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EDITORIAL

Preventing healthcare-associated transmission of the Middle East Respiratory Syndrome (MERS): Our Achilles heel

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Summary Middle East Respiratory Syndrome (MERS) coronavirus is the most recent among the Coronaviridae family to jump species and infect humans. Major healthcare associated MERS outbreaks have occurred in the Middle East and Korea that affected both patients and healthcare workers. These outbreaks were characterized by intra and inter-hospital spread and were exacerbated specifically by overcrowding, delayed diagnosis and appropriate use of personal protective equipment. Recent experience with this virus emphasizes the importance of compliance with infection control practices and with other interventions addressing patient triage, placement and flow within and between healthcare facilities. Our Achilles heel remains compliance with the best infection prevention practices and their harmonization with patient flow. Both infection prevention compliance and maintenance of patient flow are critical in preventing healthcare-associated transmission of many of these emerging infectious diseases, including MERS.

Middle East Respiratory Syndrome (MERS) coronavirus is the most recent among the Coronaviridae family to jump species and infect humans [1]. Despite the potential role of camels in disease transmission, the current burden of the virus lies in its association with healthcare-based outbreaks [2,3,4]. To date, the majority of cases have been identified in the Kingdom of Saudi Arabia. Hospital outbreaks emphasize the importance of compliance with infection control standards, where not only the obvious practices of hand hygiene and proper use of personal protective equipment (PPE) are important but other interventions addressing patient triage, placement and flow within and between healthcare facilities are also critical to preventing disease spread. The largest reported outbreak was in Jeddah, Saudi Arabia, in the spring of 2014, where 255 individuals were diagnosed with MERS and an estimated 97.3% were healthcare-associated infections [2]. One-third of the cases were among healthcare providers. A more recent outbreak in the Republic of Korea was traced back to one traveler from the Arabian Peninsula, and again, a substantial portion of infections was associated with healthcare [3].

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Root causes of this outbreak included delayed case recognition, overcrowding in emergency rooms, and ''doctor shopping''. The recent outbreak in our hospital in Riyadh, Saudi Arabia, in August and September 2015 was traced to delayed recognition of MERS cases, overcrowding of the Emergency Department and incomplete adherence to infection control practices, such as the use of barrier precautions and hand hygiene [5]. These outbreaks did not only lead to patient-level morbidity and mortality but they also had substantial economic, social and even political impacts. Importantly, the ability of hospitals to provide care for routine illnesses was clearly jeopardized during these MERS outbreaks. Additionally, as in the past outbreaks of Severe Acute Respiratory Syndrome (SARS), fears among healthcare workers of becoming infected while caring for infected patients led to a significant psychological and emotional burden [6]. The recent MERS outbreaks are reminiscent of SARS in 2003, H1N1 in 2009 and even some clusters of avian influenza. These recent MERS outbreaks stress, yet again, the vulnerability of healthcare systems to the threat of emerging respiratory pathogens. These threats are not over; and the most likely runner up candidate for an outbreak would be a newly shifting influenza virus [7].

Are hospitals and health systems ready for such a challenge? Unfortunately, they are not. A new report indicated that more than half of U.S. states are poorly prepared to respond to infectious disease outbreaks [8]. For example, to better understand practices that would facilitate primary prevention among healthcare providers and patients, consider influenza vaccination. In a survey of infection prevention and control specialists at 386 U.S. hospitals, only 43 percent indicated that influenza vaccinations were mandatory for all health care providers in their hospitals or clinic settings [9]. Only 1.3 percent of Veterans Affairs hospitals required all healthcare providers to obtain an influenza vaccine [9]. Studies demonstrate that many hospitals in the USA lack negative pressure rooms and lack surge capacity for health care providers and medical equipment/supplies in regard to preparedness for emerging infectious diseases [10,11]. Likewise, many hospitals around the globe are not prepared to manage a surge of cases of Acute Respiratory Infections (ARIs). In a study of 325 Asian ICUs, 13.4% did not have single rooms and 36.7% did not have negative-pressure rooms [12]. In a study in China, only 2.2% of hospitals had all of the PPE needed to protect healthcare providers, and only 30.6% reported that their health care staff had been trained in hospital emergency preparedness for infectious disease events [10].

Compliance with infection prevention and control practices is our Achilles heel and is critical in preventing healthcare-associated transmission of many of these emerging infectious diseases, including MERS. Despite many strengths in our healthcare systems, the root causes of transmission of several recent respiratory viral infections has been poor compliance with approaches to respiratory illness. A universal approach to all patients presenting with ARI has been recommended by the World Health Organization (WHO) and the Centers for Disease Control (CDC) [13,14]. Early identification and diagnosis of ARI is key to prompt isolation and the only methods to ensure an interruption in the chain of transmission. Yet, early diagnosis and isolation are commonly delayed. For that reason, we should refocus our efforts and ensure that patients with ARI symptoms are placed in droplet and contact isolation. Even if MERS has been primarily diagnosed in the Arabian Peninsula; physicians around the world need to have a low index of suspicion for patients presenting with respiratory illness. Remember, avian influenza was linked to Asian countries yet, H1N1 emerged in Mexico [13,14]. Healthcare providers need to be taught to think critically, to be aware of the association of these various infections with different geographic parts of the world and to be aware of their case definitions when dealing with ARI cases.

The WHO recommends that patients with suspected or confirmed MERS be isolated under droplet and contact precautions using eye protection; and that patients be placed in airborne isolation when performing aerosol generating procedures (AGPs), whereas the CDC recommends airborne isolation for all suspected and confirmed cases of MERS [14]. This discordance in recommendations may reflect the availability of resources, yet leads to confusion among providers. Our experience has shown that a modified approach balances resources and risk. We saw no transmission when placing suspected cases in droplet isolation with the exclusive use of airborne isolation when performing an AGP and saw no transmission for confirmed cases when following these practices (unpublished data). Hence, we feel that these decisions can be based on the availability of resources and also on a good patient-by-patient risk assessment.

