Review Article

A review on quarantine during COVID-19 outbreak: Lessons learned from previous epidemics

Kimia Vakili[1], Elahe Ahsan[1], Mobina Fathi[1], Niloofar Deravi[1], Shirin Yaghoobpoor[1], Melika Mokhtari[2], Tara Fazel[3], Mercede Holaki[4], Sara Javanmardi[5], Reza Shekarriz-Foumani[6], Maryam Vaezjalali[7*]

[1] Student Research Committee, School of medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2] Student Research Committee, Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran
[3] Student Research Committee, school of international campus, Guilan University of Medical Sciences, Rasht, Iran
[4] Dental Student's Scientific Research Center, School of dentistry, Tehran University of Medical Sciences, Tehran, Iran
[5] Student research committee, Faculty of Dentistry, Alborz University of Medical Sciences, Karaj, Iran
[6] Department of Community Medicine, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[7] Department of Microbiology, Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Corresponding author and reprints: Maryam Vaezjalali. Department of Microbiology, Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
Email: maryam.vaezjalali@sbmu.ac.ir
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Abstract

Background: Since the emergence in December 2019, the novel coronavirus disease 2019 (COVID-19) has caused a global pandemic that has infected so many people all around the world. As there are no vaccination or antiviral treatment available yet, public health measures play a substantial role in the management of this pandemic. Governments of affected countries have imposed different quarantine policies and travel bans. As quarantine can have many controversial aspects, this review intends to clarify its role in disease control and other aspects of human everyday life with due attention to a couple of epidemics in the past (SARS, MERS, and flu) and ongoing COVID-19 outbreak.

Methods: We conducted a thorough search in PubMed, Research Gate, Google Scholar, Excerpta Media Database (EMBASE), and Web of Science databases and collected all relevant articles to Quarantine in the past epidemics (SARS, MERS, and flu) as well as ongoing COVID-19 pandemic.

Results: A total of 176 articles were extracted in our primary search process. Primarily, 53 articles have been excluded because of duplication. The other 44 articles have been excluded due to different reasons (Lack of useful information and eligibility of data). Finally, 79 articles were selected for more evaluation (published until April 2020).

Conclusion: By having previous epidemics, including SARS, MERS, and flu, in mind, quarantine and isolation seem to be proper choices for this situation. But, as this epidemy is bigger than former ones, stricter public health measurements, such as serious social distancing and community-wide containment, are recommended.

Keywords: COVID-19; Coronavirus Infections; Quarantine

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Introduction

Term of quarantine is originated from "Quaranta" in Italian language and is related to the sequestration which was imposed on merchant ships that were arriving during the plague outbreak in the 14th century and lasted 40 days (1). Quarantine stands for the movement confinement of people who are assumed to have exposure to a contagious disease, but they do not feel ill, because they didn't get infected or they are in incubation period (2). This term may be used instead of isolation and containment interchangeably. All these terms are considered as public health strategies aimed to protect general hygiene, but they differ in the exposed individual whether they are symptomatic or not (1):

(1) Isolation: Isolation is the separating sick people with contagious diseases from non-infected people to protect non-infected ones, and mostly happens in hospital settings. Isolating patients is especially effective in interrupting transference if early detection is achievable before visible viral shedding (2, 3). When an individual shows symptoms, quarantine can no longer be applied and that person should be in isolation (1, 4).

(2) Quarantine: Quarantine includes infringement of civil liberties and limitation of movement (5, 6). Limitations for people who are assumed to be exposed to a communicable disease but are not sick, either because they are not infected or they are still in their incubation period. These persons will require psychological supports, water and food, and medical and household supplies. Financial payment for lost workdays should be contemplated (7).

(3) Social distancing: means to create a set space between persons that will reduce the chance of transmission of disease, e.g., 3 to 6 feet for droplets (1, 4). Diseases that are transmitted by respiratory droplets need definite proximity of people. Cancellation of gatherings and closure of schools or office buildings and suspension of public markets are examples of social distancing (7).

