# Review On Middle East Respiratory Syndrome (Mers-Cov)

Beyenech Gebeyehu [2], Wale Firew [1]

[1] Department of Animal Health, Instructor at Burie Poly Technique College, Burie, P.o.box. 75, Ethiopia
[2] Lecturer at Mekelle Univeristy, Department of Veterinary Medicine, Mekelle, P.o.box. 2084, Ethiopia
walextensay@gmail.com

**Absract:** The Middle East Respiratory Syndrome coronavirus (MERS-CoV) is positive-sense, single-stranded RNA novel species of the genus Betacoronavirus; as it was first reported in 2012 after genome sequencing of a virus isolated from sputum samples from patients who fell ill in a 2012 outbreak of a new flu. In humans, the virus has a strong tropism for non-ciliated bronchial epithelial cells, and it has been shown to effectively evade the innate immune responses and antagonize interferon (IFN) production in these cells. The median incubation period for secondary cases associated with limited human-to-human transmission is approximately 5 days (range 2-13 days). In MERS-CoV patients, the median time from illness onset to hospitalization is approximately 4 days. The virus is transmissible from animals to humans, humans to humans and also from humans to animals. Common signs and symptoms include fever (100°F or higher), chills/rigors, headache, non-productive cough, dyspnoea, and myalgia. Peoples at high risk include recent travelers from the Arabian Peninsula; those in close contacts of an ill traveler from the Arabian Peninsula; those having chance of close contacts of a confirmed case of MERS; healthcare personnel not using recommended infection-control precautions, and people with exposure to camels. While the mechanism of spread of MERS-CoV is currently not known, based on experience with prior coronaviruses, such as SARS, the WHO currently recommends that all individuals coming into contact with MERS suspects should wear a medical mask, and laboratory technicians should put on other additional safety personal protective equipment, including gloves and protective gowns.
[Beyenech G., Wale F. **Review On Middle East Respiratory Syndrome (Mers-Cov).** *Biomedicine and Nursing* 2017;3(2): 64-73]. ISSN 2379-8211 (print); ISSN 2379-8203 (online). http://www.nbmedicine.org. 10. doi:10.7537/marsbnj030217.10.

**Keywords:** Arabian Peninsula**,** MERS-CoV, personal protective equipment, SARS

## 1. Introduction

The name "coronavirus" is derived from the Latin *corona*, meaning *crown* or *halo*, and refers to the characteristic appearance of virions (De Groot *et al.,* 2013). Coronaviruses are a large family of viruses that cause a range of illnesses in humans, from the common cold to the Severe Acute Respiratory Syndrome (SARS) (WHO, 2014). Coronaviruses are species in the genera of virus belonging to one of two subfamilies Coronavirinae and Torovirinae in the family Coronaviridae, in the order Nidovirales. Coronaviruses are enveloped viruses with a positive-sense RNA genome and with a nucleocapsid of helical symmetry. The genomic size of coronaviruses ranges from approximately 26 to 32 kilobases, extraordinarily large for an RNA virus**.** This morphology is created by the viral spike (S) peplomers, which are proteins that populate the surface of the virus and determine host tropism. Coronavirus particles are irregularly-shaped, approximately 60-220nm in diameter, with an outer envelope bearing distinctive, 'club-shaped' peplomers. (De Groot *et al.,* 2013).

Coronaviruses were classified into 4 genera on the basis of their antigenic relationships, including Alpha coronavirus, Betacoronavirus, Gamma coronavirus, and Delta coronavirus, as described by the International Committee for Taxonomy of Viruses. Virus from each genus has been found in diverse host species including mammals and birds. Among these genera, viruses of the Alpha coronavirus, Betacoronavirus, and Delta coronavirus have been detected in swine (Chan *et al.,* 2013).

Known human coronaviruses likely originated as zoonotic pathogens that underwent host range expansion. These include coronaviruses associated with mild respiratory disease, such as HCoV-229E, HCoV-HKU1, HCoV-NL63, and HCoV-OC43, as well as strains that cause severe disease, including severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) (Li *et al*., 2005).

Middle East respiratory syndrome coronavirus (MERS-CoV) is a lineage C Betacoronavirus found in humans and camels that is different from the other human beta coronaviruses (severe acute respiratory syndrome coronavirus, OC43, and HKU1) but closely related to several bat coronaviruses (Zaki *et al*., 2012).

MERS-CoV infected several human cell lines, including lower (but not upper) respiratory, kidney, intestinal, and liver cells, as well as histiocytes (Chan *et al*., 2013). The range of tissue tropism in vitro was

broader than that for any other known human coronavirus. In another study, human bronchial epithelial cells were susceptible to infection (Kindler *et al*., 2013). Dipeptidyl peptidase 4 (DPP4; also known as CD26), which is present on the surfaces of human conciliated bronchial epithelial cells, is a functional receptor for MERS-CoV (Raj *et al*., 2013).

Middle East Respiratory Syndrome (MERS) is a viral respiratory illness that is new to humans. It is caused by a virus called Middle East Respiratory Syndrome Coronavirus, or MERS-CoV. It was first reported in Saudi Arabia in 2012 and has since spread to several other countries, including the United States. Most people infected with MERS-CoV developed severe acute respiratory illness, including fever, cough, and shortness of breath. Many of them have died (CDC, 2014).

As of January 23, 2015, WHO has confirmed 956 laboratory-confirmed cases of MERS-CoV infection, which include at least 351 deaths. All reported cases have been directly or indirectly linked through travel or residence to nine countries: Saudi Arabia, the United Arab Emirates, Qatar, Jordan, Oman, Kuwait, Yemen, Lebanon, and Iran. In the United States, two patients tested positive for MERS-CoV in May 2014, each of whom had a history of fever and one or more respiratory symptoms after recent travel from Saudi Arabia (Bialek *et al*., 2014). Several lines of evidence support the hypothesis that the MERS coronavirus has emerged from a mammalian reservoir host species. MERS-CoV genetic sequences have been isolated from two species of mammals sampled in close proximity with human MERS-CoV cases: dromedary camels in contact with confirmed human cases in Qatar and Saudi Arabia, and an Egyptian tomb bat in Saudi Arabia (Alagaili *et al.,* 2014).

