ACTA SCIENTIFIC MICROBIOLOGY (ISSN: 2581-3226)

Volume 4 Issue 2 February 2021

Review Article

# COVID-19 in Eastern Mediterranean Region: A Prospect to Better Learning

**Sharadambal Ramaseri Sunder[1]*, Satya Sudheer Pydi[2], Devender Bansal[1] and Elmoubasher Abu Baker Abd Farag[1]**

[1]*Ministry of Public Health, Doha, Qatar*

[2]*Sedeer Medical Services and Trading LLC, Doha, Qatar*

***Corresponding Author:** Sharadambal Ramaseri Sunder, Department of Communicable Diseases Control Programs, Ministry of Public Health, Doha, Qatar.

**Received:** December 02, 2020

**Published:** January 30, 2021



## Abstract

**Background**: The SARS CoV-2 (COVID-19) pandemic has triggered a severe economic contraction and public health concerns in Eastern Mediterranean Region (EMR) by challenging each country's ability to cope up to the infection. Situations are apparently not similar across all the countries in the region. At the early phases of the outbreak, many countries followed strict containment measures to limit the spread of this virus. As the numbers were raising drastically, all the countries carefully strategized various methods to contain the virus. In order to battle this pandemic on all fronts, awareness of aspects influencing the transmission and its management options are critically essential.

**Aim:** This study aimed to emphasize on the strategies that would help in understanding the impact on preparedness, and response activities to contain the COVID-19 infection.

**Methods:** We conducted a fast-paced review of articles published from December, 2019 to August, 2020 on SARS-COV-2 and COVID-19. Publications ranging from observational to experimental studies, short communications, review articles, letters to editor and perspectives with respect to Eastern Mediterranean region were included.

**Results:** The outcomes were concerning to risk assessment, preparedness, response, and control measures in relation to COVID-19 in EMR and recommendations pertaining to wellbeing.

**Conclusion:** There is a desperate need of regional cooperation to protect the health of the people living in EM region. COVID-19 outbreak has triggered a clear need of detection, prevention and control strategies of zoonotic infections which would emerge in future.

**Keywords:** COVID-19; WHO- EMR; Risk Factors; Preparedness; Response

## Introduction

SARS-CoV-2 (COVID-19), a fatal zoonotic disease of humans emerged in Wuhan, China in 2019. By 31 January 2020, it was declared as Public Health Emergency by the World Health Organization (WHO). The outbreak spread globally and was subsequently categorized as pandemic on 11 March 2020 [1]. As of mid-August 2020 more than 21 million confirmed cases and more than 700,000 deaths were reported globally. Eastern Mediterranean being the 4th highly affected region with total 1,723,673 reported positive cases and 45,704 deaths [2].

WHO defines geographically diverse area of 22 countries as Eastern Mediterranean region (EMR) [3-5]. The term Middle East describes the transitional regions located in Southwest Asia and Northeast Africa. The EMR region is further distributed to Middle Eastern countries including seven Arab states which border the Persian Gulf, namely Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE, also known as the Arab states of the Persian Gulf) and Lebanon, Occupied Palestinian territory, Yemen, Jordan, Syrian Arab Republic; North African Countries including Egypt, Libya, Morocco, Sudan, Tunisia, Djibouti, Somalia

and Asian countries including Afghanistan, Pakistan, Iran with a total population of over 656 million.Though these countries abound with socio-political disparity and contradictions, they share many common rudiments of history and culture [6].

Recurrence of pathogenic coronaviruses causing, severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) has triggered a constant unprecedented pressure on public health systems to control the disease transmission within this region [7,8]. The outbreak of COVID-19 pandemic and its spread has evidenced to be enormous threat to health and wellbeing, social welfare, and global economy causing panic not only within the region, but also worldwide [9,10]. By 11 April 2020, all 22 countries of WHO-EMRO have been reported to be affected by COVID-19 [11]. Despite COVID-19 has been considered to have low case fatality rate (CFR) of 5% [12] to that of SARS ~10-11% [13,14] and MERS ~35% [15,16] respectively, so far it has resulted in more deaths surpassing both SARS and MERS [17].

