Clinical Characteristics and Reproduction Number of Coronavirus Disease (COVID-19) Cases in Markazi Province in Iran

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ABSTRACT

Background: The first case of Coronavirus Disease (COVID-19) was reported in Iran on February 19, 2020. This study aimed to assess the characteristics and reproduction number (R) of COVID-19 in Markazi province in Iran.

Methods: This is a cross-sectional study. Confirmed cases (N=2430) in the regions covered by Arak University of Medical Sciences from Feb 20 to Aug 26, 2020 were enrolled in the study. The included variables were clinical and demographic characteristics of COVID-19 patients. The case fatality rate (CFR), incidence rates, and R were estimated based on the daily reported data. For estimating R, generation time was assumed on multi scenarios. R was estimated by R0-package. Moreover, Chi square test was applied. All the analyses were performed in STATA, Excel, ArcMap and R. A p-value less than 0.05 was considered as statistically significant.

Results: The mean age of the participants was 51.78±20.58 years, and 206(8.50%) cases were among healthcare workers. Among the patients, 499(20.50%) had a history of cardiovascular diseases and 337(13.90%) diabetes type 2. The most prevalent symptoms were cough 1347(55.40%), fever 1233(50.70%), and dyspnea 960(39.50%). The highest incidence rate of COVID-19 in the study area (Delijan) was 575.35 per 100,000 persons. CFR was 205(8.40%). At the end of the study period, R was calculated as 1.04 (CI 95%: 1.00, 1.08) in all districts of Arak University of Medical Sciences. The highest R (1.08, 95% CI: 1.06, 1.10) was observed in Farahan.

Conclusion: As R is slightly high, the risk of epidemic has reduced gradually. However, observing social distance and related guidelines are still recommended.

Keywords: COVID-19, Demographic and clinical characteristics, Epidemiology, Iran, Reproduction number

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**INTRODUCTION**

The first case of Coronavirus Disease (COVID-19) was reported in Iran on February 19, 2020, in Qom province, 150 km south of the capital city of Tehran. Several days later, Markazi province, 140 km west of the Qom, where the current study was performed, was introduced as the second place where the case of COVID-19 was reported.1, 2

As COVID-19 has imposed a heavy human life and financial burden on countries and threatened their health system, identifying the characteristics of the infected people, its fatality rate, and reproduction number are very important. On one hand, performing these types of studies provides the background to present better healthcare services and better public health response. On the other hand, designing cost-effective vaccines and treatments needs previously identified characteristics of the infected people.3 These issues have necessitated identifying characteristics and basic reproduction numbers of COVID-19 cases. Lastly, our knowledge is little regarding COVID-19 in the city and country. The results of this study have many implications for the global level, too.

There previously have been guidelines on protecting healthcare workers (HCWs) when exposed to patients, especially the infected ones.4 However, HCWs may have decreased the use of these guidelines due to low supervision and decrease in contagious diseases. This issue has caused a great deal of morbidity and mortality among HCWs. As asymptomatic cases have the main role in transferring COVID-19, the importance of observing these protective guidelines has increased. In this regard, the current study aimed to assess the infection rate among HCWs and compare it with other countries. Healthcare systems which have already been challenged with low human resources will be more challenged with high infection and death among HCWs.5

One of the ways to identify the contagiousness and transmissibility rate of an epidemics is calculating the reproduction number. This index makes it possible to predict an infectious disease transmission, the effectiveness of the evaluation of the performed measures, and lastly the results of policies taken to control it.6

As reproduction number of COVID-19 is variable in different populations and periods, Iranian researchers have modelled the transmissibility of the COVID-19 virus in different regions. In this regard, some studies have estimated it in Qom city7 and western Iran8 and accordingly have proposed the required preventive and control measures. However, this province is placed among the first provinces that have reported the cases of COVID-19; also, due to its geographical position that connects many provinces to each other, it can be introduced as one of the main COVID-19 epicenters in Iran. Therefore, the current study was performed to assess the characteristics and basic reproduction numbers of COVID-19 cases in the center of Iran, Markazi province.

