the majority, of those who responded that they are unlikely to go to work if requested in events of radiological emergencies were emergency physicians. The data in Table 2 represent self-reported attitude differences toward radiation emergencies among responders. Most respondents, regardless of previous radiation training, rated their comfort level in caring for patients who present acutely with radiation injuries as uncomfortable (46.4%) ($N = 32/69$) or very uncomfortable (24.6 %; $N = 17/69$). Only 1.4% ($N = 1/69$) of the participants felt very comfortable in performing decontamination. Physicians without training or experience in using radiation detection equipment were more uncomfortable in surveying patients with contamination from radioactive materials using detectors ($N = 26/69$) ($N = 16/69$). The level of comfort was higher in diagnosing acute radiation syndrome ($N = 16/69$) compared with diagnosing internal contamination ($N = 6/29$). There was no statistically significant difference between physicians who received training in the past 5 y, compared with those who did not (P value = 0.6).

Participants were asked about the main responsible agency for responding to radiation incidents. Seventy-two percent of the respondents ($N = 50/69$) knew that the Civil Defense and Ambulance authority (CDAA) is the responsible agency. Thirty-one percent ($N = 22/69$) stated that there are no protocols in their hospital about the response to radiation incidence, while 55% ($N = 38/69$) were uncertain. Participants were asked to rate their need for educational materials in the department to guide their management of radiation incident victims. Fifty-nine percent ($N = 41/69$) believed that they were in extreme need of educational materials, and only 1.4% ($N = 1/69$) believed strongly that they did not need educational material in this field. Subsequently, participants were asked to indicate their preferred method of education in radiological emergencies: 72% ($N = 50/69$) selected courses as a method of training followed by 18.8% ($N = 13/69$) who preferred lectures. Only 4.3% ($N = 3/69$) preferred webinars.

https://doi.org/10.1017/dmp.2023.191 Published online by Cambridge University Press

Table 3. Self-reported knowledge of total respondents

Knowledge score	*N*	Minimum	Maximum	Mean (SD)	Median (IQR)
All participants	69	0	80	46.23 (16.10)	50 (35, 60)
Physician	34	10	80	47.65 (14.37)	50 (40, 60)
Resident	35	0	80	44.86 (17.72)	50 (30, 60)

Abbreviations: IQR, interquartile range; *N*, number; SD, standard deviation.

Table 4. Self-reported knowledge subgroup analysis

Knowledge score		*N*	Mean (SD)	*P*-Value
In the past 5 years, have you attended any training in radiological emergency preparedness or response?	Yes	26	46.92 (18.06)	0.784
	No	43	45.81 (15.0)	
Designation	Physician	35	44.86 (17.72)	0.476
	Resident	34	47.65 (14.37)	
Have you ever used or been trained in using a radiation detector?	Yes	11	52.73 (14.21)	0.146
	No	58	45.0 (16.25)	
Physician experience	≤5 years	15	46.0 (14.54)	0.561
	≥5 years	19	48.95 (14.49)	
Resident level	Junior (R1 & R2)	19	42.11 (17.18)	0.324
	Senior (≥R3)	16	48.13 (18.34)	

Knowledge score	n	Resident n (%)	Physician n (%)	*P*-Value
In the past 5 years, have you attended any training in radiological emergency preparedness or response?				
Yes	26	12 (34.3)	14 (41.2)	0.624
No	43	23 (65.7)	20 (58.8)	

Abbreviations: *N*, number; SD, standard deviation.

Knowledge

Self-reported knowledge was assessed using 10 knowledge questions in basic physics, diagnosis of radiation injuries, and management of radiation emergencies (Table 3). The median score of self-reported knowledge was 50 with interquartile ranges (IQRs) of 35 and 60. There was no difference in the median score between residents and physicians. Table 4 shows a subgroup analysis of the knowledge score. There was no statistically significant difference in the knowledge score between junior or senior residents ($P = 0.32$) or years of experience between physicians ($P = 0.56$). There was no difference as well between those who attended radiation preparedness training and those who did not ($P = 0.14$).

Discussion

Radiation emergencies involve a variety of accidental (eg, nuclear plants) or intentional (eg, nuclear warfare) incidents.[6–8] Awareness about radiological emergencies, as well as preparedness and establishment of management guidelines, are necessary to recruit adequate resources to prevent, respond to, and recover from such incidents. Our study aimed to characterize the existing gaps in preparedness, training, and knowledge of radiation emergencies among emergency physicians and emergency medicine residents in Oman. Self-reported comfort levels of respondents to deal with radiation emergencies were low. However, self-reported comfort levels increased slightly with some form of radiation emergency preparedness training.

A significant disparity in willingness to work during radiation emergencies, with residents showing a more positive inclination, while a substantial majority of experienced emergency physicians express reluctance.

