─────────────**Editorial**

Prediction and Trend of COVID-19 in Iraq

Ahmed Hardan* PhD Community Medicine
World Health Organization Consultant

Early data from the 2020 COVID-19 pandemic suggest that there was over-estimated the within-country rate of spread of COVID-19 virus. Here, we present analysis and prediction for COVID-19 in Iraq, in terms of the incidence, transmission pattern and risk factors for persistent circulation of the SARS-CoV2 in Iraq and neighboring countries. Globally, as of 12 July 2020, there have been 12,401,262 confirmed cases of COVID-19, including 559,047 deaths, reported to the World Health Organization (WHO)[1].

The WHO has confirmed more than one million cases of COVID-19 in the 22 countries of WHO's Eastern Mediterranean Region[2]. Since January 2020, WHO has been sounding the alarm and raising awareness in the Eastern Mediterranean Region about COVID-19. From testing suspected cases, training rapid response teams, providing protective gear for health workers, to getting the message out via social media, WHO is in a race against time to help countries respond and prevent further spread of the virus. The current spread of a COVID-19 virus highlights gaps in our understanding of the disease transmission at national and provincial scales. The purpose of this study is to give a prediction of the epidemic peak of COVID-19 in Iraq, which might help the health system to act appropriately to reduce the risk, morbidity and mortality in Iraq. Here, we describe factors affecting epidemic of COVID-19 in Iraq. We try to examine the potential for the containment of COVID-19 in the country, and to predict the likely impact of mitigation measures on the viral transmission in Iraq and neighboring countries.
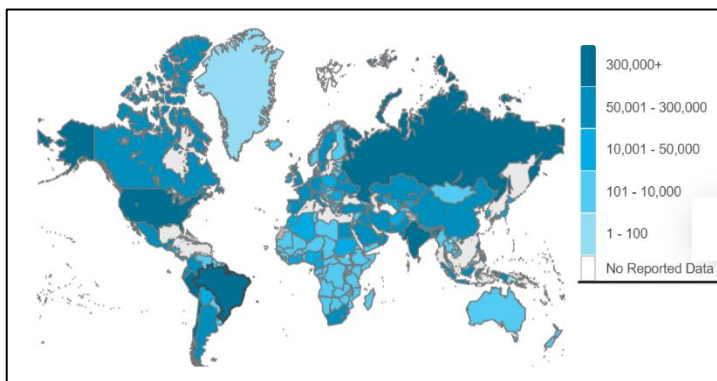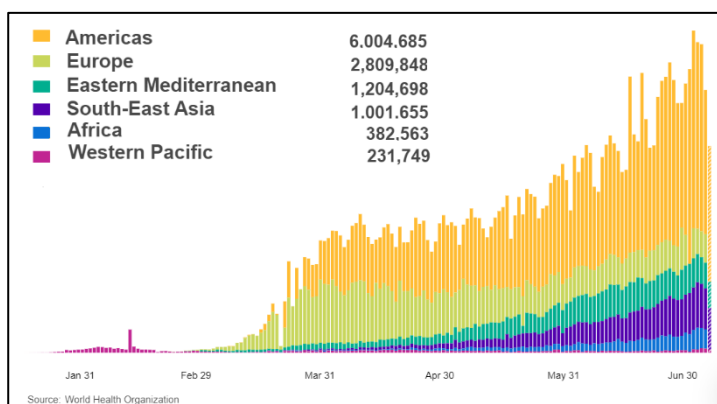

Figure 1: Map of Global COVID-19 as at 15 July 2020[3].

Figure 2: Epidemic curve of COVID-19 in WHO regions as at 15 July 2020[3].

We used the Common WHO Epidemic Analysis Approach[4] to generate further understanding of SARS-CoV2 spread in Iraq. The analysis provided an estimate of the viral transmission potential during the COVID-19 pandemic and generated ensemble forecasts for the activity peaks in Iraq. These results were validated against the real-life WHO surveillance data collected in EMRO.

In addition, we incorporate epidemiological attributes of COVID-19 viral infection with population estimates to simulate the spreading of COVID-19 virus. The population is constructed according to national demographics and statistics from Ministry of Health data of Iraq. The analysis and prediction are effectively representing the 40.2 million people living in Iraq.

The approach for risk assessment in this study is based on the balance of epidemiological, social, ecological data of Iraq and neighboring countries while maintaining overall flexibility in the description of the transmission rates, intervention measures, and outbreak conditions with special emphasis on Iraqi provinces.

