International Journal of Medical Research Professionals
P-ISSN: 2454-6356; E-ISSN: 2454-6364
DOI: 10.21276/ijmrp

IJMRP

Original Research Article.

Evaluation of Jeddah Governmental Health Institutes in Health Preparedness to Chemical and Biological Weapons Of Mass Destruction

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ABSTRACT

Introduction: Terrorism has become recognized widely as a significant threat to the safety and public as a result of the rise of technical capabilities, the rapid expansion of the global biotechnology industry, and the growth of freely sophisticated networks of large-scale terrorist groups that have expressed interest in terrorism. Hence, present study aimed to optimize the application of health services by improving the level of preparedness of health institutes towards chemical and biological weapons of mass destruction, emphasize this concept, and hence the need to research on it.

Materials and Methods: The present cross-sectional analytic study was conducted in 6 general governmental hospitals of the ministry of health in Jeddah among 484 staff; out of them (192) were first respondents and (292) were healthcare providers. The aspects analyzed were communications; access to care; continuity of the plan; capacity; availability of pharmaceutical procedures and supplies; medical and mortuary care procedures; education/training; security; psychiatric services; laboratory diagnostic capability; and surveillance with questions under each category. Collected data was analyzed using SPSS version 22 and Fisher's Exact test, Pearson's Chi-square test, and t-test were used for statistical analysis with significance level considered at p less than 0.05.

Results: In the present study, first respondents and healthcare providers differed regarding their knowledge about their general role in an emergency/disaster plan. Only (29.7%) of first respondents and (18.2%) of the healthcare providers were trained on wearing chemical cartridge air purifying respirators, despite the fact that (72.9%) and (61.3%) of them respectively, report their willingness to continue caring for patients in the event of an outbreak of a potentially deadly illness (which could be triggered by a terrorist attack). No facility has a surveillance system to detect early signs of biological and chemical terrorism (0%).

Conclusion: This study demonstrated that there are notable areas for improvement in most aspects of facilitates preparedness status, in particular: planning for WMD, giving HVA more space in planning and reviewing pharmaceutical equipment capacity and also, increasing the multi-hospital drills with more education on specific protocols for dealing with biological and chemical agents is mandatory.

Keywords: Emergency Care; Healthcare; Hospital; Mass Disasters; Preparedness.

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Article History:

Received: 15-10-2017, **Revised:** 04-11-2017, **Accepted:** 22-11-2017

Access this article online	
Website: www.ijmrp.com	Quick Response code
DOI: 10.21276/ijmrp.2017.3.6.030	

INTRODUCTION

Hospitals are the community settings of care for emergencies and disasters. Whether these crises affect an individual (cardiac or trauma), a group (vehicular accidents), or the whole community (natural or man - made disasters), hospitals provide both emergency care and treatment to individuals in collaboration with Red Cross and Civil Defense who contributed to be the first respondents in crises threatens national health security. Furthermore, all hospitals traditionally develop "disaster plans"

that contains protocols and procedures to be implemented when unexpected demands are take placed on the facility. There are internal strategies of disaster dealing with any threats occur inside the institution, i.e., loss of electric power, failure of central oxygen systems—and external plans of disaster which provide the strategy to be used when any events such as fires, chemical releases, or any natural disasters that lead to significant patient surges.[1]

Terrorism has become recognized widely as a significant threat to the safety and public as a result of the rise of technical capabilities, the rapid expansion of the global biotechnology industry, and the growth of freely sophisticated networks of large-scale terrorist groups that have expressed interest in terrorism. When WMD occurs, hospital key persons such as the department of an emergency director, director of nursing, and hospital engineers would be called on to emphasize community medical responses.[2] It is so-called the hospital emergency department of practice (HEMCOP) in the United States.[3] However, even in Euro-American countries, national WMD readiness and preparedness training have usually concentrated on the traditional first-responder communities, such emergency medical services (EMS), military, and law enforcement, fire, and personnel.[4] Thus, healthcare providers and first responders will need to be aware of potential agents of bioterrorism and chemical incidents, know how to rule out agents of bioterrorism and chemical incidents, know how to discover and diagnose agents of bioterrorism and chemical incidents, and have knowledge of treatment choices available for the agent used. Hence, present study aimed to optimize the application of health services by improving the level of preparedness of health institutes towards chemical and biological weapons of mass destruction, emphasize this concept, and hence the need to research on it.