A hospital-based Respiratory Protection Program (RPR)

To comply with the above recommendations for preventing healthcare transmission of respiratory

Table 1 Examples of elements under the three pillars of infection prevention and control in the healthcare setting.

Element	Pillar	Examples
I. Policy and procedure		
	Governance	• Committee/department ○ Multidisciplinary ○ Reporting directly to highest level of leadership ○ Defined authority and accountability
	Policy and practices	• Management of employee database for ease of contact tracing ○ Serology status to blood borne pathogens ○ Immunization status ○ Respiratory fit testing status ○ Latent TB status • Hand hygiene • Standard precautions • Extended precautions • Policy ○ Outbreak management ○ Isolation and barrier precautions ○ Aseptic technique ○ Cleaning, disinfection and sterilization ○ Supplies and their reuse • Contact tracing • Surveillance and data management
II. Facility and human resources		
	The infection control team	• Trained and experienced infection control officers and hospital epidemiologists • Infection preventionists, 1/100 acute care beds and 1/200 non-acute care beds
	Respiratory triage areas	• Early recognition of and separation of patients with respiratory illness from those with no respiratory illness • Establishing isolation facilities where patients with respiratory illness can be evaluated and treated separately from those with no respiratory illness
	Inpatient facility	• Single bedded rooms are preferred • Cohort policies when single bedded rooms not available • Running clean water sinks, soap, should be available • Alcohol-based hand hygiene rub or gel be as a hand hygiene solution
	Negative pressure rooms (NPRs)	• NPRs are necessary for airborne isolation • The facility has the ability to expand on NPRs if needed. Incase of surge of respiratory illness patients • NPRs should be regularly monitored according to policy
	Single bedded isolation rooms	• For droplet and contact isolation
	Consumables related to IPC practices	• Personal protective equipment (PPE) should always be available: ○ Masks ○ Gowns ○ Water proof gowns ○ Gloves ○ Goggles/face shields • Soap • Hand hygiene dispensers and alcohol-based hand rub
	CSSD facility	• Policies in place to assure evidence-based cleaning, disinfection and sterilization of equipment • Consider no-touch technologies to enhance cleaning • Abandon reuse of single-use items without a clear policy
III. Behavior, accountability and leadership		
	Education	• Monthly, quarterly, annual • Hands-on, practice-based training • Online training
	Competency evaluation	• Certified competency evaluation as part of the educational processes
	Example setting	• Visible leadership presence • Leaders as role models
	Rewarding of exemplary performance	• Setting an accountability hierarchy

HH: hand hygiene, ABHR: alcohol-based hand rubs.

pathogens, hospitals must develop a system-wide and systematic approach to ensure that there is an understanding of respiratory pathogens as well as their diagnoses, and hospitals must empower such programs to prepare and respond to emerging respiratory diseases. Healthcare leadership will need to balance the cost and benefit of investing in such programs. Developing a RPP for enhanced preparedness to new infectious and unexpected respiratory outbreaks and pandemics requires that the infection control programs redefine their roles under three main pillars: policy and procedure, facility preparedness and accountability and leadership, Table 1. A RPP would be essential to address, at a minimum, the availability of proper isolation facility, equipment and supplies, including soap and water, alcohol based hand gel, masks and respirators. The latter requires proper fitting of all at-risk healthcare providers. Further considerations would include the availability of alternatives for respirators, such as the Powered Air Purifying Respirators (PAPRs), which require proper cleaning and storage, as well as training on their usage. Assessing the capacity for airborne isolation is a major intervention, but a necessary one. Some healthcare facilities will have to build new facilities or renovate old ones to fulfill airborne isolation requirements [14].

As a part of their disaster preparedness, healthcare facilities should have a specific plan to address possible infectious disease disaster scenarios. Among the top infectious scenarios are: the emergence of a novel respiratory pathogen; a viral hemorrhagic pathogen, such as Ebola (EHV); or an agent with the potential to be used in a bioterrorism attack, such as anthrax or smallpox. The infectious disease disaster plan (IDDP) will have unique elements that depend on the characteristics of the pathogen, its transmission and the presence of effective mitigation strategies. Hence, an IDDP would need to be accompanied by special drills to ensure the full preparedness of the facility and staff. Such drills would lead to clarification of individual roles, the refinement of incident command structure and the development of needed training materials and policies. Such a plan would also need to be integrated and practiced at many levels of the healthcare system. At a minimum, it could be practiced as a tabletop exercise, but more effectively, it should be practiced at the hospital level, at the health system level, and at the city, regional and national levels, if possible. In essence, an IDDP needs to be adopted at the national level to ensure support and sharing of human and non-human resources [15].

In summary, an outbreak can be taken as an opportunity to assess readiness and build capacity by hospitals. Many examples exist from the SARS outbreaks in a number of cities, from the MERS outbreaks and, most recently, from Ebola outbreaks. Over the past decade alone, we have witnessed the emergence of at least two novel influenza strains, two corona viruses and the unprecedented spread of a known viral hemorrhagic virus, Ebola. Despite the available resources in some countries, the Achilles heel of most healthcare systems remains their inability to predict and detect such threats, then to respond and manage them. The development of preparedness plans that are integrated into health-care systems, regardless of how simple these healthcare systems may be in many low income source countries, will be the first step to enable nations to address the next respiratory threat. In addition, support to implement the International Health Regulation (IHR) guidelines are desperately needed if countries are expected to recognize and contain emerging pathogens. This would be necessary to prevent these pathogens from becoming global threats.

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