

Saudi Healthcare Facilities Risk Management and Infection Control Preparedness to Overcome Covid-19 Pandemic

Fadilah Sfouq Aleanizy (✉ faleanizy@gmail.com)

King Saud University <https://orcid.org/0000-0002-6161-3121>

Fulwah Yahya Alqahtani

Prince Sattam bin Abdulaziz University College of Pharmacy

Research

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Abstract

Background: The purpose of this study was to evaluate how well prepared Saudi healthcare facilities to overcome COVID-19 pandemic.

Methods: A cross-sectional study was conducted using online-administered English questionnaire that distributed throughout Saudi commission for health specialities at Saudi hospital during the period of April-June 2020. The questionnaire represent a minimum level of knowledge and practices for all components of risk management and infection control and prevention program which should be known and practiced by all healthcare workers. The study population included all healthcare workers in Saudi hospitals designated to deal with COVID-19 cases.

Results: The study revealed that the overall knowledge of risk management plan and infection prevention control was found to be comparatively excellent (80.4%), and there were no discrepancies among the participants according to gender, education, occupation, however, some differences and variation according to age group and the years of experience. Most responses were from hospital located in central province (72.7%), governmental hospital (88%), and mostly provide family services (68%). The majority of hospitals have isolation units (88.2%) either under the authority of Ministry of health or not. Also there were enough training for medical staff which is considered as a base for good practice of risk management and infection control and prevention procedures, policies and guidelines.

Conclusion: The study concluded that outstanding knowledge of all healthcare workers at Saudi hospitals regarding risk management plan and pandemic sub-plan of infection control and prevention policies procedures and principles, regardless the variations among the staff, however these base knowledge have helped Saudi Arabia health authority to successfully overcome COVID-19.

Background

In all developed and developing countries the healthcare facilities play a crucial role in national and local responses to emergencies, such as communicable disease epidemics and/or pandemics (1-4). Most of the actions required to prepare for epidemics/pandemics apply, or can be adapted to, the management of other crises, such as disasters. All hospitals obligated to have plans for their attentiveness and handling epidemics/pandemics, if necessary, to update their epidemic/pandemic response plans and their capacity to implement these plans (5). Hospitals which do not have response plans can use CDC and WHO guide to make a start in the planning process and in regulating their plans to respond to an epidemic/pandemics (5). Infection prevention and control is an enduring hospital activity undertaken by all healthcare workers and units. All healthcare providers and workers must have access and training on infection control protocols (6). To reduce transmission of healthcare-associated infections and thereby to enhance the safety of all who are present in a hospital, including patients, staff and visitors. To enhance the ability of a hospital to respond to an epidemic/pandemic, and to reduce or eliminate the risk of the hospital itself amplifying the epidemic/pandemic (5, 6). Today, the infection with Covid-19 consider pandemic. Globally, as of 6:30pm CEST, 19 May 2020, there have been 4,735,622 confirmed cases of COVID-19, including 316,289 deaths, reported to WHO (7, 8). In Saudi Arabia, from Mar 2 to 6:30pm CEST, 19 May 2020, there have been 59,854 confirmed cases of COVID-19 with 329 deaths (8). The Kingdome of Saudi Arabia (KSA) has well established healthcare facility and strict infection prevention control protocol (9, 10). As COVID-19 cases reported within Saudi Arabia, the Ministry of Health is intensify observation and infection measures. All suspected cases are inspected, mainly at points of entry, and confirmed cases are directly isolated and treated (9-12). The Saudi Ministry of health (MOH) has elected 25 hospitals, measure up to 80,000 hospital beds and 8000 intensive care unit (ICU) beds, for the treatment of COVID-19 cases. 2200 beds have been selected for the isolation of suspected cases to be quarantined (9, 13). Based on previous experience of KSA with other coronaviruses such as MERS-CoV (14), from June 2012 to 23 February 2016, Saudi Arabia developed specific guidelines based on WHO guidelines to deal with the virus (9, 13). KSA has a unique expertise in managing mass gatherings and emergency preparedness during the annual hajj pilgrimage (11, 15). To limit the spread of COVID-19, Saudi Ministry of Health is [interact](#) with the public through all possible channels, exclusively on social media. Also produced guide to COVID-19 to provide Saudi citizens and residents access to COVID-19 facts and precautionary messages in 12 languages (9). Actions to engage the public in prevention and control activities, and to combat false information about the disease, have been significantly scaled up (9, 15). The aim of this study is to evaluate Saudi healthcare facilities risk management and infection control preparedness to overcome Covid-19 pandemic. The purpose of this study was to analyse how well prepared Saudi healthcare facilities to overcome COVID-19 pandemic

