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American Journal of Infection Control 47 (2019) 431–434

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major Article

Infection control influence of Middle East respiratory syndrome coronavirus: A hospital-based analysis

Jaffar A. Al-Tawfiq MD, FACP, FRCPE, FRCPL [a,b,c,*], Rana Abdrabalnabi RN, MPH [d], Alla Taher RN [d], Shantymole Mathew RN [d], Kamal Abdul Rahman RN [d]

[a] Specialty Internal Medicine, Johns Hopkins Aramco Healthcare, Dhahran, Saudi Arabia
[b] Indiana University School of Medicine, Indianapolis, IN, USA
[c] Johns Hopkins University School of Medicine, Baltimore, MD, USA
[d] Infection Control Unit, Johns Hopkins Aramco Healthcare, Dhahran, Saudi Arabia

Key Words:
MERS
Personal Protective Equipment
Cost
Economic impact
Healthcare

Background: Middle East respiratory syndrome coronavirus (MERS-CoV) caused multiple outbreaks. Such outbreaks increase economic and infection control burdens. We studied the infection control influence of MERS-CoV using a hospital-based analysis.

Methods: Our hospital had 17 positive and 82 negative cases of MERS-CoV between April 1, 2013, and June 3, 2013. The study evaluated the impact of these cases on the use of gloves, surgical masks, N95 respirators, alcohol-based hand sanitizer, and soap, as well as hand hygiene compliance rates.

Results: During the study, the use of personal protective equipment during MERS-CoV compared with the period before MERS-CoV increased dramatically from 2,947.4 to 10,283.9 per 1,000 patient-days ($P < .0000001$) for surgical masks and from 22 to 232 per 1,000 patient-days ($P < .0000001$) for N95 masks. The use of alcohol-based hand sanitizer and soap showed a significant increase in utilized amount ($P < .0000001$). Hand hygiene compliance rates increased from 73% just before the occurrence of the first MERS case to 88% during MERS cases ($P = .0001$). The monthly added cost was $16,400 for included infection control items.

Conclusions: There was a significant increase in the utilization of surgical masks, respirators, soap and alcohol-based hand sanitizers. Such an increase is a challenge and adds cost to the healthcare system.

Middle East respiratory syndrome coronavirus (MERS-CoV) emerged in June 2012 in the Kingdom of Saudi Arabia (KSA),[1] and the first healthcare–associated MERS infection was described in multiple facilities in Al-Hasa, KSA.[2] Since then, a total of 2,229 cases have been reported to the World Health Organization from 27 countries, with an overall case fatality rate of 35.6%.[3] Most cases of MERS-CoV have been reported in the Arabian Peninsula, with KSA having the majority of reported cases.[4]

MERS-CoV causes multiple outbreaks within and outside Saudi Arabia.[4] Such outbreaks may cause economic and infection control burdens on affected healthcare facilities. During the severe acute respiratory syndrome (SARS) outbreak, the disease had a great impact on infection control measures.[5] In a simulation involving outbreaks of SARS, 2009 pandemic H1N1, and 1918 Spanish influenza, these situations resulted in additional costs of $25,000-$99,000 when no alert was present to as high as $1,537,000 for SARS during an orange alert level.[6] During the initial years of MERS-CoV outbreaks, the exact infection control requirements were not known,[7] although there was a known need to increase infection control capacity in healthcare settings.[8] Although a few articles have addressed the preparedness of hospitals to face MERS, there are no data on the impact of MERS-CoV on infection control resources within hospitals.[9,10] Here, we study the infection control influence of MERS-CoV by analyzing data on specific infection control parameters using a hospital-based analysis.

METHODS

Our hospital was the first outside the United States to be accredited by the Joint Commission and to subsequently maintain accreditation by the Joint Commission International. The

* Address correspondence to Jaffar A. Al-Tawfiq, MD, Specialty Internal Medicine, Johns Hopkins Aramco Healthcare, PO Box 11705, Dhahran 31311, Saudi Arabia.
E-mail address: jaltawfi@yahoo.com (J.A. Al-Tawfiq).
Conflicts of interest: None to report.

