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## Qatar experience on One Health approach for middle-east respiratory syndrome coronavirus, 2012–2017: A viewpoint



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## ARTICLE INFO

**Keywords:**  
One Health  
MERS-CoV  
Qatar

## ABSTRACT

The emergence of the Middle East Respiratory Syndrome Corona Virus (MERS-CoV) in the Middle East in 2012 was associated with an overwhelming uncertainty about its epidemiological and clinical characteristics. Once dromedary camels (*Camelus dromedarius*) was found to be the natural reservoir of the virus, the public health systems across the Arabian Peninsula encountered an unprecedented pressure to control its transmission. This view point describes how the One Health approach was used in Qatar to manage the MERS-CoV outbreak during the period 2012–2017.

One Health focuses on the association between the human, animals and environment sectors for total health and wellbeing of these three sectors. To manage the MERS outbreak in Qatar through a One Health approach, the Qatar National Outbreak Control Taskforce (OCT) was reactivated in November 2012. The animal health sector was invited to join the OCT. Later on, technical expertise was requested from the WHO, FAO, CDC, EMC, and PHE. Subsequently, a comprehensive One Health roadmap was delivered through leadership and coordination; surveillance and investigation; epidemiological studies and increase of local diagnostic capacity.

The joint OCT, once trained had easy access to allocated resources and high risk areas to provide more evidence on the potential source of the virus and to investigate all reported cases within 24–48 h. Lack of sufficient technical guidance on veterinary surveillance and poor risk perception among the vulnerable population constituted major obstacles to maintain systematic One Health performance.

### 1. The problem

The emergence of the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in the Middle East in 2012 [1] has remained a public health concern particularly in the Arabian Peninsula till the present time. Dromedary camels (*Camelus dromedarius*) have been found to be the natural reservoir from which the viral spill-over to humans can occur. Camels show no or minor clinical signs if infected with MERS-CoV [2]. As of the end of February 2019, 2374 laboratory confirmed human cases worldwide, including 823 associated deaths (case-fatality rate: 34.6%), have been reported. The majority of these

cases were reported from Saudi Arabia (1983 cases, including 745 related deaths) [3]. In Qatar, a total of 24 human cases have been reported along with 8 related deaths. At the beginning of the MERS outbreak in 2012, the lack of knowledge, particularly on the mode and speed of transmission of this novel virus, challenged the healthcare systems in Qatar as well as the entire Gulf region, amid fears that transmission could readily happen between humans. The unfamiliarity of the responding agencies of the Gulf Cooperation Council (GCC) with such an extraordinary threat heightened the concerns of the affected communities in Qatar as MERS cases continued to be reported from all neighbouring GCC countries. Moreover, the GCC countries are

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characterised with intensive movement of people and camels across the borders.

An eager race was started to establish the epidemiology of the disease. The epidemiological link of MERS-CoV with camels was revealed in October 2013. Two patients had frequent contact with animals, including camels, and had no history of travel outside Qatar in the two weeks before they became ill. MERS-CoV was detected from nasal swabs of three camels with which the patients had contact [4]. A huge pressure was placed on the Qatar National Outbreak Control Task Force (OCT) to find answers for the novel disease to control the outbreak and inform the public. During the early phase of the MERS-CoV epidemic, the OCT had to decide from where to start and which methods to follow.

The One Health approach focuses on the association and interconnection between three sectors: human, animal and environmental health, and recognizes the total health and wellbeing of these three sectors [5]. One health is defined as “A collaborative, multisectoral, and transdisciplinary approach - working at the local, regional, national, and global levels - with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment” [6]. This view point describes how the One Health approach was used in surveillance and response to MERS-CoV in Qatar during the period 2012 to 2017. It could be useful to similar authorities to inform their preparedness plans for the next potential emerging zoonotic epidemic in light of the strengths and challenges experienced by Qatar.

## 2. Action taken

The OCT was reactivated in Qatar in November 2012 following the detection of the second MERS-CoV case (sixth worldwide) in the country. The OCT was established before as a requirement of the International Health Regulation (IHR) (2005). It is a joint outbreak investigation team composed of public and animal health experts lead by the Ministry of Public Health (MoPH) in Qatar, applying the One Health approach and dealing with zoonotic infections. The OCT played a fundamental role in the national response to the Severe Acute Respiratory Syndrome (SARS) and Influenza (H1N1) virus pandemic in 2009. The new OCT involved multidisciplinary and multisectoral representation primarily from the MoPH and the Ministry of Municipality and Environment (MME) in Qatar. To develop a coherent investigation and response strategy, the MoPH leaders decided to support the OCT with technical expertise from the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the Centres for Disease Control and Prevention of the United States (CDC), Public Health England (PHE), and Erasmus Medical Centre (EMC) in the Netherlands.

