Original Article

Awareness and preparedness of first responders regarding chemical, biological, radiological, nuclear and explosive (CBRNE) disaster management of a tertiary medical institute in South India: A mixed methods study

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Abstract

Background: In case of a CBRNE catastrophe, junior doctors (first responders) will be the first to respond to the CBRNE disaster, so they should be fully equipped with the knowledge and skills of managing CBRNE casualties and preventing the endangerment of lives. **Objectives:** To assess the awareness and preparedness of first responders in medical institutions regarding CBRNE casualties' management and to explore the perceptions of first responders towards CBRNE disaster management. **Materials and Methods:** The present study was a mixed methods study which was conducted during the months of January to March 2020 among 153 study participants. Focus group discussions (FGDs) were conducted along with free listing and pile sorting till data saturation. Data entry was done in an Excel sheet and data analysis was be done using SPSS software v. 21. **Results:** Out of the 153 participants only 37 participants (24.1%) had ever heard about the term "CBRNE" (chemical, biological, radiological and nuclear disasters) or "hazmat" (hazardous material). At the end of FGDs, participants could answer affirmatively that they had heard the term "decontamination" of CBRNE casualties. Very few participants could ambiguously explain the meaning of the term "decontamination" in the context of CBRNE casualty. **Conclusion:** There is an imperative need for enhancing not only knowledge and awareness, but also proper training for first responders to utilizing simulation sessions. This is particularly important as health care professionals are the first line of defence when it comes to identifying and treating patients that have come into contact with CBRNE hazards.

Keywords: CBRNE, disaster management, first responders

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Background

India, the fifth-largest economy in the world, envisages becoming a USD five trillion economy by 2024.[1,2] India has achieved this economic rise through its global soft power, democratic credentials, and its demographic dividend.[3]

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In the last two decades, India's fast economic rise has been correlated with increasing acts of violence by non-state actors. Violence by non-state or proxy actors usually involves asymmetrical warfare which is highly intense, short-duration events with maximum impact.[4] These acts are usually carried out in economic and commercial areas to subdue economic activity. Though the methods used by these non-state actors to inflict harm to date are conventional, there have been instances in the past where non-conventional CBRNE warfare was used on the susceptible population.[5]

The initials "CBRNE" stands for "chemical, biological, radiological, nuclear, and explosive" and is commonly used worldwide. These types of weapons can cause both mass casualties as well as massive disruption of society, economy, and a nation.[6]

Instances of CBRNE attacks are well documented in the 1995 sarin attack in the Tokyo subway, the 2001 anthrax letters in the US letters where anthrax spores were sent to several news agencies and two US senators, causing the deaths of five people, and recently in 2015, Syria, whereof rebels made low-grade on, used chemical weapons like chlorine and mustard gas against Kurdish fighters on several occasions.[5]

Stray incidents of CBRNE exposure like Mayapuri, Delhi where the Cobalt-60 exposure led to subsequent radiation injuries to handlers is an eye-opener that CBRNE defence is the need of the hour. This includes protective measures taken in situations in which chemical, biological, radiological, or nuclear warfare (including terrorism) hazards may be present. CBRNE defence consists of CBRNE passive protection, contamination avoidance, and CBRNE mitigation.[7] CBRNE defence is based on the following pillars: 1. Avoidance 2. Detection 3. Protection 4. Decontamination and 5. Damage control/consequence management.[6]

In India, the CBRNE defense and training is the responsibility of the National Disaster Management Authority (NDMA) under the Ministry of Home affairs. The training and use of equipment are provided by the Defense Research and Development Organisation (DRDO) to the army, police personnel, and the staff at airports and sea ports.[7] They are trained in the detection of CBRNE emergencies and mitigation measures. Training of emergency medical management of CBRNE casualties is limited only to NDMA personnel, army medical personnel, and medical personnel employed in CBRNE installations.[8]

When disasters strike, primary care physicians and junior doctors are at the front lines of the response in their community. Curriculum guidelines have been developed to aid in preparation of family medicine residents to fulfil this role. Junior doctors as first responders need to be aware and prepared to provide primary care in management of CBRNE disasters.

Objectives

1. To assess the awareness and preparedness of first responders in medical institutions regarding CBRNE casualty management.
2. To explore the perceptions of first responders towards CBRNE disaster management.