https://doi.org/10.1016/j.ajic.2018.09.015

organization has state-of-the-art infection control practices and procedures. The hospital was one of the first in the world to deal with MERS-CoV cases, when 99 patients who met the case definition of suspected MERS-CoV were admitted. Of those cases, 17 tested positive and 82 tested negative for MERS-CoV between April 1, 2013, and June 3, 2013.[11-13] Of the positive cases, as described previously, 30% had healthcare–associated infections, because the hospital received patients in transfer from other facilities.[2] In this study, we aimed to re-evaluate the impact of these cases on infection control practices, including the use of gloves, surgical masks, N95 respirators, alcohol-based hand sanitizer, and soap, expressed as mL per 1,000 patient-days. Data on the monthly use of gloves (pairs), surgical masks, and N95 respirators were obtained from the central supply service, assessed based on retrospective analysis of overall supply ordering by the hospital, and expressed per 1,000 patient-days. We also evaluated any change in monthly hand hygiene compliance rates. The data span from May 2012 to July 2013 and include the pre-MERS period (May 2012 to March 2013), the MERS period (April to May 2013), and the post-MERS period (June to July 2013). Data were extracted from the infection control database, and monthly patient days were obtained from the health information unit. This study was approved by the institutional review board of the Johns Hopkins Aramco Healthcare.

RESULTS

During the observation period, the utilization of personal protective equipment (PPE) with cases of MERS-CoV compared with the period before MERS-CoV cases increased dramatically from 2,947.4 to 10,283.9 per 1,000 patient-days ($P < .0000001$) for surgical masks and from 22 to 232 per 1,000 patient days ($P < .0000001$) for N95 masks (Fig 1). It is interesting to note that the increase in utilization of N95 masks preceded the increase in surgical mask utilization by about 1 month.

The utilization of alcohol-based hand sanitizer and soap is shown in Figure 2; there was a significant increase in the used amount ($P < .0000001$). Hand hygiene compliance rates are shown in Figure 2. The hand hygiene compliance rate increased from 73% just before the occurrence of the first MERS case to 88% during MERS cases ($P = .0001$) (Fig 3). The monthly added cost was $16,400 for the included infection control items, such as hand sanitizers, soap, surgical masks, and N95 respirators.

DISCUSSION

In the most recent updates by the World Health Organization, a total of 2,040 (31%) cases were healthcare facility–associated infections.[14] In addition, initial MERS-CoV symptoms tend to be nonspecific and might not be noticed. Thus, adherence to standard precautions is a critical factor in the prevention of MERS-CoV transmission.[14] This adherence, as well as the initial uncertainty about transmission routes early in the course of the disease, had resulted in widespread fear of MERS-CoV. It is known that application of standard infection control results in the termination of MERS-CoV outbreaks.[2,4,15,16] Here, we showed a significant increase in the use of PPE (mainly surgical masks, respirators, alcohol-based hand sanitizer, and soap). There was a significant increase in the utilization of surgical masks and respirators during the study period. There are mixed recommendations for the care of patients with MERS-CoV with regard to placing patients in airborne isolation and thus the use of N95 respirators, droplet precautions, and surgical masks.[7,15,17,18] The use of surgical masks was noted to increase significantly during the 2009 H1N1 influenza pandemic, with a reported 52% increase in use.[19] This increase in the use of PPE is paralleled by an increase in cost. It is recommended that hospitals maintain an adequate supply of PPE for use during infectious disease outbreaks. In 1 study, it was calculated that 4 sets of PPE (N95 respirators, double gloves, gowns, and goggles) per day are needed for each healthcare worker in the high-risk group, and 2 sets of PPE are required for medium- and low-risk groups.[20] Another implication for the increased use of PPE is the generation of medical waste, which we did not address in this study. In 1 simulation exercise, an additional 570 L of waste was generated per day.[21]

We were not able to show a significant increase in hand hygiene practices despite the significant increase in utilization of alcohol-based hand sanitizers. This observation may be related to the fact that baseline hand hygiene was about 88% in the preceding months. However, the hand hygiene compliance