Methods

Study design

This is a cross-sectional study used a survey method, applying a structured online English questioner that were distributed to the hospitals designated by Saudi MOH to encompass COVID-19 cases throughout Saudi commission for health specialities during the period of April-June 2020. The questioner involve questions that covers the risk management and infection control preparedness of Saudi healthcare facilities to fulfil their role in containing COVID-19 pandemic.

Study population

Based on previous review (16), total number of healthcare workers is about 350,000 of them around 200 are working at infectious disease department so the sample to be sufficiently representative with a margin of error of 5% and a confidence level of 95% it should have 132 participants using the following sample size calculation websites (<https://select-statistics.co.uk/calculators/sample-size-calculator-population-proportion/>). Questioner were distributed to healthcare workers in a healthcare setting that provide care for COVID-19 infected patients designated by Saudi MOH. Healthcare providers from hospitals around all Saudi Arabia provinces' were included. 164 responses were collected of them 161 analysed and 3 of them were excluded.

Inclusion criteria

The study included all healthcare workers in Saudi hospital from different nationalities in all department.

Excluding criteria

Any uncompleted questioner and none healthcare oriented workers were excluded.

Data Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 23.0 software (SPSS Inc., Chicago, IL, USA).

Results

The study sample included 161 subjects were all their sociodemographic characteristics shown in **(Table 1)**. The study sample were male (n = 89) and female (n = 72), although, it is found a statistically significant difference between age groups $p < 0.0001$, but not by gender as male and female nearly similar. More than half respondents were between 31-40 years old 50.3%, followed by 26.7% of age group 20-30 years old then >40 years old 23%. The majority of the sample are graduates 42.2 % and with master's degree and above 39.8%, professional with fellowships 12.4% and half respondent were MD doctors 49.7% with similar percent distribution between males and females, however, statistically significant difference $p < 0.0001$ distributed according to their years of experience.

Analysing the background characteristics of the healthcare facility to comprehend COVID-19 cases as shown in **(Table 2)**, nearly all of hospitals were governmental 90 % and minorities were private 11% with significant difference with p value ≤ 0.002 . It was found statistically significance $p < 0.0001$ responses as most of the hospitals provided family health services including maternity and children 67.1% providing inpatient care 88.2% and having isolation units 87.6%. The distribution of questioned hospitals were mostly located in central Province 72.7% showing statistically significance $p < 0.0001$, differences from other provinces.

Knowledge about risk management preparedness to overcome covid-19

For any healthcare facility to be prepared to face any emergency or risk as COVID-19 pandemic, a hospital should have in emergency response plan with effective mechanisms to be implemented and being adjustable to any risk. **Table 3** showed statistical significant responses $P < 0.0001$, with an average of 75% of all respondent agreed that their hospital has flexible and well implemented risk management plan. Such a plan executed by committee that responsible for developing the hospital emergency risk management programme 68.3% and $P < 0.0001$, and around 66.5% of respondents agreed that their hospital have well established command group by the hospital emergency committee with a significant value, $P < 0.0001$. One of the most important aspects of the risk management plan is to have effective coordination strategy of the hospital during an epidemic emergency either between department which observed to be significantly matter as 75.8% approved it and 69.6% endorsed that their facility coordinate effectively with different hospitals and health authorities during COVID-19 pandemic. Also 67.1% were compatible the effective coordination of their hospitals with local infrastructure providers, along with 72% manage supplies and infrastructures by implementing infection prevention and control measures during the COVID-19 pandemic and 67.1% agreed on the availability of appropriate resources in sufficient quantities, with effective plan of management and usage.