Validation of specific assumption on the spread of SARS-CoV2 in Iraq was based on understanding of observed epidemic patterns, study of the effectiveness and results of different intervention made by authorities of Iraq[5].

COVID-19 in Eastern Mediterranean Region

There are rapidly growing numbers of severe and fatal cases in some border countries for Iraq. Several countries in Eastern Mediterranean Region (EMR) have already reported nationwide community transmission[6]. However, it is known that the virus spreads very quickly in the absence of effective mitigation measures. Based on the high transmissibility of the virus and the continued increase in the notification rate in all EMRO countries, the probability of increased community transmission is considered very high for Kuwait, Saudi Arabia and Iran. It is high for Syria, moderate for Turkey and low for Jordan.
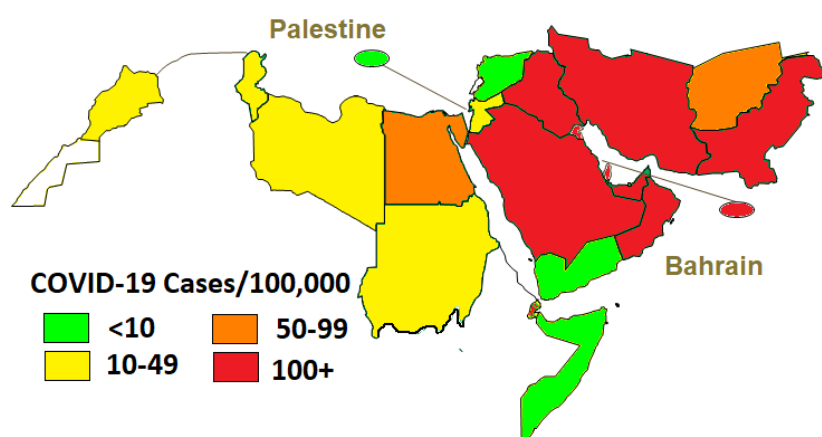

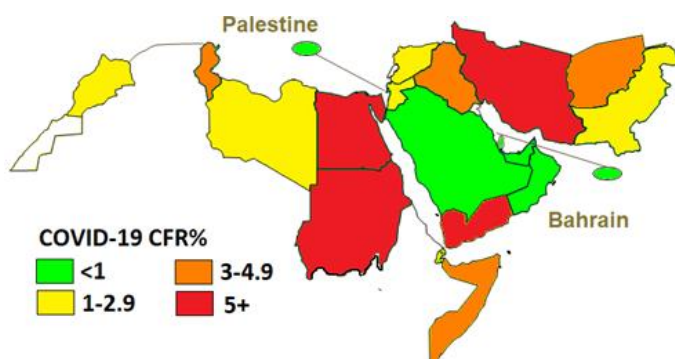**Figure 3: Incidence of COVID-19 in EMRO Countries 2020**

Figure 4: Case fatality rate (%) of COVID-19 in EMRO Countries 2020.

Focused Surveillance System in Iraq

The MOH in Iraq aims to increase the understanding of the COVID-19 dynamics in the country and support the planning of public health actions, established a focused surveillance system since the start of the pandemic early in 2020, building on a previously existing surveillance system in the Center for Communicable Disease Control in Baghdad. The system contains data on all laboratory confirmed cases of COVID-19 as per the WHO case definition. Laboratory confirmation World Health Organization guidelines using RT-PCR protocols[7]. Su*rveillance data are collected daily using a secure online from the 18 provinces of Iraq, according to an increasingly harmonized track-record. Data collected includes information on: demographics, clinical severity, comorbidities, date of symptom onset, date of diagnosis, outcome, province and health facility of diagnosis and province of residence[8].

COVID-19 in Iraq

Differences in incidence among Iraqi provinces are driven by the relative risk of transmission of the virus by province. The data are used to differentiate spreading patterns in the country. Iraq has a trained national rapid response team, for timely investigation and response to any emerging public health threat but require refresher training on how to investigate and respond to the COVID-19. Early warning surveillance system in Iraq is in place, but it is important to strengthen existing disease surveillance and laboratory capacities for surveillance and investigation of, and response to, the COVID-19 outbreak.