The high mortality rates in family-based and hospital-based outbreaks, especially in patients with comorbidities such as diabetes and renal failure along with the respiratory droplet route of transmission evoked global concern and intensive discussion in the media. MERS typically begins with fever, cough, chills, sore throat, myalgia, and arthralgia, followed by dyspnea and rapid progression to pneumonia within the first week, often requiring ventilatory and other organ support (Arabi *et al.,* 2014)).

Recommendations for prevention of MERS are available from WHO, the US Centers for Disease Control and Prevention, and the Saudi Ministry of Health. The main infection prevention and control measures are droplet precautions (wearing a surgical mask within 1 m of patients) and contact precautions (wearing gown and gloves on entering patients' rooms and removing them on leaving). Droplet precautions should be added to the standard precautions when providing care to all patients with signs of acute respiratory infection (MOH-SA, 2014).

As of 2015 there is no specific vaccine or treatment for the disease. However, a number of antiviral medications are currently being studied. Just over 1000 cases of the disease have been reported as of May 2015, about 40% of those who become infected die from the disease (Zumla *et al*., 2015).

Therefore the objective of this paper is to point out the epidemiology and zoonotic importance of the disease, to note the risk factors related to the disease and how to combat the risks, to highlight the prevention and control of the MERS.

## 2. Middle East Respiratory Syndrome (Mers-Cov)

### 2.1. Etiology

Middle East Respiratory Syndrome (MERS) is a viral respiratory illness that is new to humans. It is caused by a virus called Middle East Respiratory Syndrome Coronavirus, or MERS-CoV, which is a lineage C beta coronavirus, and positive-sense ssRNA virus (CDC, 2014). It was first reported in 2012 after genome sequencing of a virus isolated from sputum samples from patients who fell ill in a 2012 outbreak of a new flu (de Groot *et al.,* 2013).

### 2.2. Epidemiology

#### 2.2.1. Occurrence and Geographic Distribution

Since April 2012, at least 1630 laboratory-confirmed human infections with Middle East respiratory syndrome coronavirus (MERS-CoV) have been reported to the World Health Organization (WHO), occurring primarily in countries in the Arabian Peninsula; the majority of cases have occurred in Saudi Arabia, including some case clusters. Cases have also been reported from other regions, including North Africa, Europe, Asia, and North America. In countries outside of the Arabian Peninsula, patients developed illness after returning from the Arabian Peninsula or through close contact with infected individuals (WHO, 2016).

The index case was a man in Jeddah, Saudi Arabia, who was hospitalized with pneumonia in June 2012. He developed acute respiratory distress syndrome (ARDS) and acute kidney injury and died; MERS-CoV was isolated from his sputum (Zaki *et al*., 2012). In September 2012, a nearly identical coronavirus was detected in a man who also had an acute respiratory distress syndrome and acute kidney injury requiring admission to the intensive care unit (Corman *et al*., 2012). He initially developed symptoms in Qatar but had recently traveled to Saudi Arabia and sought care in the United Kingdom (Zaki *et al*., 2012). The two earliest confirmed cases were subsequently reported from Jordan. Both patients died during a cluster of acute respiratory illness in April 2012, which included 10 healthcare workers.

Serologic testing suggested that seven surviving hospital contacts had MERS-CoV infection (WHO, 2012).

Several cases has occurred in individuals outside the Arabian Peninsula who had either traveled to the Arabian Peninsula in the recent past or who had had close contact with a patient with MERS who had recently returned from the Arabian Peninsula (Birmingham *et al*., 2012). In April 2013, a cluster of 23 confirmed cases and 11 probable cases of MERS-CoV was detected in Al-Hasa in the Eastern Province of Saudi Arabia Almost all cases were directly linked to person-to-person exposure (Assiri *et al*., 2013).

A sharp increase in the number of cases was reported in Saudi Arabia and the United Arab Emirates in March and April 2014. Of the over 500 cases reported, the majority represented hospital-based outbreaks in the Saudi Arabian cities of Jeddah (255 cases), Riyadh (45 cases), Tabuk, and Madinah and in Al Ain City, Abu Dhabi, United Arab Emirates, and included cases in healthcare workers, patients admitted for other medical problems, visitors, and ambulance staff. Up to 75 percent of cases during this period appeared to be acquired from exposure to persons known to be infected (WHO, 2014).

The Cases has also been reported from other regions, those which are outside the Middle East countries, including the first case in the United States occurred in an American healthcare worker in his sixties who lived and worked in Riyadh but traveled to Indiana in April 2014, where he presented for care (CDC, 2014). A second imported case in the United States was confirmed in May 2014 in Florida in an individual who was visiting Saudi Arabia (FLH, 2014).

The first cases in South Korea occurred in May 2015; the index case was a man who had recently traveled to Bahrain, the United Arab Emirates, Saudi Arabia, and Qatar. By early July 2015, a total of 185 secondary and tertiary cases had been reported among household and hospital contacts; 36 deaths were reported (Cowling *et al*., 2015) and one case occurred in a man who traveled to China following exposure to two relatives with MERS-CoV infection; this patient is the first reported case in China (Da Guan *et al*., 2015).

In Philippines and United Kingdom (On 27 July 2015) and also some case reports from African countries such as, Algeria, Egypt, Tunisia and a larger outbreak of MERS among camels in Kenya in January 2016 that results a death of about 500 camels without any known human cases (CDC, 2016). As of 14 January 2016, 1649 cases of MERS, including 638 deaths, had been reported by local health authorities worldwide.