Regarding the level of knowledge, practice, capabilities and capacities within the hospital there was significant response with $P < 0.0001$ from around 76% respondents in agreement alongside 81.4% of the risk management plan include a plan for hospital to provide general and specialized services while dealing with the pandemic emergency. A significant value added $P < 0.0001$ to the risk management plan to include pandemic emergency sub-plan to deal with Covid-19 74.5% and the existing sub-plans with capacity to cope with pandemic 72.7% and have capacity to cope with the all health demands 77.6% and around 66% in agreement to the adaptation of their hospital risk sub-plan to COVID-19,

and adaptation to the specific challenges during COVID-19 pandemic. Planning the hospital personnel relate to the risk management, their awareness to deal with pandemic emergency as COVID-19 a significant reply $P < 0.0001$ of about 77%, as well as 70% consented having training to perform the necessary actions in any emergency and 73% trained to implement the emergency risk plan during COVID-19 pandemic, however, only 58.4% complied that their facility have considered their physical and social matters during covering the burden of pandemic emergency.

Knowledge about infection prevention control preparedness to overcome covid-19

Component of the hospital emergency response plan include infection control and measures and also include COVID-19 sub plan developed based on the hospital's hazards emergency risk assessment (**Table 4**). 74.5% of subjects replied that their hospitals have protocols and measures to cope with Covid-19 pandemic as infection prevention control risk plan and 71.4 the plan have containment measures to endure COVID-19 pandemic. Moreover, 66% ensured that their risk plan involve a backup plan and local communication plan and 72% confirmed the hospital plan consist of measures to prioritizing and adaptation of work routines and systemic response during COVID-19 pandemic. In case of containing pandemic infection prevention control measures incorporate not only local policies and decisions but also national one such as the situation today of COVID-19 Pandemic. These national and local policies encamps variety of strategies were around 80% to implement appropriate measures (all-hazards specific measures) to deal with COVID-19 pandemic in all questioned Saudi hospitals with 65% developed incident action plan by incident command group to report any incidence of Covid-19 cases. The infection control management plan include a range from 70-80% of involvement of all staff members in infection prevention and control protocol in normal and pandemic situations in addition to training of the staff to fulfil their roles in implementing the hospital's emergency response in infection prevention and control flowing a set of guidelines on standard precautions for infection prevention for COVID-19 and knowledge of basic protective measures against any pandemic.

General Knowledge about facility preparedness to overcome COVID-19

Regarding the association of different variables (age, gender, education, occupation, experience and facility types) with the knowledge level of respondents towards their facilities risk management and infection prevention control and how well their facilities prepared to overcome COVID-19 pandemic represented in (**Table 5**). A very good positive relation (correlation) was found between Hospital personnel/Infection prevention control and each of Infection control plans and measures and Hospital personnel/ Risk management since $r = 0.825$, $P < 0.0001$ and $r = 0.808$, $P < 0.0001$ respectively. In addition, very good positive relationship between infection control plans and measures and mechanisms and how well implemented $r = 0.819$, $P < 0.0001$. Also, a good positive relation between Hospital personnel/Infection prevention control and well implementations of all measures since $r = 0.738$, $P < 0.0001$. Good positive correlation observed between infection control plans and measures with both Pandemic as Covid-19 Sub-plan and hospital personnel/risk management as $r = 0.782$ and $r = 0.757$, $P < 0.0001$ respectively. Good positive correlation showed between hospital personnel/risk management and mechanism and implementation and pandemic as COVID-19 $r = 0.792$ and $r = 0.731$, $P < 0.0001$ respectively. Similar correlation between mechanism and implementation of pandemic as COVID-19 $r = 0.741$, $P < 0.0001$. Also, a moderate positive relation (correlation) between Hospital personnel/Infection prevention control and each of pandemic as Covid-19 Sub-plan and Hospital effective coordination were found since $r = 0.678$, $P < 0.0001$ and $r = 0.623$, $P < 0.0001$ respectively. However, a weak positive relation (correlation) between Hospital personnel/Infection prevention control and availability of resources, with effective plan was found since $r = 0.416$, $P < 0.0001$.

Finally, the multi-line analysis (**Table 6**) shows that Hospital Emergency Response Plan have significant correlation mechanisms and implementations $p \leq 0.014$ and with hospital emergency response COVID-19 pandemic sub-plan $p \leq 0.039$. However, slight significant correlation concerning the effective coordination $p \leq 0.037$, yet, no significant correlation with the knowledge and involvement of the hospital personnel in the risk management plan $p \leq 0.055$, as well as the availability of resources, with effective plan $p \leq 0.071$. In case of Infection control plans there is strong correlation with the application and implementation of the infection measures $p \leq 0.016$ and the knowledge, involvement and training of all hospital personnel $p \leq 0.022$ of all infection prevention and control procedures to overcome COVID-19 pandemic.