**MATERIALS AND METHODS**

This is a cross-sectional study conducted in Markazi province of Iran. Markazi province with a population of about 1,430,000 is located in central Iran. The data on 2430 confirmed cases of COVID-19 from Feb 20 to Aug 26, 2020 were used in this study. There are 3 medical universities in Markazi province, among which Arak University of Medical Sciences (ARAKMU) is the largest one that covers 9 cities with a population of about 977,013.9 This study was performed using the secondary data in the regions covered by ARAKMU (Arak, Delijan, Shazand, Khondab, Ashtian, Farahan, Komijan, Mahallat and Tafresh cities) and all COVID-19 confirmed cases were enrolled. There are 2 specialized hospitals for COVID-19 cases in Arak city (Amir-al-momenin and Aiatollah Khansari hospitals), the capital of Markazi province with a population of about 526,182, and 1 specialized ward in each of 8 public hospitals located in the other 8 cities.
COVID-19 epidemic started from 20 Feb 2020, in the regions covered by ARAKMU.10

Inclusion criteria were having the residence in regions covered by ARAKMU and giving the Polymerase chain reaction (PCR) test to confirm COVID-19. All the included samples that had done PCR test were (10627) among those who had referred to private clinics, specialized COVID-19 hospitals, the cases diagnosed by primary health care (PHC) centers, those identified by tracking the contacts and lastly the cases identified through public screening were routinely referred to the stated hospitals to perform COVID-19 test. Among them, 2430 and 8197 cases were included and excluded, respectively. The results of all tested cases were reported to the ARAKMU center for disease prevention and control (CDC) on a daily basis. The data were obtained from this center. The data reliability was performed by comparing CDC data with the hospitalization and death data of the diagnostic laboratory that indicated 95% consistency. The variable of “sample preparation date” was the basis of calculation. Moreover, the variable of “resident place” was used for the regions covered by the university. The reported places of residence other than the regions covered by ARAKMU were excluded from the final analysis. The cases of COVID-19 were confirmed by reverse transcription polymerase chain reaction (RT-PCR) assays based on the protocol established by the WHO.11

The study variables were sex (female/male), age (lower than 5, 5-15, 16-45, 46-60 and higher than 60 years old), healthcare worker (yes/no), self-reported history of heart disease (Has your doctor ever told you that you have heart disease? yes/no), self-reported diabetes type 2 (Has your doctor ever told you that you have diabetes? yes/no), city of residence (Arak/Delijan/Mahalat/Ashtian/Tafresh/Khondab/Shazand/Farahan/Komijan), area of residence (rural/urban), admission to an intensive care unit (ICU) (yes/no), death (yes/no), and on admission, having fever (yes/no), cough (yes/no), dyspnea (yes/no), myalgia (yes/no), headache (yes/no), diarrhea (yes/no), sore throat (yes/no), runny nose (yes/no), abdominal pain (yes/no), vomiting (yes/no), chest pain (yes/no), symptoms, and admission status (inpatient/outpatient).

Frequencies and percentage of categorical variables and for continuous variables mean and standard deviations (SD) were reported. Chi-square analysis was applied to determine statistically significant differences between categorical variables and admission status.

The estimated case fatality rate (CFR) was obtained by the number of deaths divided by the number of confirmed infections. Furthermore, incidence rates were calculated by dividing the number of diagnosed infections by the number of populations for each studied area.

The R was estimated based on the reported data during the study period. The generation time (GT) is the time between the infection time of an infected person and the infection time of his or her infector. Probability density functions for generation intervals have been an important input for epidemic models and epidemic data analysis.12 For estimating R, GT was assumed on multi-scenarios. Similar to Hwang et al.13 in two scenarios, GT was considered with the assumption that the data have gamma distribution with mean±SD of the first 6±3 and second 4±2 days. R and related 95% confidence intervals (CI=95%) were estimated by exponential growth and or maximum likelihood method. The exponential growth rate in the onset of an epidemic can be linked to the initial reproduction ratio. The exponential growth rate, denoted by “e”, is defined by the per capita change in the number of new cases per unit of time. As incidence data are integer valued, Poisson regression is indicated to estimate this parameter, rather than linear regression of the logged incidence. The reproduction number is computed as $R_0=1/eC(-e)$ where C is the moment generating function of the generation time distribution. It is necessary to choose a period in the epidemic curve over which growth is exponential. It proposes the use of the deviance-based R-squared statistic to guide this choice.14
Since it is better to calculate R based on the local level, it was calculated in each of the cities covered. The epidemic curves were drawn by the city of residence (Figure 1). Furthermore, R curves were drawn for AUMS and for the center of Markazi province, Arak. All the analyses were performed in STATA 12.0, Excel, version 2003, ArcMap 10.0 and R software, version 3.6.3. A P value less than 0.05 was considered as statistically significant.