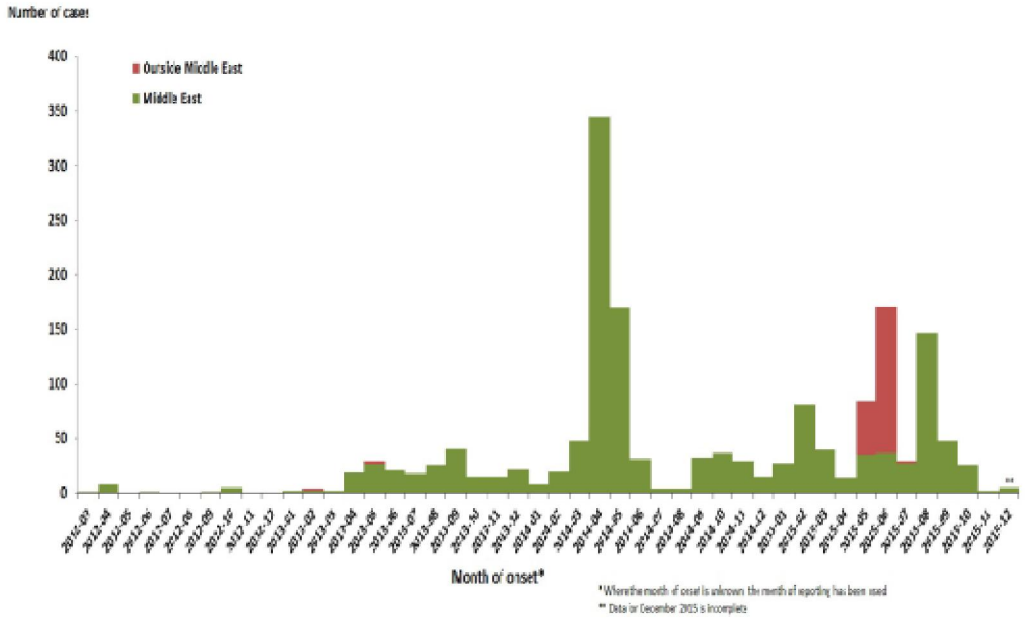


**Figure 1.** Distribution of confirmed cases of MERS by month and probable place of acquisition of infection, March 2012–31 December 2016 (CDC, 2015)

**Table 1.** Cases of MERS-CoV by country of reporting, March 2012–14 January 2016.

| Reporting country | Number of case | Number of deaths | Fatality rate (%) |
|---|---|---|---|
| **Middle East** | 1297 | 527 | 41 |
| **Saudi Arabia** | 1285 | 551 | 43 |
| **United Arab Emirates** | 83 | 11 | 13 |
| **Jordan** | 35 | 14 | 40 |
| **Qatar** | 13 | 5 | 38 |
| **Oman** | 7 | 3 | 43 |
| **Iran** | 6 | 2 | 33 |
| **Kuwait** | 4 | 2 | 50 |
| **Yemen** | 1 | 1 | 100 |
| **Lebanon** | 1 | 0 | 0 |
| **Europe** | 15 | 8 | 53 |
| **United Kingdom** | 4 | 3 | 75 |
| **Germany** | 3 | 2 | 67 |
| **France** | 2 | 1 | 50 |
| **Netherland** | 2 | 0 | 0 |
| **Greece** | 1 | 1 | 100 |
| **Turkey** | 1 | 1 | 100 |
| **Austria** | 1 | 0 | 0 |
| **Italy** | 1 | 0 | 0 |
| **Asia** | 191 | 37 | 19 |
| **China** | 1 | 0 | 0 |
| **Malaysia** | 1 | 1 | 100 |
| **Philippines** | 3 | 0 | 0 |
| **South Korea** | 185 | 36 | 19 |
| **Thailand** | 1 | 0 | 0 |
| **United State of America** | 2 | 0 | 0 |
| **Africa** | 6 | 2 | 33 |
| **Algeria** | 2 | 1 | 50 |
| **Egypt** | 1 | 0 | 0 |
| **Tunisia** | 3 | 1 | 33 |
| **Total (Globally)** | **1649** | **638** | **39** |

**(Source:** CDC, 2016)

In Ethiopia (Figure 2 below, panel C), samples from 188 dromedaries, ranging between 1 to 13 years of age were collected as part of a study evaluating the presence of toxoplasmosis and respiratory tract diseases in 3 provinces including Afar (118 cases), Somalia (11 cases) and Oromia (59 cases) during 2011–2013. All samples were taken by jugular vein puncture according to local laws, and serum samples and were stored at -20°C until they will be tested. All serum samples were shipped to the Erasmus MC laboratory in the Netherlands in agreement with Dutch import regulations. The serum samples were tested for the presence of IgG antibodies reactive with S1 antigens against MERS-CoV (CDC, 2014).

High percentages of animals seropositive for MERS-CoV were observed in Nigeria and Ethiopia; the overall seropositivity was 94% in adult dromedaries in Nigeria and 93% and 97% for juvenile and adult animals, respectively, in Ethiopia (Figure 2). All provinces in which dromedaries were sampled in both countries showed high rates of seropositivity (Figure 2). The overall seropositivity in dromedaries in Tunisia was 30% for animals≤2 years of age and 54% for adult animals.

**2.2.2. Host range**

Several lines of evidence support the hypothesis that the MERS coronavirus has emerged from a mammalian reservoir host species. MERS-CoV genetic sequences have been isolated from two species of mammals sampled in close proximity with human MERS-CoV cases: dromedary camels in contact with confirmed human cases in Qatar and Saudi Arabia, and an Egyptian tomb bat in Saudi Arabia (Alagaili *et al.,* 2014).

Early research suggested the virus is related to one found in the Egyptian tomb bat. In September 2012, Ron Fouchier speculated that the virus might have originated in bats (Doucleff and Michaeleen, 2012). Work by epidemiologist Ian Lipkin of Columbia University in New York showed that the virus isolated from a bat looked to be a match to the virus found in humans (Abedine and Saad, 2013).

Beta coronaviruses were detected in Nycteris bats in Ghana and Pipistrellus bats in Europe that are phylogenetically related to the MERS-CoV virus (Augustine *et al*., 2013).

