International Research Journal of Medicine and Medical Sciences
Vol. 3(4), pp. 103-112, October 2015
ISSN: 2354-211X
Full Length Research Paper

Knowledge, attitude and practices of healthcare providers towards MERS-CoV infection at Makkah hospitals, KSA

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Accepted 21 September, 2015

ABSTRACT

Middle East Respiratory Syndrome-coronavirus (MERS-CoV) infection is becoming a global health problem that is primarily detected in KSA with progressive increase in cases and deaths. Mass gathering and cross country mixture during season of Hajj and Umrah, the associated hygienic conditions and limited community knowledge about the infection are possible causes. Although many researchers have analyzed epidemiology of the infection, there are few reports of knowledge, attitude and practice (KAP) of healthcare providers towards the infection in KAS. A cross-sectional study was conducted in Makkah public hospitals from September 2014 to April 2015. A total of 281 participants representing healthcare providers were included in this study. Data representing knowledge, attitude and practices were collected using structured self-administered questionnaires. The mean age of the participants was 30.8 ± 6.3, years ranged from 21 to 57. More than half of them were females (57.7%) and 46.3% were nurses. In general, our findings showed that only one third of them (32.4%) acquired good knowledge about the infection with mean knowledge score 18.3 ± 3.9 (out of 28) and most of them (91.8%) showed negative attitude towards the infection with mean attitude score 5.4 ± 1.6 (out of 11). However, 87.9% reported good practices with mean practice score 7.2 ± 1.5 (out of 8). There are significant positive associations between knowledge and both attitude and practices scores. The mean knowledge score was significantly higher among those with age ≥ 30 years, physicians and those with > 10 years of experience and the mean practice score was significantly more among females. In conclusion, our study showed that there are knowledge gap and negative attitude among healthcare providers at Makkah hospitals towards MERS-CoV infection although they reported good practices. Continued and strengthened educational programs are needed to improve their knowledge and change their attitudes towards MERS-CoV infection that will be in the interest of global public health.

Keywords: Knowledge, attitude, practice, healthcare providers, MERS-CoV.

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INTRODUCTION

Coronaviruses are common viruses that most people get sometime in their life and may also infect animals. Human coronaviruses (hCoV) usually cause mild to moderate upper respiratory tract illnesses. Severe Acute Respiratory Syndrome (SARS-CoV) that emerged in 2003 was a stark reminder that any newly emerging zoonotic coronaviruses has the potential to transmit from person to person, especially in healthcare settings, and to cause severe human illnesses. Novel coronavirus (nCoV), described as Middle East Respiratory Syndrome coronavirus (MERS-CoV), is a particular strain different from any other known hCoV with a possibility of zoonotic

transmission. Investigations are being done to figure out the reservoir and source of infection, route of transmission to humans, severity and clinical impact with gradually increasing number of reported cases (CDC, 2014).

There has been a rapid international response following the news of this new virus. An interim case definition was developed rapidly by WHO to ensure that a systematic approach is followed for appropriate identification and investigation of suspected cases (WHO, 2014).

As of April 16, 2015; 1106 laboratory-confirmed cases have been reported to WHO including cases from different countries worldwide; 10 countries from Middle East, 2 from Africa, 8 from Europe, 2 from Asia and the USA. About 63.5% of reported cases were males, the median age was 48 years (range 9 months to 99 years) and about 3 to 4 out of every 10 patients reported have died (WHO, 2015).

The discovery of this new virus requires the countries of the region to demonstrate to rest of the world how vigilant and prepared they are to prevent the international spread of a new infection and protect both global health and the wellbeing of their own peoples. The countries of the region need to be vigilant and put in place enhanced public health surveillance plan for identifying suspected cases using WHO's recommended case definition and investigation protocol (Malik et al., 2012).

Saudi Arabia is still battling with MERS-CoV infection. It has taken a great concern at the governmental and public levels as it led to a number of human infections and deaths. Since June 2012 to April 20, 2015; the total number of infected cases with MERS-CoV infection, as reported by Ministry of Health in Saudi Arabia, reached 981 cases accounting for about 89% of global cases of which 428 cases have died (43.6%) accounting for about 93.8% of total global deaths (CCC, 2015).