This study was approved by the ethics committee of ARAKMU (IR.ARAKMU.REC.1399.102).

**RESULTS**

The results indicated that most of the cases were women with the mean age of 51.78±20.58; most of the cases were in the 16-45 years old age-group. Furthermore, these variables were considered by inpatient and outpatient status of COVID-19 patients in Table 1.

Regarding background diseases and situations, the frequency distributions of the history of cardiovascular diseases and diabetes are shown in Table 1. The most prevalent symptoms reported by COVID-19 patients were cough, fever and dyspnea. Arak and Delijan cities had the greatest number of confirmed cases (Table 1). There were statistically significant differences by admission status for age, History of heart disease, History of diabetes type 2, City of residence, Area of residence, fever, cough, dyspnea, runny nose, vomiting, headache, death, Admission to an intensive care unit (ICU) and HCW (P=0.001) (Table 1).

The most incidence rates of COVID-19 per 100,000 persons were located in Delijan (575.35, CI 95%: 510.10, 640.59), Farahan (331.10, CI 95%: 264.98, 397.23), Tafresh (309.08, CI 95%: 240.15, 378.00), Khondab (273.98, CI 95%: 229.90, 318.06), Arak (251.29, CI 95%: 238.54, 264.05), Komijan (178.37, CI 95%: 135.05, 221.70), Ashtian (171.18, CI 95%: 107.83, 234.53), Mahallat (148.17, CI 95%: 116.12, 180.22), and Shazand (127.58, CI 95%: 107.18, 147.99), respectively. CFR in all of the population was relatively high (Table 1). A map of the distribution of COVID-19 cases in this province is displayed in Figure 2.

