

Outbreak Investigation of the Middle East Respiratory Syndrome in Khames Mushait

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Abstract

Introduction: Middle East Respiratory Syndrome (MERS) is a fatal viral respiratory illness. More than half of the laboratory-confirmed MERS-CoV infections with human-to-human transmission reported globally are healthcare-associated settings. On February 4, 2020, the Ministry of Health (MOH) and the Field Epidemiology Training Program Team investigated a cluster of 6 confirmed MERS cases reported by Asir Health Affairs in a private hospital in Khames Mushait-city, Saudi Arabia.

Aim: To identify the source, mood of transmission, epidemiologic links between cases, epidemiologic and clinical features, and contacts tracing of the cases.

Method: Descriptive study was conducted by reviewing the medical records and the MOH investigation forms of the laboratory-confirmed MERS cases and contacts reported between January 19 to January 29, 2020.

Result: A cluster of 6 confirmed cases was reported. Its source was unknown. There were 3 (50%) health care workers, 3 (50%) Saudis, and 4 (75%) females. Four (75%) had chronic diseases. The median age was 49.4 (range 26-65) years. One death was reported with a fatality rate of (16%). Two hundred twenty-six healthcare workers (HCWs) and 85 community contacts were traced.

Conclusion: The investigation team suggested that the source might be an asymptomatic patient from outside the hospital. Thus, it is highly likely that the weak adherence of HCWs to infection control and preventive measures (IPC) led to infection transmission to other HCWs and patients with no community transmission. As a result, cases with comorbidities suffered critical complications. Therefore, the hospital should commit to applying the MOH guidelines to detect and manage MERS cases and IPC measures.

Keywords: Middle East respiratory syndrome, coronavirus, MERS-CoV, epidemiology, outbreak, Healthcare-associated outbreaks.

الملخص

المقدمه: متلازمة الشرق الأوسط التنفسية هي مرض فيروسي خطير، وأكثر من نصف حالات عدوى الفيروس المؤكدة مخبرياً عن طريق انتقال العدوى من شخص إلى آخر ، والتي تم الإبلاغ عنها عالمياً مرتبطة بأماكن تقديم الرعاية الصحية. في 4 فبراير 2020 ، قامت وزارة الصحة السعودية بالتعاون مع فريق برنامج البائيات الحقلية بالتقصي عن فاشية لمتلازمة الشرق الأوسط التنفسية مكونة من 6 حالات مؤكدة في مستشفى خاص في مدينة خميس مشيط، حيث أبلغت عنها الشؤون الصحية في عسير بالمملكة العربية السعودية.

الهدف: تحديد مصدر العدوى ، طريقة الانتقال ، الصلات الوبائية بين الحالات، السمات الوبائية والسريرية للحالات ، وتتبع المخالطين للحالات.

المنهجية: أجريت الدراسة الوصفية من خلال مراجعة السجلات الطبية واستمارات التقصي الخاصه بوزارة الصحة لحالات متلازمة الشرق الأوسط التنفسية المؤكدة مخبرياً (MERS-CoV) والمخالطين لهم، المبلغ عنها في الفترة من 19 يناير إلى 29 يناير 2020.

النتيجة: تم الإبلاغ عن 6 حالات مؤكدة. لم يتم التعرف على مصدر العدوى. كان هناك 3 (50%) عاملين صحيين ، 3 (50%) سعوديين و 4 (75%) إناث. أربعة (75%) من الحالات المؤكدة لديهم أمراض مزمنة. كان متوسط العمر 49.4 سنة (يتراوح من 26 إلى 65) سنة. سجلت حالة وفاة واحدة بمعدل وفيات (16%). تم حصر والتقصي عن 226 عاملاً في مجال الرعاية الصحية و 85 من المخالطين المجتمعين.