Even though with the past experiences of SARS and MERS, countries in the region seemed to be more efficient in identifying and responding to the outbreak. Diverse statistics for different geographical regions have been observed by world health authorities which in turn is dependent on many social and environmental factors [10]. The most effective approach to prevent the adverse consequences against COVID-19 pandemic requires awareness of aspects influencing the transmission and to implement the precise management options. Multiple factors may contribute to the risk of possible spread of COVID-19 infection. A comprehensive strategy including surveillance, diagnostics, research, and clinical treatment is highly required. This current review presents an outline of various risk factors causing vulnerability to COVID-19 in WHO-EMR and responses to restrain the infection. It also focuses on understanding the impact of preparedness, response, and improvisation strategies that could further aid the betterment of responses for future encounters.

## Zoonotic viral spill over

It is well comprehended that the occurrence of various human Corona infections till date including COVID-19 is considered to be a spill over of virus from zoonotic origin more specifically from bats, all though the intermediate hosts may vary [1]. The demand of live animals including domestic & exotic wild life and meat being imported in middle east would present major risk for disease transmission. As these animals might act as intermediate host in viral transmission to humans coming in contact with the animals body fluids, excretions or by consumption of animal products. The importation of animals with poorly established surveillance systems in detection of zoonotic outbreaks would raise an enormous concern in Middle east [18].

## Air travel

Commercial air travel is considered to be the major element of rapid spreading of COVID-19 between countries [19]. Although UAE was reported to be the first Middle Eastern country with COVID-19 positive case, Iran is considered to be an epicentre of the EMR region [20,21]. As of 16 August, 2020, Iran had confirmed 341,070 cases and 19,492 associated deaths [2]. The COVID-19 importation into Iran was considered to be outcome of its decision to keep diplomatic relations open with China [22]. Further, corona virus has been reported to be imported from Iran to at least Nine neighbouring countries of WHO-EMRO which includes two from Asian region (Pakistan and Afghanistan) and seven from Middle Eastern region (Bahrain, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, Lebanon) [21,23].

## Religious mass gathering

Religious gatherings can pose a great potential threat to global health security with its risk for the transmission of pathogens amongst pilgrims and also to the native population [24]. Major religious mass gathering held in EMR region might pose a challenge, as these events could compromise the health system of the host country [25]. One of the major pillars of Islamic religion is the annual pilgrimage. These religious gatherings take place in three countries of the EMR region (Iran, Iraq and Saudi Arabia). Saudi Arabia being the holy place with two Mosques located in Makkah and Medina, hosts the major annual religious mass gathering events known as Hajj and Umrah. These international events with huge religious, geopolitical, and economic significance are of high visibility. Hajj is one of the largest recurring mass gatherings in the world attracting millions of pilgrims from various countries [26,27] Group prayers are also important in the Islamic religion, with Mosques holding group prayers attended by a larger number of worshipers each day [27]. It is assumed that the propinquity between pilgrims due to the crowded accommodation, worshipers, and prayers creates a conducive environment for transmission of infectious diseases and may result in importation or exportation of infectious diseases, interpreting it to be a major public health concern [24-26,28].

## Socio-economic condition

COVID-19 is lot more than a health crisis. It has the potential to devastate social, economic and political conditions and cause discernable impact around the world [29]. But these effects have not been the same in all countries. State fragility and conflict are among the biggest challenges to attain sustainable development goal. There is huge variation in the gross national income among the countries in EMR region, which might influence the overall health spending and achievements in the Region [6]. Although certain countries under WHO-EMR are wealthiest nations (States of the Persian Gulf) because of their natural gas and oil resources, the response to the pandemic has proven to be challenging even for these high-income countries with robust health systems. EMR is also home to some of the poorest countries in the world particularly those affected by protracted conflicts or humanitarian crises [30,31]. Twelve out of 22 countries are facing unprecedented emergencies with armed conflict in WHO-EMR [32]. The COVID-19 pandemic has swept through several countries including Afghanistan, Iraq, Libya, Syria, and Yemen, the regions struggling with the effects of a decade of uprisings, insurgencies, terror threats, war and international conflicts [22]. Conflict is a threat to global health security because affected countries are less able to prevent, detect, and respond to disease outbreaks [29-32]. For the past few decades, these war prone countries have been facing poor public health infrastructures due to insufficient funding and resources. Also, the conflicts have resulted in the destruction of healthcare facilities [30,33]. The weakened public healthcare system, amid widespread poverty and instability, faces a serious challenge. Hence spread of contagious infection in these countries, Syria, Libya and Yemen will have a catastrophic impact not only on its citizens but all over the world.