The R on the basis of the GT has been calculated on several scenarios in two times: first, in March 19, and second in August 26, 2020.
| Variables                          | N (%)       | Admission status | P value* |
|-----------------------------------|-------------|------------------|----------|
|                                   |             | Outpatient N (%) | Inpatient N (%) |
| Sex                               |             | 412(32.20)       | 869(67.80) |
|                                   | Female      | 1281(52.70)      | 365(31.80) |
|                                   | Male        | 1149(47.30)      | 784(68.20) |
| Age                               |             |                  | 0.8      |
|                                   | lower than 5| 7(39)            | 11(61.00) |
|                                   | 5-15        | 47(70)           | 20(30.00) |
|                                   | 16-45       | 467(51)          | 447(49.00) |
|                                   | 46-60       | 158(28.30)       | 401(71.70) |
|                                   | upper than 60| 98(11.20)       | 774(88.80) |
| History of heart disease          | Yes         | 73(14.60)        | 426(85.40) |
|                                   | No          | 1039(69.90)      | 1227(63.50) |
| History of diabetes type 2        | Yes         | 46(13.60)        | 291(86.40) |
|                                   | No          | 731(34.90)       | 1362(65.10) |
| City of residence                 | Arak        | 1487(61.20)      | 1039(69.90) |
|                                   | Delijan     | 297(12.00)       | 177(59.60) |
|                                   | Mahalat     | 82(3.40)         | 74(90.20) |
|                                   | Ashtian     | 28(1.20)         | 19(67.90) |
|                                   | Tafresh     | 77(3.20)         | 24(31.20) |
|                                   | Khondab     | 148(6.10)        | 48(32.40) |
|                                   | Shazand     | 150(6.20)        | 147(98.00) |
|                                   | Farahan     | 96(4.00)         | 76(79.20) |
|                                   | Komijan     | 65(2.70)         | 49(75.40) |
| Area of residence                 | Rural       | 461(19.00)       | 323(70.00) |
|                                   | Urban       | 1969(81.00)      | 1280(65.00) |
| Fever                             | Yes         | 1233(50.70)      | 912(74.00) |
|                                   | No          | 1197(49.30)      | 741(26.00) |
| Cough                             | Yes         | 1347(55.40)      | 1007(74.80) |
|                                   | No          | 1083(44.60)      | 646(25.20) |
| Dyspnea                           | Yes         | 960(39.50)       | 822(85.60) |
|                                   | No          | 1470(60.50)      | 381(14.40) |
| Myalgia                           | Yes         | 653(26.90)       | 434(66.50) |
|                                   | No          | 1777(73.10)      | 1219(33.50) |
| Sore throat                       | Yes         | 266(10.90)       | 173(65.00) |
|                                   | No          | 2164(89.10)      | 1480(64.00) |
| Runny nose                        | Yes         | 53(2.20)         | 24(45.30) |
|                                   | No          | 2377(97.80)      | 1629(65.80) |
| Diarrhea                          | Yes         | 156(6.40)        | 114(73.10) |
|                                   | No          | 2274(93.60)      | 1539(67.70) |
| Vomiting                          | Yes         | 257(10.60)       | 205(79.80) |
|                                   | No          | 2173(89.40)      | 1448(66.60) |
| Headache                          | Yes         | 448(18.40)       | 260(58.00) |
|                                   | No          | 1982(81.60)      | 1393(70.30) |
| Chest pain                        | Yes         | 197(8.10)        | 128(65.00) |
|                                   | No          | 2233(91.90)      | 1525(68.30) |
| Abdominal pain                    | Yes         | 134(5.50)        | 92(68.70) |
|                                   | No          | 2296(94.40)      | 1561(68.0) |
| Death                             | Yes         | 205(8.40)        | 198(96.60) |
|                                   | No          | 2225(91.60)      | 1545(65.40) |
| Admission to an intensive care unit (ICU) | Yes  | 79(3.30)         | 78(98.70) |
|                                   | No          | 2351(96.70)      | 1575(67.00) |
| Health care worker                | Yes         | 206(8.50)        | 63(30.60) |
|                                   | No          | 2224(91.50)      | 1590(71.50) |

*Chi-square test
Accordingly, on the basis of 2 GT scenarios calculated, in the first time, R was lowest in Komijan city and highest in Arak and Khondab cities. (Table 2). The highest to the lowest R values were observed in Arak, Khondab, Ashtian, Farahan, Mahallat, Delijan, Shazand, Tafresh and Komijan cities, respectively. However, it is notable to state that the difference of R from 1 was statistically significant only in Arak and Delijan cities. The R lower than 1 means that the epidemic place in the control step. R equal to 1.5 (the amount calculated for Arak city) indicates that, for example, 10 infected

Table 2: Generation time and reproduction number (R) of COVID-19 in Arak University of Medical Sciences during Feb 20 to Aug 26, 2020