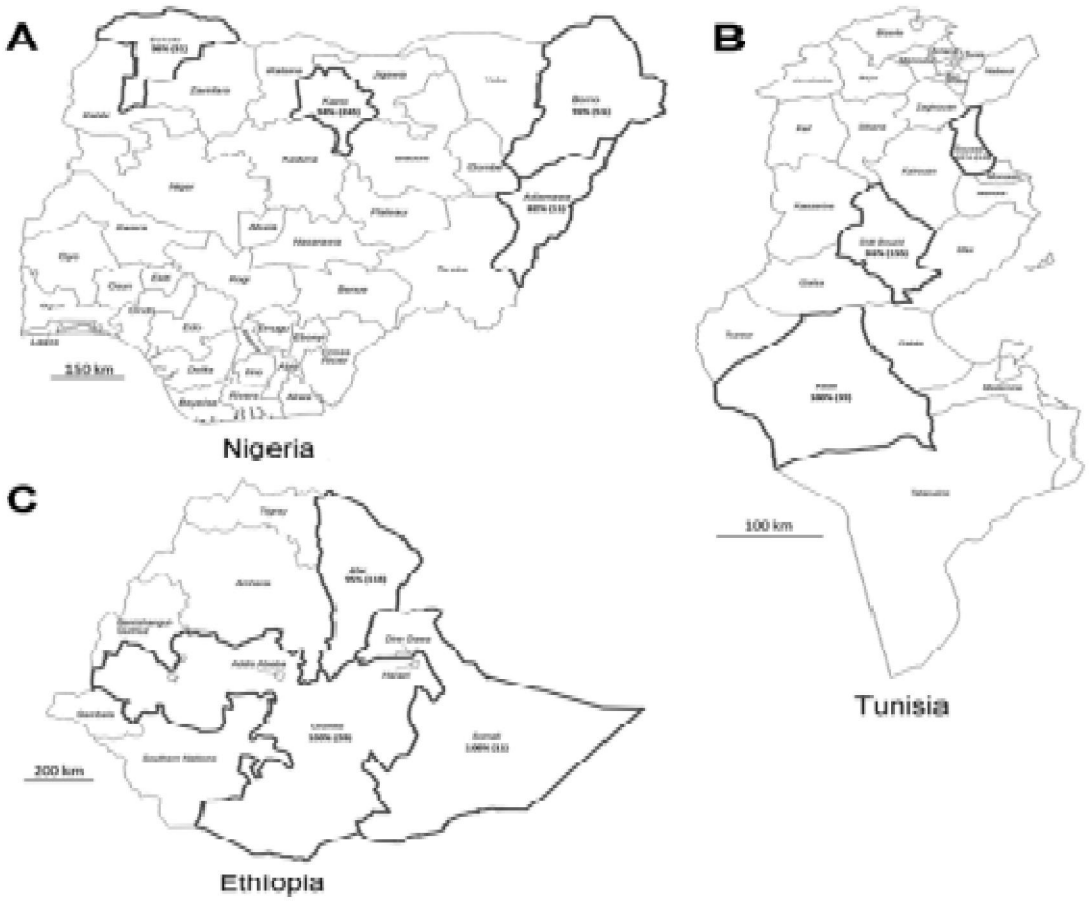


**Figure 2**: MERS seroprevalence in Ethiopia, Nigeria and Tunisia, (CDC, 2014)

On 9 August 2013, a report in the journal *The Lancet Infectious Diseases* showed that 50 out of 50 (100%) blood serum from Omani camels and 15 of 105 (14%) from Spanish camels had protein-specific antibodies against the MERS-CoV spike protein. Blood serum from European sheep, goats, cattle, and other camelids had no such antibodies (Reusken *et al.,* 2013).

A further study on dromedary camels from Saudi Arabia published in December 2013 revealed the presence of MERS-CoV in 90% of the evaluated three hundred thirteen dromedary camels, suggesting that dromedary camels not only could be the main reservoir of MERS-CoV, but also the animal source of MERS (Hemida and M, 2013).

According to the 27 March 2014 MERS-CoV summary update, recent studies support that camels serve as the primary source of the MERS-CoV infecting humans, while bats may be the ultimate reservoir of the virus. Evidence includes the frequency with which the virus has been found in camels to which human cases have been exposed, serological data which shows widespread transmission in camels and the similarity of the camel CoV to the human CoV (WHO, 2014).

On 6 June 2014, the *Arab News* newspaper highlighted the latest research findings in the New England Journal of Medicine in which a 44-year-old Saudi man who kept a herd of nine camels died of MERS in November 2013. His friends said they witnessed him applying a topical medicine to the nose of one of his ill camels, four of them reportedly sick with nasal discharge -seven days before he himself became stricken with MERS. Researchers sequenced the virus found in one of the sick camels and the virus that killed the man, and found that their genomes were identical. In that same article, the *Arab News* reported that as of 6 June 2014, there have been 689 cases of MERS reported within the Kingdom of Saudi Arabia with 283 deaths (Mohammed and R, 2014).

Almost all adult camels (>90 percent) from countries in the Arabian Peninsula, Jordan, Egypt,

Nigeria, and Ethiopia show antibody evidence of prior MERS-CoV infection; adult camels in other countries of the region (Kenya, Tunisia, Spain, Canary Islands) are also MERS-CoV antibody positive but at a lower prevalence (Müller *et al*., 2014). No other domestic animals tested have shown evidence of infection (CDC, 2014).

In another study, three dromedary camels inoculated with MERS-CoV intra-tracheal, intra-nasally, and conjunctively shed large quantities of virus from the upper respiratory tract. Infectious virus was detected in nasal secretions for 7 days post inoculation and viral RNA for up to 35 days post inoculation (Reuss *et al*., 2014). In another study, viral RNA was detected in the milk of camels (Arabi *et al*., 2014).

**2.2.3. Transmission**

The possibility exists that African or Australian bats harbor the virus and transmit it to camels. Imported camels from these regions might have carried the virus to the Middle East. Transmission between Camel and human is reported to be either consuming raw meat or milk of camels, or direct contact with them. An ahead-of-print dispatch for the journal *Emerging Infectious Diseases* records research showing the coronavirus infection in dromedary camel calves and adults; 99.9% matching to the genomes of human clade B MERS-CoV (Maged *et al.,* 2014).