الخلاصة: اقترح فريق التقصي أن مصدر العدوى قد يكون مريضاً من خارج المستشفى لم تظهر عليه اعراض المتلازمة ولم يتم تشخيصه، كان له اتصال مباشر بالعاملين الصحيين. وبالتالي ، فمن المرجح أن ضعف الالتزام بمكافحة العدوى والتدابير الوقائية (IPC) أدى إلى انتقال العدوى إلى المرضى والعاملين الآخرين. بينما الأمراض المزمنة لدى أربع حالات أدت إلى دخولهم العناية المركزة و وفاة واحدة. لذلك ، يجب على المستشفى الالتزام بتطبيق إرشادات وزارة الصحة في الكشف عن حالات متلازمة الشرق الأوسط التنفسية وكيفية التعامل معها جنباً إلى جنب مع الإجراءات الوقائية ومكافحة العدوى.

الكلمات المفتاحية: متلازمة الشرق الأوسط التنفسية ، فيروس كورونا ، علم الأوبئة ، فاشية فيروس كورونا الشرق الأوسط ، MERS-CoV ، الأوبئة المرتبطة بأماكن تقديم الرعاية الصحية.

Introduction

The Middle East respiratory syndrome (MERS) is a viral respiratory illness caused by a novel betacoronavirus called Middle East respiratory syndrome coronavirus (MERS-CoV) (Centers for Disease Control and Prevention, 2019). It is believed that (MERS- CoV) was first transmitted from infected dromedary camels (the intermediate host) to humans by direct or indirect means as it is a zoonotic viral infection. It can also be transmitted from human to human through close unprotected contact, as health care provision to an infected patient without applying strict hygiene measures (World Health Organisation, 2019).

In 2012, the virus was first identified in the Arabian Peninsula, where the most reported cases and the most massive healthcare-associated outbreaks were seen in Saudi Arabia and the United Arab Emirates, including the Republic of Korea (Centers for Disease Control and Prevention, 2019; World Health Organisation, 2020). By January 2020, the total number of laboratory-confirmed MERS cases reported globally to WHO under the International Health Regulation (2005) was 2499, with 861 associated deaths (Case-Fatality Rate (CFR) 34.4%) from 27 countries (World Health Organisation, 2020). The largest number of confirmed cases was in Saudi Arabia, with 2106 reported cases until January 2020; 19.1% were Health Care Workers (HCWs) and 783 associated deaths (CFR of 37.2%).

In healthcare facilities, it is challenging to identify patients with MERS-CoV infection early or without testing because of the similarity of its symptoms and clinical features with other respiratory infectious illnesses (Guarner, 2020), as the surveillance case definition for MERS in Saudi Arabia requires specific clinical characteristics (Command and Control Center of the Ministry of Health, 2018). These Healthcare-associated Outbreaks revealed extensive transmission of MERS-CoV infection between HCWs and patients (Guarner, 2020). Therefore, the strengthening of Infection Control and Prevention (IPC) measures leads to a reduction in the number of reported cases (Hunter et al., 2016; World Health Organisation, 2020).

In Khames Mushait city (population 512,599) Asir region, Saudi Arabia, the first MERS case was reported in November 2012. From 2012 to 2019, 38 confirmed cases were reported, including an outbreak of 5 cases in a governmental hospital. In January 2020, a private hospital reported a cluster of 6 confirmed MERS cases. In response to this outbreak, the Saudi Ministry of Health (MOH), represented by Asir Health Affairs with the cooperation of the Field Epidemiology Training Program Team (FETP), initiated an epidemiological investigation. This investigation aimed to identify the source, mood of transmission, epidemiologic links between cases, epidemiologic and clinical features, and contacts tracing of these cases.

Method

Aim: To identify the source, mood of transmission, epidemiologic links between cases, epidemiologic and clinical features, and contacts tracing of this MERS outbreak cases at a private hospital in Khames Mushait in Saudi Arabia during January 2020.

Study design

A descriptive study was conducted by reviewing the medical records and MOH investigation forms of the laboratory-confirmed MERS cases and their contacts that were reported from a private hospital in Khames Mushait in Saudi Arabia between January 19 to January 29, 2020.