| City                  | Generation Time Mean±SD | R* (CI 95%) (Feb 20 to Mar 19, 2020) | R** (CI 95%) (Feb 20 to Aug 26, 2020) |
|----------------------|-------------------------|-------------------------------------|---------------------------------------|
| Arak                 | 6±3                     | 1.48 (1.32, 1.67)                   | 1.05 (0.99, 1.10)                     |
| Arak                 | 4±2                     | 1.32 (1.21, 1.44)                   | 1.02 (0.97, 1.07)                     |
| Delijan              | 6±3                     | 1.16 (1.01, 1.34)                   | 1.03 (1.02, 1.04)                     |
| Delijan              | 4±2                     | 1.11 (1.00, 1.23)                   | 1.02 (1.01, 1.03)                     |
| Mahalat              | 6±3                     | 1.21 (0.94, 1.55)                   | 1.01 (0.98, 1.03)                     |
| Mahalat              | 4±2                     | 1.14 (0.96, 1.36)                   | 1.00 (0.99, 1.02)                     |
| Ashtian              | 6±3                     | 1.38 (0.89, 2.15)                   | 1.04 (1.01, 1.07)                     |
| Ashtian              | 4±2                     | 1.26 (0.92, 1.73)                   | 1.03 (1.00, 1.05)                     |
| Tafresh              | 6±3                     | 1.09 (0.76, 1.53)                   | 1.05 (1.03, 1.07)                     |
| Tafresh              | 4±2                     | 1.06 (0.83, 1.35)                   | 1.03 (1.02, 1.05)                     |
| Khondab              | 6±3                     | 1.48 (0.83, 2.69)                   | 1.00 (0.99, 1.02)                     |
| Khondab              | 4±2                     | 1.31 (0.88, 2.03)                   | 1.00 (0.99, 1.01)                     |
| Shazand              | 6±3                     | 1.14 (0.82, 1.56)                   | 0.99 (0.97, 1.01)                     |
| Shazand              | 4±2                     | 1.09 (0.87, 1.37)                   | 0.99 (0.98, 1.00)                     |
| Farahan              | 6±3                     | 1.22 (0.83, 1.76)                   | 1.08 (1.06, 1.10)                     |
| Farahan              | 4±2                     | 1.15 (0.88, 1.49)                   | 1.05 (1.04, 1.07)                     |
| Komijan              | 6±3                     | 0.69 (0.69, 1.42)                   | 1.02 (0.99, 1.04)                     |
| Komijan              | 4±2                     | NA                                   | 1.01 (1.00, 1.03)                     |
| Arak University of Medical Sciences | 6±3                  | 1.28 (1.19, 1.37)                   | 1.04 (1.00, 1.08)                     |
| Arak University of Medical Sciences | 4±2                  | 1.19 (1.13, 1.25)                   | 1.04 (1.04, 1.05)                     |

*R based on Exponential Growth Method; **R based on Maximum likelihood Method

Figure 2: Map of the distribution of COVID-19 cases in the study area
people can infect 15 susceptible persons. By administering an interventional program with 100% effectiveness with this R, it is expected that if 33% of the population is covered by that intervention, the number of R will be lower than 1. Also, by administering an interventional program with this R and 50% and/or 33% effectiveness, it is expected that if 66% and/or 100% of the population are covered by that intervention, the amount of R will be lower than 1. Moreover, R equal to 1.5 means that the probability of effective contact is 1.5%. This amount leads to a gradual epidemic that will infect 60% of the population (Table 2, Figures 1, 3 and 4).

In the second time, R was lowest in Shazand city and highest in Farahan city (Table 2). The highest to lowest R values were observed in Farahan, Tafresh, Arak, Ashtian, Delijan, Komijan, Mahallat, Khondab and Shazand cities, respectively. However, it is noteworthy to mention that the difference of R from 1 was statistically significant only in Farahan, Tafresh, Ashtian and Delijan cities (Table 2).

**Discussion**

Markazi province was the second province where the first case of COVID-19 was found. However, the number of cases was decreased following the performance of telephone screening of COVID-19 suspected cases using PHC system on the basis of the symptoms of dry cough, fever, and dyspnea.

The study indicated that morbidity of COVID-19 varies in the cities located in Markazi province. Among the reasons are difference in demographic variables, distance from the epicenter city, restrictive policies, and the status of COVID-19 epidemiology in those cities.

Regarding demographic variables, this study indicated that the greatest number of inpatient cases were among the elderly. A study in Iran indicated that higher percentage of deaths occurred among the elderly.15 Also, another study in Iran indicated that most of the cases and the severe ones occurred among the patients over 50 years old and those with background diseases.16 The evidence in Italy indicates that as its population is older than other countries, it has higher morbidity and mortality. Due to having comorbidities including hypertension, diabetes and chronic respiratory diseases, the elderly have a higher morbidity and mortality. However, the selected strategy to deal with the patients is highly effective on the number of deaths.17 This study is in the same line with other studies in Iran, indicating that a greater number of positive cases occur among the women.15, 18 It has been proven that women due to their chromosomal status19 and also special women hormone, estrogen,20 have higher resistance
Clinical characteristics and basic reproduction numbers of COVID-19

The results indicated that a higher percentage of the cases are among upper middle-ages and the elderly. The cases with severe diseases and hospitalized in the ICU units were those with higher ages and background diseases. A Chinese study confirmed that most patients hospitalized in the ICU units had higher ages and comorbidities than patients not admitted to the ICUs. The results indicated that one fifth of the cases had a history of cardiovascular diseases and then diabetes type 2. A study in Wuhan indicated that half of the COVID-19 cases had one or more comorbidities. Accordingly, blood pressure, malignancy, diabetes and cardiovascular diseases are among the most important comorbidities, respectively.

