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## Original article

# Outbreak of Middle East respiratory syndrome coronavirus, Saudi Arabian experience



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## ABSTRACT

**Objective:** MERS-CoV infection is uncommonly identified among patients visiting healthcare facilities & we were vigilant in screening all patients entering our hospital to prevent cross infection among patients, visitors & healthcare providers and aiming to prevent potential outbreaks with MERS-CoV infection. In spite of our efforts on practicing Failure Mode Effect Analysis for MERS-CoV infection management we ended up having an outbreak with MERS-CoV. Based on our experience, we actively implemented policies, procedures & practices on early identification & appropriate isolation practices along with supplemental infection prevention & control measures for preventing future outbreaks at our healthcare facility.

**Methods:** Retrospectively we analyzed our failure in preventing the outbreak of MERS-CoV infection among our hospitalized patients by identifying the outbreak & actively intervening as a team to control the outbreak with the support of Hospital Higher management, Administrators, Quality improvement team, Infection prevention & control team & the active support of all healthcare workers of the facility.

**Results:** Following the early identification of MERS-CoV outbreak, we could successfully prevent large scale outbreak both in the hospital & the community.

**Conclusion:** Continuous implementation of infection prevention & control standards along with early clinical diagnosis of MERS-CoV infections based on the case definition as laid out by the Ministry of Health will prevent infectious outbreaks at healthcare facilities.

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## 1. Introduction

Middle East respiratory syndrome coronavirus (MERS-CoV) was first identified from a 60-year-old Saudi male patient admitted to a private hospital in Jeddah, Saudi Arabia on June 13, 2012, with history of fever, cough, expectoration, and shortness of breath who eventually expired 11 days after admission from progressive respiratory failure.<sup>1</sup> Sputum sample had tested negative for common respiratory viruses viz: Influenza A and B, Parainfluenza virus types 1–3, Respiratory syncytial virus, and Adenovirus. Inoculation of processed sputum sample from the patient on viral cell cultures (LLC-MK2 and Vero) produced specific cytopathic effect in a Netherlands virology centre known as Erasmus Medical Center and so the identified virus was initially labelled as Human Coronavirus Erasmus Medical Center.<sup>1</sup> In September 2012, similar virus was recovered from a patient with severe respiratory symptoms who had a history of travel to Saudi Arabia and had

been transferred from a hospital in Qatar to a hospital in London and so named as Human Coronavirus England 1.<sup>2</sup>

This new disease was also traced to an earlier time period. In April 2012, a cluster of cases of pneumonia occurred in health care workers of an intensive care unit in a hospital in Zarqa, Jordan, of which 2 patients died, both of whom were confirmed to be infected with the novel coronavirus by retrospective analysis of stored sample.<sup>3</sup> Since its initial discovery, the virus had been described under various names (human beta coronavirus 2c EMC, human beta Coronavirus 2c England-Qatar and novel Coronavirus). This lack of uniformity in virus nomenclature complicated communication among health care workers, governments, and the general public. So the Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses decided to call the new coronavirus as Middle East Respiratory Syndrome Coronavirus (MERS-CoV). This name was accepted by the World Health Organization (WHO) and the Ministry of Health (MOH) of Saudi Arabia.<sup>4</sup> From the identification of 1st MERS-CoV patient, until January 17, 2017, 1879 laboratory-confirmed cases of MERS-CoV infection with 666 (35.4%) deaths have been reported.<sup>5</sup>

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## 2. Epidemiology

Understanding of epidemiology of MERS-CoV increased after a large hospital outbreak in Al-Hasa in the eastern province of Saudi Arabia where cluster of MERS-CoV infections and health care-associated human-to-human transmission of MERS-CoV were reported. The case fatality rate in the outbreak was 65% and it was found that the disease presentation ranged from mild to fulminant in clinical severity. Clinical syndrome was found to be similar to severe adult respiratory syndrome (SARS), with initial presentation as nonspecific fever and non-productive cough, later progressing to pneumonia. Significant number of patients with MERS-CoV infection also had gastrointestinal symptoms (vomiting and diarrhoea), a finding similar to that with SARS. In the majority of patients in the study, fever was high, but the pulmonary involvement on chest radiography was variable. The survival rate was higher among patients who were identified by active surveillance during the outbreak than among those patients who were identified clinically. The incubation period of MERS-CoV was estimated to have an incubation period of 14 days, with 5% of cases developing within 1.8 days and 95% within 10.6 days.<sup>6</sup>

## 3. Almana general hospital experience

Despite Failure Mode and Effect Analysis (FMEA)<sup>7</sup> that was conducted to prevent MERS-CoV outbreak in our healthcare facility which is also located in the same geographical location where increasing number of MERS-CoV outbreaks are noted. Our hospital is a 150 bedded secondary care level facility and an outbreak with MERS-CoV among 5 patients occurred in October 2015 where the 1st patient was diagnosed on the 2nd of October 2015. All the 5 patients were confirmed by virological diagnosis and all these patients succumbed to their illness at a government referral centre dedicated to care for patients with MERS-CoV infection. The cause of death was respiratory failure along with renal shutdown. During this outbreak, 2 nursing staff who cared for the above patients in the medical intensive care unit were also infected with MERS-CoV. Of the 2 nursing staff, one was asymptomatic and the other was severely symptomatic who needed ventilator support as she progressed to respiratory failure. Both the nursing staff recovered completely with 3 negative virology tests on their respiratory samples. As a result of MERS-CoV outbreak at our facility, we had to face the following adverse effects:

The hospital was kept closed for new admissions for 40 days until the hospital was declared free of new MERS-CoV cases on the 10th of November 2015. The regional community and our hospital healthcare workers (HCWs) developed anxiety to the risk of developing MERS-CoV infection. Following the opening of our facility for new patient admissions, significant reduction in patient visits and admission was noted which costs the hospital management, significant financial loss and loss of reputation.