## Age and co-morbidities

Patients with co-morbid conditions are more vulnerable to infection with COVID-19. It is important to focus on people who might be at the highest risk, as they might be affected both directly and indirectly. Although severe COVID-19 disease can occur in healthy individuals of any age, it predominantly affects adults with advanced age or underlying medical co-morbidities [7,8]. Studies have reported patients in Middle Eastern region with COVID-19 are within the age range of 15–75 years and with high prevalence of co-morbid conditions such as diabetes, hypertension, cardiovascular disease [30,34-36]. The COVID-19 pandemic has immediate implications for people suffering with diabetes. Diabetes weakens the immune function, hence contributing to a higher risk of severe COVID-19 infection and increased fatality rate compared to non-diabetic patients. Qatar estimates to be one of the highest prevalence of diabetes (17%), resulting in risk of substantial proportion of the population to severe COVID-19 infection. It is vital for all health services to have a strategy for managing diabetes in epidemics and to share their knowledge and experience to face further challenges [37].

## Geographical location and population density

Several studies have highlighted the importance of geographical location as an important variable. People living in closer proximities to outbreaks and clusters, are consistently reported to worse health and wellbeing [38]. As of 29 August 2020, Iran has reported most of the cases in WHO-EMR followed by Saudi Arabia, Pakistan, Iraq, Qatar, Egypt, Oman, Kuwait, UAE, Morocco and Bahrain. Most of the countries with high reported cases are Asian countries followed my Middle Eastern countries of EMR. However, it is important to note the huge variation in the populations of these countries would affect the rate of infection. To put this in context, Qatar was observed to have high infection rate and also high recovery rate compared to any other countries in EMR. The case fatality rate remained to be high (>5%) in Yemen followed by Sudan, Iran and Egypt [39] **(**Figure 1, Table 1).

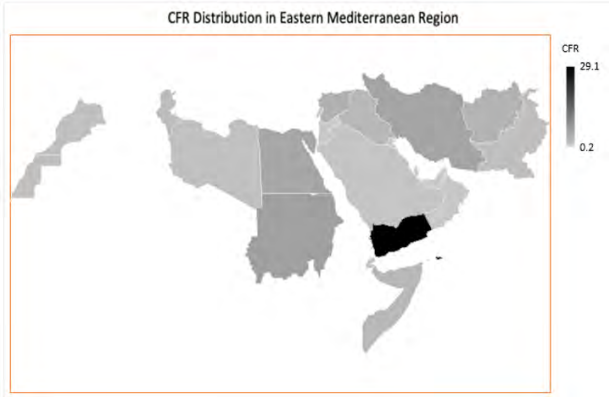


**Figure 1:** Case fatality rate (CFR) of COVID-19 in WHO-Eastern Mediterranean Region.

Map representing COVID-19 case fatality rates in Eastern Mediterranean Region. Darker region represents countries with high fatality rate, greyed areas are countries with mid-level and lighter regions represent countries with low CFR.

