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Are Saudi medical students aware of middle east respiratory syndrome coronavirus during an outbreak?

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Received 27 February 2016; received in revised form 11 June 2016; accepted 24 June 2016

KEYWORDS

Coronavirus;
MERS-CoV;
Medical students;
Saudi Arabia;
Awareness

Summary Recently, an outbreak of MERS-CoV occurred in King Abdulaziz Medical City (KAMC), Riyadh. This outbreak contributed to the students at the King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) becoming more involved in promoting health awareness in their communities.

This was a cross-sectional study that evaluated students in the clinical phase of medical school. The data were collected by an online questionnaire. The measurements were obtained using a researcher-administered and a self-reported questionnaire that had been previously validated. A *p*-value of less than 0.05 was considered statistically significant.

One hundred and thirty-six students participated and showed good awareness regarding the clinical aspects of MERS, such as etiology, diagnosis, management, and prevention. However, 76% of the students were not aware of the mortality rate. Conversely, this study uncovered a low level of awareness in the basic sciences. Interestingly, fifth year medical students were more familiar with the incubation period than final year students (*p*-value <0.05). Regarding gender differences, more female students were knowledgeable about the incubation period and the possible asymptomatic presentation of the disease than male students (*p*-value <0.05). However, male students were more aware of the diagnostic tests for MERS than their female counterparts.

Medical students were knowledgeable about the clinical aspects of MERS but were lacking background awareness in the basic sciences.

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<http://dx.doi.org/10.1016/j.jiph.2016.06.013>

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Please cite this article in press as: Al-Mohrej A, Agha S. Are Saudi medical students aware of middle east respiratory syndrome coronavirus during an outbreak? J Infect Public Health (2016), <http://dx.doi.org/10.1016/j.jiph.2016.06.013>

Introduction

Middle East Respiratory Syndrome (MERS) is a viral infection that has recently emerged in humans and causes a severe acute respiratory illness with a mortality rate of 30–40% in average risk patients [1]. MERS is caused by a virus named MERS-CoV, which belongs to a large family of viruses called coronaviruses [2]. It was initially termed human (or novel) corona virus but was later changed to MERS-CoV [3]. Corona viruses are single-strand, positive-sense RNA viruses that measure 120–160 nanometers in diameter and are pleomorphic in shape [4]. In September 2012, the first case of MERS (the so called index case) was reported in Saudi Arabia and presented as symptoms of pneumonia and acute kidney injury [5]. Soon after, another patient from Qatar who had visited Saudi Arabia began experiencing acute respiratory symptoms and renal failure. The symptoms and type of viruses reported in these two patients were the same [6,7]. The age of patients with MERS ranged from 9 months to 94 years, and the median age was 48 years [8]. Male patients constituted 64% of the total number of cases in non-health care worker patients [8]. Conversely, according to Balkhy et al., the median age of health care workers who got MERS during the outbreak from June to August 2015 was 37 years, and female workers constituted 77% of the total cases [9]. In addition, the mortality rate in the infected general population was higher and incomparable to the that of health care workers because they were younger, healthier, and with fewer comorbidities [9].

The typical presentation of MERS is a severe acute respiratory illness with a fever, cough, and shortness of breath that can progress to pneumonia and kidney failure [10]. The patients with underlying conditions before becoming infected were more likely to die from MERS than healthy patients [10]. Conversely, some patients presented with atypical symptoms, such as diarrhea, nausea, and flu-like symptoms, while some patients remained asymptomatic [10]. The treatment for MERS-CoV, as for other coronaviruses, is supportive care because there is currently no curative treatment available [10].

Camels were believed to be the host of MERS-CoV based upon a study conducted in Saudi Arabia, which isolated and identified the genome of the viruses from a sick man and one of his camels [11]. Bats were also believed to play a role in disease transmission according to another study conducted in Saudi Arabia, which isolated coronavirus sequences by PCR from bats by taking fecal and rectal swabs [12]. Although bats could serve as a

reservoir for MERS-CoV, it is unlikely that they would be responsible for direct transmission of the infection to humans because it is uncommon to have direct or close contact between bats and humans [13].

Recently, there was an outbreak of MERS in Riyadh that involved one of its' medical cities, King Abdulaziz Medical City, which had only thirty-one infections from June to August 14th, 2015 [14]. On August 18th, 2015, there was an announcement of ten new cases; nine of them acquired the virus from the hospital [14]. Globally, one of the first large outbreaks that took place outside the Arabian Peninsula was in South Korea, which occurred between May and July 2015, and was followed by another outbreak in Riyadh in Saudi Arabia [15]. Based upon the recent outbreaks and the role of medical students in bringing awareness of MERS to the community, we aimed to assess the awareness of medical students studying in their clinical years to identify any gaps in their knowledge and to recommend any interventions to improve their awareness for better health education.