Setting

The data collected from two settings: A 264-bed private hospital that serves the public through payment and health insurance and a 576-bed governmental hospital that operates under the MOH and serves as the MERS designated referral hospital. For this study's purpose, the private hospital will be referred to as Hospital A and the government hospital as Hospital B.

Ethical approval

This study did not require ethical approval because it was conducted as a part of the MOH investigation of the MERS outbreak in January 2020. All cases were investigated using the standard notifiable and MERS investigation forms of the MOH. All data, cases, and contacts personal identification information kept confidential.

Epidemiologic Investigation

The confirmed case was defined as any reported case from Asir health affairs with laboratory-confirmed MERS-CoV infection from December 21, 2019, to February 12, 2020, who was exposed to Hospital A as a HCW, patient, or visitor. The study period was determined to capture all persons with exposure to Hospital A, in the 14 days before illness onset of the index case and after the last reported case. The probable case was defined as any reported patient from Asir Health Affairs who had both clinical features and an epidemiologic link. The epidemiologic links were defined as the exposure to a confirmed case, contact with dromedary camels, or reported consumption of camel products, but with absent or inconclusive laboratory results for MERS-CoV infection during the same period (Command and Control Center of the Ministry of Health, 2018). The index case is the first case that was reported in Hospital A to come to the investigator's attention. The secondary case is a confirmed MERS case exposed to the index case or exposed to the same environment (Hospital A) that contaminated by the index case.

The FETP team reviewed the available medical and public health records for all reported cases during the study and conducted a meeting with (ICP) officer at Hospital A. The medical history, symptoms at onset, clinical course, demographic information, pre-illness exposures, evaluation, and treatment locations have been collected.

Contact tracing

Close contacts were identified according to the MOH guidelines for MERS surveillance and contact tracing (Command and Control Center of the Ministry of Health, 2018). These contacts are divided into 2 categories: HCWs contacts category: Those working at Hospital A and other healthcare facilities and had contact with the confirmed MERS cases during the period from January 4 to January 29, 2020 and the community contacts category: Those who lived with, worked with, or cared for the confirmed MERS cases from January 4 to January 29, 2020, and not a healthcare worker. The data of all contacts were gathered by reviewing the contacts tracing forms and follow-up lists provided by Hospital A and Asier Health Affairs.

Laboratory Investigation

Real-Time Revers-Transcription Polymerase Chain Reaction (rRT-PCR) used to test the nasopharyngeal (NP) swab samples collected from the cases and (HCWs) contacts in the MOH Regional Laboratory at Jeddah.

Statistical Analysis

A descriptive statistical analysis of the average mean and median for the demographic characteristics of the 6 cases and their contacts was calculated using the Microsoft Excel Program. The frequency of these cases contacts persons was also analyzed.

Results

Epidemiologic Investigation

Asir Health Affaire reported 6 laboratory-confirmed MERS cases between January 19 to January 29, 2020 (Table 1, Figure 1). Of these cases, 3 (50%) were Saudis, and 4 (66%) were females. The Median age was 45 (range 28 – 72) years. The most common underlying medical condition was asthma that reported by 3 (50%). Four (66%) patients reported > 2 respiratory symptoms. No history of direct or indirect camel contacts 14 days before the illness onset. The median incubation period was 8 (range 4-11) days (Figure 2), and the median period from onset to death or discharge was 20 (range 8.0-64.0) days. The source of this outbreak was unknown. Three (50%) patients had a median age of 65 (range 52-72) years. One death was reported (Case Fatality Rate 16%). The deceased patient was a Saudi man (72 years old) with a history of diabetes and hypertension. Three (50%) HCWs with a median age of 36 (range 28-38) years. One was the index case, and 2 asymptomatic cases were identified as a result of the contact tracing of the index case.

At a national level, in relation to this outbreak, there were no additional MERS cases reported 14 days before the illness onset of the index case or 14 days after the last case.