| Middle Eastern Countries | Total cases | Total Recovered | Total deaths | CFR | % Percentage recovery |
|---|---|---|---|---|---|
| Bahrain | 50756 | 47370 | 189 | 0.4 | 93.3 |
| Iraq | 223612 | 164874 | 6814 | 3.0 | 73.7 |
| Kuwait | 83578 | 75320 | 525 | 0.6 | 90.1 |
| Oman | 85005 | 79608 | 650 | 0.8 | 93.7 |
| Qatar | 118196 | 115017 | 196 | 0.2 | 97.3 |
| Saudi Arabia | 312924 | 287403 | 3813 | 1.2 | 91.8 |
| United Arab Emirates | 68901 | 59861 | 379 | 0.6 | 86.9 |
| Lebanon | 14937 | 4133 | 146 | 1.0 | 27.7 |
| Occupied Palestinian territory | 28110 | 18983 | 160 | 0.6 | 67.5 |
| Yemen | 1937 | 1100 | 563 | 29.1 | 56.8 |
| Jordan | 1869 | 1367 | 15 | 0.8 | 73.1 |
| Syrian Arab Republic | 2504 | 569 | 100 | 4.0 | 22.7 |
| North African Countries | | | | | |
| Egypt | 98062 | 69612 | 5342 | 5.4 | 71.0 |
| Libya | 12629 | 1310 | 226 | 1.8 | 10.4 |
| Morocco | 57085 | 41901 | 1011 | 1.8 | 73.4 |
| Sudan | 13045 | 6594 | 823 | 6.3 | 50.5 |
| Tunisia | 3323 | 1504 | 73 | 2.2 | 45.3 |
| Djibouti | 5439 | 5307 | 60 | 1.1 | 97.6 |
| Somalia | 3275 | 2471 | 95 | 2.9 | 75.5 |
| Asian countries: | | | | | |
| Afghanistan | 38140 | 29059 | 1402 | 3.7 | 76.2 |
| Pakistan | 295053 | 279937 | 6283 | 2.1 | 94.9 |
| Iran | 369911 | 318270 | 21249 | 5.7 | 86.0 |

**Table 1:** WHO COVID-19 STATUS OF EMRO.

Status of COVID-19 in WHO-EMRO countries geographically. Total positive cases recovered cases, and deaths reported as of 29-August-2020.

## Asymptomatic carrier

Studies showed that the prevalence of COVID-19 in asymptomatic patients is underestimated and might increase [40]. There is a high proportion of COVID-19 asymptomatic patients who could transmit the infection to all communities. Asymptomatic patients may not be identified by symptom-based screening and such patients might cause potential risk for nosocomial transmission and posed to be a significant public health threat, if they are not recognized to have COVID-19 [41]. Thus, managing asymptomatic subjects who can carry and likely transmit the virus is a major healthcare challenge while the pandemic is looming [42]. Also possibility of recuperating patient shedding virus even after recovery may necessitate reassessment of COVID-19 transmission dynamics [1].

## Environmental factors

Numerous epidemiologic investigations have observed an association of COVID-19 with respiratory droplet transmission. Yet understanding of the transmission risk is incomplete. Studies have reported the presence of viral nucleic acid in feces increasing the opportunity of transmission [1]. Overcrowded community environments which offer poor housing conditions and limited access to clean water have a particularly negative impact on the individual's

ability to manage the impacts of pandemics. The environmental persistence of the Covid-19 virus is also related to the use of resources particularly in shared health and community environments [38].

### Refugees and/or internal distressed people

The COVID-19 pandemic cannot be contained within borders. Refugee population are not only at risk by themselves as they lack treatment ability, but also serve as a mode for virus transmission. Coronavirus is spreading like wildfire**.** While the virus has struck most world, Americas, Europe, and Eastern Mediterranean region countries are bracing themselves for severe damage. Among many other challenges that countries in the EMR face, refugee protection is particularly a difficult challenge [22,32]. WHO- Eastern Mediterranean region is home for 64% of the world's refugees. Refugees are most vulnerable population due to several factors such as substandard living, shortage of water, sanitation, and hygiene (WASH) infrastructure, high population density areas (refugee camps). Millions of refugees and migrants residing in countries devastated by protracted conflicts with weakened health systems. Although many such settings have yet to feel the full impact of COVID-19, the pandemic is now having an unprecedented impact on mobility. This is in terms of border and migration management, as well as on health, social, and economic situation of migrant populations globally [22,43].

### Migrant workers

The recent economic development and globalization of countries in EM Region has attracted high numbers of both skilled and semi-skilled workers from Western, African and Asian countries to various sectors including construction, retail and domestic service. Migrant workers are highly vulnerable population, as they often have limited access to healthcare and they live in confined quarters, posing a significant risk of COVID-19 infection. With reports of high proportion of COVID-19 cases within worker communities, thousands of migrant workers were sent back to their native countries. Low income countries which has poor socio-economic condition due to outbreak were not even able to facilitate adequate self-quarantine and follow up measures, which has led to increasing the risk of COVID-19 infection [44].