Materials and Methods

The present study was a mixed methods study (the quantitative part being the descriptive cross-sectional study and the qualitative being the focus group discussion). The study was conducted during the months of January to March 2020 among 153 study participants (first responders being Compulsory Rotatory Residential Internship [CRRI] and junior doctors) assuming a 95% confidence level and 5% margin of error. They were recruited using a simple random sampling technique from a study population of 253 interns (CRRI) and junior resident doctors presently working in a teaching medical institute. The study participants were interviewed at the location and at the time of their convenience, and after obtaining informed consent, data was collected using a semi-structured questionnaire. Institutional ethics committee clearance was obtained before start of study. The questionnaire included the socio-demographic profile, awareness, and preparedness of the respondent with respect to CBRNE casualty management. The data were entered and coded in Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 21. Continuous data was depicted as mean and standard deviation while categorical data was depicted in percentages. Chi-squared test was used to measure significant differences in categorical variables.

Qualitative methodology

To explore the first responders' awareness and preparedness for chemical, biological, radiological, nuclear, and explosive (CBRNE) disaster management, investigators conducted online focus group discussions (FGDs) in two batches of 10 first responders each through Google meet. Also, free listing and pile sorting were used to collect relevant qualitative data.

The following steps were done for FGD:

- A topic guide was prepared
- The study participants were chosen via convenient sampling method
- The participants were requested to join the scheduled meet at a specific time
- Necessary arrangements were made for uninterrupted online FGD
- Consent was obtained for participation and audio recording of the proceedings
- Facilitators were trained in qualitative methods and were well versed in the regional language
    a. FGDs were conducted with the CRRIs who were the first responders, who were willing to participate.

b. Each FGD lasted for about 45 minutes.
c. Each FGD comprised of a maximum of 10 participants (minimum 8 participants) from the college. The study population comprised of the following groups of people

- CRRIs
  - Adult females: 18–25 years
  - Adult males: 18–25 years
- Data was collected till information was saturated
- Topic guide and interview schedule for the FGD were prepared using the below given flowchart. [Figure 1]

The analysis of FGDs was done through a conventional content analysis approach. Data was analyzed and managed simultaneously by sketching ideas, taking field notes, summarizing field notes, identifying codes, reducing codes into themes in Microsoft Excel, and finally developing categories.

Results

Quantitative

A total number of 153 first responders participated in the study. The mean age of the study participants was 23.3 years. Seventy-six were male (49.6%) and 77 were female (51.4%). One hundred thirty-eight (90.1%) were CRRI and 15 (9.8%) were junior residents. All of the respondents had working in the present hospital for more than six months and 118 participants (77.1%) had finished their casualty posting on the date of data collection [Table 1].

Out of the 153 participants, only 37 (24.1%) had ever heard of the term "CBRNE" or "hazmat" (hazardous material), while all 153 participants were aware of the term "disaster management". Eighteen (11.1%) participants had read about CBRNE in medical books, 10 (6.5%) had heard it in their classes and 9 (5.8%) have heard of it casualty.

All 153 participants replied that they never studied CBRNE warfare, defense, and casualty management as it was not included in their MBBS curriculum. All participants also replied that they had never studied or underwent training about CBRNE casualty management in their internship orientation program.

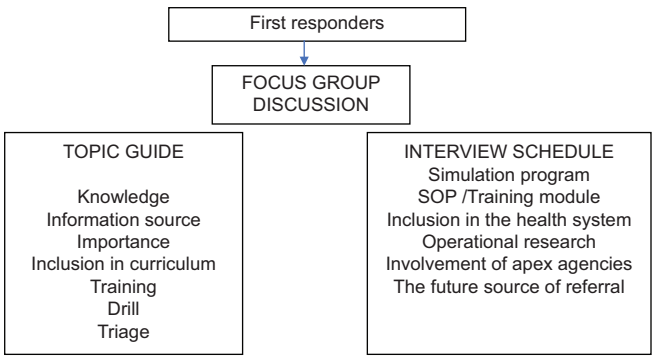

Figure 1: Flowchart showing Topic guide and interview schedule for the FGD

All participants replied with a negative that they underwent any drill in CBRNE casualty management either institutionally or of their interest.