We need to better understand the public health implication of emergence of this new respiratory virus from the Arabian Peninsula to understand the exposure risks. The current situation needs to be monitored carefully as there is a fear from increased number of human infections and deaths with Umrah and Hajj season where hundreds of thousands of individuals from all walks of life are pouring into the Holy Places in Saudi Arabia (Makkah and Madinah) through the City of Jeddah, where many cases were identified. Till now, no MERS-CoV cases have been confirmed in Hajj season, however, in Umrah, several cases have been reported and one of the risk factors was visiting healthcare setting in Makkah. So, the concern over the possibility of an outbreak during Hajj should not be taken lightly, particularly as nothing is yet known about the severity and transmissibility of this virus in mass gatherings situations. The problem of MERS-CoV infection becomes more complicated in absence of any prophylactic vaccines, curative treatment and lack of experience in control measures (Al-Ahdal et al., 2012).

Only few reports from KSA have discussed this critical issue that might affect people in multidisciplinary sectors concerned with Hajj and Umrah. We targeted healthcare providers in Makkah hospitals by assessing their knowledge, attitude and practices (KAP) towards MERS-CoV. They are considered a high risk group through direct contact with the suspected cases of infection during Umrah and Hajj season. Also they are expected to have an essential participation in health education activities towards the infection.

MATERIALS AND METHODS

Study design

It is an institutional based cross sectional study conducted in Makkah public hospitals: King Abdul Aziz, King Faisal, Al-Nour Specialist, Agiad, and Hera during the period from September 2014 to April 2015.

Subjects and inclusion criteria

Inclusively all healthcare providers (physicians, specialists, technicians and nurses) in the emergency departments in Makkah public hospitals at the time of the visits and who agreed to participate in the study were included regardless of age, gender or type of their work.

Sample size

The sample size was calculated by Raosoft sample size calculator (Raosoft, 2004). Based on estimated population 613 (according to statistical office in each hospital) and anticipated response 50%, the required sample size was 237 with a confidence level of 95% and a 5% margin of error. Convenience sampling was used in finding the respondents; all available healthcare providers at the time of the visits were selected. A total of 500 questionnaires were distributed among the working staff during the visits. Each questionnaire was evaluated for missing data at the time of submission and corrected in the presence of the respondent to make sure each question is answered. The total response rate was 56% representing 281 out of 500 distributed questionnaires.

Study instrument

A self-administered questionnaire was created both in Arabic and English after a thorough search in the literature based on the most recent available information from the World Health Organization, Centers for Disease Control and prevention and Saudi' Ministry of Health websites. The initial draft was sent to a group of experts chosen according to their experience and expertise in the related fields to reflect on questions in terms of relativity, simplicity and importance. A pilot study was conducted on 20 subjects (4 from each hospital including all healthcare providers) to test validity of the questionnaire or any needed modifications and the questionnaire was finalized after a series of group discussion. The data of pilot study was removed from final analysis.

The questionnaire was divided into 4 parts; the first part contains demographic information of the respondents, the second part identifies respondents' source of knowledge and measure their level of knowledge (n = 21 questions), the third part determines their attitude (n = 11 questions) and the fourth part assesses their practices (n = 8 questions) towards MERS-CoV infection.

To measure the level of knowledge, multiple choice questions

were used and divided into two groups. The first group contains more than 3 answers (n = 7 questions), and the second group contains only 3 answers (yes, no, don't know) (n = 14 questions). To evaluate the first group of questions, complete right answer was given (2 points), incomplete answer was given (1 point) and wrong answer was given (0 point). To evaluate the second group of questions, right answer was given (1 point) and wrong answer was given (0 point). The total knowledge score was 28 (ranged from 0 to 28) that dichotomized to good knowledge (score ≥ 21) or poor knowledge (score < 21) (defined by incomplete answer and wrong answer in the first group and wrong answer in the second group).

Questions of attitude were measured by 3 point Likert scale of agreement (agree, uncertain or disagree) with overall attitude score of 11 (ranged from 0 to 11) that dichotomized to positive attitude (1 point) with score ≥ 8 or negative attitude (0 point) with score < 8.