If these measures are found to be insufficient, community-wide containment probably needs to be applied which is an intervention implemented to an entire society, city or region, that is designed to lower personal contacts, excluding minimal interaction to ensure essential supplies (7). As quarantine can have many different aspects in the field of public health, this review intends to clarify quarantine's role in disease control by going through what has happened during previous epidemics.

Methods

A systematic study was conducted by searching databases including PubMed, Google Scholar, ResearchGate, Excerpta Media Database (EMBASE), and Web of Science. Our search was based on the articles about the efficacy of quarantine and other useful public health measurements in management of the past epidemics (SARS, MERS, and flu) as well as ongoing COVID-19 pandemic. **Results**

A total of 176 articles were extracted in our primary search process. Primarily, 53 articles have been excluded because of duplication. The other 44 articles have been excluded due to different reasons (Lack of useful information and eligibility of data). Finally, 79 articles were selected for more evaluation (published until April 2020). We did not have any language limitations and all the relevant studies in any language were included (Figure 1).

Since the first day of new Coronavirus outbreak in Wuhan, China, the number of cases and casualties of this disease in mainland China and other countries (such as USA, Italy, Spain, South Korea, and Iran) is constantly increasing, and the shape of the epidemiological map is changing quickly (8). As a result, the World Health

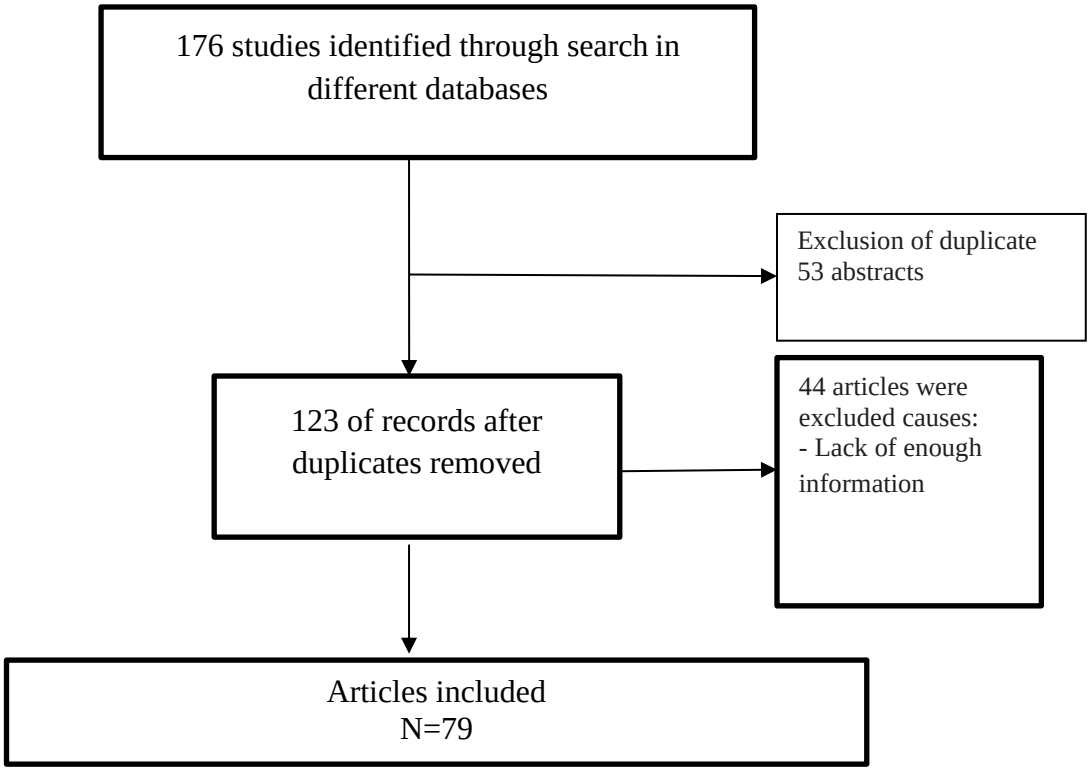

Figure 1. The flowchart of selected articles*COVID-19 and Quarantine*

Organization (WHO), announced that "Coronavirus disease-2019 (COVID-19) is a Public Health Emergency of International Concern (PHEIC)" (9). So, with its high transmittance and rapid global spreading, COVID-19 is now being compared with the Spanish flu outbreak in 1918, which infected about a quarter of the world's population at the time (10). Based on the primary epidemiologic data of the COVID-19 outbreak (until 22 January 2020), the mean reproduction number (R0) was estimated to be 6.47 (11), but after that, as the disease was spreading throughout the world this number has changed. According to several studies published until March 2020, have estimated the minimum R0 for China (and overseas) at 1.4 and the maximum at 7.23. In Italy, R0 was 4.2. These numbers were larger than R0 of SARS (R0=4.91) (12) and MERS (R0=2.0–2.8) (13). Hence, COVID-19 can be introduced as a highly transmittable disease in comparison to SARS and MERS. The very first observation of the incubation period of SARS-CoV-2 came from the National Health Commission of China, reporting an incubation time between 1 and 14 days (14). But according to Leung's study, the distribution of the incubation period is significantly different between travelers to Wuhan and non-travelers. This difference, indicated by the means of 1.8 to 7.2 days (with variances of 0.7), might be due to the different infection doses (based on location) to which travelers and non-travelers were exposed (15). This difference implies that the incubation period of this disease may change under different conditions, therefore it requires further studies.