Discussion

Since the swiftly spread of COVID-19 globally, and the elevated incidence of people infected. COVID-19 has a higher rate of transmissibility properties than previous coronaviruses and alters multiple organs. The lack of awareness in hospital infection control and worldwide air travel facilitated rapid global dissemination (17). As WHO internationally declares COVID-19 as a pandemic (8), and advice for adapting certain protective measures to control the disease's outbreak (18), almost all countries adhere and pertain all these measures. However, the variation depends when and how they applied them. Starting by applying quarantine and closing all public activities, were telecommuting, virtual learning, and halting all airlines internationally are the leading measures (13). In Saudi Arabia, since the start of the COVID-19 pandemic, the Ministry of Health operates a Command and Control Centre for COVID-19, and started applying careful monitoring of the current situation (9, 10, 14),

particularly in the absence of any prophylactic vaccines or curative treatment globally (8, 13). All protective safety measures started as early as the pandemic announced and healthcare rights were equal to all Saudi population (Saudi citizens and expatriates) in spite of a very low number of reported COVID-19 cases in the country compared to the world. Daily updates through Saudi CDC and Wegaya, to ensure educating and updating healthcare providers and public about the disease (9, 10). Unified management procedures and protocols for all healthcare facilities were mandated and tracked (9). The purpose of this study was to measure the level of preparedness of Saudi healthcare facilities to overcome COVID-19 pandemic and the level of knowledge of healthcare workers of the preparedness plan, although different public health policies were implemented in the last months, and the mandatory nature of these protective measures. Previous reports of Saudi healthcare facilities adherence to protective measures display that the level of information and education are related to a positive attitude toward infectious preventive practices (19). Of the 470 total hospital in Kingdom of Saudi Arabia (20), 25 designated hospital (20 Primary and 5 secondary) to endorse COVID-19 cases (**Table 7**) (11, 15). All designated hospitals have responded to our survey and hence other hospital were even questionnaire. The study significantly showed that hospital in Saudi Arabia are at all times in a state of preparedness to participate entirely, competently and successfully in the coordinated health-sector response to an emergency, such as infectious disease and particularly COVID-19 epidemic with $p = 0.0001$. Hence, a sum of statistical significant established risk management mechanisms and procedures comprising strategies needed for overall coordination of the hospital's epidemic risk management activities, $p = 0.0001$, such as; all-hazards emergency risk assessment and specific epidemic event risk assessment, prevention, preparedness, response and recovery to overcome COVID-19 pandemic. In addition, strong significance $p = 0.0001$ shown in regards to Infection control measures and procedures to enhance the ability of a hospital to respond to an epidemic and reduce transmission of infections and thereby to enhance the safety of all and eliminate the risk of the hospital itself amplifying the COVID-19 epidemic. All risk management and infection control related factors showed significance level of correlation with age groups $p \leq 0.05$, in particular older age group ≥ 31 years old showed more understanding and awareness about their hospital's risk management plan and infection control measures along all related aspect of how well prepared to conquer COVID-19 pandemic, but not by gender as male and female approximately comparable. Also the level of education either holding diploma or above master degrees did not have any important impact on the level of knowledge and alertness were all categories showed equal level. Consistent result were shown in regards to all professional groups with equivalent level of understanding and awareness about their hospital's risk management plan and infection control protocol. It is reassuring that no categorization in regard to gender or education or profession affected the level of knowledge or insights about their hospitals' risk management plan and infection control procedures to defeat COVID-19 pandemic. The years of working experience has a significant relevance $p \leq 0.009$, as most healthcare workers with experience less than or equal 20 years has less information about their hospital risk management plan compared to ≥ 20 years of experience who either get to know by time or practice or involvement. However, all groups of working experience have shown to be significantly knowledgeable ($p \leq 0.030$) about infection control measures. The type of hospitals of either governmental or private demonstrated statistical superiority $p \leq 0.05$, related to all aspects of risk management plan except the availability of resources which shown no significance that may be attributed to miss usage of resources at the beginning of the COVID-19 situation which was then directed and controlled by critical measures and recommendation provided to all health sectors by Ministry of Health to maintain the best practices guidelines and taking into consideration the local resources to cover all hospitals during the pandemic (9, 14). All hospital classifications revealed statistical significance P value ranging from ≤ 0.026 - 0.001 in relation to all aspects of isolation units and providing overnight and inpatients care as risk management and infection control measures. With the exception of no significant value added to the effective coordination of these isolation units and the inpatient care which might be due to the limited bed capacity of each hospital, however the Ministry of Health operates a Command and Control Centre has situated protocols and guidelines to solved this issue by operative communication between all hospitals and quarantine specified location for none critical cases (18). During COVID-19 pandemic all Saudi hospital demonstrated statistical significant $p \leq 0.001$, enhanced infection prevention and control awareness and well implemented measures which are critical to prevent the possible spread of infection in health care facilities. Moreover, a significant value $p \leq 0.05$, added to the provided training to all hospital personnel regarding the infection prevention measures (21).