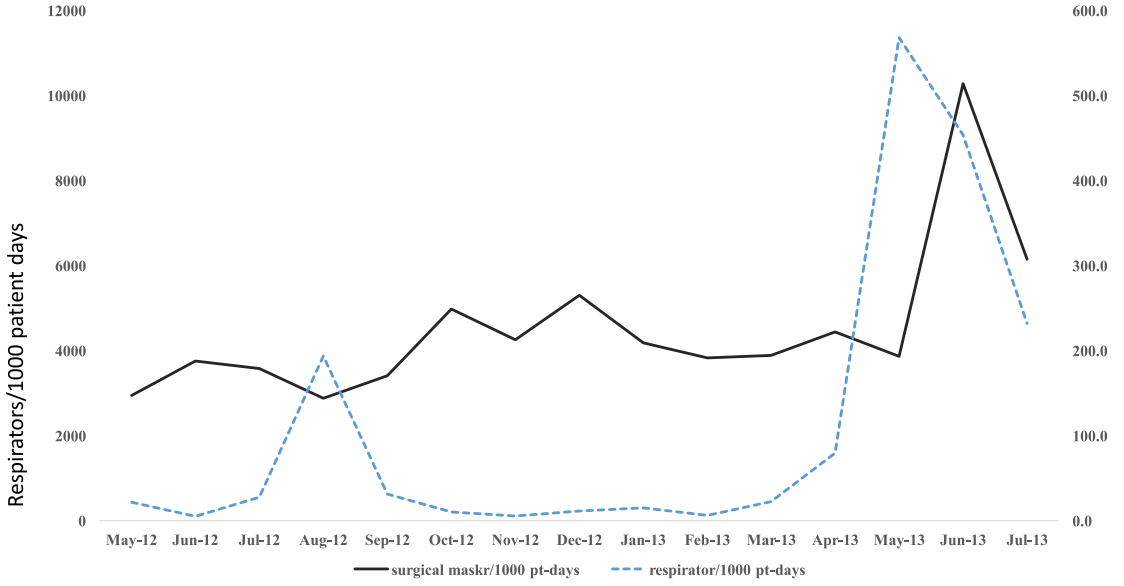

Fig 1. A run chart showing the utilization of surgical masks (solid line) and respirators (dashed line) in the period before Middle East respiratory syndrome cases (May 2012 to March 2013) and during Middle East respiratory syndrome cases (April to July 2013).

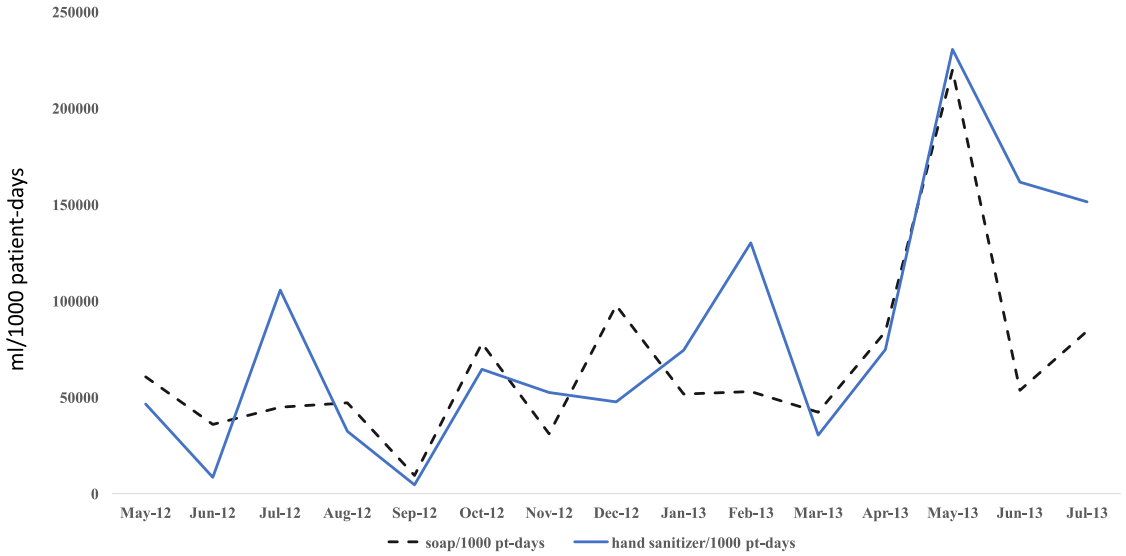

Fig 2. A run chart showing the utilization of alcohol-based hand sanitizers (solid line) and soap (dashed line) in the period before Middle East respiratory syndrome cases (May 2012 to March 2013) and during Middle East respiratory syndrome cases (April to July 2013).

rate dropped to 73% just before the occurrence of the first MERS case and then picked up to 88% ($P = .0001$). It has been shown that both observation and a multifaceted approach increase hand hygiene compliance,[22,23] and that utilization of secret shoppers may give a false sense of the actual rates of hand hygiene compliance.[24] Another possible explanation is that the utilized soap and hand sanitizer may have been used by patients and visitors.