At first, as this disease emerged in Wuhan, China, prevention strategies for COVID-19 outbreak were defined at three levels (16): on 20 January 2020, "No.1 announcement" was issued by National Health Commission of the People's Republic of China, officially including COVID-19 into class B infectious diseases management, and also approved class A infectious disease

management to be conducted parallel (17). According to this policy, isolation observation and treatment protocols should be run by medical institutes to control COVID-19 spread. On 22 January 2020, guidelines for the control and prevention of COVID-19 were published by the National Health Commission for medical institutes for nosocomial infection prevention (18). On 28 January 2020, protocols for rapid control and prevention measures were issued by National Health Commission to apply a "big disinfection and big isolation" policy, and therefore effectively restrict the epidemic spread during the Chinese New Year Festival (19). Some targeted measures were applied for rural (published on 28 January 2020) and the elderly population (published on 31 January 2020) by these strategies as well (20, 21). Several public health measures (intended to prevent or slow down COVID-19 transmission) were implemented; including diagnosis of the cases, case isolation, identification and follow-up of contacts, rapid identification, infection control and prevention in health care centers, awareness-raising in the population (especially high-risk groups), conduction of health measures for travelers, and use of personal protective equipment (PPE) (22, 23). Furthermore, other countries started taking measures to prevent COVID-19 as well, for example, the President of the USA stated Suspension of Immigrant and Nonimmigrant Entry (who may pose a risk of COVID-19 transmission) on January 31, 2020 (24). Other measures implemented by other countries were quarantine of travelers who came from high-risk countries and symptoms-based screening at borders (25). These measures were employed during Ebola outbreaks as well. As an example, temperature screening at borders led to detect the majority of exported cases of COVID-19 according to a WHO report (26).

As respiratory droplets are one of the main transmission ways of COVID-19, isolation (of the affected population) and the use of PPE are some of the key measures to prevent transmission of this disease. For subjects coming from high-risk areas or having contact with confirmed cases, a 14 days' quarantine period is applied. As a result, if any sign or symptoms related to COVID 19 did not emerge in this period, the subject is considered not infected and therefore the quarantine can be removed. A 14 days domiciliary quarantine (i.e. staying at home, with minimal contact with others) since the confirmation of positive test, is applied for patients who were diagnosed with mild disease (and did not need medical support) (27).