Hence, we from the infection prevention and control (IPC) services initiated a collaborative approach with the support of the following departments; Hospital quality improvement, Nursing services, Chief Executive Officer, Medical Director and the Hospital higher Management, to focus on the practice of HCWs in managing suspected MERS-CoV infection. A team was formulated to come up with the analysis, results, and effectiveness of planned solutions to the problem with implementation of the following preventive measures. Scheduled monthly meeting of project team members was conducted and was continuously reviewed. Review and update of MERS-CoV policy and procedure along with structural compliance was adhered to. Intensive onsite education to all HCWs of the hospital and subsequent competency test results were tabulated and reported to the MOH

preventive medicine department. HCWs with low competency test results were re-educated along with hands on training.

Triage teams were formed and got posted at all hospital entry points to screen all patients, visitors and HCWs for symptoms (fever, cough, difficulty in breathing, diarrhoea, vomiting, headache, bodyache) and signs (Evidence of pneumonia or acute respiratory distress syndrome, leucopenia, thrombocytopenia) correlating with MERS-CoV infection. Any epidemiological history of contact with a confirmed or suspected MERS-CoV infected patient, camels or its products in the previous 14 days were to be considered for MERS-CoV screening. The virus gets suspended in the air for at least 36 h and commonly spreads by air borne route especially when aerosol generating procedures are conducted<sup>6</sup>. Hence, individuals identified with the above signs, symptoms and epidemiological link are promptly transferred to air borne infection isolation rooms (AIIRs) for further evaluation by the physicians. New respiratory illness room with portable High efficiency particulate arrestors (HEPA) was created to isolate suspected MERS-CoV infected patients within the Emergency Medical Services. The physicians were provided with hands on training on proper collection of nasopharyngeal samples to prevent occurrence of false negative virology results. HCWs prior to entering the patient room were strictly supervised for donning the personal protective equipments (PPE) in sequence after adequate hand hygiene. Sequences of wearing the PPE are as follows; clean gown, N95 Mask, Face shield and gloves. Removal of the PPE after completion of patient care was also done in a sequence in the reverse order and special emphasis was laid on performing hand hygiene between each PPE removal. The hospital management of information system installed video programs on all infection prevention practices including the case definitions for MERS-CoV on the hospital portal and all televisions displayed at all patient care locations. Social workers and patient educators were trained and encouraged to provide education to all visitors, patients and their families on MERS-CoV infection and prevention methods.

The hospital higher management fully supported the interventional program conducted by the infection prevention and control team. The IPC team recommended installing fumigation machines delivering a combination of hydrogen peroxide with silver ions for disinfection of patient rooms following patient discharge. The air ventilation system within the entire hospital building was cleaned and disinfected along with appropriate change of HEPA filters. The housekeeping staff had been provided with adequate training on the process of terminal cleaning and subsequent use of the fumigation system. Portable radiological machines such as ultrasound, C – arm machines have been used for all clinically suspected MERS-CoV patients. The hospital construction services created additional AIIRs which totaled to 22. In addition, portable HEPA filter machines (8) were procured to be used in respiratory illness rooms identified at high risk patient care locations viz: haemodialysis unit, Outpatient services, Special care baby unit, Paediatric services, Obstetric and Internal Medicine wards.

The IPC team underwent re-training with regular refresher courses on the management of MERS-CoV infections with the preventive medicine services of MOH. The MOH team also conducted multiple unannounced visits to the hospital for conducting audits on infection control practices by the healthcare providers. Any identified deficiency was promptly corrected with the active support of the hospital Medical Director. Since then, the HCWs along with the active support of IPC services are performing continuous surveillance on suspected MERS-CoV patients, actively isolating them, performing adequate and appropriate respiratory sample collection and prompt transport to the regional virology laboratory. The virology test results are

made available within 24 h. Until date (July 2017), there are no healthcare associated MERS-CoV Infection among patients, visitors and HCWs of our hospital and improved compliance with the IPC policies and procedures were achieved.

#### 4. Conclusion

The emergence of MERS-CoV nearly 10 years after SARS-CoV disappearance has shown that pathogenic coronaviruses may continue to spill over from zoonotic sources into the human population. Surveillance studies of viruses in animal species, including bats, rodents, and livestock, will help us to understand the potential human pathogens that exist in the environment before they can spill over human population. There are no antiviral medications available to treat MERS-CoV infections and the patient management is purely symptomatic. There is a need to develop vaccines and therapeutic strategies to prepare for the emerging coronaviruses. The sooner we understand the dynamics of current threats, the more we will be better equipped to save people from infection and disease.

#### Conflict of interest

None.

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