MATERIAL AND METHODS

The present cross-sectional analytic study was conducted in 6 general governmental hospitals of the ministry of health in Jeddah from January 2017 to August 2017. A total of (484) staff participated in the study; out of them (192) are first respondents and (292) are healthcare providers. The study populations included healthcare providers (physicians and nurses of emergency departments) and healthcare administrations of 6 general hospitals; first respondents (firefighters in 5 units, and paramedics in 21 units distributed around Jeddah) and First respondent' administrations (Saudi Civil Defense and Saudi Red Crescent Authority). Healthcare provider and first respondent with less than six months on the job or in the facility were excluded to avoid bias could happen in case of the lake of information or experience and institutes not in the first line response to disaster emergency. The aspects analyzed were communications; access to care; continuity of the plan; capacity; availability of pharmaceutical procedures and supplies; medical and mortuary care procedures; education/training; security**;** psychiatric services; laboratory diagnostic capability; and surveillance with questions under each category.

Sample size was calculated using Epi info program version 7.2. Reviewing the literature[5,6] revealed that the average prevalence used was 50% to get the maximal sample size, 95% confidence interval, the power 80% and the margin of error of 5%.

A chemical and bioterrorism preparedness checklist was developed by a committee to consider the issues and how a facility might prepare itself for a biological, or chemical event. The checklist provided to hospitals to help them explain and evaluate their present state of preparedness for chemical and biological incidents. [7]

The questionnaire consisted of a number of questions described and assessed their state of preparedness in chemical and biological incidents. Questionnaire was translated to Arabic with simple language to be easy for answering, avoiding difficult and complicated medical terms, then reviewed and accepted by experts in the field of study. The construct validity was assured as the instruments was adapted from of AHA checklist and usage of this checklist by different researchers found through literature review to measure the preparedness for CBWMD in several countries.[8] For content validity, the instruments were translated by English expert into the Arabic language, then translated back to the English.

The study was pilot-tested who were selected from the same population but not included in the main study with the purpose of testing the feasibility of the study. The questionnaire with a covering letter were delivered to the health institutes in Jeddah city manually, specifically to the directors of the departments to be distributed among staff and filled by them according to the required sample size, all with the timeframe of one month. Follow-up was made with them to collect the questionnaires from the directors manually within one month.

The study was approved by the Saudi Board Community Medicine Residency Program Scientific Committee to conduct the research. Verbal consent was taken from each participant.

Acknowledgments were sent to participants, authorities, and supervisors with the promise of feedback information and recommendations to enhance improvement. Collected data was coded and filled in excel data sheets and then converted to Statistical Package for Social Sciences (SPSS) version 22 for statistical analysis using code (0= No, 1= Yes) were both descriptive statistics (frequencies, means, and standard deviations) and inference statistics (Fisher's Exact test, Pearson's Chi-square test, and t-test) were described. Testing for normality done using Kolmogorov-Smirnoff test. This study used an alpha level of statistical significance of less than 0.05 and the main results of this research presented using graphs and tables. Quality control was carried out at the stages of coding and data entry.

RESULTS

A total of (484) staff participated in the study; out of them (192) are first respondents and (292) are healthcare providers. All of the first respondents are male. (96.4%) of the first respondents are Saudi by the nationality, which is more than healthcare providers who are Saudi (50%).

The result of the Chi-square test showed a significant difference (P= 0.039) between first respondents (67%) which knows about the meaning of WMD more than the healthcare providers (58%) with the difference of (9.3%) (table 1).

The table 2 shows that only (26.3%) of total healthcare providers are prepared to chemical and biological weapons of mass destruction, which is slightly higher than the first respondents (20.1%).

Table 1: Understanding biological and chemical mass distraction weapons meaning among staffs.

Parameters		Respondents (n=192)		Care providers (n=292)		
		n	%	n	%	P-value
Do you know what does biological and chemical mass distraction weapons mean?	Yes	129	67.2%	169	57.9%	
	No	63	32.8%	123	42.1%	0.039

Table 2: The percentage of positive answer that addressing the preparedness status to chemical and biological weapons of mass destruction among the first respondents and healthcare providers.