These rules can be effectively running in the community, but they should be cautiously applied to hospitals. Hospitals are key places during epidemics: they admit frail patients, expose them to the virus, and then readmit them to the community; as a result, they can spread the infection. For instance, the current outbreak in Northern Italy is occurred due to a single infected patient, having access to a community hospital. In that hospital, this patient infected several patients and health-care providers (28). Furthermore, the patient isolation in hospitals can cost a lot of money, for example in the terms of PPE used by the health-care providers, and also, space and time dedicated to them. This condition can be even more complicated with patients in ICU, where endotracheal tubes and other operations on patients' respiratory tract can be considered as highways for viral spreading (27). In the following, 3 examples of different measures that have already been conducted in the case of COVID-19 outbreak and were reported to be effective due to recent studies will be discussed:

Quarantine for asymptomatic visitors from high-risk areas can be considered as a preventive method that its effectiveness has been historically proven; it should be actively exerted (29, 30). Nevertheless, this measure seems inadequate to alleviate the present epidemic. Additionally, with the great risk of dissemination within the

community, the more active preventive containment policy is recommended to decrease international transmission. It is also important to note that, according to public attitude, high-level quarantine should not be considered as a violation of human rights or irrational racism; while a serious health security emergency is threatening public health (31).

The other important thing that must be cautiously regarded in the case of quarantine, is its duration. The parameter that defines this duration is the incubation period of the disease. According to recent studies, the incubation period of SARS-CoV-2 infection ranges from 2 to 14 days (most often, from 3 to 7 days) (32). On the other hand, according to a study conducted by Leung, which reported that there must be a difference in incubation period between travelers and non-travelers, revealed that the 95th percentile of incubation period in non-travelers could be 14.6 days and up to 17.1 days. As a result of this high variability in the incubation period, it was suggested that the duration of the quarantine period must be prolonged to 3 weeks (15).

Other limitations

Travel restriction

According to modeling assessments of travel limitations in the COVID-19 outbreak, as the virus had already spread from Wuhan to other cities within China by 23 January 2020, the travel quarantine of Wuhan has managed to only modestly delay the epidemic spread to other cities of China (33-35). These models indicate that despite the initial effectiveness of the Wuhan travel ban at minimizing international case entrance, after 2-3 weeks, the number of cases outside China have continued to grow because of cases that originated from other places. Moreover, modeling studies also showed that extra travel limitations (up to 90% of the traffic) have a modest effect unless they were paired with further public health interventions and behavioral changes, to achieve a significant reduction in disease spread (36). These models also showed that even with strong travel restrictions in mainland China (since 23 January 2020), many subjects, who were already exposed to the SARS-CoV-2, have been traveling throughout the world undetected. In conclusion, it is expected that travel restrictions in the case of COVID-19 outbreak will have modest effects, and should be paired with other transmission-reduction interventions to mitigate the epidemic (37).

Enhanced Traffic Control Bundling (eTCB)

Taiwan, conducted a national version of TCB during the SARS epidemic in 2003, that could effectively minimize nosocomial infection among patients, healthcare workers (HCWs), and visitors coming to hospitals (38, 39). Traffic Control Bundling (TCB), a type of multi-modal care (40, 41), includes three important measurements:

(1) Triage before entering hospitals: during outdoor triage stations, according to fever screening, suspected patients will directly be sent to a specific contamination zone (through a guarded control route).
(2) Strict separation among zones of risk: “zones of risk” are specifically differentiated (a) contamination, (b) transition, and (c) clean zones.
(3) Strict requirements and protocols for personal protective equipment (PPE) use coupled with checkpoint hand disinfection: HCWs that move from contamination zone to clean zones, must stop in the transition zone and undergo decontamination process. They also should disinfect their hands at every checkpoint between these zones (38).

Enhanced TCB (eTCB) has two enhancements, in addition to traditional TCB:

(1) eTCB adds a quarantine ward to the transition zone. The quarantine ward is devoted to patients with uncommon manifestations and those who are waiting for their final diagnosis. These patients are directly sent to this ward from outdoor triage and stay there for

the full incubation period (42). Like traditional TCB, HCWs coming from the clean zone to quarantine ward must use PPE. On the other hand, during moving from the quarantine ward to the isolation ward, HCWs must undergo checkpoint disinfection, which is must also be done when they move from isolation ward to the clean zone as well (again, via a transition zone).