### Stigma

Populations affected by humanitarian crises are expected to be particularly susceptible to COVID-19 due to stigmatization and several other factors. The pilgrim's stigmatization & victimization sensed on social media and stigma towards health care workers were attributed to fear of infection. These situations escalate both necessity and the difficulty of delivering accurate and actionable information to potentially affected population [45,46].

## Discussion

Although lessons from previous MERS outbreak have arguably helped some countries in improvising their healthcare systems and response to COVID-19 in the region, health systems in most of the countries are depending on the existing policies with subjected variability and adaptation. Therefore, to combat the pandemic, a strong surveillance system along with understanding of local community resources and healthcare/welfare needs is critical [38,44,47,48].

EMR region being the area of many public health issues, there is a dire necessity for access to basic health care and preventive education to general public [49]. WHO/EMRO has activated incident management system at its regional office in Cairo, Egypt to coordinate and support these activities in the region. Further, most of the countries in EM region, along with following WHO recommendations, has been developing and enhancing their preparedness and response capacities such as surveillance, risk communication, coordination, response preparation, human resources, laboratory capacities, legislation and policy etc., according to the local needs to contain COVID-19 infection [24,48,50].

Though with the guidance of WHO most of the countries in EMR region have implemented restrictive measures such as air travel suspensions, temporary government-enforced lockdowns, closure of international borders, travel bans, quarantine, schools and academic institutions closure, strict social distancing etc., the responses of countries in this region to COVID-19 was observed to be uneven [10,20,22, 23,28,29,30,51-53]. For example, Saudi Arabia has taken historical decision of closing the holy shrine and made available free testing of COVID-19 for migrants to address the issue [48], on other hand Iran has followed the prisoners release strategy, a human-rights based approach to prioritize public health [54]. Countries like UAE and Egypt have banned use of hookah along with other common measures followed [55]. However, Limited responses were detected in countries with poor economic background or regions facing conflicts/war [24,30,56-58]. It was also witnessed that the high income countries, along with low and

middle income countries with fragile and under-resourced health systems have failed to comply adequately with the WHO's recommendations on containment of COVID-19 epidemic [38,44,47,48].

Alternatively, the awareness of COVID-19 and measures to control its spread has decreased the likelihood of potentially dangerous practices towards the pandemic. This indicates the importance of enhancing citizen's knowledge via health education, which can also result in improved practices relating to the pandemic. It is reported that educational program in these countries help in creating awareness to people about the risk of COVID-19 infection [59,60]. Furthermore, teleworking for education and employment acts as a platform to boost community coping. It also supports massive public health advocacy campaign by promoting simple directives like staying home, social distancing, and personal safety measures through possible platforms such as television, and social media. It was observed that in addition to education and employment, people actively participated in stress relieving activities (Physical/Mental health) with less stringent restrictions on participation which has identified benefits for health and wellbeing, agency, participation and social inclusion for both younger and older adults [38,48]. Telemedicine has the potential to help in controlling the spread of virus, by permitting a supportive care required by other mildly ill patients while minimizing their exposure to COVID-19 virus [61].

Additionally, strategies to strengthen control measures would be more successful if communities are also engaged. To control this pandemic, a globally coordinated action needs to be planned. Involving religious and community leaders in supporting the public health measures would be an added advantage. They play a pivotal role in shaping the mindset of the community, where even the government fails. Global leaders should promote the health measures suggested by WHO with more authority and accountability to combat COVID-19 [9,48].

Currently there are no vaccines available to treat COVID-19 pandemic. Several drugs approved for treating other diseases have been repurposed by scientists to treat COVID-19. By 11 January 2020, genome sequence of SARS-CoV-2 virus causing COVID-19 was published. This triggered intense global R&D activity in developing a vaccine against the disease. With a dire need, on 16 March 2020, the first COVID-19 vaccine candidate entered clinical trials. Later several other clinical trials were also registered, including trial for other vaccines, drugs, food supplements. Even UAE has launched phase III trial of Sinopharm's COVID-19 vaccine. Drugs under investigation include anti-viral hydroxychloroquine and chloroquine, protective monoclonal antibodies, and human convalescent serum [47,62]. Moreover, UAE, Saudi Arabia, Kuwait, Qatar and many other countries have expressed interest in COVAX facility which encourages rapid, fair and equitable access to COVID-19 vaccines worldwide [63].