Parameters	Respondents (n=192)	Care providers (n=292)
General information	66.1%	53.4%
Communications and public affairs	41.7%	43.3%
Access to care	30.3%	36.2%
Pharmaceutical and equipment	20.3%	45.2%
Medical care procedures	39.5%	29.7%
Training and personal	21.7%	29.7%
Psychiatric services and crisis counseling	3.5%	21.1%
Laboratory diagnostic capabilities	11.8%	18.4%
Surveillance	12.5%	13.1%
Total positive responses	20.1%	26.3%

Table 3: General planning information aspect difference between the first respondents and healthcare providers (n = 484)

Parameters		Respondents (n=192)		Care providers (n=292)		P-value
		n	%	n	%	
1. Facility emergency/disaster plan includes a section of biological and chemical terrorism preparedness/response	Yes	67	34.9%	100	34.2%	<0.001
	No	79	41.1%	190	65.1%	
	Don't know	46	24.0%	2	0.7%	
2. In case of available plan, do you know your rule in it	Yes	60	31.3%	56	19.2%	<0.001
	No	132	68.7%	236	80.8%	
General planning information, in total	Yes	127	66.1%	156	53.4%	<0.001

The low percentage of first respondents (4%) can handle psychiatric services and crisis counseling. Only (13%) of both the first respondents and healthcare providers showed positive response toward surveillance as the awareness of facing WMD.

Comparatively higher percentages of both first respondents and healthcare providers which have positive sights were in general information, communications, and public affairs as preparedness for the chemical and biological terrorism.

First respondents showed more positive responses (66.1%) toward overall general information than the healthcare providers, but (24%) of first respondents do not know that whether their facility emergency/disaster plan includes a section of bioterrorism/ chemical incidents preparedness or not. Also, out of the healthcare providers who know about the section in their facility emergency/disaster plan, (80.8%) of them are not aware of their rule in it (table 3). There is a statistically significant difference between the first respondent and healthcare providers regarding the access to care aspect preparedness (p=0.027) (table 4). There are more trained first respondents to meet the requirements for the health needs of children (52.6%) and homeless population (45.8%). Whereas, there are more trained healthcare providers to meet the requirements for the health needs of chronically ill who requires access to critical services (36.6%), and, physically and mentally disabled persons (29.5%). A higher percentage of healthcare providers are trained to manage patients (49.7%), transport patients, staff, and equipment to and from the alternative site(s) (52.7%), and, also to establish inter-facility communication between the base and the alternative sites than the first respondents (41.1%).There is a statistically significant difference between the first respondents and healthcare providers regarding the pharmaceutical and equipment aspect of preparedness (P<0.001). Healthcare providers have easier access from hospital inventory such as antidotes and therapies (35.6%), and, drug administration equipment (50.7%) than the first respondents (table 5). There is a statistically significant difference between the first respondents and healthcare providers regarding the medical care procedures aspect of preparedness (P<0.001) (table 6). First respondents are more willing to continue caring for patients in the event of an outbreak of an unknown but potentially deadly illness (72.9%). However, there are more healthcare providers with training on wearing HEPA masks (32.2%) than the first respondents (9.9%).

Table 4: Access to care aspect difference between the first respondents and healthcare providers (n = 484)

Parameters		Respondents (n=192)		Care providers (n=292)		P-value
		n	%	n	%	
A. Training on resource specifically designed to reduce barriers and meet the requirements for the following:						
1. Children	Yes	101	52.6%	107	36.6%	<0.001
	No	91	47.4%	185	63.4%	
2. Elderly	Yes	85	44.3%	129	44.2%	0.984
	No	107	55.7%	163	55.8%	
3. Homeless	Yes	88	45.8%	65	22.3%	<0.001
	No	104	54.2%	227	77.7%	
4. Remote	Yes	30	15.6%	65	22.3%	0.072
	No	162	84.4%	227	77.7%	
5. Chronically ill who need access to critical services	Yes	28	14.6%	107	36.6%	<0.001
	No	164	85.4%	185	63.4%	
6. Those who encounter language barriers	Yes	57	29.7%	80	27.4%	0.584
	No	135	70.3%	212	72.6%	
7. Physically and mentally disabled	Yes	23	12.0%	86	29.5%	<0.001
	No	169	88.0%	206	70.5%	
B. Training on manage patient to and from the alternative sites	Yes	74	38.5%	145	49.7%	0.016
	No	118	61.5%	147	50.3%	
C. Training on transport patients, staff, and equipment to and from the sites	Yes	40	20.8%	154	52.7%	<0.001
	No	152	79.2%	138	47.3%	
D. Training to establish inter-facility communication between the base and the alternative sites	Yes	55	28.6%	120	41.1%	0.005
	No	137	71.4%	172	58.9%	
Access to care, in total	Yes	581	30.3%	1058	36.2%	0.027