Most of the responders are aware that CDAA (Civil Defense and Ambulance Authority) is the main responsible agency for radiological incidents. However, most of the respondents are unaware if there is an existing protocol for radiation emergencies in their hospitals. Our results show self-reported knowledge gaps among emergency medicine residents and faculty. These knowledge gaps could be due to rare occurrence of such incidents, limited training, and lack of hands-on practice. Specific areas of gaps in knowledge need to be addressed in future studies.

We believe that emergency department staff should have foundational knowledge about radiation emergencies. Respondents believe that they need education in this area. Results of this survey suggest that in-person courses are preferred educational materials over online learning. Annual radiation drills would provide a means for physicians to practice their knowledge in a safe, controlled environment and may be considered in further studies. Furthermore, establishing continuous communication between the emergency department and CDDA may be important to address the issue. Working on protocols on detection, protection, and management of radiation emergencies are important.

Future research can identify which content areas require further training. This can be applied to other medical specialties as well. Assessing the public awareness of radiation emergencies and efforts to increase patients' awareness of the effects and risks may be a topic of future investigation.

The significance of this study lies in its call for improved preparedness among emergency department staff when it comes to handling radiation emergencies. The development of future training programs is necessary.

The proposal of annual radiation drills as a means for physicians to practice their knowledge in a safe and controlled environment is noteworthy. This recommendation suggests a proactive approach to ensuring that medical professionals are adequately equipped to handle radiation emergencies, and it invites further research to assess the effectiveness and feasibility of such drills.

The emphasis on establishing continuous communication between the emergency department and the CDDA (presumably an authoritative body or agency related to radiation emergencies) highlights the importance of collaboration and information sharing in addressing this critical issue. This collaborative approach can help in the development and dissemination of protocols for the detection, protection, and management of radiation emergencies.

Furthermore, the suggestion that future research can identify specific content areas requiring further training and that these

https://doi.org/10.1017/dmp.2023.191 Published online by Cambridge University Press

findings could be applied to other medical specialties underscores the potential broader impact of this study. It highlights the relevance of the findings beyond the emergency department setting.

The idea of assessing public awareness of radiation emergencies and strategies to enhance patient awareness is forward-thinking. This broader perspective acknowledges the importance of not only educating health-care providers but also empowering the public to better understand the risks and effects of radiation emergencies.

However, it is crucial to acknowledge the study's limitations, including the use of convenience sampling, a relatively small and non-random sample, and the reliance on self-reported knowledge. These limitations should guide future research efforts in refining methodology and addressing potential biases.

Conclusions

Our study revealed that most emergency medicine physicians and residents in Oman who responded to our survey have self-reported knowledge gaps. This affects their comfort level in managing radiation emergencies. Training should be implemented in this group of health–care providers to improve their knowledge. Therefore, we suggest designing and delivering radiation preparedness courses incorporated into the resident curriculum and the continuing professional development requirements to meet those needs. Functional exercises should be performed regularly to solidify the knowledge learned from radiation preparedness courses.

Competing interests. The authors declare no conflicts of interest or sources of funding.

References

1. **Nofal A, Alfayyad I, Khan A, *et al.*** Knowledge, attitudes, and practices of emergency department staff towards disaster and emergency preparedness at tertiary health care hospital in central Saudi Arabia. *Saudi Med J.* 2018; 39(11):1123-1129.
2. **Alruwaili A, Islam S, Usher K.** Disaster preparedness in hospitals in the Middle East: an integrative literature review. *Disaster Med Public Health Prep.* 2019;13(4):806-816.
3. **Murray BP, Kim E, Ralston SA, *et al.*** Radiation emergency readiness among US medical toxicologists: a survey. *Disaster Med Public Health Prep.* 2021;15(3):292-297.
4. **Sheikh S, McCormick LC, Pevear J, *et al.*** Radiological preparedness-awareness and attitudes: a cross-sectional survey of emergency medicine residents and physicians at three academic institutions in the United States. *Clin Toxicol (Phila).* 2012;50(1):34-38.
5. **Al Shahrani K.** Self-reported knowledge and attitude of emergency physicians and residents regarding preparedness for radiological emergencies in the Aseer Region, Kingdom of Saudi Arabia. *Saudi J Med Pharm Sci.* 2016;2(4):86-94. https://saudijournals.com/media/articles/SJMPS_2486-94.pdf
6. **Veenema TG, Lavin RP, Bender A, *et al.*** National nurse readiness for radiation emergencies and nuclear events: a systematic review of the literature. *Nurs Outlook.* 2019;67(1):54-88. doi: 10.1016/j.outlook.2018.10.005.
7. **Van Dyke ME, McCormick LC, Bolus NE, *et al.*** Radiological emergency preparedness: a survey of nuclear medicine technologists in the United States. *J Nucl Med Technol.* 2013;41(3):223-230. doi: 10.2967/jnmt.113.124677.
8. **Nelson LS, Baker BA, Osterhoudt KC, *et al.*** The 2012 core content of medical toxicology. *J Med Toxicol.* 2012;8(2):183-191. doi: 10.1007/s13181-012-0223-5.