The aim of this study was to assess the awareness and background knowledge of medical students in their clinical years in King Saud Bin Abdulaziz University for Health Sciences in Riyadh regarding MERS during the outbreak.

Materials and methods

The study was conducted in the College of Medicine, King Saud Bin Abdulaziz University for Health Sciences (KSAU-COM) in Riyadh, Saudi Arabia. The College was established by Royal Decree No. 3-B-53278, dated January 1, 2004. It is located in King Abdulaziz Medical City, Riyadh. The College provides programs for obtaining a MBBS degree and a Master's in Medical Education. We selected to study students enrolled in one of the above mentioned programs because of their exposure to the recent outbreak of MERS that occurred in the hospital they were studying in.

This was a cross-sectional study that used consecutive samples because all of the male and female medical students in their clinical years (approximately 293) who agreed to participate in the study and completed the survey were included.

The data were collected using a fourteen-item online questionnaire that evaluated the medical student's level of awareness regarding MERS. The questionnaire included three main domains that covered their knowledge about basic medical sciences, such as virology, and their knowledge of clinical management and infection prevention and control. Some of the questionnaire items were

Table 1 Baseline characteristics of the respondents.

Variables	Categories	N	%
Gender	Female	55	40.4
	Male	81	59.6
Academic year	Fifth	48	35.3
	Sixth	88	64.7
Age	20–25	127	93.4
	26–30	9	6.6
Heard of (MERS) before this current outbreak	No	16	11.8
	Yes	120	88.2
Source of information	College of Medicine	17	12.5
	Social Media	75	55.1
	The community	27	19.9
	Ministry of Health	8	5.9
	NOT heard of it before	9	6.6

adapted from another study with permission from its' authors [16]. However, new items were added to measure the medical student's awareness of basic medical sciences regarding the virus.

The questionnaire was reviewed and validated by three experts in the medical education, infectious diseases, and biostatistics fields. After the pilot study, the reliability was calculated and found to be 0.71.

Data management and analyses were performed using the Statistical Packages for Social Sciences (SPSS) version 21. Descriptive analyses were performed by reporting the number and percentages for the different categorical variables. Regarding the inferential statistics, the associations between knowledge and the different subjects' characteristics were evaluated using chi-square, and a P-value was reported. A p -value <0.05 was used to indicate statistical significance.

Results

At KSAU-COM, 136 [male 81 (60%), female 55 (40%)] students responded to the questionnaire. Out of the respondents, 48 (35.3%) students were in their fifth year, while the remainder of the students were in their sixth year. Table 1 shows the demographic characteristics of the respondents. All of the participants were Saudi nationals.

Medical students overall awareness of MERS based upon their responses to a questionnaire

The questionnaire shown in Table 2 was used to measure the awareness of the students of MERS.

General awareness of medical students regarding the important aspects of MERS, such as knowledge of basic science and virology, the mode of transmission, diagnosis, and the treatment and prevention of MERS.

Overall, the majority of the students (88%) had heard of the disease before the outbreak in their hospital, with social media being the most common source of obtaining this information (55%). The majority of the students (97.1%) were able to state what MERS stands for. Regarding the students' knowledge of the new cases in August 2015 that were diagnosed globally, 50% of the students were unable to estimate the correct number of new cases.

Regarding items assessing their knowledge of the basic sciences, only a minority of the students (14%) knew the genus to which the virus belonged. Also, only a small number of the students (21%) were aware of the basic structure of the virus. Overall, awareness in the basic sciences related to MERS was below the expected level.

Regarding the clinical items, 74% of the students were aware that patients with the disease could be asymptomatic. Moreover, 75.7% of the students knew the correct incubation period of the virus. Additionally, 75% of the students reported that camels could be a possible primary host for MERS-CoV, while 13% of students thought that bats were the host of the virus. Regarding transmission of disease, 97.1% of the students believed that close contact with ill patients was the mode of transmission. In addition, 96.3% realized that cough, fever, chills, and shortness of breath were the typical symptoms of the infection.

Among the respondents, 66% of students knew that real-time polymerase chain reaction (PCR) testing of a respiratory specimen was used to diagnose MERS. Also, 61% of the students successfully answered that supportive treatment was the only treatment available for patients with MERS. On questions regarding preventive measures, all of the students knew that hand washing with an alcohol-based hand sanitizer, covering his/her mouth when

Table 2 Answers of all respondents.