(2) Face masks and checkpoint hand disinfection are necessary for all visitors coming to the hospital. This measurement should be supplemented with elevated environmental disinfection.

In conclusion, it can be said that eTCB breaks the cycle of community-hospital-community disease circulation, by limiting nosocomial transmissions (43).

Lessons from previous epidemics

SARS and Quarantine:

SARS first appeared in Guangdong, China, in mid-November 2002 (44). SARS was a highly contagious viral disease caused by a sub-type of coronaviruses called *SARS* (Severe Acute Respiratory Syndrome) coronavirus (*SARS*-CoV). The virus was transmitted to humans from other species and subsequently spread between humans (45). After China, the first reports of similar cases were in Hanoi, Vietnam (46), Hong Kong (47), Canada, Singapore, and Taiwan (48), respectively. Between November 2002 and July 2003, 8096 cases of SARS were confirmed in 29 countries, with 774 deaths (49).

With no definitive treatment or vaccine for the virus, global organizations, governments, and public health authorities recommended and took measures to control the outbreak. These included public awareness of the disease, reducing social contact, identifying and quarantining people after contact with the affected person, early detection of the disease, and isolation of the symptomatic individuals (50). Quarantine and isolation were two very effective strategies for controlling the SARS epidemic because they reduced the contact of vulnerable people with affected people, thereby reduced the risk of transmitting the disease to susceptible individuals (12, 44, 51). Public health epidemiologists have used mathematical models and ethical frameworks to evaluate the rationality and effectiveness of large-scale quarantine at its social cost (52).

At the SARS epidemic, different countries considered different methods for quarantine. In China, Singapore, Canada, Taiwan, and Vietnam, quarantine was carried out for 10 to 14 days for people who were in close contact with people with SARS or suspected of having the disease (45).

In Toronto, Canada, public health officials ordered people who had been in contact with SARS patients to stay in quarantine for 10 days after exposure (52). The incubation period for SARS is between 2 to 9 days (29); therefore, 10 days was chosen for quarantine. During this time, people under quarantine had to wear masks, avoid contact with other people in the home, and constantly monitor themselves looking for symptoms of SARS. During the quarantine period, public health workers were required to contact quarantined individuals to check whether they complied with quarantine or not, to support them, and if necessary, provide food and income lost due to quarantine by referring to the relevant institutions. People who did not comply with quarantine rules could be fined up to $ 5,000 (52, 53). Although quarantine has had a significant impact on the eradication of SARS around the world, according to a study conducted by Hawryluck et al. on 129 quarantined individuals through an online survey, 28.9% and 31.2% of them showed PTSD and depression symptoms, respectively. Also, having direct or indirect contact with people infected with SARS was associated with PTSD and depression. On the other hand, the prevalence of PTSD was higher in people who were quarantined for a longer period (54). In some other countries quarantine was accompanied by the imposition of more restrictions and

breaking the quarantine resulted in more severe penalties. Among the countries affected by SARS, China had the highest incidence and probably had 5,327 cases of SARS (55, 56). About 50 percent of cases of SARS in China was in Beijing (57). About 30,000 were quarantined in Beijing, of which 60 percent were quarantined individually (56). Also in Beijing, a collective quarantine was enforced for the remaining 40% (12,000 individuals). Hospitals, residential buildings, construction sites, and universities were completely blockaded and also, some rural areas in China, such as Hubei Province, were sealed off. China was not the only country to have a collective quarantine, but the collective quarantine was also implemented in Vietnam, Hong Kong, and Taiwan in addition to individual quarantine. Holiday camps, hotels, hospitals, universities, government buildings, etc. were used to house people under group quarantine (45, 53, 58). Due to the high prevalence of SARS in China, the Chinese government had imposed prison sentences or even the death penalty on those who did not comply with quarantine and deliberately violated quarantine laws. In China, meals were provided for and delivered to quarantined people. Social committees also sent flowers and letters to them. In Taiwan, as in China, meals were delivered to people under quarantine. Supportive phone calls and giving $ 147 to post-quarantine people were also among the support provided to the Taiwanese people (52, 56, 59, 60). In Singapore, home quarantine was implemented since March 24 for people in contact with SARS patients (61). However, In Hong Kong, people who had had contact with people with SARS were advised to be under medical supervision for ten days and to visit the prescribed medical centers (62). In general, there was a lot of cooperation from people in different countries to comply with quarantine laws (53). In Toronto, Canada, for example, only 27 official quarantine orders were issued, and other people voluntarily quarantined themselves (63).