Questions of practices with overall practice score of 8 (ranged from 0 to 8), were given (yes, no or sometimes) option against each set of question, were dichotomized to good practice (1 point) with score ≥ 6 or poor practice (0 point) with score < 6.

The total scores for knowledge, attitude, and practice were categorized into good/positive or poor/negative based on 75% cut-off point out of the total expected score for each.

Ethical consideration

Ethical clearance was obtained from the committee of bio-ethics at Umm Al-Qura University (project # 43409062) and then from the research ethical committee at Al-Noor Specialist Hospital (No. 512267\302\47). Letters of cooperation were written from Directorate of Health Affairs at Makkah to public hospitals involved in the study. Furthermore, oral consent was obtained from the respondents prior to participation in the study with brief explanation on the objectives and benefits of the study with emphasis that personal data would be confidential and used for the scientific work only.

Statistical analysis

Statistical analysis was carried out using the SPSS computer package version 17.0 (SPSS Inc., Chicago, IL, USA). The mean ± SD were used for quantitative variables while number and % were used for qualitative variables. In order to assess differences in means of quantitative variables independent samples t-test and One-Way ANOVA test were applied. Correlation was analyzed using Pearson correlation coefficient. The statistical methods were verified, assuming a significance level of $p < 0.05$ and a highly significant level of $p < 0.001$.

RESULTS

General characteristics

The study included 281 healthcare providers working at emergency departments at Makkah hospitals with mean age 30.8 ± 6.3 years ranged from 21 to 57 years. More than half of them were females (57.7%). The study included 40 (14.2%) subjects working at King Abdul Aziz Hospital, 45 (16.0%) at Agiad Hospital, 57 (20.3%) at Al-Noor Specialist Hospital, 80 (28.5%) at King Faisal Hospital and 59 (21.0%) at Hera Hospital. Near half of them were nurses (46.3%) while physicians, specialists and technicians accounted for 20.6, 9.6 and 23.5%, respectively. Regarding years of work experience, about one third of them (33.8%) had experience of less than 5 years, nearly half of them (49.1%) from 5 to 10 years and only 17.1% had more than 10 years of work experience (Table 1).

Source of knowledge

Slightly more than half of studied sample (52.3%) depended on internet and social media as a main source of knowledge about MERS-CoV and a considerable percent (44.8 and 43.4%) depended on T.V and health educator respectively. While the least source (5.3%) was radio (Table 2).

Knowledge

The overall mean knowledge score was 18.3 ± 3.9. About one third of the studied sample (32.4%) had good knowledge and the remaining two thirds (67.6%) had poor knowledge (Figure 1).

Poor knowledge was more apparent in response to questions regarding reservoir of infection (49.5%), methods of transmission of infection to human (31.0%), transmission through renal dialysis (58.7%), characteristics of Saudi' infected cases (36.0%), incubation period in human (40.9%), disease manifestations in human (42.0%), recommendations when admitting suspected or confirmed case at hospital (46.6%), recommendations for contact of confirmed case at home (28.1%), diagnosis of disease in human (24.2%), availability of vaccine (26.0%), protection by seasonal influenza vaccine (40.6%), travel ban to the kingdom (43.8%), methods of providing healthcare to patients (50.9%) and returning to daily activities in case of cure (69.4%) (Table 3).

Attitude

The overall mean attitude score was (5.4 ± 1.6). Only 8.2% of the studied sample had positive attitude and 91.8% had negative attitude (Figure 1).

On average, the most negative attitudes of healthcare providers observed regarding the negative impact of corona infection on KSA economy (84.3%), fear from getting infection by one of their family members (90.4%), afraid to go to common places in order not to get infection (72.2%), closure of schools and work places in case of epidemic (81.5%) and threat from handling corona infected patient (86.1%). On the other hand, majority of participants responded positively regarding importance of notification to health authorities (94.3%), use of the face mask during working hours (74.0%), corona infection is preventable (86.1%) and role of health education in disease prevention (76.9%) (Table 4).

Table 1. General characteristics of the studied sample.