Contact tracing

Three hundred and eleven close contacts were identified: Community category of 85 contacts, only 21(25%) of them showed mild symptoms (cough and fever) and tested for MERS-CoV with negative results (Table 2). HCWs category of 226 contacts. All were traced and tested for MERS-CoV. While 2 contacts showed symptoms with negative results, two asymptomatic contacts which were the second and third cases were positive. All contacts were followed up for the longest incubation period, which was 14 days.

Cases Description

The 6 cases had illness onset during the period from January 4 to January 26, 2020 (Table 1). The first reported case (index case) was 38 years old Filipino female with a history of diabetes and asthma. She is a registered nurse at the Respiratory Disease and Internal Medicine Clinics of Outpatient Department (OPD), with no recorded contact with a camel or a known MERS patient before the illness onset by 14 days. Onset of fever, cough, sore throat and malaise began on January 4, 2020. During her work at the (OPD), she visited the Emergency Department (ED) in Hospital A frequently and being misdiagnosed with a common cold. On January 15, her condition deteriorated to be admitted to the Intensive Care Unit (ICU) with pneumonia at the same hospital. On January 19, her MERS-CoV NP swab tested positive, which led to transferring her to Hospital B for isolation. During the period between January 21 and January 29, 5 additional cases were reported and transferred to Hospital B for isolation, including the second and third cases. Both were HCWs (33%), provided care for the index case in the ICU of Hospital A, and identified after contact investigation as asymptomatic MERS cases on January 21 and 23, respectively; 28 years old Indian female and 36 years old Filipino female, not known to have a history of chronic conditions.

The other 3 (50%) patients had close contact with the third case at Hospital A (OPD) during the period from January 5 to January 13 and developed respiratory symptoms, including cough, fever, and shortness of breath from January 14 to January 26 (Figure 2); fifty-two years old Saudi female, security guard, 72 years old retired Saudi male and 65 years old Saudi retired male. They sought medical assistance from various emergency departments until they were diagnosed on January 25, 26 and, 29, respectively. During the Isolation period in Hospital B, 3(50%) cases: 1 HCW and 2 patients were intubated. One patient died (CFR 16%), while the other 5 cases were discharged after two consecutive negative MERS-CoV samples.

Special Cases

Two cases had contacts with the index case and developed symptoms, but their MERS-CoV NP swabs tested negative. The first case was 51 years old female, Filipino, not known to have any medical condition. She was the care provider for the index case in Hospital A. After shortness of breath and fever developed on January 17, she sought care at Hospital A and admitted to the isolation unit as a probable MERS case. On January 20, her NP specimen test was negative for MERS-CoV, but due to the epidemiological link, a second swab was taken and also came negative. The sample was repeated for the third time, and the result was negative. On January 23, 2020, she was discharged from the isolation unit.

The second case was 32 years old female, Filipino, not known to have any medical conditions. She also was the care provider for the index case in Hospital A. On January 20, she developed fever, cough, and sore throat, then went to the Emergency Department of Hospital A. There, she was treated as a Probable MERS case. MERS-CoV NP swab was taken then she was instructed to be isolated at her home. According to the epidemiological link, the NP specimen was repeated three times, and all results came negative. On January 23, 2020, she was discharged from home isolation.

Discussion

This MERS outbreak investigation described 6 laboratory-confirmed cases, including their 311 traced contacts. The investigation revealed that all of the confirmed cases contracted the MERS-CoV infection at the hospital setting. Consistent with our finding, Drosten et al. (2014) stated that more than 50% of the laboratory-confirmed MERS-CoV infections with human-to-human transmission were reported globally to date are healthcare-associated settings.

Three cases had complications and needed special care and intubation, including one reported male death. All of them were elderly and known to have comorbidities such as diabetes, hypertension, and asthma. The gender, age, and comorbidity factors contributed to increasing the MERS-CoV infected cases' severity and mortality. These results aligned with the results of a study by Feikin et al. (2015).

The index case had no history of direct or indirect contact with camels or previous contact with a confirmed MERS patient. To our knowledge, the source of infection was unknown. Therefore, we suggested that the index case might be infected by close unprotected contact with asymptomatic MERS patient at the hospital. Similarly, in a healthcare setting outbreak in South Korea, the infection transmission occurred from asymptomatic individuals who had unprotected close contact with the initial patient (Moon & Son, 2017).