While much effort has been made to harmonize the COVID-19 surveillance data to enhance comparability, the diversity of information sources means that considerable variability remains across provinces of Iraq in the coverage and quality of data. Some figures of some provinces may be underestimated or overestimated when it is not possible to distinguish whether the data include the private sector or COVID-19 cases which are managed at home.

The first case of COVID-19 in Iraq was reported on 22 February 2020 and the number of reported cases has increased day by day[9]. A locally-acquired COVID-19 case was detected which was the first signal of ongoing transmission of SARS-CoV-2 in the country.

As seen in table 1 and figure 5, the number of newly reported cases per week has increased and a serious outbreak in Iraq is a realistic outcome.

The outbreak rapidly escalated to a national level epidemic, amid the WHO declaration of a pandemic, (Figure 6).

The current spread of a COVID-19 virus highlights gaps in our understanding of the disease transmission at national and provincial scales. There was substantial transmission in parts of Iraq but very little in other parts. This slow progression between national and province level synchrony is not obviously consistent with theoretical studies of the within-country dynamics.

Table 1: Number of newly reported COVID-19 cases in Iraq until 15 July 2020[10].

Province	Cases	Death
Baghdad	31422	1431
Nineveh	561	11
Basrah	6975	269
Arbil	2689	70
Misan	4241	207
Anbar	749	38
Sulaimaniyah	7580	332
Diyala	2643	112
Thi Qar	6019	414
Kirkuk	3178	166
Wasit	5489	128
Karbala	4150	132
Dohuk	326	0
Qadisiyah	3820	138
Najaf	4703	92
Babel	4197	126
Muthanna	1550	55
Salah al Din	2238	60
Total	92530	3781
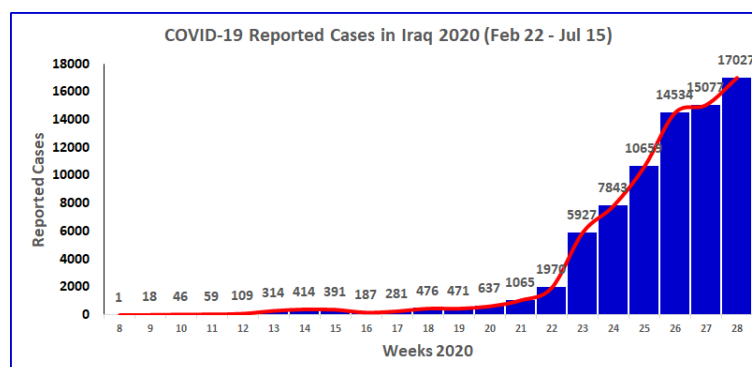
Figure 5: Epidemic curve of COVID-19 in Iraq as at 15 July 2020.
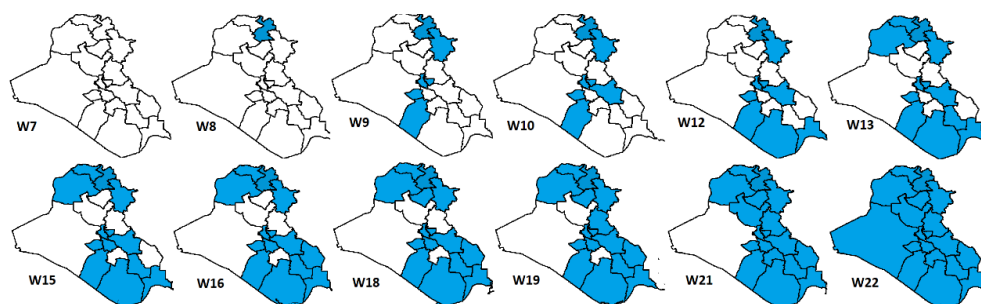
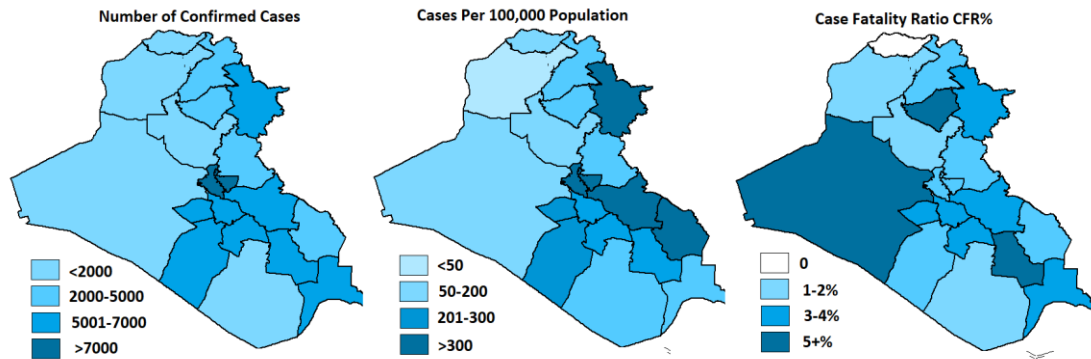**Figure 6: Spread of COVID-19 epidemic in provinces of Iraq by weeks 2020.**