### Lessons learnt

While countries around the region have started implementing phased exit strategies following national lockdowns, many countries are still witnessing rising numbers of COVID-19 cases and deaths. Though each country in the region has been trying to mitigate the impact of COVID-19 infection to the extent of available resources and funding. We consider that global efforts are required to fill the current gaps in knowledge associated with the SARS-CoV2 virus and its spread. There is a desperate need of regional cooperation to protect the health of the people living in the region. As most of the Eastern Mediterranean countries with major proportion of migrant, refugee and IDP populations, it is necessary to focus on providing access to good healthcare facilities for these vulnerable population along with the usual support they have been receiving.

## Conclusion

Conclusively, this outbreak has triggered a clear need of detection, prevention and control strategies for COVID-19 and other zoonotic infections which would emerge in future. With a history of Eastern Mediterranean Region facing frequent spill overs of zoonotic infections to humans, there is a grave need of strengthening the one health approach strategies in-turn focusing towards interlinked animal, environment, human health factors and intensification of their surveillance system.

## Authors Contribution

- Sharadambal Ramaseri Sunder: Conception and design of the study, data analysis and interpretation, drafting the article.
- Satya Sudheer Pydi: data analysis and interpretation, drafting the article
- Devender Bansal: revising it critically for important intellectual content
- Elmoubasher Abu Baker Abd Farag: revising it critically for important intellectual content design of the study, final approval of the version to be submitted.

## Bibliography

1. Dhama K., *et al*. "SARS-CoV-2 jumping the species barrier: Zoonotic lessons from SARS, MERS and recent advances to combat this pandemic virus". *Travel Medicine and Infectious Disease* 37 (2020): 101830.

2. Coronavirus disease (COVID-19) Situation Report - 165, World Health Organization (2020).

3. http://www.emro.who.int/landing-pages/countries/countries.html

4. Badur S., *et al*. "Systematic review of the rotavirus infection burden in the WHO-EMRO region". *Human Vaccines and Immunotherapeutics* 15.11 (2019): 2754-2768.

5. Al-Rousan N and Al-Najjar H. "Is visiting Qom spread COVID-19 epidemic in the Middle East?" *European Review for Medical and Pharmacological Sciences* 24 (2020): 5813-5818.

6. Malik MR., *et al*. "Novel coronavirus infection in the Eastern Mediterranean Region: time to act". *Eastern Mediterranean Health Journal* 19.1 (2013): S31-S38.

7. Velavan TP and Meyer CG. "The COVID-19 epidemic". *Tropical Medicine and International Health* 25.3 (2020): 278-280.

8. Fang Y., *et al*. "Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR". *Radiology* 296 (2020): E115-E117.

9. Kickbusch I., *et al*. "Covid-19: how a virus is turning the world upside down". *British Medical Journal* 369 (2020): m1336.

10. Lassoued A., *et al*. "Dataset on the COVID-19 Pandemic Situation in Tunisia with Application to SIR Model". *Med Rvix preprint* (2020).

11. Coronavirus disease (COVID-19) Situation Report – 82, World Health Organization (2020).

12. Safadi MA. "The intriguing features of COVID-19 in children and its impact on the pandemic". *The Journal of Pediatrics* 96 (2020): 265-268.

13. Heymann DL and Shindo N. "COVID-19: what is next for public health?" *Lancet* 395.10224 (2020): 542-545.

14. Park M., *et al*. "COVID-19: Lessons from SARS and MERS". *European Journal of Immunology* 50 (2020): 308-316.

15. Kassahun B., *et al*. "Review on coronavirus, a middle east respiratory syndrome (MERS-CoV)". *Online Journal of Animal and Feed Research* 10.1 (2020): 01-11.