The delay of proper diagnoses and isolation of the index case and her continuous working and contacting others as a nurse in the OPD resulted in the infection of 5 cases with MERS-CoV infection. In another study, the exposure to the index case before being diagnosed led to the transmission of infection to more than 90% of its contacts (Al-Tawfiq & Auwaerter, 2019).

It is highly likely that the lack of strict following to the IPC measures, proper triage procedures and use of Personal Protective Equipment (PPE) by the second and the third case was the leading cause of contracting the infection while providing care for the index case. The third case transmitted the infection to other patients during her work at the OPD.

This chan of infection transmission could have been prevented through following IPC measures and proper use of PPEs. A study by Hastings, Tokars Hastings et al. (2016) showed similar conclusions.

Our results showed that despite the two special cases that had contact with the index case and showed MERS-CoV infection symptoms, their NP swabs tested negative while repeated three times. According to Al-Tawfiq and Auwaerter (2019) and Assiri et al. (2013), the lower respiratory samples showed more accurate and better diagnostic results than the nasal or oral swabs. Therefore, using the lower respiratory sample with these special cases might have allowed early detection of the MERS-CoV.

This investigation traced more HCWs' contacts than community contacts due to the occurrence of the outbreak in a health care facility. By doing so, this contact tracing followed the MERS' MOH guidelines (Command and Control Center of the Ministry of Health, 2018) in applying the recommended comprehensive contact tracing to prevent subsequent infections (European Centre for Disease Prevention and Control, 2018).

This investigation was limited in relation to some community contacts demographic information. Thus, the data about the community contact's medical history were missing from the reviewed forms.

Conclusion

This study investigated the source, mood of transmission, epidemiologic links between cases, epidemiologic and clinical features, and contacts tracing of the 6 MERS cases in January 2020 at a private hospital in Khames Mushait city in Saudi Arabia. Despite that the source of this outbreak was unknown, the transmission of the MERS-CoV infection among HCWs and patients was inside the hospital. Therefore, it was suggested that the index case might be had close unprotected contact with an asymptomatic patient during her work in the OPD. It is possible that the lack of proper following to the (IPC) measures, PPE, and safe triaging was the leading cause of this outbreak.

The delay in diagnosing the index case was suggested to exacerbate the issue by infecting others with comorbidities deteriorating their conditions and resulting in the death of one of those cases. This was evident by the fact that the contact tracing revealed no community transmission.

Recommendations

This investigation offers some recommendations for enhancing ICP measures in ED and OPD. According to MOH guidelines, prompt recognition and detection for suspected MERS-CoV cases, visual triage, and scoring system for respiratory illness patients are mandatory in both areas (Command and Control Center of the Ministry of Health, 2018). All suspected or confirmed cases must be placed under proper isolation. HCWs with mild respiratory illnesses should be isolated at home and followed up by a medical team. HCWs should follow the hospital standard precautions consistently with all patients, regardless of their diagnosis, especially in high-risk clinical areas. The HCWs should be trained frequently for the proper use of PPE. Early detection and isolation of infectious individuals, as well as the full adherence to ICP measures among HCWs, are necessary factors to prevent further transmission of MERS-CoV.