In many countries, identifying and quarantining patients, as well as examining those who had been in contact with them, significantly prevented the transmission of the virus. The quarantine led to stress, psychosocial pressures, financial problems, and numerous workforce challenges for individuals, families, and governments (50). Investigating the effectiveness of public health interventions, searching for ways to make quarantine more focused, and making it less onerous are among the priorities for further research set by The WHO SARS Scientific Research Advisory Committee (64).

MERS and Quarantine:

MERS outbreak in Korea from May till December 2015, caused 38 deaths, 186 infected individuals, and 16992 exposed persons who were quarantined at home for two weeks (65), which resulted in about 9.311 won economic loss, equal to 8.5 billion dollars (66). According to Oh et al. (67) peak of the viral shedding was in the second week of the disease period in severely infected cases; so to limit the virus spread remarkably, MERS cases should be identified rapidly and then quarantined properly. Park et al. (68) reported that such a strategy was helpful in South Korea to control the MERS outbreak. Oh et al. (69) stated that aggressive quarantine strategies may be required particularly when many individuals in health care centers are exposed. Because asymptomatic MERS-CoV infected persons are not diagnosed, they may cause a continuous outbreak (70-72).

Voluntary quarantine pieces of advice recommended individuals contacted with MERS infected cases within the illness period have to quarantine themselves in a health care center or at home for two weeks. Therefore, a total of 14702 individuals were quarantined. In the quarantine period, the health status of the individuals was monitored, and to compensate for the income loss within this period, necessities

were provided. Within the quarantine period, those individuals who showed symptoms of the disease would be isolated and then treated at an early stage, and those who didn't develop disease symptoms in a 2-week quarantine would be discharged from additional monitoring (73). Although, most of the time these guidelines were ignored and therefore resulted in public outrage in Korea and also China and Hong Kong (74, 75) and additionally caused legislating punishments for passengers who declare misleadingly about their health status (74, 76). Cohort quarantine perhaps was useful in hindering the spread of the virus in the community, though there was an occurrence of further transmission among the hospital members who were cohort quarantined. it is reported that caregivers might cause the transmission (77).

Findings of Kim et al. study (78) shows that MERS infected patients' treatment in quarantine had considerable effects on their mental health. Based upon Jeong et al. (79) study on the mental health of 1656 quarantined patients, 7.6% developed anxiety symptoms and 6.4% declared experiencing anger feeling within the 14 days of quarantine. Based on Lee et al. study, medical staff (who performed tasks related to MERS) were more likely to develop mental problems during the outbreak and quarantine period, so they should be considered as the target of psychiatric intervention and care (65). Kim et al. recommended offering mental services to all MERS patients, whether they have any psychiatric disorder or not, to detect the psychiatric symptoms at early stages (78).

1918 Pandemic (H1N1 virus): a historical lesson

A historic quarantine perspective may help to comprehend its uses better and trace stigma and prejudice long roots from the 1918 influenza epidemic (H1N1 virus) (80). The multilateral health surveillance systems made with difficulty over the last few decades in the US and Europe did not help to control the influenza pandemic during the years 1918–1919 when the war had divided the world (81).

The army's medical officers quarantined soldiers with symptoms or signs at the pandemic start; the disease being very contagious, however, spreads rapidly, infecting people in almost all countries. Different pandemic reactions were attempted. In main Western cities across the world, health authorities applied many disease-containment tactics, such as the closure of schools, theaters, and churches, as well as public gathering debarment. A sporting event, where 10,000 adolescences were to take part, was suspended in Paris (82).

