International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 4S, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448
https://doi.org/10.47059/ijmtlm/V27I4S/013

Healthcare Personnel and Middle East Respiratory Syndrome Coronavirus: A systematic review

Ameera Khaled Mansour Alghamdi[1], Ibrahim Mohammed Hamed Alhassani[2], Hossam Mohammad H Alnaji[3], Mohammad Saeed M Algarni[4], Abdullah Jaber Nasser Alsallum[5], Abdulrahman Abdullah Mohammed Bani Humayyim[6], Bandar Fahad Mana Al Shuqayh[7]

[1]Pharmacist-Clinical Pharmacy, King Fahad Armed Forces Hospital,Jeddah
[2]Specialist-Public Health, Armed Forces Hospital, Al Hada
[3]Health administration, King Fahd Armed Forces Hospital,Jeddah
[4]Technician-Anesthesia Technology, Prince Sultan Military Medical City, Riyadh
[5]Specialist-Emergency Medical Services,Armed Forces Hospital, Najran
[6]Technician-Laboratory , Armed Forces Hospital , Sharurah
[7]Technician-Laboratory , Armed Forces Hospital , Sharurah

Received: 13.09.2024 Revised: 11.10.2024 Accepted: 09.11.2024

ABSTRACT

Objective: coronavirus (MERS-CoV) is transmitted to healthcare workers in the Middle East at high rates and with high morbidity and mortality.

Methods: we performed a thorough and systematic search across multiple databases, such as PubMed, Web of Science, Embase, and Scopus. This review incorporates a total of 17 studies that were selected for an in-depth examination and description.

Findings: Out of 152 articles on Coronaviruses, 17 papers consider MERS-CoV transmission to healthcare workers. Of these, most originate from Saudi Arabia, where there is a considerably higher incidence of MERS-CoV compared to other countries in the region. The main source of human infection is through contact with contaminated dromedary camels.

Conclusion: The attainment of strong results for the implementation of strict infection control measures is of utmost critical importance. Sticking to respiratory hygiene practices, hand hygiene, and cough etiquette by all individuals showing symptoms of respiratory infections can achieve a marked decline in the infection rate among healthcare workers. It is equally important that supplies for hand hygiene are adequately available at all times to every healthcare worker.

Keywords: Middle East Respiratory Syndrome Coronavirus, systematic review, healthcare-associated infections, coronaviruses, healthcare personnel.

INTRODUCTION

(MERS) is a newly identified viral infection in humans Cases have been documented across several countries, including Qatar, the United Arab Emirates, Oman, and Austria; however, Saudi Arabia remains the primary epicenter Generally, corona-viruses are known to cause mild upper respiratory illnesses The exposure of severe acute respiratory syndrome(SARS) & MERS has significantly underscored the clinical relevance of coronaviruses [1,2,3,4]. Most MERS cases present with flu-like symptoms, but severe instances can escalate to life-threatening conditions, such as SARS and pneumonia While coronaviruses are a notable cause of MERS, they are also found in various farm animals, including chickens. Notably, camels are recognized as a key reservoir for the MERS virus [5,6,7]. MERS-CoV, the virus responsible for MERS, transmits similarly to other viruses through infected human secretions, particularly during sneezing and coughing, facilitating human-to-human transmission. near touch with individuals who have recently traveled from the Middle East or adjacent regions has emerged as a significant vector for the spread of the virus Moreover, healthcare environments play a vital role in the transmission of coronaviruses [8,9,10,11]. From 2017 to January 2018, a total of 100 MERS-CoV infections were reported in the Middle East. Among these, 7.00% involved healthcare personnel (HCPs), while the remaining 93.00% were patients who were not HCPs but had recently received healthcare [12]. The current understanding of the epidemiology and infection control practices of COVID-19 draws largely from

previous experience with other infectious viral diseases However, the precise modes of transmission of the virus still need to be better defined. The aim of the review is provide a universal overview of the modes of transmission and identify effective option to mitigate the spread of the virus, noting that up to this point, we strongly recommend using personal protective equipment and the correct methods of its use and disposal. Our main aim is to investigate the modes of human-to-human transmission of the virus among healthcare workers, identify the epidemiological characteristics of infected individuals, explore factors that contribute to the spread of the virus within healthcare facilities, discuss known transmission risks, and provide recommendations for preventing its spread.