Question	Answers	N	%
In August of 2015, what is the estimated number of NEW cases reported globally?	Incorrect	68	50.0
	Correct	68	50.0
In your opinion, MERS stands for?	Incorrect	4	2.9
	Correct	132	97.1
To which genus does MERS corona virus belong to?	Incorrect	117	86.0
	Correct	19	14.0
Structure of corona virus	Incorrect	108	79.4
	Correct	28	20.6
Can a person be infected with the virus and does not have any symptoms?	Incorrect	35	25.7
	Correct	101	74.3
The incubation period of MERS-CoV is?	Incorrect	33	24.3
	Correct	103	75.7
The possible primary host of MERS-CoV can be?	Incorrect	16	11.8
	Correct	120	88.2
MERS-CoV can be transmitted by	Incorrect	4	2.9
	Correct	132	97.1
What is a typical symptom of MERS?	Incorrect	5	3.7
	Correct	131	96.3
The diagnosis of MERS can be confirmed by	Incorrect	46	33.8
	Correct	90	66.2
Treatment of MERS-CoV is?	Incorrect	53	39.0
	Correct	83	61.0
Prevention of the spread of MERS-CoV is by?	Incorrect	5	3.7
	Correct	131	96.3
The approximate mortality rate in an average risk patient is?	Incorrect	103	75.7
	Correct	33	24.3
Is there an available vaccine for MERS-corona virus?	Incorrect	11	8.1
	Correct	125	91.9

coughing or sneezing, and avoiding close personal contact are the primary measures for preventing transmission. Also, 92% of the students were aware that vaccines were unavailable during the outbreak. However, only 24% of the students could identify the approximate mortality rate from the disease.

The awareness of MERS-CoV according to the gender of the respondents

The awareness of MERS-CoV according to the gender of the respondents is shown in Table 3. More male students did not know the correct incubation period of the virus and the possible asymptomatic presentation of the disease than female students, and the difference between the genders was statistically significant with p values of 0.01 and 0.004, respectively. However, male students were more aware of the diagnostic test than female students, which was statistically significant with a p value of 0.04.

No other statistical significant differences were found between male and female students.

The awareness of MERS-CoV according to the respondent's year of medical school

The awareness of MERS-CoV according to the respondent's year of medical school is shown in Table 4. Interestingly, the fifth and sixth year medical students' knowledge was only statistically significantly different regarding their understanding of the incubation period for MERS-CoV ($p < 0.05$), and oddly, the sixth year students had less awareness. In relation to prevention, diagnosis, mode of transmission, and other items, no statistically significant differences were observed between the two groups.

Discussion

The present study attempted to assess medical students' knowledge about MERS, specifically, the management of MERS as well as infection prevention and control. Prior studies demonstrated a high level of awareness in the general Saudi population as well as in dental students that was consistent with the results of the present study [16,17].

Table 3 Comparison of the answers based on the gender of respondents.

Question	Answer	Gender				p-Value
		Male		Female		
		N	%	N	%	
In August of 2015, what is the estimated number of NEW cases reported globally?	Incorrect	39	48.1	29	52.7	0.600
	Correct	42	51.9	26	47.3	
In your opinion, MERS stands for?	Incorrect	2	2.5	2	3.6	0.693
	Correct	79	97.5	53	96.4	
To which genus does MERS corona virus belong to?	Incorrect	70	86.4	47	85.5	0.873
	Correct	11	13.6	8	14.5	
Structure of corona virus:	Incorrect	63	77.8	45	81.8	0.567
	Correct	18	22.2	10	18.2	
Can a person be infected with the virus and does not have any symptoms?	Incorrect	28	34.6	7	12.7	0.004
	Correct	53	65.4	48	87.3	
The incubation period of MERS-CoV is?	Incorrect	26	32.1	7	12.7	0.010
	Correct	55	67.9	48	87.3	
The possible primary host of MERS-CoV can be?	Incorrect	9	11.1	7	12.7	0.774
	Correct	72	88.9	48	87.3	
MERS-CoV can be transmitted by	Incorrect	2	2.5	2	3.6	0.693
	Correct	79	97.5	53	96.4	
What is a typical symptom of MERS?	Incorrect	2	2.5	3	5.5	0.364
	Correct	79	97.5	52	94.5	
The diagnosis of MERS can be confirmed by	Incorrect	22	27.2	24	43.6	0.046
	Correct	59	72.8	31	56.4	
Treatment of MERS-CoV is?	Incorrect	31	38.3	22	40.0	0.839
	Correct	50	61.7	33	60.0	
Prevention of the spread of MERS-CoV is by?	Incorrect	1	1.2	4	7.3	0.066
	Correct	80	98.8	51	92.7	
The approximate mortality rate in average risk patient infected with MERS-CoV is?	Incorrect	60	74.1	43	78.2	0.583
	Correct	21	25.9	12	21.8	
Is there an available vaccine for MERS-corona virus?	Incorrect	5	6.2	6	10.9	0.320
	Correct	76	93.8	49	89.1	