The application of measures, such as social distancing and respiratory hygiene, was promoted by physicians. These measures, however, were employed relatively late and uncoordinatedly in war-torn zones in particular, where interventions (such as border controls, travel restrictions) were not practical as the troops' movement was making the virus possible to spread more (80).

Often, health authorities' decisions appeared more concentrated on convincing the public that the attempts are made to prevent the virus from spreading rather than on preventing its spread in reality (83). The role of the media in affecting future public opinion started to be shaped. Newspapers took opposing views concerning health measures, thus assisted panic spread. In Italy, civil authorities forced Corriere Della Sera, the largest and most powerful newspaper, to stop reporting the mortality rate (150–180 deaths/day) in Milan as the reports made people more anxious (83).

In the 20th century, during the "Asian flu" pandemic of 1957–1958 as the second influenza pandemic, several countries adopted steps to control the disease spread. In general, the disease was milder than the 1918 influenza; thus, the universal condition was different. Influenza awareness was significantly advanced: the pathogenic cause was identified in 1933,

seasonal epidemic vaccines were accessible, and the treatment of complications was possible with antimicrobial medicines. A global influenza surveillance network further was introduced by the World Health Organization, warning new influenza (H2N2) virus early when spread in February 1957 in China and later globally. Over the third and mildest influenza in the 20th century, i.e., the influenza A (H3N2) pandemic of 1968–1969, this scenario reoccurred. The virus was identified first in early 1968 in Hong Kong, and in September 1968, it reached the US by its Marines, who returned from Vietnam. The virus spread across the world over the winter of 1968–69; the impact was minimal; thus, no particular containment steps were taken (80).

Psychological aspects of quarantine and social distancing

Isolation and quarantine of the people at risk often avert the spread of infectious diseases. Such strategies limit daily activities, the mobility, and social connection of the individuals who are affected. In recent COVID-19 pandemic isolation and quarantine are being implemented in many situations, requiring an assessment of global research about how these interventions impact the outcomes of mental health among communities (84).

A high mental health burden was recorded among people who have undergone quarantine or isolation (85-87). Differing depression rates were reported among the research participants (86-91). Anger and irritability were reported among the research participants (86, 88, 89, 92, 93). Also, four reviews reported different stress rates between the research participants who underwent isolation or quarantine (85, 86, 89, 90). Another concern to those who are confined due to quarantine order is psychological stress. The psychological effect arises from two causes: first the disease's fear and vagueness, and second incarceration (1).

Available studies have studied factors linked to rage and anxiety symptoms after quarantine during the MERS epidemic and found that during the beginning stages of the MERS epidemic, individuals experienced heightened anxiety with a higher level of information about the infection and higher trust in unofficial information (94).

A Middle East respiratory syndrome coronavirus (MERS-nCoV) epidemic in Korea from May to December 2015 resulted in 38 deaths, 186 infection cases, and 16,692 exposed people who were quarantined. Healthcare staff who treated MERS-nCoV contaminated patients in quarantine have observed a great risk of symptoms of post-traumatic stress disorder (PTSD). Also, 16.6 percent and 7.6 percent of the exposed individuals in quarantine who had not been diagnosed with MERS-nCoV contamination showed feelings of anger and anxiety symptoms, especially, during the quarantine time. 6.4% and 3.0% of patients showed anger and anxiety symptoms even 4 to 6 months after the time when quarantine ended (95).

Isolation and quarantine for the prevention of infection also affected the health care workers 'wellbeing and mental health. Brooks et al. for example, noticed many mental health problems in health care providers who worked in quarantine such as posttraumatic stress-related symptoms, alcohol use, poor concentration, irritability, anxiety, exhaustion, avoidance behavior, work performance deterioration, insomnia, depression, detachment and acute stress disorder even after 3 years of quarantine. In addition, isolation and quarantine had impacted the informal caregivers' mental health. Brooks et al. recorded that 28 percent of parents of children in quarantine had trauma-related mental disorders (86).