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No.	Age	gender	Nationality	Occupation	Existing medical conditions	Source of Infection	Animals contact	Date of symptoms onset	Symptoms	Date of diagnosis	Date of hospital admission	Contacts tracing
case1(Index)	38	female	Filipino	HCW	DM, Asthma	unknown	no	4-Jan	Fever, cough, SOB	19-Jan	19-Jan	111(HCWs),3(community)
case2	28	female	Indian	HCW	NO	close contact to 1st case	no	Asymptomatic	Asymptomatic	21-Jan	21-Jan	33(HCWs),4(community)
case3	36	female	Filipino	HCW	NO	close contact to 1st case	no	Asymptomatic	Asymptomatic	23-Jan	23-Jan	37(HCWs),12(community)
case4	52	female	Saudi	security guard at governmental hospital	Asthma	close contact to 1st case	no	14-Jan	Fever, cough, SOB	25-Jan	25-Jan	15(HCWs),17(community)
case5	72	male	Saudi	retired	DM, HTN	contact to 3rd case	no	19-Jan	Cough, fever, chest tightness	26-Jan	26-Jan	23(HCWs),16(community)
case6	65	male	Saudi	retired	Asthma	contact to 3rd case	no	26-Jan	SOB, cough	29-Jan	29-Jan	7(HCWs),33(community)

Tables

Table 1: The laboratory-confirmed Middle East Respiratory Syndrome Coronavirus infection reported cases line-list, Khames Mushait, Saudi Arabia, January 2020.

Table 2: Demographic and clinical characteristics of patients with laboratory-confirmed

Demographic and clinical characteristic	HCWs cases N=3	Patient cases N=3	HCWs Contacts N=226	community contacts N=85
Median age, y(range)	36(28-38)	65(52-72)	32(21-62)	31(1-75)
Female sex, no. (%)	3(100)	1(33.3)	188(42.4)	43(50.5)
Non-Saudi, no. (%)	3(100)	0	214(94)	19(22.6)
Exposures within 14 days before symptom onset Camel, no. (%)	0	0	0	0
Symptoms*				
Any symptoms reported, no. (%)	1(33.3)	3(100)	3(1.3)	21(25)
Documented fever($\geq 38.5^{\circ}\text{C}$) or symptom of respiratory illness, no. (%)	1(33.3)	3(100)	2(.8)	3(3.5)
Shortness of breath, no. (%)	1(33.3)	2(66.6)	0	1(1.1)
Fatigue\Malaise, no. (%)	1(33.3)	3(100)	2(.8)	3(3.5)
cough, no. (%)	1(33.3)	3(100)	2(.8)	15(17.8)
Rhinorrhoea, no. (%)	0	0	0	0
Muscle aches, no. (%)	1(33.3)	3(100)	2(.8)	3(3.5)
Chest pain, no. (%)	1(33.3)	3(100)	0	0
Headache, no. (%)	1(33.3)	3(100)	2(.8)	3(3.5)
Sore throat, no. (%)	1(33.3)	3(100)	2(.8)	1(1.1)
Wheezing, no. (%)	1(33.3)	3(100)	0	0
Vomiting\ nausea, no. (%)	0	0	0	0
Medical History				
Any underlying condition, no. (%)	1(33.3)	3(100)	40(17.5)	Not known
Diabetes mellitus, no. (%)	1(33.3)	1(33.3)	6(2.6)	Not known
Hypertension, no. (%)	0	1(33.3)	12(5.2)	Not known
Renal diseases, no. (%)	0	0	0	Not known
Cardiovascular diseases, no. (%)	0	0	1(.4)	Not known
Cancer, no. (%)	0	0	0	Not known
Hepatitis, no. (%)	0	0	0	Not known
Asthma, no. (%)	1(33.3)	1(33.3)	20(8.7)	Not known
Obesity, no. (%)	0	0	0	Not known
Severity of symptoms				
Care in ICU, no. (%)	1(33.3)	2(66.6)	0	0
Supplemental O2 required, no. (%)	1(33.3)	2(66.6)	0	0
intubated, no. (%)	1(33.3)	2(66.6)	0	0
Died, no. (%)	0	1(33.3)	0	0
Reason tested for MERS-COV				
Screening as part of contact investigation, no. (%)	2(66.6)	0	226(100)	21(25)
Symptoms consist with MERS-CoV, no. (%)	3(100)	3(100)	0	21(25)
Unprotected Close Contact with confirmed MERS- COV case				
lived with, no. (%)	1(33.3)	0	1(.4)	47(55)
Visited*, no. (%)	0	0	226(100)	66(78)
provided care for*, no. (%)	2(66.6)	0	3(1.3)	9(11)

(HCWs) healthcare workers, (MERS-CoV) Middle East Respiratory Syndrome coronavirus.