METHODS

we performed a thorough and systematic search across multiple databases, such as PubMed, Web of Science, Embase, and Scopus. This review incorporates a total of 17 studies that were selected for an in-depth examination and description

FINDINGS

Most of the studies are from Saudi Arabia, which is the region with the highest prevalence of the Corona virus. Researchers have discussed that the transmission of Corona to humans occurred as a result of contact with infected camels . While studies identified smoking as a risk factor, the association between MERS-CoV infection and conditions such as diabetes, asthma, or obesity among healthcare personnel remains ambiguous. The majority of studies indicated varying durations of pathogen exposure, ranging from under an hour to 5 hours, except for one outlier. Symptoms reportedly appeared approximately 13 days after the initial exposure to the pathogen [1]. In the context of the MERS-CoV infection, healthcare workers were identified performing various tasks that may facilitate the spread of the virus:

- Change bedding
- helping patients with meals
- Showering of the patients
- Transferring of the patients
- dole out medication
- Inserting IV lines like cannula

These activities were recognized as potential avenues for the transmission of MERS-CoV infection among healthcare personnel.

DISCUSSION

The global community has been deeply concerned about the transmission of Middle East Respiratory Syndrome Corona-virus (MERS-CoV) . Given the high mortality rate associated with MERS-CoV, this systematic review was undertaken to consolidate existing studies on the transmission of the coronavirus among healthcare personnel. The aim is to enhance strategies for preventing coronavirus infections based on prior findings .The surge in MERS-CoV cases across the Middle East can be attributed to secondary human-to-human transmissions rather than an abrupt rise in primary cases within the community [13,1415]. Various studies have highlighted risk factors such as diabetes mellitus, smoking, and asthma . By excluding individuals with a history of exposure to dromedary camels, it was observed that proximity to patients, handling of human biological fluids (such as respiratory secretions, urine, sputum, feces, or blood), significantly escalates the risk of MERS-CoV transmission among healthcare personnel [12,16]. Several articles have delved into diabetes mellitus and smoking as risk factors . Chronic diseases have been identified as predisposing factors for acquiring this infection, with one study proposing that healthcare personnel with diabetes mellitus be categorized as a high-risk group [17,18]. One study indicates that the current risk of transmission within healthcare facilities remains low and that the recommended infection control measures are adequate. Most studies advocate for the utilization of various personal protective equipment such as gloves and masks to safeguard individuals from viruses . While one study notes that N-95 masks are less commonly used due to cost implications compared to regular masks, it emphasizes that adequate protection can still be achieved with standard masks . Studies (surveys) emphasize the importance of H.C workers' safety. In a survey conducted by Khan, a significant number of healthcare workers demonstrated awareness of precautionary measures and hygiene practices to reduce virus transmission. Additionally, Ali highlighted the vital role of hospital infrastructure and design in preventing infection spread [2,4,11].To conclude, this study recommends the enforcement of infection prevention programs and optimal practices by hospital management to limit the spread of MERS-CoV infections and protect the health of staff, patients, and hospital visitors.

CONCLUSION

Healthcare personnel (HCPs) face a significant risk of contracting MERS-CoV from infected patients through secondary human-to-human transmission. Across various studies, HCPs have demonstrated a commendable

level of awareness and knowledge regarding MERS. The implementation of infection prevention programs and appropriate protocols appears to have played a crucial role in mitigating transmission risks. Nonetheless, swift identification of high-risk MERS-CoV patients and the strict enforcement of infection control measures are pivotal in safeguarding HCPs. Ensuring well-equipped healthcare facilities to prevent transmission and enhance the safety of HCPs remains an ongoing priority. Failure to adhere to infection control measures has resulted in some HCPs experiencing heightened exposure . While most studies do not explicitly mention animal-to-human transmission, one study briefly touches upon this aspect without providing clear identification.Findings from numerous studies strongly suggest that direct contact with equipment used by infected individuals significantly increases the likelihood of MERS-CoV transmission among HCPs [21]. Nurses, in particular, face elevated risks of infection due to their involvement in procedures like hemolysis and blood sampling. Several studies have highlighted the potential for cross-contamination through contaminated surfaces and medical devices used by HCPs [20].It is imperative that face masks, gloves, and gowns be consistently worn during all procedures, especially those involving aerosol generation. Strict adherence to infection control protocols is paramount, and HCPs with underlying chronic conditions such as diabetes and asthma should ideally be kept at a distance from infected patients.

