

# Clinical evolution of health care workers during the SARS-CoV-2 pandemic

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**Background:** Coronavirus disease 2019 (COVID-19) front line Health care workers (HCWs) and its variants are in high risk of acquiring the disease and subsequently exposing patients and others. The aim was to describe COVID-19 infected HCWs evolution in a third level hospital in the State of Mexico.

**Methods:** This observational, descriptive, and retrospective study was carried out from January 2020 to August 2021. To determine the factors associated with the mortality of HCWs, different models were built with the logistic regression test using the SPSS program, considering a value of  $P < 0.05$  as statistically significant.

**Results:** 323 HCWs were studied, of which there was a mortality of 8 (2.4%). A regression model introducing only the variables marital status, confinement, sex and age, the following values were obtained:  $R = 0.467$ ,  $R^2 = 0.218$ , adjusted  $R^2 = 0.208$  and a standard error of the estimate of 0.140 (ANOVA with a  $p \leq 0.01$ ).

**Conclusion:** 28% of COVID-19 health worker infected and a mortality of 2.4%. The variables marital status, confinement, sex and age were strong enough in a regression model to be significant for survival.

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The coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has accumulated more than 14 million infections and 600,000 deaths worldwide<sup>1</sup> and has been described as the greatest global crisis since the Second World War.<sup>2</sup>

Health care workers (HCWs) who are on the front lines of responding to COVID-19 and its variants are at increased risk of acquiring the disease and subsequently of exposing patients and others,<sup>3</sup> not only due to their close contact with highly infectious patients, but also due to their exposure to undiagnosed or subclinical infectious cases. This risk has been increased by poor access to personal protective equipment around the world.<sup>4</sup>

Currently, there is no clarity regarding the prevalence of SARS-CoV-2 infections among HCWs according to specific clinical settings, limiting the possibility of designing effective preventive measures to limit transmission of the virus within a hospital and other spaces.<sup>5,6</sup> This would allow us to understand the behaviour of HCWs in a specific way and to be able to specify the effectiveness and operation of the strategies or measures implemented by the health authorities in a local context.

In addition, it is unknown whether the clinical characteristics and outcomes of HCWs may be different from those of the general population, considering that repeated exposure to the virus may lead to a higher viral load of SARS-CoV-2 and, therefore, to worse clinical outcomes.<sup>7,8</sup> It is necessary to know how HCWs face or have faced the pandemic, to specify the effects of exposure to the virus and thus recognise any differences compared with the rest of the population. However, official flowcharts on the risks for HCWs remain limited.<sup>9</sup> The WHO estimates that as of April 8, 2020, more than 20,000 HCWs in 52 countries had contracted COVID-19.<sup>10</sup>

In addition to the above, COVID-19 has placed an enormous burden on health systems due to high transmission rates, and the prevalence of serious disease and mortality.<sup>11</sup> This forces health systems to increase their hospital capacity, both in terms of infrastructure and human capital.

The risk of viral transmission to HCWs has been a concern since the start of the outbreak and the first person to raise concerns about the disease to the

international community was Dr. Li Wen-Liang, an ophthalmologist from Wuhan who sadly died of the disease, which he probably contracted while he was at work.<sup>12</sup> From a historical and conjunctural analysis, pandemics have left lessons to humanity, which must be quantified by health sciences.

In Mexico, according to the official report of May 22, 2021, of the 280,781 total accumulated cases confirmed as COVID-19, 38.9% were nurses, 35.3% doctors, 32% other health workers, 2% laboratory technicians, and 1.8% dentists.<sup>13</sup> Based on this, the following study aims to identify the main factors that determined the clinical evolution of health care workers during the SARS-CoV-2 pandemic in a Mexican third level hospital.

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## MATERIAL AND METHODS

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### *Study Design*

This observational, descriptive, and retrospective study was carried out from January 2020 to August 2021 at the "Mónica Pretelini Sáenz" Maternal Perinatal Hospital (HMPMPS) of the Institute of Health of the State of Mexico (ISEM), a third level care in Toluca, Mexico, with a total of 1,156 assigned HCWs.