Experts from these institutions engaged the OCT in an extensive risk assessment of the MERS outbreak situation. A comprehensive road map was developed to provide guidance on surveillance, investigation and response, using a joint One Health approach. This road map included: (1) Coordination and joint leadership, (2) Joint surveillance and field investigation, (3) Epidemiological studies, and (4) Increase of local diagnostic capacity.

### 2.1. Coordination and joint leadership

The road map emphasized the fostering of a conjoined leadership in terms of planning and decision making. An improved level of coordination was witnessed thereafter between authorities across a number of areas; sharing of information turned into timely practice, the process for decision making and approval of plans became quicker, access to allocated resources and high risk areas (e.g., slaughter house, animal holdings, camel racing areas, hospitals etc.) became easier, and communicating the risk to the public reflected one voice for joint authorities.

### 2.2. Joint surveillance and field investigation

A joint Rapid Response Team (RRT) was assigned from the MoPH and the MME to carry out field investigation after being subjected to refresher training on skills and principles of outbreak investigation. To initiate One Health surveillance it was agreed to build the RRT on the already functioning Severe Acute Respiratory Infections (SARI) surveillance team in the Public Health Department. The SARI team routinely searches for SARS and Influenza virus among suspected cases admitted to hospitals with respiratory symptoms. Importantly, the community was also engaged in this form of surveillance as family members, friends and co-workers of the suspected cases were educated about MERS symptoms and how to report them.

The ability to access and investigate all of the 24 reported cases within 24–48 h of reporting was one of several fruits of the One Health surveillance, permitting to yield further epidemiological evidence on the potential role camels play in the virus transmission. Whenever a human case was suspected with MERS infection, a patient investigation was conducted, which included contact tracing, work and movement of the patient and history of camel contact. If the patient had direct or indirect camel contact, the RRT informed their veterinary counterpart. The veterinary team tested the camels around the patient. The public health team tested all human contacts around the patient. Later on, a complete report of that patient was prepared. Based on these reports, a complete One Health approach was developed and implemented. At least 3 MERS cases were detected during routine case investigations and contact tracing at the community settings.

### 2.3. Epidemiological studies

The One Health road map recommended to start with a case-control study and seroepidemiological surveys targeting at-risk populations including humans and camels besides testing the stored human respiratory samples retrospectively to determine whether the virus was totally novel to Qatar population. The outcome of joining forces in carrying out these studies was outstanding. First and foremost it helped facilitate the access of the joint RRT to the camel barns and the farms hosting race camels. Collection of samples and data of camels and their caregivers became easier, allowing a series of subsequent fundamental epidemiological, veterinary and clinical studies to take place.

Through these studies it was possible to provide the first global molecular evidence that camels are a potential source for MERS-CoV [4]. The door was opened to a number of research studies that ensued thereafter to yield insights into some essential aspects of MERS-CoV. While some studies focused on exposure to camels and the husbandry practices, others addressed the mode of transmission to humans, and possible risk factors [4,7–14]. These findings have been used to provide further guidance for studies and prevention measures in Qatar and other affected countries.

### 2.4. Increase the local diagnostic capacity

During the early days of the outbreak, the Influenza laboratory in the National Influenza Centre of Hamad Medical Corporation, Qatar was the primary destination to examine MERS-CoV samples. As the epidemic evolved and the OCT reactivated, the workload to diagnose human or camel specimens gradually increased. Joint training activities for both human and animal labs were organized on lab detection of MERS-CoV. MERS-CoV sample storage and the test capacity in both human and veterinary laboratories were scaled up. A network including international reference laboratories was initiated and this alliance is maintained to date to tackle other zoonotic diseases like Influenza, Rabies etc. To improve coordination and communication, a focal person was assigned from human and veterinary laboratories to ensure timely data and sample sharing.

### 3. Facilitators and barriers

The commitment of the MoPH and MME in Qatar to the One Health approach that governed the response to MERS-CoV was largely due to the previous experiences with SARS and H1N1 pandemic as these experiences helped to show the feasibility and advantages of joint efforts to policy-makers. The joint strategic technical collaboration between the Qatari authorities and the international technical bodies such as the WHO, FAO, CDC, PHE and EMC have greatly facilitated the preparation and implementation of the road map. Community engagement was another key factor that improved the investigation of suspected cases.