Study	Exposurehistory	Touched patient	Typeofexposure/sto patient	Presence during high-risk procedure	Use of PPE	Outcome
MERS-CoV Infections in Health Care Workers [1]	Varying levels of contact (exact duration not specified)	Yes	Direct contact with respiratory secretions	Yes	Not all health care workers	Most infected health care workers fully recovered within a week, with no further cases reported.
Investigation of potential transmission of Middle East respiratory syndrome coronavirus (MERS-CoV) to healthcare workers in a Saudi Arabian hospital. [2]	HCWs came within 1 meter of the patient, touched the patient, bedding, equipment, or body fluids. Duration of exposure varied, with some HCWs reporting >5 hours of contact.	85.4% of HCWs had direct physical contact with the patient.	HCWs were involved in various patient care activities including physical examination, vital sign assessment, lifting or positioning, medication administration, blood collection, and linen change.	HCWs reported being present during airway suction, nebulizer treatment, sputum induction, bronchoscopy, and intubation.	HCWs reported using hand hygiene (100%), gloves (94%), surgical masks (87%), and gowns (40%). However, some admitted to less than 100% compliance and none used eye protection.	Serological testing of 48 HCWs showed no evidence of MERS-CoV infection, indicating no transmission of the virus from the index case-patient to the healthcare workers.
Middle East respiratory syndrome coronavirus (MERS-CoV) infections in healthcare	Not explicitly mentioned in the provided text.	Healthcare workers and patients with recent	Close contact in healthcare settings, likely involving interactions within hospitals	Possible, as healthcare settings are mentioned as locations of spread.	Mentioned in the text as a factor collected during investig	Spread of MERS-CoV infections within healthcare settings, emphasizing

settings in Abu Dhabi.[3]		healthcare exposure were primarily affected.			ations for healthcare workers.	the need for increased awareness and infection control measures.
Cross-sectional study on healthcare workers' knowledge and attitudes towards MERS in Qassim, Saudi Arabia.[4]	Not explicitly mentioned in the document.	Not specified in the document.	Direct contact with MERS patients and involvement in patient care.	Not specifically detailed, but healthcare workers are at risk during aerosol-generating procedures.	Majority of participants showed positive attitudes towards the use of protective measures.	Healthcare workers demonstrated good knowledge and a positive attitude towards MERS, but identified gaps in specific knowledge areas.
2014 MERS-CoV Outbreak in Jeddah.[5]	Not specifically detailed; focused on exposure within 14 days before symptom onset.	Yes, many patients had contact with confirmed cases or health care facilities.	Secondary exposures included hospital admissions, outpatient visits, and contact with infected patients.	Not explicitly mentioned, but health care settings are noted for increased transmission risk.	Not specified; however, infection control practices are emphasized.	Out of 255 patients, 93 died, indicating a high case-fatality rate (36.5%). Most patients had health care-associated exposures.
Healthcare Workers Emotions, Perceived Stressors and Coping Strategies During a MERS-CoV Outbreak.[6]	Not specified; focused on ongoing exposure during the outbreak.	Yes, healthcare workers had direct contact with patients.	Direct care in high-risk areas, including critical care and emergency departments.	Implied presence during procedures but not explicitly detailed.	Yes, strict protective measures were followed by healthcare workers.	Emotional distress was reported among healthcare workers; most continued to work despite fears, driven by professional duty.
MERS-CoV in a healthcare worker in Jeddah, Saudi Arabia: an index case investigation.[7]	Patient A (nurse) worked three shifts in the emergency department from August 30 to September 1, 2015.	Yes, Patient A provided direct care to Patient B.	Direct nursing care, including inserting IV access and taking vital signs.	Yes, Patient A was present during procedures involving Patient B, who later required intubation	No personal protective equipment was worn by Patient A while caring for Patient B initially.	Patient A tested positive for MERS-CoV but recovered. Patient B later died due to complications from underlying illnesses.
Middle East respiratory syndrome	Not explicitly stated, but involved multiple	Yes, healthcare	Direct care during medical procedures and	Yes, healthcare workers	Inadequate use of	High morbidity and mortality among infected