Figure 7: Number and incidence rate and case fatality ratio of COVID-19 in Iraq as at 15 July 2020.

Prediction of the COVID-19 in Iraq

The study estimate that the basic reproduction number for the epidemic in Iraq is R0=2.6 (95% CI, 2.4 – 2.8) and the epidemic peak could possibly reach the late summer. In addition, we obtain two epidemiological insights; firstly; the intervention made by authorities in Iraq has a positive effect on the delay of the epidemic peak; secondly; intervention over a relatively long period is needed to effectively reduce the final epidemic size. We try to examine the potential for the containment of COVID-19 in the country, and to predict the likely impact of mitigation measures on the pandemic in Iraq.
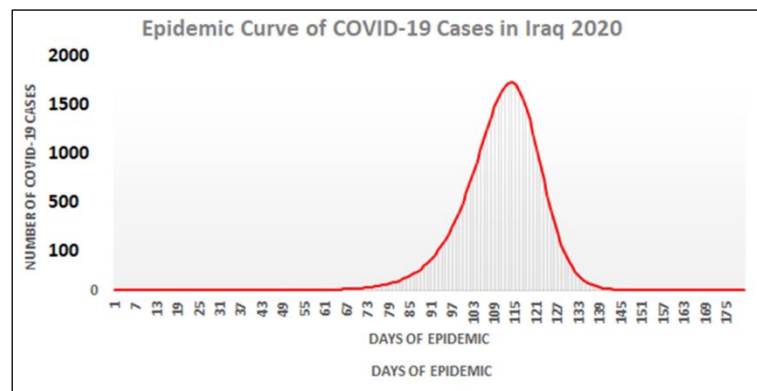

Figure 8: Predicted epidemic curve of COVID-19 in Iraq 2020.

Iraq called for interrupt transmission chain among human to human. Health Authorities have recognized that they are unable to control the pandemic without shutting down normalized public life, following the strict behavior measurements established at national level by Iraq and people such as social distancing, in-house quarantine (self-isolation) and interruptive actions against the transmission chain. As such measures are established, the expectation is to reduce the transmission rate and to efficiently handle the ongoing pandemic caused by this SARS-CoV2 virus at national and provincial levels, (Figures 8 and 9).
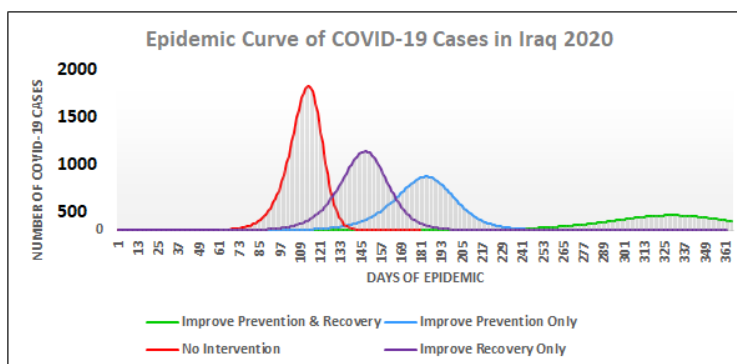
Figure 9: Predicted impact of interventions on epidemic curve of COVID-19 in Iraq 2020.