Table 5: Pharmaceutical and equipment aspect difference between the first respondents and healthcare providers (n = 484)

Parameters		Respondents (n=192)		Care providers (n=292)		p-value
		n	%	n	%	
1. Easy access from hospital inventory:						
a. Antidotes and therapies for patients that are exposed to biological or chemical agents	Yes	52	27.1%	104	35.6%	0.049
	No	140	72.9%	188	64.4%	
b. Drug administration equipment	Yes	26	13.5%	148	50.7%	<0.001
	No	166	86.5%	144	49.3%	
Pharmaceutical and equipment, in total	Yes	78	20.3%	252	45.2%	<0.001

Table 2: Medical care procedures aspect difference between the first respondents and healthcare providers (n = 484)

		Respondents (n=192)		Care providers (n=292)		P-value
		n	%	n	%	
1. Willing to continue caring for patients in the event of an outbreak of an unknown but potentially deadly illness	Yes	140	72.9%	179	61.3%	0.008
	No	52	27.1%	113	38.7%	
2. Trained on wearing	Yes	146	76.0%	86	29.5%	<0.001
a. Self-contained breathing apparatus	No	46	24.0%	206	70.5%	
b. Supplied air respirators	Yes	52	27.1%	91	31.2%	0.336
	No	140	72.9%	201	68.8%	
c. Chemical cartridge air purifying respirators	Yes	57	29.7%	53	18.2%	0.003
	No	135	70.3%	239	81.8%	
d. HEPA masks	Yes	19	9.9%	94	32.2%	<0.001
	No	173	90.1%	198	67.8%	
3. Decontamination methods could be used for any case arrive at your facility	Yes	65	33.9%	54	18.5%	<0.001
	No	127	66.1%	238	81.5%	
4. Training procedures and updates assigned to decontamination rooms	Yes	52	27.1%	50	17.1%	0.009
	No	140	72.9%	242	82.9%	
Medical care procedures, in total	Yes	531	39.5%	607	29.7%	<0.001

Table 7: Laboratory diagnostic capabilities aspect difference between the first respondents and healthcare providers (n = 484)

Parameters		Respondents (n=192)		Care providers (n=292)		p-value
		n	%	n	%	
1. Procedures/protocols in place for:	Yes	20	10.4%	55	18.8%	0.012
a. Receiving of suspected laboratory specimens that it is contaminated with biological or chemical agents	No	172	89.6%	237	81.2%	
b. Handling of suspected laboratory specimens that it is contaminated with biological or chemical agents	Yes	22	11.5%	48	16.4%	0.128
	No	170	88.5%	244	83.6%	
c. Transportation of suspected laboratory specimens that it is contaminated with biological or chemical agents	Yes	25	13.0%	48	16.4%	0.304
	No	167	87.0%	244	83.6%	
2. Contact number of Poison Control and Forensic Medical Chemistry Center	Yes	24	12.5%	64	21.9%	0.009
	No	168	87.5%	228	78.1%	
Laboratory diagnostic capabilities, in total	Yes	91	11.8%	215	18.4%	0.020

Table 8: Surveillance aspect difference between the first respondents and healthcare providers staff (n = 484)

Parameters		Respondents (n=192)		Care providers (n=292)		
		n	%	n	%	P-value
1. Implementing surveillance system to detect early signs of biological and chemical terrorism	Yes	5	2.6%	41	14.0%	<0.001
	No	187	97.4%	251	86.0%	
2. Having a list of all potential biological and chemical agents	Yes	42	21.9%	41	14.0%	0.025
	No	150	78.1%	251	86.0%	
3. Having management information manual of all potential biological and chemical agents could be used in terrorism	Yes	25	13.0%	33	11.3%	0.569
	No	167	87.0%	259	88.7%	
Surveillance, in total	Yes	72	12.5%	115	13.1%	0.801

The differences between the two types of staff are statistically significant for all the sub-aspects of laboratory diagnostic capabilities in total (P=0.020) (table 7). More specifically, (18.8%) of the healthcare providers know the procedures/protocols in place for taking of suspected laboratory specimens that may be contaminated with biological or chemical agents, whereas, the figure is (10.4%) in the case of first respondents. Healthcare providers know the contact number of Poison Control and Forensic Medical Chemistry Center (21.9%) more than the first respondents (12.5%). The difference between the two types of staffs is not statistically significant when considering the overall surveillance aspect (P=0.801) (table 8). However, there are statistically significant differences between them based on having a list of all potential biological/chemical agents (P=0.025). (14 %) of healthcare providers implement surveillance system in their hospital to detect early signs of biological and chemical terrorism, whereas, this percentage is (2.6%) in the case of first respondents.