This study indicated that the most prevalent COVID-19 symptoms reported are cough, fever and dyspnea, respectively. The present guidelines on COVID-19 published by the healthcare system authorities indicate that the most prevalent symptom is dyspnea. However, a systematic review indicated that a low percentage of the patients had this symptom.

Figure 4: The changes of reproduction number by week from 20 Feb, to 26 Aug, 2020 in A) Districts of Arak University of Medical Sciences and B) The center of Markazi province; Arak.
symptom. The current study indicate that dyspnea is the third most prevalent COVID-19 symptom.

The results indicated that a high percentage of the cases were among HCWs. Morbidity and mortality among HCWs have always been of interest. A high percentage of the confirmed COVID-19 cases in China have been among HCWs, and a considerable number of them have died. Also, a high percentage of the COVID-19 cases in Italy was among HCWs and about half of them have died. One fifth of the cases in Lombardy, Italy, were also among HCWs. This rate was higher in Spain. Morbidity and mortality rate due to the previous coronavirus outbreaks such as severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) have been high. Despite cautions and guidelines on the high transferability of nosocomial infections, high morbidity and mortality have happened among HCWs due to not taking these precautions seriously. In this regard, countries should distribute healthcare protective items such as face masks in the community with the priority of HCWs, so that there is healthy HCWs to provide services against COVID-19. HCWs that provide services to COVID-19 patients are faced with high stress, burnout and low working capacity. Performing the Productivity Improvement Act can provide adequate support for them and promote workforce productivity, quality of care, increase in the morale of HCWs, decrease in the problems related to work plan development, and equity in the payments.

CFR index has many heterogeneities in different regions of the world. It has been reported lower in the African region and higher in the East Mediterranean region compared to the results of the current study. There have been many causes for this difference. First of all, the Corona test is not done for everyone and secondly many of the infected people indicate mild symptoms of the disease that are not reported as positive cases. Another issue is the population size and background diseases. Accordingly, it has been proven that age, gender, and background diseases have a direct relationship with CFR. A study on COVID-19 in Wuhan, China, indicated that CFR was higher among the elderly. The results indicated that the number of cases in the studied cities decreased in a similar time frame that is indicative of similar policies on restrictions, social distancing, and media campaigns. The case of China also indicated that the number of cases after a period of disease outbreak decreased following restrictive measures.

In the months of the onset of epidemic, it is necessary for the cities to impose many restrictions on the entry of passengers from the cities that are most affected. Japan, as the third country that has been affected by this disease, has been successful in controlling it by imposing severe restrictions on the entry of passengers from China to Japan, establishing active care, following the contacts, and using different guidelines. However, the implementation of strict travel restrictions without public health policies and behavior change has a limited effect on the disease transmission.

This study, along with the strengthens, had some limitations. Although CFR calculation in this study has many implications, it has been considered very simple. Valid calculation of CFR needs the identification of all positive cases. However, this is almost impossible due to the large number of asymptomatic patients. In other words, as the most reported confirmed cases in this study were among the patients with severe forms of the disease, it should be noted in all of the interpretations that the calculated values are minimal amounts and the actual values may be much higher. Many of the infected persons are asymptomatic and can transmit the disease to others. Thus, it is recommended that CFR should be calculated again after the final determination of the cases. Moreover, since a number of asymptomatic patients were not included in this study, potentially there was under-reporting bias for the findings of this study.

Reproduction number or R is an important index to estimate the transmissibility of
the COVID-19 outbreak. The amount of R obtained in the onset of the study period was meaningfully lower than other countries’ estimations.32, 36, 37 Low R value indicates that governmental policies on observing social distancing, travel prevention and closure of universities, schools, industries, and jobs have been successful. Another study in Iran, confirming the findings of this study, states that R has a decreasing trend.38 The most important limitation of this study was lack of considering other influential variables on COVID-19 morbidity; so further studies are recommended to be conducted in this regard.