Variables		Studied sample (No. = 281)	
		No.	%
Age (years) mean ± SD		30.8 ± 6.3	
Min – Max		21 –57	
Age	< 30 years	137	48.8
	≥ 30 years	144	51.2
Gender	Male	119	42.3
	Female	162	57.7
Work place (hospital)	King Abdul Aziz	40	14.2
	Agiad	45	16.0
	Al-Noor Specialist	57	20.3
	King Faisal	80	28.5
	Hera	59	21.0
Occupation	Physician	58	20.6
	Nurse	130	46.3
	Specialist	27	9.6
	Technician	66	23.5
Years of work experience	< 5 years	95	33.8
	5 – 10 years	138	49.1
	> 10 years	48	17.1

Table 2. Distribution of the studied sample according to source of their knowledge about MERS-CoV.

Source of knowledge	Studied sample (No. = 281)	
	No.	%
T.V	126	44.8
Radio	15	5.3
Newspaper	57	20.3
Neighbors & friends	33	11.7
Doctor	93	33.1
Coworker	68	24.2
Health educator	122	43.4
Internet & social media	147	52.3
Other	19	6.8

Practices

The overall mean practice score was 7.2 ± 1.5. The majority of the studied sample (87.9%) reported good practice and 12.1% reported poor practice (Figure 1). The results are summarized in Table 5.

Other relations

There are significant positive associations between knowledge and both attitude and practices scores. The mean knowledge score was significantly higher among those with age ≥ 30 years (P = 0.002), physicians (P < 0.001) and those with > 10 years of experience (P = 0.008) and the mean practice score was significantly more among females (P = 0.037) (Table 6).

DISCUSSION

To the best of our knowledge, this is the first study in the Western area in KSA that provides significant insight into knowledge, attitude and practices (KAP) of healthcare providers about MERS-CoV. In general, our results showed relatively poor knowledge, negative attitude and reported good practices towards MERS-CoV. These findings disagree with recently published similar study at Al Qassim region that reported good knowledge and positive attitude of healthcare workers towards the infection (Khan et al., 2014).

Source of information

Internet and social media were the main source of knowledge about MERS-CoV among the majority of our participants. This finding was in agreement with Khan et al. (2014) at Al Qassim region and another study on

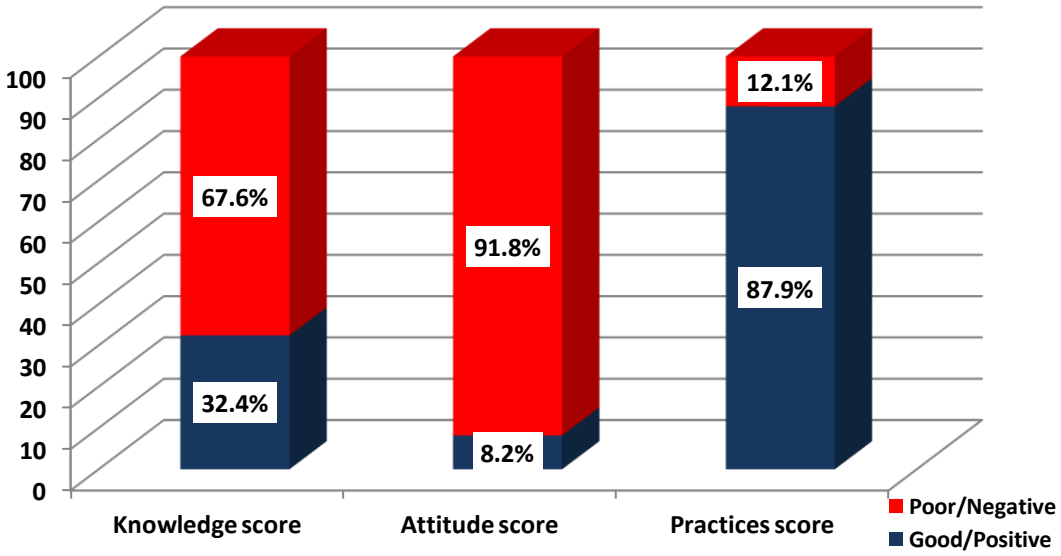

Figure 1. Overall knowledge, attitude and practices scores about MERS-CoV.

Table 3. Knowledge of the studied sample about MERS-CoV infection.