16. Killerby ME., *et al*. "Middle east respiratory syndrome coronavirus transmission". *Emerging Infectious Diseases* 26.2 (2020): 191-198.

17. Mahase E. "Coronavirus: covid-19 has killed more people than SARS and MERS combined, despite lower case fatality rate". *British Medical Journal* 368 (2020): m641.

18. Walker K. "Stricter control of wildlife trade needed to reduce virus risk". *Nature Middle East* (2020).

19. Lee A. "Wuhan novel coronavirus (COVID-19): why global control is Challenging?" *Public Health* 179 (2020): A1-A2.

20. Reyad O. "Novel Coronavirus COVID-19 Strike on Arab Countries and Territories: A Situation Report I". *arXiv* (2020).

21. Zhuanga Z., *et al*. "Preliminary estimation of the novel coronavirus disease (COVID- 19) cases in Iran: A modelling analysis based on overseas cases and air travel data". *International Journal of Infectious Diseases* 94 (2020): 29-31.

22. Lynch M. "The COVID-19 Pandemic in the Middle East and North Africa". *The Project on Middle East Political Science* (2020).

23. Mikhael EM and Al-Jumaili AA. "Can developing countries face novel coronavirus outbreak alone? The Iraqi situation". *Public Health in Practice* 1 (2020): 100004.

24. Gele A. "What works where in prevention of Covid-19: The case of Somalia". *Eastern Mediterranean Health Journal* 26 (2020): 5.

25. Memish ZA., *et al*. "Hajj: infectious disease surveillance and control". *Lancet* 383 (2014): 2073-2082.

26. Al-Tawfiq JA and Memish ZA. "COVID-19 in the Eastern Mediterranean Region and Saudi Arabia: prevention and therapeutic strategies". *International Journal of Antimicrobial Agents* 55 (2020): 105968.

27. Yezli S and A Khan. "COVID-19 social distancing in the Kingdom of Saudi Arabia: Bold measures in the face of political, economic, social and religious challenges". *Travel Medicine and Infectious Disease* (2020).

28. Coronavirus disease 2019 (COVID-19) strategic preparedness and response plan: Accelerating readiness in the Eastern Mediterranean Region (2020).

29. Hasab A., *et al*. "Situational Analysis and Epidemic Modeling of COVID-19 in Egypt". *Journal of High Institute of Public Health* 50.1 (2020): 46-51.

30. Karamouzian M and Madani N. "COVID-19 response in the Middle East and north Africa: challenges and paths forward". *Lancet GH* 8.7 (2020): E886-E887.

31. Hariri M., *et al*. "The COVID-19 Forecast in Northwest Syria. The Imperative of Global Action to Avoid Catastrophe". *Med Rvix preprint (2020)*.

32. Brennan R., *et al*. "Responding to health emergencies in the Eastern Mediterranean region in times of conflict". *Lancet* (2020).

33. Daw MA. "Corona virus infection in Syria, Libya and Yemen; an alarming devastating threat". *Travel Medicine and Infectious Disease* (2020).

34. Lighter J., *et al*. "Obesity in Patients Younger Than 60 Years Is a Risk Factor for COVID-19 Hospital Admission". *Clinical Infectious Diseases* (2020).

35. Alalwan AA., *et al*. "A Hemodialysis Patient with Severe COVID-19 Pneumonia". *Cureus* 12.5 (2020): e7995.

36. Zhang Q and Song W. "The challenges of the COVID-19 pandemic: Approaches for the elderly and those with Alzheimer's disease". *Med Communications* (2020): 1-5.

37. Taheri S., *et al*. "Managing diabetes in Qatar during the COVID-19 pandemic". *The Lancet Diabetes and Endocrinology* 8.6 (2020): 473-474.

38. Hitch D., *et al*. "The Functional Impacts of the Covid-19 Pandemic: A Rapid Review (2020).

39. https://app.powerbi.com/view?r=eyJrIjoiN2ExNWI3ZGQtZDk3My00YzE2LWFjYmQtNGMwZjk0OWQ1MjFhIiwidCI6ImY2MTBjMGI3LWJkMjQtNGIzOS04MTBiLTNkYzI4MGFmYjU5MCIsImMiOjh9

40. Al-Sadeq DW and Nasrallah GK. "The incidence of the novel coronavirus SARS-CoV-2 among asymptomatic patients: a systematic review". *International Journal of Infectious Diseases* (2020).