In the present study, 139 participants (90.8%) could correctly explain the meaning of triage in usual casualties of disasters,

Table 1: Sociodemographic data and awareness and preparedness regarding CBRNE disaster management

Variables	*n*=153	%
Gender		
M	76	49.6
F	77	51.4
Present position		
Junior Resident	15	9.9
CRRI (Intern)	138	90.1
Do you know the full form of CBRNE		
Yes	37	24.1
No	116	75.9
Where have you heard about it (*n*=37)		
Medical books	18	48.6
Lectures	10	27.1
Casualty	9	24.3
Were you ever taught CBRNE casualty management in your curriculum		
Yes	0	0
No	153	100
Were you ever taught CBRNE casualty management in your curriculum internship training program?		
Yes	0	0
No	153	100
Did you ever undergo a training program about CBRNE casualty Management in an Internship?		
Yes	0	0
No	153	100
Did you ever undergo drill training CBRNE casualty Management during your internship in the institution or of your interest?		
Yes	0	0
No	153	100
How do you triage in a usual disaster?		
Can tell the procedure	139	90.8
Not able to tell the procedure	14	9.2
Do you know the procedure of triage of CBRNE casualties?		
Yes	2	1.3
No	151	98.7
As a first responder, do you know the meaning of the term "decontamination in CBRNE casualties?		
Yes	2	1.3
No	151	98.7
Could you tell the sequence of steps in decontamination of CBRNE casualties?		
Could tell correctly	0	0
Couldn't tell correctly	153	100
As a First responder, how will you protect yourself from CBRNE exposures during casualty management?		
CBRNE suit	14	9.1
Don't know	139	90.9

but only 2 participants (1.3%) could explain triage in CBRNE disasters.

In the present study, only two (1.3%) participants could answer affirmatively that they have heard the term decontamination of CBRNE casualties. Only two (1.3%) participants could ambiguously explain what the meaning of the term decontamination in the context of CBRNE casualty is. However, none of the participants could explain the steps in decontamination of a CBRNE casualty.

Only 14 (9.1%) participants knew that a CBRNE suit is essential for protection during CBRNE casualty management. All 153 participants agreed that CBRNE disaster casualty management should be included in the teaching curriculum, and hands-on training with a drill should be included in the internship orientation program [Table 1]. Comparison was also made for awareness on usual disasters and CBRNE disasters [Table 2].

We conducted focus group discussions with 12 interns. About five themes were derived from the content analysis of the interviews [Tables 3–5].

Table 2: Comparison of awareness regarding usual disaster and CBRNE disaster

Variables	Yes	No	Total	*P*
Aware of "CBRNE Disaster"	37	116	153	<0.00001
Aware of the term "Disaster Management"	140	13	153	
Awareness about CBRNE triage management	2	151	153	<0.00001
Awareness about usual disaster Triage	139	14	153	

Table 3: Awareness and preparedness of first responders about CBRNE disaster Management

Qualitative results-Clustering of perceived knowledge about CBRNE

Participant	About CBRNE	Group
1	Knowledge	Awareness
4	Information source	
7	Importance	
11	Inclusion in Curriculum	
5	Training	Preparedness
2	Drill	
19	Triage	
10	Simulation program	
3	Sop/training module	Future needs and research
6	Inclusion in the health system	
13	Operational research	
8	Involvement of apex agencies	

CBRNE: Chemical, Biological, Radiological, Nuclear and Explosive

Discussion

Most of the participants in the study (first responders) replied that they had never studied or underwent training about CBRNE casualty management in their internship orientation program. All participants replied negatively that they underwent any drill in CBRNE casualty management either institutionally or of their interest. Our results are similar to the one conducted among the house surgeons where majority had poor knowledge on management of mass disaster of all types.[9] This is also in accordance with the statement published in the journal disaster medicine and public health preparedness in the year 2020 which states that as most public health and medical response personnel have never encountered these types of problems and CBRNE casualty management, participating in exercises will help to provide additional knowledge and skills and make clear whether and when more training is needed.[10] In our focus group discussions, the majority of the first responders felt that simulation programs for CBRNE management should be included as part of CRRI training and that first responders protection should be taught in detail. This is comparable to the statement that CBRNE training in India lacks these unique simulation facilities for improving the experiential learning process of course participants. This applies especially to the aspects pertaining to the medical management of CBRNE casualties.[7]

To ensure that the awareness levels are more broad-based, it was recommended that CBRNE defence be introduced as a topic in schools and colleges as part of the disaster management curriculum.[11] This is similar to our present research where first responders emphasize the importance of including CBRNE training as one of the competencies in the medical curriculum. In the current study, only 2 (1.3%) participants could ambiguously explain the meaning of the term "decontamination" within the context of CBRNE casualty. None of the participants could explain the steps in decontamination of a CBRNE casualty. This is in contrast to the study findings in the United States whereas, higher proportions of trained physicians were more comfortable in assessing, decontaminating, and managing victims of CBRNE incidents.[12]

A systematic literature review[13] of CBRNE events included evacuation, triage, and decontamination of vulnerable people, emphasizing the importance of extensive research on CBRNE which is similar to our study findings where first responders stated that they don't have much idea about the operational research and the involvement of apex agencies.