Conclusion

WHO report examines and compares aspects of health systems around the world and provides conceptual insights into the complex factors that explain how health systems perform, and offers practical advice on how to assess performance and achieve improvements with available resources. It is assuring that during such critical time as COVID-19 pandemic all Saudi hospital and healthcare staff and workers showed an overall relatively high significance of knowledge and awareness as well as effective communication between all parties throughout the country. This have helped the Saudi health system to contain the pandemic with minimum forfeiture.

Study limitation

This study has some restraints. First, it is related to the sample size. The other limitation is due to the fact that the study was only focused on the outbreak of COVID-19, we used a web-based survey method to avoid possible transmission, causing the sampling of our study to be voluntary and conducted by an online system. Given this circumstance, the possibility of selection bias must be considered.

Recommendations

It is recommended in situation like COVID-19 pandemic for health authority to set a unified risk management plan distributed and communicated for all healthcare facilities. Unified risk management plan will allow effortless circulation and follow-up and easy application for public and healthcare workers to follow same instruction at any healthcare facilities. Provide guidance for rational use of resources including laboratory testing and manage resources for lab and infection control requirements (acquisitions, tracking and monitoring) (9). Due to frightening attitudes and considerable impact on population's mental health towards COVID-19 pandemic and new demands for surveillance and control of current COVID-19 outbreaks. Some previous studies identified appropriate suggestions to facilitate compliance with control measures by the population either healthcare workers or public (22-25), including; educational and training involvement should be personalised to all exposed communities either public or healthcare workers, and including teaching preventive measures and practical identification of risks in generalized language that include not only healthcare workers but also the public (23). Subsequently, the population needs to be educated to communicate to health authority about any symptoms and not hide it because of embarrassment or fear as this might furtherly spread the infection (9).

Abbreviations

COVID-19: Coronavirus 2019

WHO: World Health Organization

CDC: Centre for Disease Control and prevention

MOH: Ministry of Health

ICU: Intensive Care Unit

KSA: Kingdom of Saudi Arabia

MD: Doctor of Medicine

N; Number

(%): Percentage

Statistics R²: statistical R-squared

SEE: Standard Error of Estimate

F: Frequency

Declarations

Ethics approval and consent to participate

The study obtained a written informed consent from the Standing Committee for Research Ethics at King Saud University, Ref No: KSU-HE-20-184, in addition to personal agreement from all respondents were required before they fill the online-questionnaires.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request

Competing interests

The authors declare no conflict of interest.

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None

Author Contributions

FSA and FYA both have made substantial contributions to conception and design. FSA and FYA both work together in the survey and the analysis and interpretation of data. All authors contribute writing, editing and reviewing the final manuscript.

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Tables

Table 1. Sociodemographic characteristics of respondents.