Knowledge	Complete right answer No. (%)	Incomplete answer No. (%)	Wrong answer No. (%)
Causative agent of corona infection	264 (94.0)		17 (6.0)
Reservoir of infection	142 (50.5)		139 (49.5)
Source of infection	259 (92.2)		22 (7.8)
Transmission from infected person to another	264 (94.0)		17 (6.0)
Methods of transmission of infection to human	194 (69.0)	80 (28.5)	7 (2.5)
Transmission through renal dialysis	116 (41.3)		165 (58.7)
Characteristics of Saudi' infected cases	180 (64.0)	23 (8.2)	78 (27.8)
Incubation period in human	166 (59.1)		115 (40.9)
Disease manifestations in human	163 (58.0)	110 (39.2)	8 (2.8)
Healthcare providers are among high risk groups	259 (92.2)		22 (7.8)
Delayed seeking treatment could lead to death	265 (94.3)		16 (5.7)
Isolation of suspected cases at emergency department	238 (84.7)		43 (15.3)
Recommendations when admitting suspected or confirmed case at hospital	150 (53.4)	120 (42.7)	11 (3.9)
Recommendations for contact of confirmed case at home	202 (71.9)	50 (17.8)	29 (10.3)
Diagnosis of disease in human	213 (75.8)	50 (17.8)	18 (6.4)
Availability of vaccine	208 (74.0)		73 (26.0)
Protection by seasonal influenza vaccine	167 (59.4)		114 (40.6)
Travel ban from the WHO to the kingdom	158 (56.2)		123 (43.8)
Methods of providing healthcare to patients	138 (49.1)	107 (38.1)	36 (12.8)
Possible curability from infection	231 (82.2)		50 (17.8)
Time to return to daily activities in case of cure	86 (30.6)		195 (69.4)

influenza A/N1H1 (Fatiregun et al., 2011). However, television was reported by other studies as a main source of knowledge about such kind of virus (Brug et al., 2004; Fatiregun et al., 2011) and scientific journals were reported by Albano et al. (2014) to play a significant role in gaining knowledge by healthcare workers about influenza A/H1N1.

This difference might be explained by the recent advancement in internet technologies and most of the educational materials and health messages on MERS-CoV, nowadays, are posted online by the WHO and Saudi' Ministry of Health which may have urged

Table 4. Attitude of the studied sample towards MERS-CoV infection.

Attitude	Agree No. (%)	Uncertain No. (%)	Disagree No. (%)
Negative effect of infection on KSA economy	149 (53.0)	88 (31.3)	44 (15.7)
Important to report a suspected case to health authorities	265 (94.3)	14 (5.0)	2 (0.7)
Important to use face mask during working hours	208 (74.0)	44 (15.7)	29 (10.3)
Corona infection can be treated at home	45 (16.1)	51 (18.1)	185 (65.8)
Corona infection is preventable	242 (86.1)	31 (11.1)	8 (2.8)
Afraid that one of your family members can get infection	207 (73.7)	47 (16.7)	27 (9.6)
Afraid to go to common places in order not to get infection	121 (43.0)	82 (29.2)	78 (27.8)
Closure of schools and work places during corona epidemic	167 (59.4)	62 (22.1)	52 (18.5)
Ability of governmental institutions to control the epidemic	170 (60.5)	78 (27.8)	33 (11.7)
Health education has nothing to do with disease prevention	36 (12.8)	29 (10.3)	216 (76.9)
Handling corona infected patient does not threaten medical and paramedical staff	39 (13.9)	44 (15.6)	198 (70.5)

Table 5. Practices of the studied samples regarding infection control measures.

Practices	Yes No. (%)	No No. (%)	Sometimes No. (%)
Use soap and water to wash my hands continuously	257 (91.5)	2 (0.7)	22 (7.8)
Cover my nose and mouth with a tissue during sneezing or coughing	262 (93.2)	6 (2.1)	13 (4.7)
Throw the used tissue in the trash	268 (95.4)	6 (2.1)	7 (2.5)
Avoid touching my eyes, nose or mouth as far as I can	264 (94.0)	6 (2.1)	11 (3.9)
Use face mask in crowds	234 (83.3)	25 (8.9)	22 (7.8)
Carefully handle suspected patient's belongings	259 (92.2)	10 (3.6)	12 (4.3)
Keep on healthy eating and health styles	253 (90.0)	9 (3.2)	19 (6.8)
Used to educate clients about the disease	219 (77.9)	22 (7.8)	40 (14.3)

healthcare providers to use internet technology to gain access to those documents. This is supported by other previously conducted research that observed how this way of communicating information has an important impact on healthcare workers' knowledge (Arda et al., 2011; Chor et al., 2011). In the same context, healthcare providers should be encouraged to visit official websites to seek knowledge on health related issues and the Ministry of Health website should also be kept updated regularly.