Yet, these achievements were not without obstacles. As camels infected with MERS only show asymptomatic or mild respiratory tract disease, camel owners and workers doubted the link between camels and the disease. Moreover, the veterinarians showed insufficient interest in mounting a large scale outbreak operation similar to the one initiated by the public health sector, as they have a shortage of technical guidance on surveillance and other technical areas including laboratory tools and diagnostic kits. The One Health approach needed more local and international support to ensure a systematic and sustained implementation. Furthermore, one study on risk perception suggested that some camel owners have poor risk perception of MERS [15]. Additionally, both public health and veterinary sectors were accustomed to work in a solo vertical way and only occasionally engaged with each other in short term research projects. Apart from the SARS and H1N1 epidemics, the two sectors worked independently, making joint technical work a difficult task. Therefore, the livestock sector did not appear to feel the same pressure as the public health sector. However, further studies are required to explore areas for improvement to ultimately make the One Health approach more appealing to all sectors involved.

### 4. Lessons learnt from the field

The One Health approach, despite lacking the appropriate technical guidance, was already functional and helped address some zoonotic diseases including Influenza and Brucella. Although capabilities and funding were unequal between the public health and the veterinary sector, the available competencies, supported with a substantial political will to join efforts and improve coordination, were sufficient to jointly address MERS-CoV. The adopted inter-sectoral collaboration for surveillance has been vital to obtain a better understanding of MERS-CoV in Qatar. Obtaining the reliable evidence about transmission between camels and humans could have never been achieved without the prompt and timely joint investigation. Building local One Health technical capacity to investigate and confirm MERS-CoV in humans and animals helped the early detection of cases in humans and animals. Such practices minimized the time and costs for public health control measures.

Community engagement has been key to establishing One Health surveillance in Qatar. Self-reporting of disease compared with the previous rejection and denial was an important change of behaviour among the people at risk, particularly those exposed to abattoir, camel race areas and the ports of entry. Furthermore, the positive community response to the MERS-CoV outbreak control policy was due to the constant transparent emergency risk communication which allowed the community to be well-informed of the situation. It also helped to maintain public trust in the competency of national authorities.

The One Health approach has been essential for generating evidence and implementing control measures to restrain MERS-CoV and other zoonotic diseases. The same approach needs to be maintained to assess the effectiveness of the control measures. As emerging zoonotic viruses continue to be a challenge, One Health surveillance must be adopted and fostered at all levels [5].

Finally, as the human MERS-cases seemed to uniquely emerge from the Arabian Peninsula, regional collaboration in sharing clinical and

surveillance data besides the results of scientific research is indispensable to finding answers to the remaining gaps in our knowledge about the disease. The unexpected disruption of the GCC countries undoubtedly hindered an effective regional collaboration in sharing data and carrying out sequencing studies. International agencies are required to call upon them to consider the One Health approach building on the Qatar experience which displayed a practical way of sharing resources and avoiding obstacles to work in the Arabian community. Establishing a regional committee for coordination and emergency risk communication is an important element to build capacities required for zoonosis control. We suggest that a regional 'One Health Centre of Excellence (OCE)' would help to develop unified standards and integrative guidelines for control of zoonoses including MERS-CoV.

### Conflict of interest

Authors declare no conflict of interest with regard to their views concerning the implementation of the One Health approach in Qatar.

### Funding

The One Health movement was supported by Ministry of Public Health, Qatar.