Many other psychological conditions and mental disorders were observed among study populations, such as fear (1, 86, 88), loneliness (1, 85, 88-90, 95, 96), low self-esteem (88, 90, 92), boredom (1, 88, 89, 95), guilt (86), a lack of control feeling (85,

89, 90), vigilant handwashing (86), mood disorders (86, 90), insomnia (86), perceived dirtiness (90) and avoiding social meetings and crowds even after isolation or quarantine (86).

Brooks et al. reported that stressors such as fears of infection, inadequate information, frustration and boredom, lack of in-person contact with teachers, friends, and classmates, family financial loss and lack of personal space at home can have even more enduring and troubling effects on adolescents and children (86).

It seems that particular consideration should be paid to the community mental health issues. Presented programs to screen mental conditions and to manage and treat cases by hiring psychologists, psychiatrists, and other related medical groups seem essential, particularly in quarantine cases (93). Focusing on trustworthy information, keeping in contact with friends, family, and colleagues, allowing your negative feelings to be expressed, maintaining daily life activities, preserving your pride, and engaging in enjoyable activities are mentioned as recommendations for coping skills for people in quarantine (95). Social media can be very helpful in this regard.

Socio-economic aspects of quarantine and social distancing

Similar to the economic events during World War II (explained by black swan theory) the COVID-19 outbreak has had a lot of harmful effects on the nation's social and economic status (97). In an attempt to slow the spread speed of this disease, governments have tried to shut down the border, restrict travels, and apply quarantine for the exposed individual. As these decisions were enforced in countries with the largest economies in the world, they may raise the fear of recession and economic crisis (98). According to Nicola et al. (97), to clarify the economic effects of COVID-19, these effects must be assessed in three sectors:

1. *Primary Sectors*: industries involved in the raw material provision, such as:
   - Agriculture: prices of agricultural commodities drop by 20% as a result of decreased demand by hotels and restaurants (99).
   - Petroleum & Oil: the fastest one-day price crash was seen in about the last 30 years (Brent Crude dropped by 24% to $34 per barrel, on 23 March 2020) (100).
2. *Secondary Sectors*: industries involved in finished product provision, such as: Manufacturing Industry: as a result of self-isolation policies, manufacturing industries are facing staffing deficiencies and importation issues (97).
3. *Tertiary Sectors*: industries involved in service provision, such as:
   - Education: according to UNESCO, closure of educational institutions has affected about 900 million learners all over the world (101).
   - Finance Industry: lockdowns and further inappropriate responses by governmental have interrupted the supply and demand chain (97).
   - Healthcare and the pharmaceutical industry: lack of enough PPE, high healthcare costs, and insufficient medical capacity (ventilators and ICU beds) are challenges ahead of this industry (97).
   - Hospitality, tourism, and aviation: The World Travel and Tourism Council has stated that, as a result of the COVID-19 outbreak, about 50 million jobs in this sector might be at risk (102).
   - Sports industry: The International Olympic Committee has decided to postpone the Tokyo 2020 Olympics to 2021 (103).

Conclusion

By having previous epidemics, including SARS, MERS, and flu, in mind, quarantine and isolation seem to be proper choices for this situation. But, as this epidemic is bigger than former ones, stricter public health measurements, such as serious social distancing and community-wide containment, are recommended. Until now,

these measurements were applied to different levels by affected countries and has been very useful in disease control. However, it should be noted that these measures have come with some costs. For example, psychological issues are one of the most important consequences of quarantine, which threatens people with the history of psychological disorders and medical staff (due to their higher exposure to terminally ill patients) even more than others. Economic issues are also very important in this regard, especially in low-income countries. On the other hand, early termination of quarantine and other public health measures can lead to the second wave of outbreak, which might be even worse than the first one. At last, it should be noted that raising public awareness of this disease is very important to prevent unpleasant experiences, like the 1918 Spanish flu pandemic, in the past.

Conflict of interest

Authors declare no conflict of interests.

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