Knowledge

It is noteworthy to mention the lack of participants' knowledge about the reservoir of infection and methods of transmission of infection to human (about 50 and 69% answered it correctly respectively). Recent studies revealed that camel could be the main reservoir of MERS-CoV infection (Alagaili et al., 2014) and the methods of transmission were documented (CCC, 2014; CDC-2, 2014). Moreover, by knowing differences in the potential for transmission of infection between individuals, our response to infectious diseases becomes appropriate and finer tuning within the spectrum of intervention strategies becomes possible (Blumberg et al., 2014).

Transmission through renal dialysis was wrongly answered by about 58% of participants. Assiri et al. (2013) discussed hospital outbreak of MERS-CoV at Al-Hasa region, Eastern Saudi Arabia and discussed the rapid transmission and high attack rate in the dialysis unit that raises substantial concerns about the risk of health care–associated transmission of this virus. They explained all the episodes of transmission in this outbreak by assuming that patients were infectious and not through the dialysis devices.

Another issue that needs to bring into light is the lack of participants' knowledge about the incubation period in human. About 41% of them answered it incorrectly. Although, researches have revealed that, the incubation period could be as long as two weeks (WHO MERS-CoV Research Group, 2013; Cauchemez et al., 2014), their knowledge regarding this question was below par. Therefore it is necessary to reveal this aspect of virus epidemiology to healthcare providers as it is useful in infectious disease surveillance and control, may aid in diagnosis if laboratory facilities are unavailable and is clinically relevant in the administration of antiviral

Table 6. Relation between characteristics of the studied sample and different scores.

Variable		Knowledge score (Max.=28)	Attitude score (Max.=11)	Practice score (Max.=8)
Age [a]	< 30 years	17.6 ± 3.8	5.4 ± 1.5	7.1 ± 1.5
	≥ 30 years	19.0 ± 3.8	5.4 ± 1.7	7.2 ± 1.5
	P-value	0.002*	0.882	0.582
Gender [a]	Male	18.6 ± 3.9	5.4 ± 1.7	6.9 ± 1.8
	Female	18.1 ± 3.8	5.5 ± 1.5	7.3 ± 1.2
	P-value	0.318	0.749	0.037*
Occupation [b]	Physician	20.0 ± 3.4	5.5 ± 1.1	7.0 ± 1.5
	Nurse	18.6 ± 3.6	5.5 ± 1.5	7.3 ± 1.3
	Specialist	16.2 ± 3.8	5.1 ± 1.8	7.1 ± 1.7
	Technician	17.0 ± 4.0	5.3 ± 2.0	7.0 ± 1.8
	P-value	<0.001*	0.650	0.433
Years of experience [b]	< 5 yrs	17.4 ± 3.7	5.4 ± 1.5	7.1 ± 1.5
	5 – 10 yrs	18.5 ± 3.8	5.4 ± 1.6	7.3 ± 1.5
	> 10 yrs	19.4 ± 4.1	5.6 ± 1.7	7.1 ± 1.5
	P-value	0.008*	0.705	0.674
Knowledge score	r		0.297	0.299
	P-value		< 0.001*	< 0.001*

Values presented as mean ± SD. r: Pearson correlation coefficient test.
[a]: Independent Samples t test. [b]: One-Way ANOVA test.* Significant

medications which are most effective when given before or immediately after symptom onset (Lessler et al., 2009).

Surprisingly, the healthcare providers were least knowledgeable regarding recommendations when admitting suspected or confirmed case at hospital as slightly more than half of them answered correctly. This highlights the possibility that participants were not thoroughly briefed about these issues by the relevant authorities during their educational campaign. This argument is also supported by another false answer from almost 59% of healthcare providers about possible protection by seasonal influenza vaccine. Researches declared the limitations to use seasonal influenza vaccine as the vaccine strains usually do not match the epidemic influenza strains antigenically. In addition, the seasonal influenza vaccine will offer little or no protection against influenza viruses of a novel subtype with pandemic potential as MERS-CoV (Partridge and Kieny, 2013).