Characteristics	N, (%)	P value
Gender		
Female	72 (44.7 %)	0.207
Male	89 (55.3 %)	
Age		
20-30 Years	43 (26.7 %)	< 0.0001
31-40 Years	81 (50.3 %)	
> 40 Years	37 (23 %)	
Education level		
Bachelor's degree	68 (42.2 %)	< 0.0001
Master's degree and above	64 (39.8 %)	
Board/ Fellowship	20 (12.4 %)	
Diploma degree	9 (5.6 %)	
Occupation		
MD doctor	80 (49.7 %)	< 0.0001
Nurses	43 (26.7 %)	
Pharmacists	27 (16.8 %)	
Allied Health Personnel	11 (6.8 %)	
Year of experience		
Less than 5 Years	31 (19.3 %)	< 0.0001
5 - 10 Years	73 (45.3 %)	
11 - 20 Years	38 (23.6%)	
More than 20 Years	19 (11.8 %)	

Table 2. Characteristics of the healthcare facilities.

	N, %	P value
Type of facility/Managing Authority		
Government hospital, MOH	75 (46.6 %)	< 0.0001
Government hospital, Other	68 (42.2 %)	
Private Hospitals	18 (11.2 %)	
Location of facility		
Central Province	117 (72.7 %)	< 0.0001
Southern Province	10 (6.2 %)	
Western Province	22 (13.7 %)	
Eastern province	8 (5 %)	
Northern Province	4 (2%)	
Services available and utilization		
Family health services including maternity and children	108 (67.1 %)	< 0.0001
Adolescent only health services	74 (46 %)	0.344
Inpatient care	142 (88.2 %)	< 0.0001
Facilities have beds for overnight observation	125 (77.6 %)	< 0.0001
Facilities have isolation units	141 (87.6 %)	< 0.0001

Table 3. Healthcare workers knowledge about risk management preparedness to overcome COVID-19 pandemic.

#	Risk management criterial	Yes	No	Don't Know	P value
1	Hospital Emergency Response Plan	82.6	6.2	11.2	< 0.0001
	a. mechanisms and implementations				
	1- Emergency Committee responsible for developing the Hospital Emergency Risk Management Programme	68.3	9.9	21.7	< 0.0001
	2- Command Group established by the Hospital Emergency Committee	66.5	8.7	24.8	< 0.0001
	3- knowledge, practice, capabilities and capacities within the hospital	75.8	10.6	13.7	< 0.0001
	4- hospital provide general and specialized services alongside the pandemic emergency				
	b. Pandemic as Covid-19 Sub-plan	81.4	8.7	9.9	< 0.0001
	1- existing sub-plans and capacity to cope with pandemic	74.5	10.6	14.9	< 0.0001
	2- have capacity to cope with the health demands				
	3- adaptation to COVID-19, and adaptation to the specific challenges during Covid-19 pandemic	72.7	13.0	14.3	< 0.0001
		77.6	11.2	11.2	< 0.0001
		65.8	9.3	24.8	< 0.0001
2	Hospital personnel				
	1. Awareness of Covid-19pandemic	77.0	10.6	12.4	< 0.0001
	2. Trained to perform the necessary actions in any emergency				
	3. Considering staff physical and social matters	69.6	14.3	16.1	< 0.0001
	4. training in implementing Hospital Emergency Response Plan	58.4	32.9	8.7	< 0.0001
		72.7	9.9	17.4	< 0.0001
3	Hospital effective coordination				
	1- Effectively coordinate between departments	75.8	9.3	14.9	< 0.0001
	2- Facility coordinate effectively with different hospitals and health authorities				
	3- facility coordination effectively with local infrastructure providers	69.6	8.7	21.7	< 0.0001
	4- supplies and infrastructures implementing infection prevention and control measures	67.1	8.7	24.2	< 0.0001
		72.0	10.6	17.4	< 0.0001
4	Availability of appropriate resources in sufficient quantities, with effective plan	67.1	17.4	15.5	< 0.0001

Table 4. Healthcare workers knowledge about Infection control preparedness to overcome COVID-19 pandemic.