Table 2: Predicted COVID-19 cases in Iraq 2020.

| Province	Cases	Hospitalization	ICU Care	Mechanical Ventilation	Death
Baghdad	196,496	43,229	9,825	3,910	8,292
Nineveh	1,389	306	69	28	59
Basrah	71,677	15,769	3,584	1,426	3,025
Arbil	680	150	34	14	29
Misan	27,165	5,976	1,358	541	1,146
Anbar	659	145	33	13	28
Sulaimaniyah	840	185	42	17	35
Diyala	614	135	31	12	26
Thi Qar	50,733	11,161	2,537	1,010	2,141
Kirkuk	5,810	1,278	291	116	245
Wasit	5,214	1,147	261	104	220
Karbala	31,283	6,882	1,564	623	1,320
Dohuk	484	106	24	10	20
Qadisiyah	5,060	1,113	253	101	214
Najaf	35,608	7,834	1,780	709	1,503
Babel	7,405	1,629	370	147	313
Muthanna	2,974	654	149	59	126
Salah al Din	599	132	30	12	25
Total	444,691	97,832	22,235	8,849	18,766
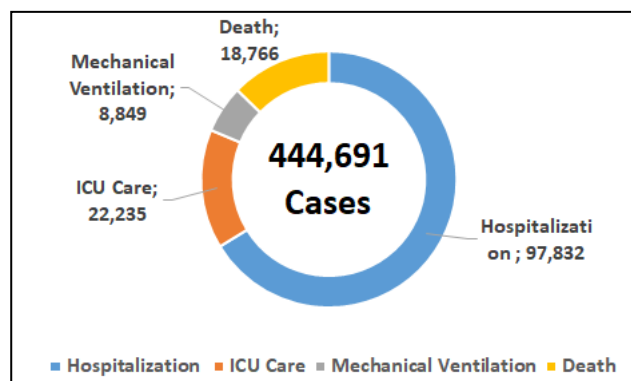
Figure 10: Predicted COVID-19 Cases in Iraq 2020

Impact of Mitigation Interventions on the COVID-19 in Iraq

The government of Iraq issued mitigation measures to slow transmission through infection prevention and control and physical distancing have been introduced at different points in time and at varying intensities across provinces of Iraq through the course of the pandemic. The school closure has started in almost all prefectures from the beginning of March 2020[11] and many social events have been cancelled off to reduce the contact risk, (Table 2). However, the effect of such social efforts might be seen in figure 11 [2]. In this study, we assume that these measures have some impact in slowing the transmission of COVID-19 in the general population and, more specifically, in defined risk groups of older adults and individuals with chronic underlying conditions. such social efforts successfully reduce the infection rate and the epidemic peak is delayed from 145 (16 July) to 192 (2 September). However, the epidemic size is almost the same. On the other hand, if the intervention is carried out strictly then the epidemic peak is delayed from 145 (16 July) to 233 (12 October) and the epidemic size is effectively reduced, (Figure 9).
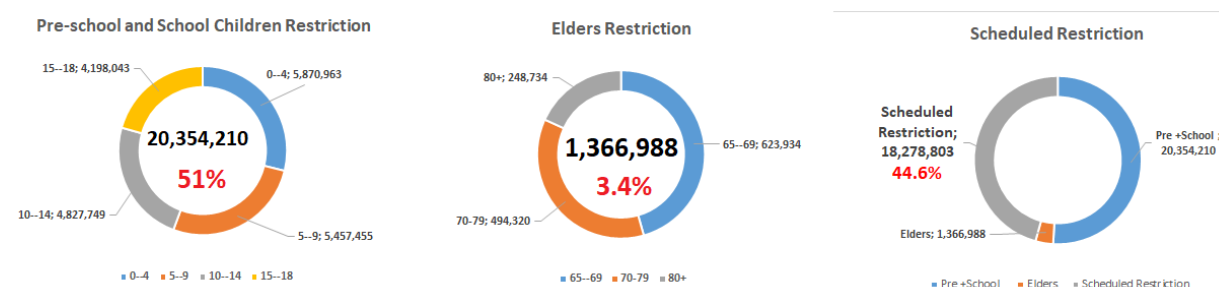

Figure 11: Risk Mitigation Restriction Measures Issued by Government of Iraq

Risk Analysis for Iraq and Border Countries

During a pandemic we cannot ignore the cross-border spread of SARS-COV2 virus. International travel will bring the virus in Iraq, and spread infections to far-flung communities. Public health authorities can only prepare and plan if they know the full picture. This study considers this regional perspective and include description of risk analysis of Iraq cross border transmission or risk of persistent transmission in border six border countries or WHO region with comprehensive COVID-19 monitoring programs namely; Jordan, Syria, Turkey, Iran, Kuwait and Saudi Arabia.

Factors favoring persistent viral transmission include; ecological changes including those due to economic development and land use, human demographics and behavior, international travel and commerce, technology and industry, microbial adaptation and viral mutation, and breakdown in public health measures, (Table 3).