### References

- [1] A.M. Zaki, S. van Boheemen, T.M. Bestebroer, A.D.M.E. Osterhaus, R.A.M. Fouchier, Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia, *N. Engl. J. Med.* 367 (19) (2012) 1814–1820, <https://doi.org/10.1056/NEJMoa1211721> (Epub 2012 Oct 17).
- [2] R. Sikkema, E. Farag, M. Islam, M. Atta, C. Reusken, M. Al-Hajri, et al., Global status of Middle East respiratory syndrome coronavirus in dromedary camels: a systematic review, *Epidemiol. Infect.* 147 (2019) E84, <https://doi.org/10.1017/S095026881800345X>.
- [3] Regional office of the Eastern Mediterranean, World Health Organization, MERS Situation Update, February 2019, <http://www.emro.who.int/health-topics/mers-cov/mers-outbreaks.html> (accessed 13rd March 2019).
- [4] B.L. Haagmans, S.H. Al Dhahiry, C.B. Reusken, V.S. Raj, M. Galiano, R. Myers, Middle East respiratory syndrome coronavirus in dromedary camels: an outbreak investigation, *Lancet Infect. Dis.* 14 (2014) 140–145, [https://doi.org/10.1016/S1473-3099\(13\)70690-X](https://doi.org/10.1016/S1473-3099(13)70690-X).
- [5] A. Zumla, O. Dar, R. Kock, M. Muturi, F. Ntoumi, P. Kaleebu, et al., Taking forward a 'One Health' approach for turning the tide against the Middle East respiratory syndrome coronavirus and other zoonotic pathogens with epidemic potential, *Int. J. Infect. Dis.* 47 (2016) 5–9, <https://doi.org/10.1016/j.ijid.2016.06.012>.
- [6] Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), <https://www.cdc.gov/onehealth/basics/index.html> (accessed 13rd March 2019).
- [7] E.A.B.A. Farag, C.B.E.M. Reusken, B.L. Haagmans, K.A. Mohran, V.S. Raj, S.D. Pas, et al., High proportion of MERS-CoV shedding dromedaries at slaughterhouse with a potential epidemiological link to human cases, Qatar 2014, *Infection Ecology & Epidemiology* 5 (2015), <https://doi.org/10.3402/iee.v5.28305>.
- [8] V.S. Raj, E. Farag, C.B. Reusken, M.M. Lamers, S.D. Pas, J. Voermans, Isolation of MERS coronavirus from a dromedary camel, Qatar, 2014, *Emerg. Infect. Dis.* 20 (2014) 1339–1342, <https://doi.org/10.3201/eid2008.140663>.
- [9] C.B. Reusken, E.A. Farag, M. Jonges, G.J. Godeke, A.M. El-Sayed, S.D. Pas, et al., Middle East respiratory syndrome coronavirus (MERS-CoV) RNA and neutralising antibodies in milk collected according to local customs from dromedary camels, Qatar, April 2014, *Euro Surveill.* 19 (23) (2014), <https://doi.org/10.2807/1560-7917.ES2014.19.23.20829> pii = 20829.
- [10] C.B.E.M. Reusken, E.A.B.A. Farag, B.L. Haagmans, K.A. Mohran, G.-J. Godeke, V.S. Raj, et al., Occupational exposure to dromedaries and risk for MERS-CoV infection, Qatar, 2013–2014, *Emerg. Infect. Dis.* 21 (8) (2015) 1422–1425, <https://doi.org/10.3201/eid2108.150481>.
- [11] C.B.E.M. Reusken, C. Schilp, V.S. Raj, E.D. Bruin, R.H.G. Kohl, E.A.B.A. Farag, et al., MERS-CoV infection of alpaca in a region where MERS-CoV is endemic [letter], *Emerg. Infect. Dis.* 22 (6) (2016) 1129–1131, <https://doi.org/10.3201/eid2206.152113>.
- [12] R.S. Sikkema, E.A. Farag, S. Himatt, A.K. Ibrahim, H. Al-Romaihi, S.A. Al-Marri, et al., Identification of risk factors for primary MERS-CoV infection in camel workers in Qatar, 2013–2014; a case-control study, *J. Infect. Dis.* 215 (11) (2017) 1702–1705, <https://doi.org/10.1093/infdis/jix174>.
- [13] [The report of the Joint External Evaluation mission, International health regulations, zoonotic disease surveillance capacity evaluation report, Qatar, \(2016\).](https://www.who.int/news-room/fact-sheets/detail/mers-cov)
- [14] E. Farag, R.S. Sikkema, T. Vinks, M.M. Islam, M. Nour, H. Al-Romaihi, et al., Drivers of MERS-CoV emergence in Qatar, *Viruses* 11 (1) (2019) 22, <https://doi.org/10.3390/v11010022>.
- [15] M.M. Makhlof, S.R. Omer, R.A.A. Elyamani, M.H. Aabdeen, M.Q. Sharaf, A.M. El-Sayed, 2015 et al., Use of Health Belief Model to assess risk perception and practices of camel farm owners in Doha about MERS-COV, 2015. *Journal of Emergency Medicine, Trauma & Acute Care*, 126 International Conference in Emergency Medicine and Public Health – Qatar 2016 doi:<https://doi.org/10.5339/jemtaq.2016.icepq.126>.