41. Al-Shamsi HO., *et al*. "Screening for COVID-19 in Asymptomatic Patients with Cancer in a Hospital in the United Arab Emirates 020". *JAMA Oncology* (2020).

42. Rahimi F and Abadi ATB. "Challenges of managing the asymptomatic carriers of SARS-CoV-2". *Travel Medicine and Infectious Disease* (2020).

43. Hargreaves S., *et al*. "Targeting COVID-19 interventions towards migrants in humanitarian settings". *The Lancet Infectious Diseases* 20.6 (2020): P645-P646.

44. Roess A. "A look at Arab regional responses to COVID-19". *Nature Middle East* (2020).

45. Negm HM. "Could COVID-19 improve psychiatric awareness at the heart of the Middle East? – A personal reflection on Bahrain's response". *Irish Journal of Psychological Medicine* (2020): 1-8.

46. Poole DN., *et al*. "Responding to the COVID-19 pandemic in complex humanitarian crises". *International Journal for Equity in Health* 19 (2020): 41.

47. Yirgu R., *et al*. "COVID-19: Initial synthesis of the epidemiology, pathogenesis, diagnosis, treatment, and public health control approaches". *The Ethiopian Journal of Health Development* 34.2 (2020).

48. Mahmud I and Al-Mohaimeed A. "COVID-19: Utilizing local experience to suggest optimal global strategies to prevent and control the pandemic". *International Journal of Health Sciences* 14.3 (2020).

49. Badrfamy R and Zandifar A. "Coronavirus disease 2019 in Iran: the need for more attention to primary health care". *Public Health* 182 (2020): 187.

50. Al-Mandhari A., *et al*. "Coronavirus Disease 2019: preparedness and readiness of countries in the Eastern Mediterranean Region". *Eastern Mediterranean Health Journal* 26.2 (2020): 136-137.

51. Das HJ. "COVID-19: Developments in West Asia. Vivekananda International Foundation (2020).

52. Ghanam R., *et al*. "COVID-19: SEIRD Model for Qatar COVID-19 Outbreak". *Letters in Biomathematics* (2020).

53. Saddik B., *et al*. "Assessing the influence of parental anxiety on childhood anxiety during the COVID-19 pandemic in the United Arab Emirates". *Med Rxiv* (2020).

54. Simpson PL and Butler TG. "Covid-19, prison crowding, and release policies". *British Medical Journal* 369 (2020): m1551.

55. Shekhar S., *et al*. "Hookah smoking and COVID-19: call for action". *Canadian Medical Association Journal* 192 (2020): E462.

56. Mousavi SH., *et al*. "The first COVID-19 case in Afghanistan acquired from Iran". *The Lancet Infectious Diseases* 20.6 (2020): P657-P658.

57. Alser O., *et al*. "Healthcare workers preparedness for COVID-19 pandemic in the occupied Palestinian territory: a cross-sectional survey". *Med Rxiv preprint* (2020).

58. Mohsen F., *et al*. "A Crisis within a Crisis: COVID-19 Knowledge and Awareness among the Syrian Population-A National Survey Assessment". *Research Sqaure* (2020).

59. Abdi - Soojeede MI. "A review of clinical manifestation on coronavirus disease (COVID-19) in Somalia". *Research Gate* (2020).

60. Mousa KNAA., *et al*. "Knowledge, Attitudes, and Practices Surrounding COVID-19 among Sudan Citizens during the Pandemic: An Online Cross-sectional Study". *Sudan Journal of Medical Sciences* (2020).

61. Portnoy J., *et al*. "Telemedicine in the Era of COVID-19". *The Journal of Allergy and Clinical Immunology: In Practice* 8 (2020): 1489-1491.

62. Le TT., *et al*. "The COVID-19 vaccine development landscape. nature reviews drug discovery". 19 (2020): 305-306.

63. Zaatar MT. "Charting the UAE's battle against COVID-19". *Nature Middle East* (2020).