DISCUSSION

This cross-sectional study was conducted to assess the real situation of preparedness of healthcare institutes, Saudi Red Crescent and Saudi Civil Defense in Jeddah regarding chemical and biological weapons of mass destruction and assessing the risk assessment for preparedness for capability and capacity to chemical and biological weapons of mass destruction among them in Jeddah, Saudi Arabia. The major findings of this study demonstrated that preparedness for terrorism utilizing chemical and biologic weapons of mass destruction need incredible improvement in Jeddah governmental health institutions which may represent a significant risk to the health of both residents and visitors to Jeddah and should be assessed furthermore.

In the present study, first respondents and healthcare providers differed regarding their knowledge about their general role in an emergency/disaster plan. While (31.3%) of the first respondents had this knowledge, only (19.2%) of the healthcare providers had it. This finding suggests that healthcare facilities are less likely to inform the staff about their role in a disaster such as a terrorist attack, something which may reflect the overall lower degree of training that healthcare providers receive to respond to emergencies appropriately.

Only first respondents' facilities (100%) provided a manual available on an electronic website for the public while both facilities do not have an electronic application for smartphones and smart devices to send notification and provide manual in case of terrorism. Such application important to communicate with public, keep them update, which will be reflected in decrease numbers of victims. This result admitting limitation as compared to a systematic review of the Apple iTunes store in California that gives plenty of application with powerful information.[9]

None of the administration (0%) assessed its pharmaceutical inventory within the past year in case of mass numbers of victims

exposed to biological or chemical agents to determine where it could support antidotes and therapies and only one healthcare administration identify external pharmacy and only (35.6%) of healthcare providers think that is easy to reach antidotes and therapies. The survey demonstrates a lack of pharmacy preparedness. This goes with the results from a survey through hospitals' pharmacies in New Jersey which shows that most of the facilities (55.5%) were unsure whether their hospitals had an adequate supply to manage WMD effects.[10]

Regarding medical and mortuary care procedures aspect of preparedness, the economic difficulties that facilities might experience could explain the differences in their level of preparedness. For instance, only (29.7%) of first respondents and (18.2%) of the healthcare providers were trained on wearing chemical cartridge air purifying respirators, despite the fact that (72.9%) and (61.3%) of them respectively, report their willingness to continue caring for patients in the event of an outbreak of a potentially deadly illness (which could be triggered by a terrorist attack). Whether this likelihood is explained by differences in human resources, financial resources or administrative approaches, it is important to reduce these differences if there is a strong commitment to preparing healthcare providers to respond to a terrorist attack as best as possible.

These findings are highlighting significant results vary from the ones obtained in a survey conducted in Australia, where it was found that while many departments had a disaster plan and (43%) reported that their plan involved training staff on how to decontaminate patients, but the availability of personal protective equipment and decontamination facilities varied widely.[11] Also, in a study in the USA using a questionnaire to 224 hospital emergency departments, which gives half (45%) had an indoor or outdoor decontamination room with isolated ventilation, shower, and water containment pathway, but only (12%) had one or more self-contained breathing apparatuses or supplied air-line respirators.[12]

There is no significant difference between both administrations regarding the psychiatric service and crisis counseling aspect as there is only one single healthcare administration have a plan for the handle and support the emotional and mental health impacts of a terrorist event for staff (16.7%). While handling the physical effects of a terrorist act is arguably more important than handling the mental effects, the fact healthcare facilities seem to give such a low degree of importance to mental necessities of the staff, patients, and their families after a terrorist attack is unsatisfactory, especially if one considers the potential economic and social impact of long-term psychological problems.

Psychosocial aspects of outbreak preparedness, such as 'childcare for employees' and 'mental support for employees" these aspects are deeply important to ensure employees work attendance and commitment to maintained efforts, while maybe finding themselves at risk of getting and transmitting the disease to their family and friends as found in another study.[13] Realistic bioterrorism plans should combine strategies to support nurses and address their physical, psychologic, and emotional issues. This aspect was not taken seriously because of the policy-makers who favor focusing on the organizational and medical aspects of preparedness, instead of the requirements that facilitate healthcare professionals to need to attend work.