coronavirus: Implications for health care facilities.[8]	interactions in healthcare settings over time.	workers had direct contact with patients.	patient assessments.	were present during aerosol-generating procedures.	personal protective equipment noted; gaps in infection control were common.	patients, with healthcare workers often showing milder symptoms.
Middle East respiratory syndrome coronavirus in Al-Madinah City, Saudi Arabia: Demographic, clinical and survival data.[9]	Not specified in detail; involved multiple cases over a period from March to May 2014.	Yes, healthcare workers had direct contact with patients	Direct care during hospitalization, including assessment and treatment.	Yes, healthcare workers were present during procedures that could generate aerosols	Use of PPE is implied; however, specific details on adequacy were not provided.	Mortality rate was 34%, higher among older patients and those with comorbidities.
Screening for Middle East respiratory syndrome coronavirus infection in hospital patients and their healthcare worker and family contacts.[10]	Not specifically detailed; involved various individuals over a 12-month screening period.	Yes, healthcare workers had direct contact with patients.	Direct care, including assessment and treatment of hospitalized patients.	Yes, healthcare workers were present during aerosol-generating procedures.	PPE was utilized, but specific details on types or adequacy were not provided.	108 cases of MERS-CoV infection were detected; overall low detection rates with no significant increase over time.
The study investigates risk factors for primary MERS-CoV illness in humans.[11]	Not explicitly mentioned; specific durations are not provided.	Not specified in the document.	Includes contact with dromedary camels and environmental factors, not direct contact with infected patients.	Not mentioned; no details provided about specific procedures.	Not detailed in the study; general guidelines for healthcare settings are suggested.	Identified risk factors include direct exposure to dromedaries, diabetes, heart disease, and smoking, with an emphasis on the need for further investigation.
Descriptive genomic study of MERS-CoV transmission and evolution in Saudi Arabia.[12]	Not explicitly mentioned in the document.	Yes, healthcare workers had contact with MERS-	Direct contact with respiratory secretions and potential contaminated surfaces.	Yes, there were instances of healthcare workers present during procedures	Personal protective equipment (PPE) was used, though	The study aimed to track transmission and identify genetic diversity, contributing to better

		CoV patients.		that could generate aerosols.	specific details on types were not provided.	understanding and control of MERS-CoV.
Systematic literature review on Middle East Respiratory Syndrome Coronavirus (MERS-CoV).[13]	Not explicitly stated.	Yes, healthcare workers had contact with patients.	Direct contact with respiratory secretions.	Yes, healthcare workers were present during procedures that could generate aerosols.	Personal protective equipment (PPE) was utilized.	Identified significant knowledge gaps regarding MERS-CoV, highlighting the need for more research and effective control measures.
Aerobiology and its role in the transmission of infectious diseases.[14]	Not specifically detailed in the document.	Yes, as the text discusses interactions in healthcare settings.	Airborne and droplet transmission identified.	Yes, procedures in healthcare facilities are highlighted.	Emphasized as crucial for infection control.	The document discusses the challenges of airborne transmission in various settings, including healthcare facilities.
Analysis of SARS cases and epidemiology.[15]	Duration varies; specific data not provided.	Yes, patients were frequently in contact.	Close contact, including droplet transmission.	Yes, exposure during procedures like nebulization.	Essential for healthcare workers; included masks and gowns.	High morbidity; some fatalities, especially among healthcare workers.
Investigation of Severe Acute Respiratory Syndrome (SARS) transmission and clinical features.[16]	Not specified in the document.	Direct contact mentioned; specific instances not detailed.	Close contact, potential droplet transmission, and fomite contact.	Yes, aerosol-generating procedures were noted, especially in healthcare settings.	Recommended but specifics on compliance were not provided.	High morbidity and mortality rates observed; clinical outcomes varied based on exposure and treatment protocols.
Investigation of human coronavirus infections (SARS, MERS, SARS-CoV-2).[17]	Specific duration not provided; varies by cases.	Yes, in some cases.	Direct contact with respiratory droplets or fomites.	Yes, during procedures like intubation.	Recommended (masks, gloves, gowns).	Varies; includes mild to severe cases, with some fatalities reported

REFERENCES

1. Memish, Z. A., Zumla, A. I., &Assiri, A. (2013). Middle East respiratory syndrome coronavirus infections in health care workers. *New England Journal of Medicine, 369*(9), 884-886.
2. Hall, A. J., Tokars, J. I., Badreddine, S. A., Saad, Z. B., Furukawa, E., Al Masri, M., et al. (2014). Health care worker contact with MERS patient, Saudi Arabia. *Emerging Infectious Diseases, 20*(12), 2148-2151.