The risk assessment for Iraq and border countries may help in epidemic forecasting and data that can be used by policy makers to anticipate trends, evaluate risks and eventually manage future events.

Table 3: Factors favoring persistent SARS-CoV2 viral transmission in neighboring countries 2020.

Factors	Jordan	Syria	Turkey	Iran	Kuwait	Saudi Arabia
Ecological changes	+	+++++	++	+++	+++	+++
Human demographics	++	++++	++	+++	+++	++
International travel	++	++	+++	+++	++	+++
Technology and industry	+	++	+	++	+	++
Microbial adaptation	+	+++	+	+	+	+++
Breakdown in public health	+	+++	+	+++	+	++
Total Score	**Low**	**High**	**Moderate**	**Very High**	**Very High**	**Very High**

Risk Analysis for Provinces of Iraq

Ongoing increase of COVID-19 cases have been reported in most provinces of Iraq. The overall weekly reported cases for the COVID-19 cases has increased from 414 cases in week 14 to 1065 cases in week 21, then 17,027 cases in week 28 while the total cumulative incidence has increased from 68 per 100,000 population to 224 per 100,000 population[12]. The incidence rate is highest in Wasit 368 cases per 100,000 population and lowest in Ninewa province 14 cases per 100,000 population. Uncertainty remains about the extent to which the prevention and control measures introduced may slow the rate of transmission, making the probability of continued transmission in all of the 18 provinces in the coming weeks very high[13].

Recent data from Iraq Ministry of Health and WHO EMRO indicate that 31% of cases require hospitalization, and 0.4% require critical care[14]. The likelihood of severe illness and death rises significantly in persons over 65 years of age and in those with defined risk factors including hypertension, diabetes, cardiovascular disease, chronic respiratory disease, compromised immune status, cancer and obesity. These risk groups account for the majority of severe disease and fatalities to date.

The risk of increasing community transmission of COVID-19 in the provinces of Iraq in the coming weeks is moderate if mitigation measures are in place, and very high if insufficient mitigation measures are in place.

Heath Care Providers in Iraq

The impact of increased community transmission would be high, especially if healthcare capacity is exceeded or if hospitals are affected and a large number of healthcare workers need to be isolated or become infected. The impact on vulnerable groups would be very high, in particular for the elderly and individuals with defined risk factors associated with elevated risks. The risk that the capacity of health system in Iraq will be affected in the coming weeks, is considered high with mitigation measures in place and very high if insufficient mitigation measures are in place.

This assessment is based on the facts that many provinces in Iraq are experiencing demands that far exceed currently available health care, including ICU capacity and, if the

pandemic continues on its current course without strong countermeasures and surge capacity enacted, there is a strong probability that all provinces will also reach this point.
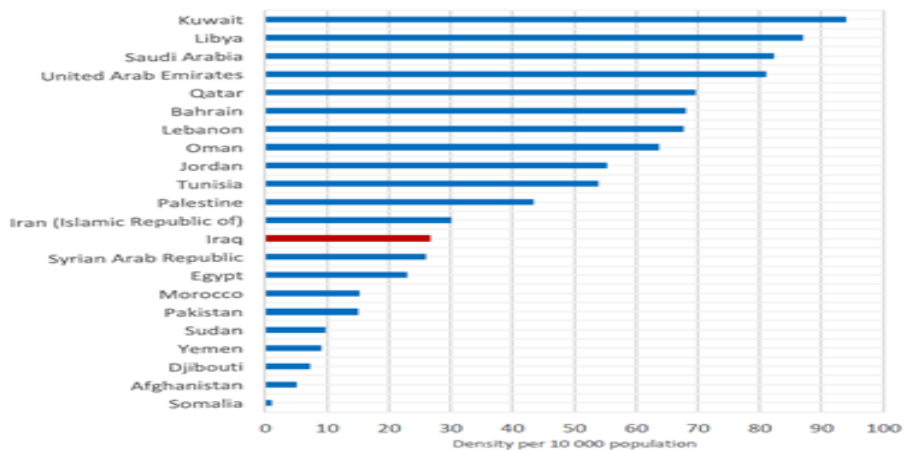

Figure 12: Density of physicians and nurses per 10000 population in Eastern Mediterranean Region 2019[15].