A significant difference between the first respondent's facilities and healthcare facilities regarding laboratory diagnostic capabilities was also found. The data provided by the first respondents is quite concerning. For instance, only (11.5%) of first respondents reported knowing how to handle suspected laboratory specimens that are contained within the biological or chemical agent. The results for the healthcare providers were not much better, as (16.4%) of them reported having this knowledge. In the eventuality of a terrorist attack with chemical and biological weapons, hospitals that are unable to handle suspect laboratory specimens effectively, cannot provide a proper response and put the entire health system in danger. This finding implies that not all departments offer diagnostic services at the same quality, which may influence their capability of assisting authorities in emergency situations such as terrorist attacks. Detecting the units that are less prepared would allow providing proper investments in training or if investments are not possible-proper plans that could compensate in a way or another for the deficit in diagnostic capabilities. This finding not different from a study that revealed that a majority (91.9%) of hospitals in the State of Mississippi lack appropriate laboratory diagnostic services capable of analyzing and identifying WMD.[14]

No facility has a surveillance system to detect early signs of biological and chemical terrorism (0%). This is inconsistent with the results of a cross-sectional study in China which revel (55.5%) of their hospitals developed surveillance systems.[15]

Another significant difference between the first respondents and healthcare providers is in their surveillance capacities. For instance, only (2.6%) of first respondents reported the presence of a surveillance system in their facilities while (14%) of healthcare providers responded the same. These results are disappointing, as an effective surveillance system may be used to respond to potential terrorist threats rapidly. Hospitals, clinics, first respondents' offices, and laboratories are typically the first source of initial surveillance data during a disaster. When there are solid, functioning healthcare infrastructure existing systems will provide the most reliable and timely data.

Unfortunately, the risk of terrorist attacks has significantly grown in the last two decades, for which it does not seem justified that most hospitals in Saudi Arabia need more effort for preparedness to face a terrorist attack, even more so when considering that it is considered a country at risk for such type of attacks.

With the current circumstances of the world, and all of these problems and wars, also due to the sensitive situation of Kingdom of Saudi Arabia at various levels, as well as, Jeddah is the second major city after Riyadh; it is the main port of the Red Sea through which most of the pilgrims arrive by air and sea to perform Haj, Umrah, and to visit the two holy mosques, the researcher wants to pay attention to the country needs of establishing and conducting a strong plan for being ready to counter biological and chemical warfare and saving lives as there is a defect in many sections within our first line defenses.[16]

However, lack of sufficient data and since this area has not been adequately investigated in Jeddah. Thus, further study is urgently needed**.**

CONCLUSION

This study demonstrated that there are notable areas for improvement in most aspects of facilitates preparedness status, in particular: planning for WMD, giving HVA more space in planning and reviewing pharmaceutical equipment capacity and also,

increasing the multi-hospital drills with more education on specific protocols for dealing with biological and chemical agents is mandatory. The absence of surveillance system and decontamination room and equipment with neglect training and is a significant limitation. There is an enormous defect in giving attention to the psychological and emotional impact of the disaster in all facilities plans. Risk assessment shows major factors affecting the preparedness status are lack of education and lack of training staff to chemical and biological incidents which means major defect in "people" dimension of preparedness

Preparedness for terrorism utilizing chemical, biologic weapon of mass destruction needs tremendous improvement in Jeddah governmental health institutions which may represent a significant risk to the health of both residents and visitors to Jeddah and should be assessed furthermore.

ACKNOWLEDGEMENT

We would like to thank Dr. Mahmood Al-Ali and Dr. Majid Al-Ghamdi for their helpful advices and guidance in conducting the study. Special thanks to Dr. Hamed Al-Baerqi, Dr. Ali Al-Shareef, Dr. Khalid Al-Ebani, Mr. Mohamed Elsayed and Dr. Aisha Waheedi for their help in the questionnaire construction and to everyone from different health facilities for their valuable cooperation.

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Source of Support: Nil.

Conflict of Interest: None Declared.

Cite this article as: Eman Abdulsalam Bakhsh, Bader A. AlJasir, Amina Bargawi, Saud A. Bakhsh, Sabirin A. Bakhsh, Omar S. Baduhduh. Evaluation of Jeddah Governmental Health Institutes in Health Preparedness to Chemical and Biological Weapons Of Mass Destruction. Int J Med Res Prof. 2017 Nov; 3(6):146-52. DOI:10.21276/ijmrp.2017.3.6.030