**CONCLUSION**

Although the COVID-19 outbreak is decreasing in Markazi province, it is necessary to update the characteristics of the infected patients in order to determine the changes in the virus strains. COVID-19 high morbidity and mortality among HCWs are warning signs for healthcare authorities to pay close attention to the protective guidelines in health system facilities. Absolutely, sharing this information among the authorities and policymakers provides the basis for prevention and control of the disease. Performing the same policies on prevention and control of COVID-19 in the levels of cities and provinces provides reciprocal benefit for them. Considering the successful programs on screening and identifying asymptomatic people, it is recommended that their implementation should continue.

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**REFERENCES**

1 World Health Organization. Coronavirus disease 2019 (COVID-19): Situation Report–31. Geneva: World Health Organization; 2020.

2 Raoofi A, Takian A, Sari A, et al. COVID-19 pandemic and comparative health policy learning in Iran. Archives of Iranian Medicine. 2020;23:220-34.

3 Goudarzi R, Tasavon Gholamhoseini M, Amini S, et al. Estimating the cost of vaccination in southeastern Iran. Human Vaccines & Immunotherapeutics. 2020. DOI: 10.1080/21645515.2020.1725357 [online]

4 Verbeek JH, Rajamaki B, Ijaz S, et al. Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. Cochrane Database of Systematic Reviews. 2020;4(4).

5 Al-zoubi NA, Obeidat BR, Al-Ghazo MA, et al. Prevalence of positive COVID-19 among asymptomatic health care workers who care patients infected with the novel coronavirus: A retrospective study. Annals of Medicine and Surgery. 2020;57:14-6.

6 Bui LV, Nguyen TT, Nguyen H. Early Estimation of Reproduction Number of Covid-19 in Vietnam. Medrxiv. 2020. DOI: 10.1101/2020.03.28.20046136 [preprint]

7 Aghaali M, Kolifarhood G, Nikbakht R, et al. Estimation of the Serial Interval and Basic Reproduction Number of COVID-19 in Qom, Iran, and Three Other Countries: A Data-Driven Analysis in the Early Phase of the Outbreak. Transboundary and Emerging Diseases. 2020. DOI: 10.1111/tbed.13656 [online]

8 Najafi F, Izadi N, Hashemi-Nazari S-S, et al. Serial interval and time-varying reproduction number estimation for COVID-19 in western Iran. New Microbes and New Infections. 2020;36:100715.

9 Statistical Center of Iran. Selected Findings of the 2016 National Population and Housing Census. Tehran: Statistical Center of Iran; 2016. [Cited 10 April 2020]. Available from: https://www.amar.org.
Moradzadeh R, Zamanian M, Amini S, Kalantari M, Nazari J

ir/Portals/1/census/2016/Census_2016_Selected_Findings.pdf

10 Moradzadeh R. The challenges and considerations of community-based preparedness at the onset of COVID-19 outbreak in Iran, 2020. Epidemiology and Infection. 2020;148:e82.

11 World Health Organization. Diagnostic testing for SARS-CoV-2: interim guidance, 11 September 2020. Geneva: World Health Organization; 2020.

12 Kenah E, Lipsitch M, Robins JM. Generation interval contraction and epidemic data analysis. Mathematical Biosciences. 2008;213:71-9.

13 Hwang J, Park H, Kim S, et al. Basic and effective reproduction numbers of COVID-19 cases in South Korea excluding Sincheonji cases. MedRxiv. 2020. DOI: 10.1101/2020.03.19.20039347 [preprint]

14 Obadia T, Haneef R, Boëlle P-Y. The R0 package: a toolbox to estimate reproduction numbers for epidemic outbreaks. BMC Medical Informatics and Decision Making. 2012;12:147.

15 Nikpouraghdam M, Farahani AJ, Alishiri G, et al. Epidemiological characteristics of coronavirus disease 2019 (COVID-19) patients in IRAN: A single center study. Journal of Clinical Virology. 2020;127:104378.