COVID-19 Cases among Health Care Providers in Iraq

Surveillance data shows clearly a very high number of COVID-19 cases 5599 cases among health care providers which represent 6.2% of all confirmed cases including 54 deaths 1.46 % of all deaths. Medical staff cases are 20%, paramedical 65% and health worker 15%. Male cases are 63% and female cases are 37%[16].

The SARS-CoV-2 can be easily spread in health care contexts and needs strong infection prevention and control practices. In Iraq, care facilities have emerged as particularly fragile environments in which infection can spread very rapidly. Affected HCW, compared with the affected general population, are on average younger and more frequently male.

Challenges for Containment of COVID-19 in Iraq

A serious concern on the situation in Iraq that undermines the plans towards containment of COVID-19 pandemic. Health Sector in Iraq is currently largely focusing on responding to different emergencies rather using a systematic and proactive strategic planning approach for long term development[17]. Poor public services like electricity, water supply, waste disposal, and others that have serious health implications. High population cross border movement raising the risk of viral importation. The quality of health professionals' training and service delivery is a major concern. Adverse effect of social determinants particularly the high rate of unemployment in young men and labour power. Continued volatile and complex security situation is resulting in population movements which are difficult to predict, the difficulty of regular supervision and monitoring due to security concerns, and the loss of expertise[18]. Lack of immunity and expected poor nutritional status complicates the health status of the population in Iraq making them susceptible to COVID-19 disease. Of particular concern is the gap in immunity for COVID-19, which could result in emergence of severe and fatal cases putting Iraq in the fight against SARA-COV2 virus.

Expectation of Global Trend of COVID-19

Risk analysis for persistent transmission at the six WHO Regions shows that unless an effective vaccine be produced[19]; viral transmission will be sustained globally with variable

extents. The SARS-CoV2 virus will be endemic in African (AFRO), Eastern Mediterranean (EMRO), South East Asia (SEARO), and Latin America from (AMRO). North America will complain of cluster outbreaks, while Europe will experience sporadic cases for the next decade. No region will reach elimination in the next future. We have implemented the most common basic reproductive number approach used by WHO for risk analysis for disease transmission, (Figure 13).
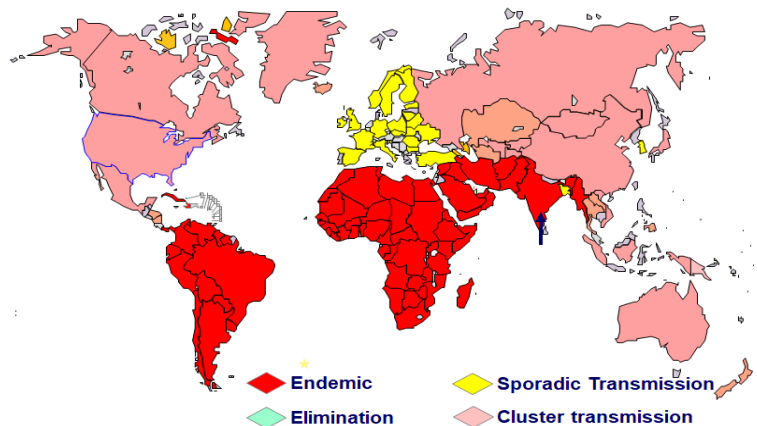

Figure 13: Global and regional prediction of COVID-19.

Conclusion

There is active transmission of SARS-CoV2 virus in Iraq and the epidemic curve is rising.

In view of the prolonged character of this situation, there is exceedingly serious concern regarding the short and longer terms consequences of COVID-19 on the health of populations living in Iraq.

The situation will not go back to normal. In the coming period, we need to see a shift in attitudes and actions and a sustained commitment from the government[20].

Recommendations
- Government is encouraged to sustain and escalate efforts to find, isolate, test and treat all COVID-19 cases and trace every contact.
- Holding of mass gatherings must be reviewed from a public health risk-assessment approach.
- Individuals must follow a rigid protective measures to protect themselves and others by practicing regular hand hygiene measures, following proper coughing and sneezing protocol, ensuring physical distancing, and wearing masks in public settings as directed by respective national health authorities[21].
- Health care to be cautious of symptoms, stay home if they feel sick, and seek medical care immediately, if needed.
- More technical, logistic and financial support for Iraq is anticipated from World Health Organization (WHO) and partners.
- Neighboring countries need to raise the level of coordination for implementation of International Health Regulations (IHR).

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