A significant number of reported confirmed MERS-CoV cases are known to have had recent contact with camels, or had consumed camel milk (Hemida *et al.,* 2013). Humans may be able to be infected through drinking unpasteurized camel milk, as experimental studies have demonstrated that the MERS-CoV can survive for prolonged periods in fresh camel milk at ambient temperatures of between $4^0$C and $22^0$C (Reusken *et al.,* 2013).

The detection of MERS-CoV in nasal swab specimens from camels indicates the potential for respiratory transmission of the MERS-CoV from camels to humans or other animals. Other possible potential mechanisms for MERS-CoV transmission include exposure to urine or feces from infected camels (Alagali *et al.,* 2013).

The infection of healthcare workers has led to concerns of human to human transmission The Centers for Disease Control and Prevention (CDC) list MERS as transmissible from human-to-human between people who are in close contact. Transmission from infected patients to healthcare personnel has also been observed (Knick *et al*., 2014). Most transmission has occurred "in the circumstances of close contact with severely ill persons in healthcare or household settings" and there is no evidence of transmission from asymptomatic cases (WHO, 2014).

**2.2.4. Tropism and incubation period**

In humans, the virus has a strong tropism for non-ciliated bronchial epithelial cells, and it has been shown to effectively evade the innate immune responses and antagonize *interferon (IFN*) production in these cells. This tropism is unique in that most respiratory viruses target ciliated cells (Kindler E *et al.,* 2013). Due to the clinical similarity between MERS-CoV and SARS-CoV, it was proposed that they may use the same cellular receptor; the exopeptidase, angiotensin converting enzyme *2* (ACE2) (Jia *et al.,* 2005). However, it was later discovered that neutralization of ACE2 by recombinant antibodies does not prevent MERS-CoV infection (Muller *et al., 2012).* Further research identified dipeptyl peptidase 4 (DPP4; also known as CD26) as a functional cellular receptor for MERS-CoV. Unlike other known coronavirus receptors, the enzymatic activity of DPP4 is not required for infection (Raj *et al.,* 2013).

The median incubation period for secondary cases associated with limited human-to human transmission is approximately 5 days (range 2-13 days). In MERS-CoV patients, the median time from illness onset to hospitalization is approximately 4 days. Bat DPP4 genes appear to have been subject to a high degree of adaptive evolution as a response to coronavirus infections, so the lineage leading to MERS-CoV may have circulated in bat populations for a long period of time before being transmitted to people (Cui *et al.,* 2013).

**2.3. Zoonotic importance**

Though it is not recognized in detail how MERS is transmitted to humans, the disease is highly zoonotic. The virus prefers non ciliated bronchial epithelial cells especially in humans and it is realized that transmission between human to human is also possible. The case clusters in the South Korea, Tunisia, Italy, United Kingdom, and in healthcare facilities in Saudi Arabia and France strongly suggest that human to human transmission occurs. Possible modes of transmission to human include droplet and contact transmission (WHO, 2014(d)).

More than half of all laboratory confirmed secondary cases have been associated with healthcare settings. The majority of cases in the spring of 2014 in Saudi Arabia were acquired through human to human transmission in healthcare settings, likely due at least in part to systemic weaknesses in infection control. A phylogenetic analysis of viruses isolated during the outbreaks in Saudi Arabia in the spring of 2014 is discussed above. Secondary transmission has also occurred in the household setting. Among 280 household contacts of 26 index patients with MERS-CoV infection, 12 probable cases of secondary

transmission were detected by PCR of a pharyngeal swab and serology (WHO, 2014(d)).

**2.4. Risk factor for the emergency sits current situations**

People who may be at considerable risk for MERS-CoV are those recent travelers from the Arabian Peninsula, those in close contacts of an ill traveler from the Arabian Peninsula, those having chance of close contacts of a confirmed case of MERS, healthcare personnel not using recommended infection-control precautions, People with exposure to camels: (CDC, 2014).

**2.5. Clinical manifestations**

Common signs and symptoms include fever (100°F or higher), chills/rigors, headache, non-productive cough, dyspnoea, and myalgia. Other symptoms can include sore throat, coryza, nausea and vomiting, dizziness, sputum production, diarrhoea, vomiting, and abdominal pain. The first patient, in June 2012, had a seven-day history of fever, cough, expectoration, and shortness of breath (Ali *et al.,* 2012).

One study of a hospital based outbreak of MERS had an estimated incubation period of 5.5 days (95% confidence interval 1.9 to 14.7 days). MERS can range from asymptomatic disease to severe pneumonia leading to the acute respiratory distress syndrome (Assiri, 2014). Renal failure disseminated intravascular coagulation (DIC) and pericarditis have also been reported (WHO, 2014(b)).

**2.6. Diagnosis**

To diagnose MERS, one should consider the following. Clinical signs (fevers, chills, myalgias, rhinorrhea, and pneumonia or who develop acute respiratory distress syndrome), history of travel from countries in or near the Arabian Peninsula within 14 days before symptom onset, or close contact with a symptomatic traveller who developed fever and acute respiratory illness (not necessarily pneumonia) within 14 days after travelling from countries in or near the Arabian Peninsula. A history of exposure to other risk factors mentioned above. Laboratory investigation and radiographic findings (may include unilateral or bilateral patchy densities or opacities, interstitial infiltrates, consolidation, and pleural effusions (WHO, 2014 (c)).

Laboratories are approved to test for MERS-CoV using CDC's RT-PCR assay. Specimen to collect include bronchoalveolar lavage sputum and tracheal aspirates which contain the highest viral loads and these should be collected when possible. MERS cases have been reported to have leucopenia, and in particular lymphopenia. For PCR testing the WHO recommends obtaining samples from the lower respiratory tract via bronchoalveolar lavage (BAL), sputum sample or tracheal aspirate as these have the highest viral loads. Serologic testing is available for the evaluation of MERS-CoV infection or exposure. The serum specimens should be collected during the acute stage of the disease and repeated during the convalescence phase (>3 weeks after the initial sample was collected). This serologic test is available from the CDC and requires approval, since it is only for research or surveillance purposes. The test uses indirect fluorescent antibody (IFA) and detection of immunoglobulin M (IgM) and immunoglobulin G (IgG) antibodies based on protein-microarray technology (Reusken *et al.,* 2014).