Conclusion

From the mixed methods analysis, it is concluded that the majority of the first responders lack awareness and are not prepared enough for CBRNE management. There is an imperative need for enhancing not only knowledge and awareness but also for proper training utilizing simulation sessions. This is particularly important as primary care physicians and junior doctors are the first line of defence when it comes to providing primary care to patients who have come into contact with CBRNE hazards.

Training primary care junior physicians allows for more inclusive differential diagnosis while encountering potential CBRNE cases. These personnel make significant decisions in emergency

Table 4: Response for each domain

Awareness and preparedness on CBRNE	Domains	Response
Knowledge	Source	Internet
	Exposure	Not completely
	Current updates	No idea
Importance	In current scenario	Will be useful
	To know about the management	It will be fruitful as it's a biological warfare Casualty management is essential
Inclusion in Curriculum	As an added competency	Definitely will be useful
	Clinical exposure along with management of casualty	Practical more than theory will be beneficial
Training	Drill	Mock drill for hands-on training
	Triage	Heard in general but no awareness specific to CBRNE
	Simulation program	Must be included as part of CRRI training First responders protection should be taught in detail
Future needs	Demands	Training sessions/workshops
	About decontamination procedures	Trained faculties SOP/Training module
	Expectations	Want to know the exact steps More in detail about the CBRNE suit Should be included in the health system
Research	Readiness to conduct	It will be useful, but no idea
	Operational research	Need proper guidance
Collaboration	Apex agencies	Need to be involved for proper guidance For future source of referral

Table 5: Main themes and categories discussed in FGD

Themes	Findings from FGD	Verbatim
Knowledge about CBRNE	No basic knowledge and awareness regarding CBRNE	"…Just heard about it somewhere from internet source….but no in-depth idea" (First responder 1)
Perceived importance	A majority of the responders felt it is most relevant in the current scenario	"I feel it will be fruitful to know as biological warfare is a real threat" (First responder 7)
Inclusion in curriculum	Agreed that it has to be included as one of the competencies	"… Can be added given the fact that practical aspect is given more weightage than theory…" (First responder 11) "Yes definitely I feel that it has to be included" (First responder 16)
Training	A simulation program along with mock drill training will be beneficial	"I have heard about triage but not specific to CBRNE…training specific to handling casualty and triage concerning CBRNE disaster will be useful I guess" (First responder 10)
Future needs	Workshop to cover CBRNE management along with steps of decontamination is needed	"Hmm…This specific disaster management should be incorporated within health system…"(First responder 3) "Trained faculties with a specific training module can be useful" (First responder 6)
Research and collaboration	Not much idea about the operational research and the involvement of apex agencies	"For proper guidance and referral…we need collaboration with apex agencies of CBRNE disaster management"(First responder 8)

CBRNE: Chemical, Biological, Radiological, Nuclear and Explosive; FGD: Focus group discussion

conditions because they act as an important part of the health care force.[14] CBRNE training exposes the first responders to the morbid reality of chemical and biological warfare agents, along with their horrifying effects on people all around the world. With proper training in CBRNE, they not only become leaders in public health but also have expertise in crisis management. Exposure to programs like IGNOU-Post Graduate Certificate in Medical Management of CBRNE disasters (Six-month PG Certificate program available through both open and distance learning for MBBS doctors) help them provide necessary primary care. The course is being provided in collaboration with the Institute of Nuclear Medicine and Allied Sciences (INMAS), Defence Research and Development Organisation (DRDO) and active support from Integrated Defence Staff (IDS) may help in the future.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Key points and take-home message: Since a majority of the first responders lack awareness and are not prepared enough for CBRNE management, there is an imperative need for enhancing not only knowledge and awareness but also proper training, utilizing, simulation sessions for these primary care providers.

Novelty: Importance of the training for primary care physicians as first responders in the detection of CBRNE emergencies and mitigation measures has been highlighted. This has not been explored in detail in India in the past.

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Conflicts of interest

There are no conflicts of interest.

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