Our study revealed that medical students had a good level of awareness of the clinical aspects of MERS, such as the diagnosis, treatment, and prevention. Approximately 92% of the students knew that there was no vaccination available, and 97% of them students were knowledgeable about the mode of transmission. This awareness could be due to their clinical studies during the outbreak and the awareness campaigns in the hospital and on social media, which were the most common sources of information. Furthermore, the internet was the most common channel for obtaining health awareness regarding MERS for the general Saudi population [18]. However, their awareness regarding the number of new cases in August 2015 was not as expected. Half of the students could not estimate the correct number of new cases, which could be due to a lack of interest or a lack of resources for the students to keep themselves updated and current with new events.

One study reported the importance of the source of the information and that a lack of information

about the students' sources and the availability of MERS-related information may have had an effect on the reliability of the results [18].

The present study showed that 86% of the students were unaware that MERS-CoV was a beta Coronaviruse. Also, 80% of the students were not aware of the basic structure of single-stranded RNA viruses. This showed that respondents' knowledge of the basic sciences and technical details related to the virus was relatively lower in comparison to their knowledge in the clinical sciences, which could be due to a variety of different factors. First, a lack of basic science courses in their curriculum could explain their lack of awareness. Second, a lack of emphasis on this information in their clinical practice could also be another possible explanation. Moreover, in awareness campaigns directed to medical students, there was not enough coverage of these elements, which resulted in decreased awareness. Therefore, decreased awareness of the technical details of the virus is expected in medical students due to the abovementioned reasons.

Table 4 Comparison of answers based on the academic level of the respondents.

Question	Answer	Academic year				p-Value
		Fifth year		Sixth year		
		N	%	N	%	
In August of 2015, what is the estimated number of NEW cases reported globally?	Incorrect	20	41.7	48	54.5	0.151
	Correct	28	58.3	40	45.5	
MERS stands for?	Incorrect	1	2.1	3	3.4	0.662
	Correct	47	97.9	85	96.6	
To which genus does MERS corona virus belong to?	Incorrect	40	83.3	77	87.5	0.503
	Correct	8	16.7	11	12.5	
Structure of MERS corona virus is	Incorrect	37	77.1	71	80.7	0.620
	Correct	11	22.9	17	19.3	
Can a person be infected with the virus and does not have any symptoms?	Incorrect	9	18.8	26	29.5	0.169
	Correct	39	81.3	62	70.5	
The incubation period of MERS-CoV is?	Incorrect	5	10.4	28	31.8	0.005
	Correct	43	89.6	60	68.2	
The possible primary host of MERS-CoV can be?	Incorrect	4	8.3	12	13.6	0.359
	Correct	44	91.7	76	86.4	
In your opinion, MERS-CoV can be transmitted by	Incorrect	2	4.2	2	2.3	0.532
	Correct	46	95.8	86	97.7	
What is a typical symptom of MERS?	Incorrect	3	6.3	2	2.3	0.239
	Correct	45	93.8	86	97.7	
The diagnosis of MERS can be confirmed by	Incorrect	20	41.7	26	29.5	0.153
	Correct	28	58.3	62	70.5	
Treatment of MERS-CoV is?	Incorrect	22	45.8	31	35.2	0.226
	Correct	26	54.2	57	64.8	
Prevention of the spread of MERS-CoV is by?	Incorrect	3	6.3	2	2.3	0.239
	Correct	45	93.8	86	97.7	
In your opinion, the approximate mortality rate in average risk patient infected with MERS-CoV is?	Incorrect	38	79.2	65	73.9	0.491
	Correct	10	20.8	23	26.1	
MERS-CoV is available vaccine for MERS-corona virus?	Incorrect	4	8.3	7	8.0	0.938
	Correct	44	91.7	81	92.0	

Because medical students are supposed to play a role as health advocates, they should thoroughly understand new medical events and obtain more in-depth knowledge regarding all aspects of the event, such as virus classification and the basic structure of the virus, than the general population to be able to raise awareness in their communities.