**2.7. Treatment**

No specific drug treatment exists for MERS and supportive treatment is the mainstay of management. Evidence-based recommendations for treatment provide the basis for decision making in clinical settings. MERS-CoV is readily inhibited by type 1 interferon (IFN-α and especially IFN-β) in cultured cells (Zielecki *et al*., 2013). And IFN-α2b combined with ribavirin can lessen lung injury and reduce lung titters when administered to rhesus macaques within 8 hours of virus inoculation (Falzarano *et al*., 2013).

Another proposed therapy is inhibition of viral protease (Ren, 2013). Researchers are investigating a number of ways to combat the outbreak of Meddle East respiratory Syndrome coronavirus, including using interferon, chloroquine, chlorpromazine, loperamide, lopinavir, and camostat (Otrompake, 2014).

**2.8. Prevention and control**

While the mechanism of spread of MERS-CoV is currently not known, based on experience with prior coronaviruses, such as SARS, the WHO currently recommends that all individuals coming into contact with MERS suspects should wear personal protective equipment for all body parts (i.e. medical mask, goggles or a face shield). Individuals should perform hand hygiene before and after contact with the patient and his or her surroundings and immediately after removal of personal protective equipment (WHO, 2013).

Applying general infection prevention and control precautions**:** Standard Precautions, a cornerstone for providing safe health care and reducing the risk of further infection, should always be applied in all health-care settings for all patients. Which include; hand hygiene, respiratory Hygiene and Cough Etiquette, Prevention of overcrowding and environmental ventilation in all areas within a health-care facility, follow standard procedures for cleaning and/or disinfection of environmental surfaces, Rapid identification of patients, Limit the number of HCWs, family members and visitors, isolate suspected patients, and the last but not the list is avoiding of unsafe contact with animals, animal secretions,

excretions, and use of other animal products like raw camel meat and milk. (Madani *et al*., 2014 and Azhar *et al*., 2014).

## 3. Conclusion and Recommendations

Almost all cases of the Middle East respiratory Syndrome Coronavirus are somehow linked to Saudi Arabia and other countries related to Arabian Peninsula. Studies find that camels in Egypt, and Kenya, Somalia and Sudan have antibodies to the coronavirus that causes MERS. In Ethiopia the virus has a recorded starting from 2011 in different regions of the country, including Afar, Somali and Oromia. This novel virus having the virus has a clinical similarity with SARS-CoV. Because of strong tropism, evading the innate immune responses and antagonize interferon (IFN) production in cells in humans, it is difficult to identify the disease early. No specific treatment or prevention methods has been demonstrated yet to be safe. Generally, Infection prevention and control measures are critical to prevent the possible spread of MERS-CoV in health care facilities.

Therefore, based on the above conclusions, the following recommendations are forwarded:

- ☞ Ethiopians should be aware of the disease in terms of transmission, host range and clinical signs because a lot of emigrating and immigrating Ethiopians between Saudi Arabia and other Arabian Peninsula regions.
- ☞ Though there are no zoonotic records for MERS-CoV in the country our society should take care of contact with camels.
- ☞ For we do have in Ethiopia a number of seroprevalent camels and we don't know when is the onset zoonotic transmission of the virus. So that educated peoples including doctors, health officers, and anyone who knows about the disease should teach and give important precautions regarding MERS-CoV to the community.
- ☞ Strict sanitary and quarantine measures should be in place to prevent introduction of the disease into non endemic countries.
- ☞ Producing vaccine as best and cost effective preventive tool.

**Acknowledgements:**

None

**Corresponding Author:**
Dr. Wale Firew
Department of Animal Health, Instructor at Burie Poly Technique College, Burie, P.o.box. 75, Ethiopia
Telephone: +251-926720706
E-mail: walextensay@gmail.com

## References

1. Abedine, S. (2013): Death to all from new SARS like virus climbs to 9. CNN. Retrieved 2013-03-13.
2. Alagaili, A.N., Briese, T., Mishra, N., Kapoor, V. and Sameroff, S.C. (2014). Midde as the respiratory syndrome coronavirus infection in dromedary camels in Saudi Arabia. Journal of Microbiology 5(2):e00884 14. Accessed 30 April 2014 at http://mbio.asm.org/content/5/2/e00884-14.
3. Ali, M., Sander, v., Theo, M., Bestebroer, A. and Osterhaus, R. (2012). Isolation of a novel coron virus from a man with pneumonia in Saudi Arabia (PDF). *New England Journalof Medicine*, 367:1814-20.
4. Arabi, Y. M., Arifi, A. A. and Balkhy, H.H. (2014). Clinical course and outcomes of critically ill patients with Middle East respiratory syndrome coronavirus infection. *Journal of Annals of Internal Medicine*, 160:389-97.
5. Assiri, A. (2013): "Hospital Outbreak of Middle East Respiratory Syndrome Coronavirus". *New England Journal of Medicine*. doi:10.1056/NEJMoa1306742. Retrieved 2014-05-21.
6. Augustina, A., Heather, J., Baldwin,. and Max, C. (March 2013): "Human Betacoronavirus 2c EMC/2012 related Viruses in Bats, Ghana and Europe". *Emerging Infectious Disease journal - CDC* 19 (3). Retrieved 20 March 2013.
7. Azhar, E. I., El Kafrawy, S. A. and Farraj, S.A, (2014). Evidence for camel-to -human transmission of MERS coronavirus. *New England Journal of Medicine*, 370 (26):2499-505.
8. Bermingham, A., Chand, M.A. and Brown, C.S. (2012). Severe respiratory illness caused by a novecoronavirus, in a patient transferred to the United Kingdom from the Middle East. *Euro Surveillance*, 17:20290.
9. Centers for Disease Control and Prevention (CDC), (2012). Severe respiratory illness associated with a novel coronavirus Saudi Arabia and Qatar, 2012. Morbidity and Mortality Weekly Report. 61:820.
10. Centers for Disease Control and Prevention (CDC), (2013). Updated information on the epidemiology of Middle East respiratory syndrome coronavirus (MERS CoV) infection and guidance for the public, clinicians, and public health authorities. Morbidity and Mortality Weekly Report, 62:793.
11. Centers for Disease Control and Prevention (CDC), (2014). CDC announces first case of Middle East respiratory syndrome coronavirus infection (MERS) in the United States. Available at: http://www.cdc.gov/media/releases/2014/p0502-US-MERS.html (Accessed on May 02, 2014).
12. Centers for Disease Control and Prevention (CDC), (2014). Middle East respiratory syndrome (MERS). Available at: http://www.cdc.gov/CORONAVIRUS/MERS/INDEX.HTML (Accessed on May 13, 2014).