Non- Saudi: Filipino, India, Somalia, Bangladesh, Egypt, Pakistan, Sudan, Syria, Jordan, Yemen, Nibali, and Nigerian.

Unprotected Close Contact: contact within 1.5 meters range with a confirmed MERS-CoV case without using PPE.

The Cases with no reported symptoms: the date of positive sample result was used in place of symptom onset.

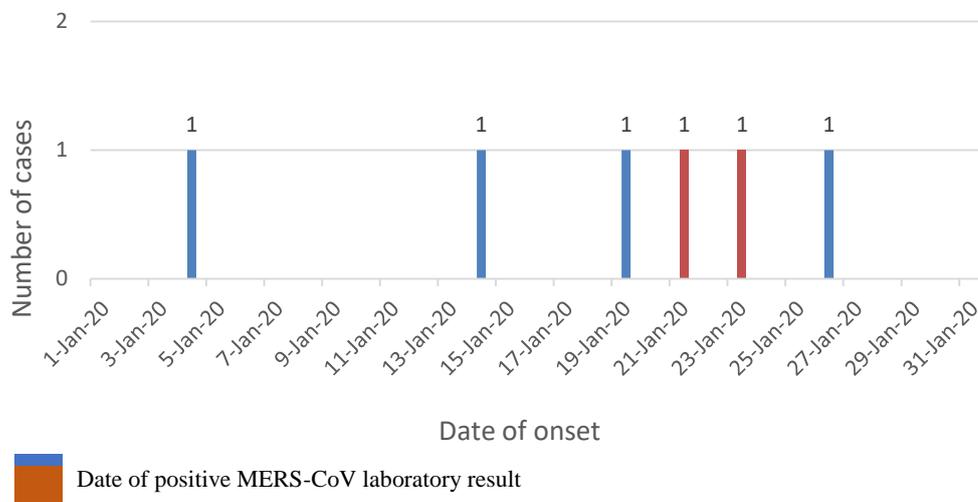
Symptoms and signs of respiratory illness: cough, shortness of breath, or wheezing.

Visited, provided care for: the period between the illness onset and the diagnosing as a confirmed MERS case.

Middle East Respiratory Syndrome Coronavirus infection and their contacts, Khames
Mushait, Saudi Arabia, January 2020

Figures

Figure 1: Epidemic curve by the onset of symptoms date for the laboratory-confirmed Middle East Respiratory Syndrome Coronavirus infection reported cases, Khames Mushait, Saudi Arabia, January 2020.



			January																												Dis. Date	
case	category	status	3 FRI	4 SAT	5 SUN	6 MON	7 TUE	8 WED	9 THU	10 FRI	11 SAT	12 SUN	13 MON	14 TUE	15 WED	16 THU	17 FRI	18 SAT	19 SUN	20 MON	21 TUE	22 WED	23 THU	24 FRI	25 SAT	26 SUN	27 MON	28 TUE	29 WED	30 THU		31 FRI
Case1	HCW	Index		0	ED V	ED V.					SL		SL	SL				S	(+)													04\03
Case2	HCW	secondary																	Care-provider of case 1		S	(+)										12\02
Case3	HCW	secondary																			o	S	(+)									01\02
Case4	Patient	secondary												O																		11\02
Case5	Patient	secondary																														Died At 05\02
Case6	Patient	secondary																														11\02

- O Symptoms and Sign Onset
- S Swabbing
- (+) Positive Result
- SL Sick Leave
- ED V Visit ED as Patient
- Dis. Discharged
- Hospital A OPD
- Single Room at Hospital A word
- ICU Isolation at Hospital A
- Hospital B
- Governmental hospital
- Privet Hospital

Figure 2: Timeline of the laboratory-confirmed Middle East Respiratory Syndrome Coronavirus infection cases, Khames Mushait, Saudi Arabia, January 2020