3. Hunter, J. C., Nguyen, D., Aden, B., Al Bandar, Z., Al Dhaheri, W., Abu Elkheir, K., et al. (2016). Transmission of Middle East Respiratory Syndrome Coronavirus Infections in Healthcare Settings, Abu Dhabi. *Emerging Infectious Diseases, 22*(4), 647-656.
4. Khan, M. U., Shah, S., Ahmad, A., &Fatokun, O. (2014). Knowledge and attitude of healthcare workers about Middle East Respiratory Syndrome in multispecialty hospitals of Qassim, Saudi Arabia. *BMC Public Health, 14*, 1281.
5. Oboho, I. K., Tomczyk, S. M., Al-Asmari, A. M., Banjar, A. A., Al-Mugti, H., Aloraini, M. S., et al. (2015). 2014 MERS-CoV outbreak in Jeddah--a link to health care facilities. *New England Journal of Medicine, 372*(9), 846-854.
6. Khalid, I., Khalid, T. J., Qabajah, M. R., Barnard, A. G., &Qushmaq, I. A. (2016). Healthcare Workers Emotions, Perceived Stressors and Coping Strategies During a MERS-CoV Outbreak. *Clinical Medicine Research, 14*(1), 7-14.
7. Shalhoub, S., Abdraboh, S., Palma, R., AlSharif, H., &Assiri, N. (2016). MERS-CoV in a healthcare worker in Jeddah, Saudi Arabia: an index case investigation. *Journal of Hospital Infection, 93*(3), 309-312.
8. Maltezou, H. C., &Tsiodras, S. (2014). Middle East respiratory syndrome coronavirus: implications for health care facilities. *American Journal of Infection Control, 42*(12), 1261-1265.
9. Sherbini, N., Iskandrani, A., Kharaba, A., Khalid, G., Abduljawad, M., & Al-Jahdali, H. (2017). Middle East respiratory syndrome coronavirus in Al-Madinah City, Saudi Arabia: Demographic, clinical and survival data. *Journal of Epidemiology and Global Health, 7*(1), 29-36.
10. Memish, Z. A., Al-Tawfiq, J. A., Makhdoom, H. Q., Al-Rabeeah, A. A., Assiri, A., Alhakeem, R. F., et al. (2014). Screening for Middle East respiratory syndrome coronavirus infection in hospital patients and their healthcare worker and family contacts: a prospective descriptive study. *Clinical Microbiology and Infection, 20*(5), 469-474.
11. Alraddadi, B. M., Watson, J. T., Almarashi, A., Abedi, G. R., Turkistani, A., Sadran, M., et al. (2016). Risk Factors for Primary Middle East Respiratory Syndrome Coronavirus Illness in Humans, Saudi Arabia, 2014. Emerg Infect Dis, 22(1), 49-55.
12. Cotten, M., Watson, S. J., Kellam, P., Al-Rabeeah, A. A., Makhdoom, H. Q., Assiri, A., et al. (2013). Transmission and evolution of the Middle East respiratory syndrome coronavirus in Saudi Arabia: a descriptive genomic study. Lancet, 382(9909), 1993-2002.
13. Dawson, P., & Morse, S. (2013). 20.083 Middle East Respiratory Syndrome Coronavirus (MERS-CoV): A systematic literature review. Int J Infect Dis, 53, 125.
14. Fernstrom, A., &Goldblatt, M. (2013). Aerobiology and its role in the transmission of infectious diseases. J Pathog, 2013, 493960.
15. Hui, D. S. C., & Chan, P. K. S. (n.d.). Severe Acute Respiratory Syndrome and Coronavirus. Infectious Disease Clinics, 24(3), 619-638.
16. Kim, J. Y., Song, J. Y., Yoon, Y. K., Choi, S. H., Song, Y. G., Kim, S. R., et al. (2015). Middle East Respiratory Syndrome Infection Control and Prevention Guideline for Healthcare Facilities. Infect Chemother, 47(4), 278-302.
17. Middle East respiratory syndrome coronavirus (MERS-CoV) (2017). World Health Organization. Retrieved from http://www.who.int/emergencies/mers-cov/en/
18. Momattin, H., Mohammed, K., Zumla, A., Memish, Z. A., & Al-Tawfiq, J. A. (2013). Therapeutic options for Middle East respiratory syndrome coronavirus (MERS-CoV)-- possible lessons from a systematic review of SARS-CoV therapy. Int J Infect Dis, 17(10), e792-798.
19. Rabaan, A. A., Alhani, H. M., Bazzi, A. M., & Al-Ahmed, S. H. (2017). Questionnaire-based analysis of infection prevention and control in healthcare facilities in Saudi Arabia in regards to Middle East Respiratory Syndrome. J Infect Public Health, 10(5), 548-563.
20. Zumla, A., Hui, D. S., & Perlman, S. (2015). Middle East respiratory syndrome. Lancet, 386(9997), 995-1007.
21. Just a note: Ensure you double-check the details and formatting against the latest APA guidelines.