On the other side, the correct responses of our participants were gathered from questions concerned with causative agent, source of infection, transmission from infected person to another, high risk groups, risk of delayed seeking treatment, isolation of suspected cases, diagnosis, no available vaccine and possible curability. These findings may be the result of awareness programs by the health authorities that emphasize on such issues and also may be ascribed to the cumulative experience from continuous exposure of healthcare providers in Makkah to different cases with acute viral respiratory illnesses during the year-round Umrah.

Attitude

Regarding attitude of healthcare providers towards infection, it was found to be in the negative range. Generally, we can explain such negative attitude by that MERS-CoV infection is new for healthcare workers with no previous experience or exposure to such cases. This might be supported by such hypothesis that described attitude, in general, as the result of either direct experiential or observational learning from the environment and an attitude based upon direct experience appears to be more likely than one based upon indirect experience to have an impact on behavior (Fazio et al., 1982).

The most negative attitude was observed when respondents adversely replied to the questions regarding negative effect of infection on KSA economy, fear from catching infection by a family member, fear to go to common places in order not to get infection, closure of schools and work places in case of epidemic and risk

from handling corona infected patient. On the other hand, the positive attitude was regarding importance of notification, use of face mask during working hours, corona infection is preventable and role of health education in disease prevention. Some of these responses are in line with different studies related to MERS-CoV infection and other related infections. More than half (55%) of Japanese healthcare workers indicated a high level of fear and anxiety from SARS infection, even in the absence of an epidemic, and a high proportion (92%) preferred to avoid the patient (Imai et al., 2005). About 90% of Thai healthcare workers accepted the personal risk of caring for H5N1-infectd patients (Apisarnthanarak et al., 2008). About 78% of Saudi public agreed to close schools in case of H1N1 influenza epidemic (Balkhy et al., 2010).

Khan et al. (2014) reported the use of protective equipment by healthcare workers as the most positive attitude when dealing with MERS. Also this result agreed with the finding reported by Thu et al. (2012) regarding the positive healthcare workers' response that personal protective equipment should be worn when dealing with healthcare associated infections.

Our participants respond positively with the role of health education in disease prevention and this finding was in line with another study in which positive attitude of healthcare workers was noted towards active participation in prevention program (Rahnavardi et al., 2008). Contrary to our results, Khan et al. (2014) observed negative attitude of healthcare workers regarding reducing the prevalence of MERS through their active participation in infection control program.

Practice

In order to prevent MERS-CoV infection, the healthcare providers reported good infection control practices, use of personal protective equipment in addition to keeping healthy lifestyle and educating clients about the disease (range of individual items, 77.9 to 95.4%). These results were very encouraging and of particular concern as adherence to such procedures could lead to decreased morbidity and mortality related to MERS-CoV infection. Similarly, Al-Saleh et al. (2014) reported high level of healthcare workers compliance to infection control practices with no difference between doctors and nurses. In contrary to our results, Thu et al. (2012) reported small number of correct responses to items about hand hygiene and use of surgical mask with the exception of the question about waste management. Also Balkhy et al. (2010) found about 60% of Saudi public with low level of self reported precautionary measures regarding swine flu.

However, putting into consideration lack of their knowledge and negative attitudes towards infection, it is difficult to determine with certainty whether the self-reported responses reflect what they actually practice. A more effective method of measuring compliance would be the direct observation of actual practice. However, it has also been noted that if self-reporting is substituted by observation, the presence of the observer will influence behavior and may improve compliance (observer effect) (McCarney et al., 2007).

General characteristics and KAP scores

In our study, age, specialty and experience were significantly associated with the mean knowledge score with higher mean score among older participants, physicians and more experienced personnel. More knowledge among physicians, compared to other healthcare providers, might be explained by their greater opportunities of professional development, clinical training and previous experience with similar viral infections of epidemic potential as SARS and swine flu. Similar results were reported by Joukar et al. (2012) however, there is a need to improve the level of knowledge of all healthcare providers towards the disease. The lack of significant association between attitude or practices and age, specialty or experience was supported by some reports (Apisarnthanarak et al., 2008) while contrasts others (Tam et al., 2007; Khan et al., 2014; Gizaw et al., 2015).