The results of this study revealed that there was a significant difference in three items when comparing male and female students. Female students were more knowledgeable about the incubation period and the possibility for the disease to present asymptotically. One could argue that female students are more interested in emerging infectious diseases, and therefore, keep more up-to-date than their male counterparts.

The results of this study also revealed that there was one statistically significant difference regarding awareness of the virus's incubation period between fifth and sixth year medical students. That is, fifth year students were more

knowledgeable about the incubation period than sixth year students. This could be explained by the fact that fifth year students had just studied the basic medical sciences, including virology, in their fourth year, so they had more recently acquired the knowledge than sixth year students. Also, fifth year students had clinical rotations in infectious diseases when they studied Pediatrics and Medicine, whereas sixth year students did not have a similar clinical rotation. One could question why we chose to evaluate only fifth and sixth year medical students. We specifically evaluated fifth and sixth year medical students because these students were in the clinical phase of their education and direct contact with patients was part of their clinical studies both before and after the outbreak.

When we compared our study results with a study conducted in dental students in Jeddah, we observed a similar awareness level regarding the mode of transmission and treatment of MERS [16]. However, medical students had much higher

awareness regarding the signs and symptoms and the incubation period of the disease [16], which could be due to their background and proximity to the outbreak at the teaching hospital. Also, there were awareness campaigns and activities that could have positively affected their awareness.

The medical students' levels of awareness regarding the primary source of infection, causative organism, treatment, and lack of a vaccine was much higher than the general Saudi population [17]. This could be due to the role of medical students as health advocates during the outbreak, which made them more informed and prepared to raise awareness in their communities. However, both the medical students and general population had good awareness of the signs and symptoms of the disease, the mode of transmission, and protective measures [17], which could be due to the awareness efforts by the Ministry of Health and other health institutions that were shedding light on the symptoms of the disease and the protective measures.

The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) have issued recommendations for the prevention and control of MERS infection in healthcare settings [19]. The prevention of MERS includes hand hygiene, wearing personal protective equipment, and patient placement [19]. One study reported the role of overcrowding of patients in emergency departments as a possible trigger that could initiate outbreaks along with poor compliance to the infection control measures [20]. Courses on new emerging diseases, field epidemiology, and tropical medicine should be introduced to medical students to prepare them for dealing with these types of health emergencies [21]. In light of the recent MERS outbreaks, we recommend additional, new courses for medical students in order to improve the students' knowledge of recent infection trends and to ensure that standard infection control measures are being appropriately used.

The key to preventing acute viral respiratory tract infection includes wearing a mask and gloves, avoiding close contact with patients, eye protection, etc. [19]. However, according to Al-Mohrej et al. the efficacy of the facemasks has not been fully established [17,22]. All of the respondents (100%) were aware of the above mentioned measures for protection, and we think this awareness was due to the activities focusing on disease prevention and control in the hospital. We also recommend that the students educate themselves by reading the materials prepared by the CDC & WHO, which cover the various aspects of the disease and shed light on the important elements of prevention and early recognition of the disease [1,2].

This study was conducted during an outbreak for several reasons. First, our medical students were raising awareness in their communities regarding MERS because it was a very common and relevant topic in the media and the community. Therefore, researchers wanted to assess whether medical students were well informed about MERS and prepared to play their role as health advocates in their communities. Second, the researchers wanted to identify areas that need to be addressed in order to improve the student's knowledge, which will lead to better education of the general population. Finally, by conducting the study during an outbreak, we uncovered how new emerging infectious diseases triggered the student's curiosity and their ability to read and react to surrounding events.

Our study had several limitations. First, there is no comparable study involving Saudi medical students in other colleges to compare with our study. A comparison group consisting of randomly sampled medical students might be needed in the study design to better understand the findings. Also, due to the relatively small number of the students in their clinical years and the low response rate despite sending multiple reminders, our sample size might not be ideal to represent the awareness level of all medical students. Therefore, future studies with a larger sample size addressing those points are warranted.

Therefore, we conclude that medical students have a similar knowledge about the clinical aspects of MERS as the Saudi general population and dental students. However, their awareness of the basic sciences was found to be lower than our expectations due to the above mentioned factors.

Funding

No funding Sources.

Competing interests

None declared.

Ethical approval

Not required.

Acknowledgements

The study would not have been possible without the constructive help of Dr. Omar A. Al-Mohrej,

who offered all possible support to this study. The authors also would like to thank Dr. Amir Omair for his help in the statistical analysis.

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