Although the data are from 2013, which may be considered a limitation, they are still valid because this is the only study documenting the burden of this new virus on health infrastructure even though 5 years have elapsed since its emergence. Other limitations of the study include the fact that the presented data are small and represent only one non–Ministry of Health hospital, and it was not possible to use the data to draw conclusions regarding a national estimate of disease burden. There are multiple hospitals supervised by the Ministry of Health, in addition to other hospitals supervised by various institutions and the private sector.

CONCLUSIONS

There was a significant increase in the utilization of surgical masks, respirators, soap, and alcohol-based hand sanitizers during

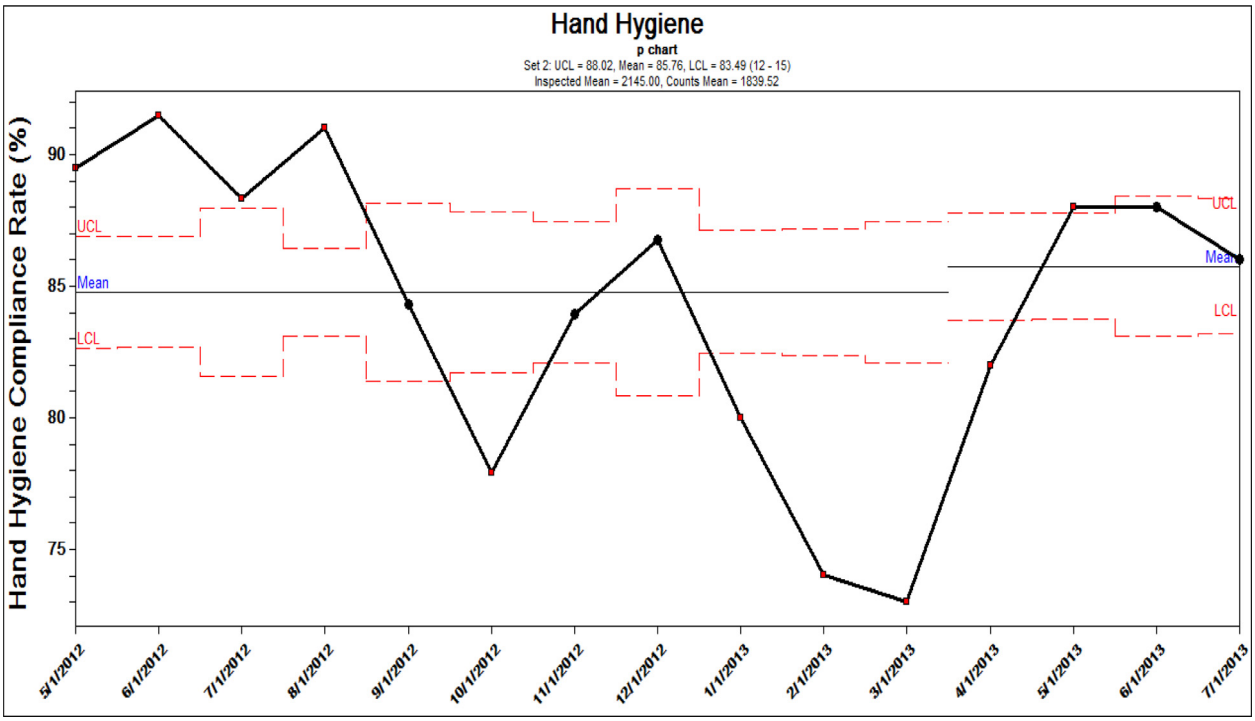

Fig 3. A run chart showing hand hygiene compliance rates in the period before Middle East respiratory syndrome cases (May 2012 to March 2013) and during Middle East respiratory syndrome cases (April to July 2013). *UCL*, Upper Control Limits; *LCL*, lower control limits.

the study period. Such an increase is a challenge and adds cost to the healthcare system.

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