A finding that seems interesting; is the significant association between gender and practice score (no significance with knowledge or attitude scores) with higher mean score among females. This finding disagreed with other studies that found gender to be a significant predictor of knowledge and attitude of healthcare workers (Amin and Al Wehedy, 2009; Alazmy et al., 2011; Khan et al., 2014; Almutairi et al., 2015). Some research discussed traditional norms and customs in Saudi Arabia that might explain the difference in gender effect on KAP of healthcare workers. Male health workers have more interaction and socialization than females, more opportunities to meet other healthcare professionals and specialists, traveling for symposiums, conferences and other health related activities and are more exposed to healthcare system as compared to their female counterpart (Moser, 2000; Vidyasagar and Rea, 2004). The significance of our finding, which antagonizes this explanation, is not clear whether progressive interaction of female healthcare workers in health related activities that will be in the interest of health services is a possible conclusion of our results; a hypothesis that needs further studies.

Significant positive correlations were found between the mean knowledge score and attitude and practice scores. Similar positive correlation between knowledge and attitude of healthcare workers was reported by Khan et al. (2014) among HCWs and Almutairi et al. (2015) among Saudi public. In view of this, it could be established that adequate knowledge can lead to positive

attitude that could be explained by the theory of Reasoned Action. A person's intention to a specific behavior is predicted by his attitude toward that behavior and how he thinks other people would view him if he performed the behavior. Thus it could be concluded that correct knowledge results in positive attitude which could be translated into practice to achieve desirable outcomes (Fisher et al., 1995).

In summary, we are able to identify specific knowledge and attitude gaps to be addressed and the major issues that need emphasis during implementation of future intervention programs to raise awareness and improve capacities of healthcare providers in Makkah hospitals towards MERS-CoV infection. However, it is important to interpret the results in the context of potential study limitations. First, as a cross-sectional study, it describes the relationship between the predictor and dependent variables as general association and not to be taken as cause-effect relationship. Second, information was obtained from available healthcare providers who were on duty during the study. Those on official leave, travels, off duty or non responders may have been excluded and information on their characteristics is unknown. In addition, this study did not include other health workers present at selected hospitals such as patient supporters and cleaners and the private sector was not included. Third, self-reported information may not be entirely accurate and should be viewed with caution as it may reflect the subjective views of participants themselves. This may limit the reliability of the findings because of the possibility that participants could give a more positive picture than would be revealed by other data collection methods, they might have answered in a manner that they perceived as correct and some participants might give answers in a manner that will be viewed favorably by the researcher and thus was not their true response (social desirability bias).

Despite the limitations identified, we believe that the study addresses a major health problem that challenges healthcare providers in Saudi Arabia especially in Makkah. It has highlighted the area where very little research has been done and the findings may have important implications for the development of coronavirus education and communication strategies suitable for improving the level of knowledge and attitude of healthcare providers about this issue and optimizing prevention programs and future research.

Conclusion

Based on the above results, there is a knowledge gap between the actual and desired knowledge of healthcare providers regarding MERS-CoV infection with about only one third of them had good knowledge score. Also the majority of healthcare providers had a negative attitude towards the infection that may have an adverse effect on dealing with suspected or confirmed cases of coronavirus. However, they reported proper practices towards the infection. This requires an intervention to improve their knowledge and attitudes towards the infection that will reflect on the overall health of both healthcare providers and suspected or confirmed cases of coronavirus infection.

ACKNOWLEDGEMENT

The authors would like to thank Institute of Scientific Research and Revival of Islamic Heritage at Umm Al-Qura University, KSA (project # 43409062) for the financial support.

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Citation: Nour MO, Babilghith AO, Natto HA, Al-Amin FO, Alawneh SM, 2015. Knowledge, attitude and practices of healthcare providers towards MERS-CoV infection at Makkah hospitals, KSA. Int Res J Med Med Sci, 3(4): 103-112.