16 Ashraf MA, Shokouhi N, Shirali E, et al. COVID-19 in Iran, a comprehensive investigation from exposure to treatment outcomes. MedRxiv. 2020. DOI: 10.1101/2020.04.20.20072421 [preprint]

17 Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. JAMA. 2020. DOI: 10.1001/jama.2020.4683 [online]

18 Shahriarirad R, Khodamoradi Z, Erfani A, et al. Epidemiological and clinical features of 2019 novel coronavirus diseases (COVID-19) in the South of Iran. BMC Infectious Diseases. 2020;20:427.

19 Schurz H, Salie M, Tromp G, et al. The X chromosome and sex-specific effects in infectious disease susceptibility. Human Genomics. 2019;13:2.

20 Robinson DP, Hall OJ, Nilles TL, et al. 17β-estradiol protects females against influenza by recruiting neutrophils and increasing virus-specific CD8 T cell responses in the lungs. Journal of Virology. 2014;88:4711-20.

21 Lei S, Jiang F, Su W, et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. EClinicalMedicine. 2020;21:100331.

22 Tan SC. Clinical and epidemiological characteristics of Coronavirus Disease 2019 (COVID-19) patients. Medrxiv. 2020. DOI: 10.1101/2020.04.02.20050989 [preprint]

23 Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020. DOI: 10.1001/jama.2020.2648 [online]

24 Remuzzi A, Remuzzi G. COVID-19 and Italy: what next? The Lancet. 2020;395:1225-8.

25 International Council of Nurses. High proportion of healthcare workers with COVID-19 in Italy is a stark warning to the world: protecting nurses and their colleagues must be the number one priority. Geneva: International Council of Nurses; 2020. [Cited 14 April 2020]. Available from: https://www.icn.ch/news/high-proportion-healthcare-workers-covid-19-italy-stark-warning-world Protecting nurses-and

26 Kluytmans M, Buiting A, Pas S, et al. SARS-CoV-2 infection in 86 healthcare workers in two Dutch hospitals in March 2020. MedRxiv. 2020. DOI: 10.1101/2020.03.23.20041913 [preprint]

27 Chowell G, Abdirizak F, Lee S, et al. Transmission characteristics of MERS and SARS in the healthcare setting: a comparative study. BMC Medicine.
Clinical characteristics and basic reproduction numbers of COVID-19

28 Twu S-J, Chen T-J, Chen C-J, et al. Control measures for severe acute respiratory syndrome (SARS) in Taiwan. Emerging Infectious Diseases. 2003;9:718-20.

29 Vali L, Tabatabaee SS, Kalhor R, et al. Analysis of productivity improvement act for clinical staff working in the health system: A qualitative study. Global Journal of Health Science. 2016;8:106-16.

30 Fisher D, Heymann D. Q&A: The novel coronavirus outbreak causing COVID-19. BMC Medicine. 2020;18:57.

31 Li Q, Guan X, Wu P, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus–infected pneumonia. The New England Journal of Medicine. 2020;382:1199-207.

32 Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet. 2020;395:497-506.

33 Zhang J, Litvinova M, Wang W, et al. Evolving epidemiology of novel coronavirus diseases 2019 and possible interruption of local transmission outside Hubei Province in China: a descriptive and modeling study. Medrxiv. 2020. DOI: 10.1016/S1473-3099(20)30230-9 [preprint]

34 Koolivand A, Amini S. The importance of PHC-based measures in controlling COVID-19 outbreak: Implications for global health system. Ethics Medicine and Public Health. 2020;14:100549. DOI:10.1016/j.jemep.2020.100549

35 Bai Y, Yao L, Wei T, et al. Presumed asymptomatic carrier transmission of COVID-19. JAMA. 2020;323:1406-7.

36 Chen T-M, Rui J, Wang Q-P, et al. A mathematical model for simulating the phase-based transmissibility of a novel coronavirus. Infectious Diseases of Poverty. 2020;9:24.

37 Read JM, Bridgen JR, Cummings DA, et al. Novel coronavirus 2019-nCoV: early estimation of epidemiological parameters and epidemic predictions. MedRxiv. 2020. DOI: 10.1101/2020.01.23.20018549 [preprint]

38 Sahafizadeh E, Sartoli S. Estimating the reproduction number of COVID-19 in Iran using epidemic modeling. Medrxiv. 2020. DOI: 10.1101/2020.03.20.20038422 [preprint]