#	Infection prevention control	Yes	No	Don't Know	P value
1	Infection control plans and measures				
	1- protocols and measures to cope with Covid-19 pandemic	74.5	6.8	18.6	< 0.0001
	2- plan to contain the pandemic situation	71.4	6.2	22.4	< 0.0001
	3- a backup plan and/or local communication plan	65.8	7.5	26.7	< 0.0001
	4- prioritizing and adaptation of work routines and systemic response during COVID-19	72.0	5.6	22.4	< 0.0001
	National and local policies and decisions for Covid-19 Pandemic				
	1- strategy to implement appropriate measures	80.7	6.8	12.4	< 0.0001
	2- all-hazards Hospital Emergency Response Plan that specifies the measures for pandemic	79.5	8.7	11.8	< 0.0001
	3- Incident Command Group with Incident Action Plan developed to report any incidence of Covid-19	65.8	9.3	24.8	< 0.0001
		65.2	10.6	24.2	< 0.0001
2	Hospital personnel				
	1. Involvement of all staff members in infection prevention and control protocol in normal and pandemic situations	70.8	13.0	16.1	< 0.0001
	2. Training to fulfil their roles in implementing the hospital's emergency response in infection prevention and control	69.6	14.3	16.1	< 0.0001
	3. Guidelines on standard precautions for infection prevention for Covid-19 knowledge of basic protective measures against the new Covid-19	80.7	6.8	12.4	< 0.0001

Table 5. Associations between age, gender, education, occupation, location of facility, type of facility and risk management measures and infection control. ** cells with p value ≤ 0.05 consider statistically significant.

Variables			Risk management measures				Infection control		
			Hospital Emergency Response Plan (Mechanisms and implementations)	Hospital Emergency Response Sub-plan	Hospital personnel	Hospital effective coordination	Availability of resources, with effective plan	Infection control plans and measures	Hospital personnel
		N	Pvalue						
Gender	Female	72	0.167	0.585	0.654	0.880	0.316	0.877	0.803
	male	89							
Age	20-30 Years	43	0.08	0.061	0.021**	0.018**	0.041**	0.010**	0.004**
	31-40 Years	81							
	41-50 Years	28							
	> 50 Years	9							
Education	Bachelor's degree	68	0.105	0.263	0.800	0.374	0.307	0.201	0.195
	Master's degree and above	64							
	Board / Fellowship	20							
	Diploma degree	9							
Occupation	MD doctor	80	0.182	0.151	0.577	0.233	0.072	0.179	0.603
	Nurse	43							
	Pharmacists	27							
	Allied Health Personnel	11							
Years of experience	Less than 5 Years	31	0.024**	0.370	0.357	0.385	0.581	0.030**	0.012**
	5 - 10 Years	73							
	11 - 20 Years	38							
	More than 20 Years	19							
Type of facility	Government hospital, MOH	75	< 0.0001**	0.004**	0.011**	0.040**	0.162	0.010**	0.020**
	Government hospital, Other	68							
	Private Hospitals	18							
The facility have isolation units	Yes	142	0.001**	0.005**	0.015**	0.223	0.026**	0.002**	0.005**
	No	19							
The facility have beds for overnight observation	Yes	125	0.006**	0.001**	< 0.0001**	0.009**	< 0.0001**	< 0.0001**	0.014**
	No	36							
The facility routinely	Yes	142	0.016**	0.002**	0.171	0.135	0.091	0.014**	0.014**

provide inpatient care	No	19							
Only adolescent health services	Yes	74	0.719	0.664	0.370	0.608	0.894	0.559	0.820
	No	87							
Family health services including maternity and children	Yes	108	0.136	0.988	0.169	0.722	0.318	0.458	0.269
	No	53							

Table 6. Multi-linear regression of summary punctuation by sub-group of questions to verify the model. ** cells with p value ≤ 0.05 consider statistically significant

	Statistics R2	SEE	F	Pvalue
Risk management measures				
Hospital Emergency Response Plan; Mechanisms and implementations	0.125	2.19	2.401	0.014**
Hospital Emergency Response COVID-19 pandemic Sub-plan	0.108	2.01594	2.034	0.039**
Hospital personnel	0.102	2.19271	1.904	0.055
Hospital effective coordination	0.109	1.92214	2.052	0.037**
Availability of resources, with effective plan	0.097	.75850	1.810	0.071
Infection control				
Infection control plans and measures	0.124	3.73138	2.367	0.016**
Hospital personnel	0.118	1.63626	2.240	0.022**

Table-7: Saudi Healthcare Facilities Resources (20).

Total Hospital in KSA	470
MOH Hospitals	274
Other Governmental Hospitals	44
Private Hospitals	152
MOH Hospital Beds	410835
Other Governmental Hospital Beds	110581
Private Hospital Beds	170428
Total Beds (KSA)	700844