13. Chan, K., H., Poon, L.L. and Cheng, V.C. (2004)."Detection of SARS coronavirus in patients with suspected SARS". *Emerging Infectious Disease,* 10 (2): 294-299. doi:10.3201/eid1002.030610. PMC 3322905. PMID 15030700. Retrieved 2014- 05-21.
14. Cowling, B., J., Park, M. and Fang, V.J. (2015). Preliminary epidemiological assessment of MERS-CoV outbreak in South Korea, May to June 2015. Euro surveillance, p 20.
15. Corman, V., M., Eckerle, I. and Bleicker, T. (2012). Detection of a novel human coronavirus by real time reverse transcription polymerase chain reaction. *Euro Surveillance* p, 17.
16. Cui, J., Eden, J.S., Holmes, E.C., Wang, L.F. (2013): "Adaptive evolution of bat dipeptidyl peptidase 4 (dpp4): Implications for the origin and emergence of Middle East respiratory syndrome coronavirus". *Virology Journal* 10: 304.
17. Da Guan, W., Mok C.K., Chen, Z.L. (2015). Characteristics of Traveler with Middle East Respiratory Syndrome, China. Emerging Infectious Diseases; 21:2278.
18. De Groot, R.J. (2013). "Middle East Respiratory Syndrome Coronavirus (MERS-CoV): Announcement of the Coronavirus Study Group". *Journal of Virology,* 87 (14):7790 2. doi:10.1128/JVI.01244 13. PMC 3700179. PMID 23678167.
19. Doucleff, M. (2012). "Holy Bat Virus! Genome Hints At Origin Of SARS-Like Virus". *NPR*. Retrieved 29 September 2012.
20. Drosten, C., Muth, D. and Corman, V.M. (2015). An observational, laboratory-based study of outbreaks of Middle East respiratory syndrome coronavirus in Jeddah and Riyadh, kingdom of Saudi Arabia. Clinical Infectious Diseases, 60:369.
21. Falzarano, D., Wit, E. and Rasmussen, A. (2013). Treatment with interferon-α2b and ribavirin improves outcome in MERS-CoV-infected rhesus macaques. *Natural Medicine,* 19: 1313–17.
22. Florida Health (2014). Health officials confirm first MERS-CoV case in Florida-available at: http://newsroom.doh.state.fl.us/wpcontent/uploads/newsroom/2014/01/051214-MERS-CoV-Case-Confirmed-in-Florida.pdf (Accessed on May 13, 2014).
23. Guery, B., Poissy, J. and Mansouf, L. (2013). Clinical features and viral diagnosis of two cases of infection with Middle East Respiratory Syndrome coronavirus: a report of nosocomial transmission. *Lance,* 381:2265.
24. Hemida, M.G. (2013): "Middle East Respiratory Syndrome (MERS) coronavirus seroprevalence in domestic livestock in Saudi Arabia, 2010 to 2013"
25. Hemida, M., G., Perera, R. and Wang P. (2013). Middle East Respiratory Syndrome (MERS) coronavirus seroprevalence in domestic livestock in Saudi Arabia, 2010 to 2013. *Euro surveillance*, 18(50):20659.
26. Jia, H., Look, D., Shi, L., Hickey, M., Pewe, L., Net land, J., Farzan, M., Wohlford-Lenane, C. and Perlman, S. (2005): ACE2 Receptor Expression and Severe Acute Respiratory Syndrome Coronavirus Infection Depend on Differentiation of Human Airway Epithelia. *Journal of Virology* (ncbi.nlm.nih.gov), 79:14614-14621.
27. Kindler, E., Jónsdóttir, H., Muth, D., Hamming, O., Hartmann, R., Rodriguez, R., Geffers, R., Fouchier, R. and Drosten, C. (2013): Efficient Replication of the Novel Human Betacoronavirus EMC on Primary Human Epithelium Highlights Its Zoonotic Potential. *Microbiology,* 4 (1).
28. Korea Centers for Disease Control and Prevention (KCDC), (2015). Middle East Respiratory Syndrome Coronavirus Outbreak in the Republic of Korea. Osong Public Health Res Perspective, 6:269.
29. Lu, G., Hu, Y. and Wang, Q. (2013). Molecular basis of binding between novel human coronavirus MERS and its receptor CD26. *Nature,* 500:227.
30. Madani, T., A., Althaqafi, A., O., Alraddadi, B. (2014). Infection, prevention and control guidelines for patients with Middle East Respiratory Syndrome Coronavirus (ME RS-CoV) infection. *Saudi Medical Journal*, 35(8):897-913.
31. Madani, T., A. (2014). Case definition and management of patients with MERS coronavi us in Saudi Arabia. *Lancet* Infectious Diseases, 14(10):911- 3.
32. Mohammed, R.F. (2014): 80% drop in MERS infections, *Arab News*, Vol XXXIX, and Number 183.
33. Müller, M., A., Corman, V., M. and Jores, J. (2014). MERS coronavirus neutralizing antibodies in camels, Eastern Africa, 1983-97. Emerging Infectious Diseases, 20:2093.
34. Müller, M.A., Raj, V.S., Muth, D., Meyer, B., Kallies, S., Smits, S.L., Wollny, R., Bestebroer, T.M. and Specht, S. (2012): "Human coronavirus EMC does not require the SARS coronavirus receptor and maintains broad replicative capability in mammalian cell lines". *Microbiology* 3 (6).
35. Oboho, I., K., Tomczyk, S., M. and Al Asmari, A. M. (2014). MERS CoV outbreak in Jeddah a link to health care facilities. *New English Journal of Medicine*, 372:846.
36. Park, H., Y., Lee, E., J., Ryu, and Y., W. (2015). Epidemiological investigation of MERS CoV spread in a single hospital in South Korea, *Euro Surveillance,* 20.
37. Park, Y., S., Lee, C., Kim and K., M. (2015). The first case of the 2015 Korean Middle East Respiratory Syndrome outbreak. Epidemiology Health 2015; 37:e2015049.
38. Pro Med Mail: Novel coronavirus Saudi Arabia: human isolate; Archive Number: 20120920.

Available at: http://www.promedmail.org/direct.php?id=20120920.1302733 (Accessed on April 22, 2013).
39. Raj,V.S., Mou, H.; Smits, S.L., Dekkers, D.H., Müller, M.A., Dijkman, R., Muth, D., Demmers, J.A. and Zaki, A. (March 2013): "Dipeptidyl peptidase 4 is a functional receptor for the emerging human coronavirus-EMC". *Nature*,495 (7440): 251–4.
40. Reusken, C., Haagmans, B., Müller, M., Gutierrez, C., Godeke, G., Meyer, B., Muth, D., Raj, V., Smits De Vries, L., Corman, V., Drexler, J., Smits, S., El Tahir, Y., De Sousa, R., van Beek, J., Nowotny, N., Van Maanen, K., Hidalgo-Hermoso, E., Bosch, B., Rottier, P., Osterhaus, A., Gortázar Schmidt, C., Drosten, C. and Koopmans, M. (2013): "Middle East respiratory syndrome coronavirus neutralizing serum antibodies in dromedary camels: a comparative serological study". *Lancet* (Elsevier Ltd). Doi: 10.1016/S1473-3099.2813.2970164-6.
41. Reusken, C. (2013). "Specific serology for emerging human coronaviruses by protein microarray". Euro surveillance 18 (14):20441. doi:10.2807/1560-7917.es2013.18.14.20441. PMID 23594517. Retrieved 2014-05-20.
42. Reusken, C. B., Haagmans, B., L. and Müller, M. (2013). Middle East respiratory syndrome coronavirus neutralizing serum antibodies in dromedary camels: a comparative serological study. *Lancet Infectious Disease*, 13(10): 859–866.
43. Reuss, A., Litterst, A. and Drosten, C. (2014). Contact investigation for imported case of Middle East respiratory syndrome, Germany. Emergency of Infection Disease, 20:620.
44. Rha, B., Rudd, J. and Feikin, D. (2015). Update on the epidemiology of Middle East respiratory syndrome coronavirus (MERS CoV) infection, and guidance for the public, clinicians, and public health authorities-January 2015. *Morbidity and Mortality* Weekly Report, 64:61.
45. Scientific Advisory Council, Ministry of Health, Saudi Arabia, (2015). Infection prevention/control and manag ement guidelines for patients with Middle East Respiratory Syndrome Coronavirus (MERS-CoV) infection second edition. Available at: http://www.moh.gov.sa/en/CCC/StaffRegulations/Corona/Documents/Guidelines_or_CoronaPatients. (accessed Feb 16, 2015).
46. World Health Organization (WHO), (2012).Novel coronavirus infection in the United Kingdom. Available at: http://www.who.int/csr/don/2012_09_23/en/index.html (Accessed on September 25, 2012).
47. World Health Organization (WHO, 2012). Global Alert and Response. Background and sumary of novel coronavirus infection as of 30 November 2012. http://www.who.int/csr/disease/coronavirus_infections/update_20121130/en/index.html (Accessed on December 06, 2012).
48. World Health Organization (WHO, 2013). Corona virus infection/MERS;lab.record http://www.who.int/csr/disease/coronavirus_infections/MERS_Lab_recos_16_Sept_2013.pdf?ua=1.
49. World Health Organization (WHO, 2014(a)). WHO risk assessment. Middle East respiratory syndrome coronavirus (MERS-CoV).Report available at: http://www.who.int/csr/disease/coronavirus_infections/MERS_CoV_RA_20140424.pdf?ua=1 (Accessed on April 24, 2014).
50. World Health Organization (WHO), 2014(b)). Middle East respiratory syndrome coronavirus (MERS-CoV) summary and literature update, available at: http://www.who.int/csr/disease/coronavirus_infections/MERS_CoV_Update_09_ May_2_14.pdf?ua=1 (Accessed on May 12, 2014).
51. World Health Organization (WHO), 2014(c)). Diseases of corna virus infection/MERS: Available at: http://www.who.int/csr/disease/coronavirus_infections/MERS_CoV_Update_27_March_2014.pdf?ua=1 (Accessed on March 04, 2015).
52. World Health Organization, (2015). Middle East respiratory syndrome coronavirus (MERS-CoV): Summary of current situation, literature updates and risk assessment available at: http://www.who.int/csr/disease/coronavirus_infections/mers-5-february-2015.pdf?ua=1 (Accessed on March 04, 2015).
53. World Health Organization (WHO), (2016). Middle East respiratory syndrome coronavirus (MERS-CoV) Thailand, abaliable at: http://www.who.int/csr/don/29-january- 2016-mers thailand/en/ (Accessed on February 04, 2016).
54. Zaki, A., M., Van, Boheemen, S., Bestebroer, T., M., Osterhaus, A.D., Fouchier, and R., A. (2012) Isolation of a novel coronavirus from a man with pneumonia in Saudi Arabia. *New English Journal of Medicine,* 367:1814–20.
55. Zielecki, F., Weber, M., and Eickmann, M. (2013). Human cell and innate immune system interactions of human respiratory coronavirus EMC compared to those of severe acute respiratory syndrome coronavirus. *Journal of Virology*, 87:5300–04.
56. Zumla, A., Hui, D.S. and Perlman, S. (2015). "Middle East respiratory syndrome". *Lancet (London, England) 386:995*-1007. Doi: 10.1016/S0140-6736(15)60454-8. PMID26049252.