### *Statistical Analysis*

To determine the factors associated with the mortality of HCWs, different models were built with the logistic regression test using the SPSS program, considering a value of  $p \leq 0.05$  as statistically significant.

### *Ethics Approval*

The study was approved by the Research Ethics Committee and the Research Committee of the HMPMPS, in accordance with the Declaration of Helsinki<sup>14</sup> and in compliance with the provisions of the Mexican General Health Law,<sup>15</sup> Fifth Title Research for the Health, Single Chapter, as well as the regulations of the General Health Law Regulation<sup>16</sup> on research in human beings.

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## RESULTS

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323 HCWs were studied, of which there was a mortality of eight (2.4%). The highest percentage of

COVID-19 infections occurred among nursing staff (Table 1). However, there were personnel with contagion in all areas. Of the HCWs studied, 215 were women (66%) and 108 men (33%), the mean age was  $40 \pm 10$  years old, 318 (98%) were not sent to confinement and 5 (2%) were, 285 (88%) had COVID-19 patient contact and 38 (12%) had no COVID-19 patient contact. 24 (7%) were vaccinated at the time of acquiring COVID-19 and 299 (93%) were unvaccinated at the time of acquiring COVID-19. 211 (65%) presented symptoms and 112 (35%) were asymptomatic. 23 (7%) were hospitalised and 300 (93%) were not.

Two logistic regression models were built, the first with all the variables of the database: does he/she have internet at home, did he/she work with symptoms, performs substantive activities and/or customer service, vaccinated, lactation, worker with children under 12 years old, marital status, suspicion of COVID-19, gender, sick leave or resignation, allergies, with symptoms, worker in contact with COVID-19 patients, required hospitalisation, suffers from obesity, does he/she offer care to dependents or third parties, suffers from hypertension, suffers from diabetes, another chronic disease, current reincorporation status, older than 60 years, age, travel time to work, worker is within the parameters for not returning to work, type of transport. Table 2 shows the coefficients of each variable, obtaining for this model,  $R = 0.950$ ,  $R^2 = 0.902$ , adjusted  $R^2 = 0.893$  and a standard error of the estimate = 0.052. Table 3 shows the corresponding ANOVA with  $p \leq 0.01$ .

In a second simplified model introducing only the variables marital status, confinement, sex and age, the following values were obtained:  $R = 0.467$ ,  $R^2 = 0.218$ , adjusted  $R^2 = 0.208$  and a standard error of the estimate of 0.140. Table 4 shows the corresponding ANOVA with a  $p \leq 0.01$ .

Regarding the eight HCWs who died, 5 were women (63%) and 3 were men (27%), the mean age was  $46 \pm 18$  years, 5 (63%) practised confinement and 3 (27%) did not, 7 (88%) had COVID-19 patient contact and 1 (12%) had no COVID-19 patient contact. Eight (100%) were unvaccinated at the time of acquiring COVID-19, all of them presented symptoms and were hospitalised.

**Table 1** Health personnel with COVID 19

| Position               | N   | % of the total infected people |
|------------------------|-----|--------------------------------|
| Nurse                  | 151 | 47%                            |
| Medical specialist     | 60  | 19%                            |
| Administrative support | 45  | 14%                            |
| Head of department     | 15  | 5%                             |
| Stretcher bearer       | 8   | 2%                             |
| Chemical               | 8   | 2%                             |
| Others                 | 36  | 11%                            |

## DISCUSSION

COVID-19 has placed an enormous burden on health systems due to high rates of transmission, prevalence of serious illness, and mortality.<sup>17</sup> The global mortality rate among HCWs and social assistance workers has been similar to that of the general population.<sup>18</sup> HCWs in Mexico were no exception, and this study indicates the behaviour of the HCWs in a third-level hospital for maternal-fetal care and neonatology during the COVID-19 pandemic.

It is important to clarify that at the beginning of the pandemic there was a total of 1,157 HCWs, of which 323 were infected, which represented 27%, mostly women (66%), with an average age of 40 years. One of the strategies in the face of the pandemic was the confinement of HCWs with risk factors such as age, associated morbidities, high-risk pregnancy, and lactation period, which made it necessary for younger personnel without associated morbidities to be the ones at the forefront of caring for pregnant patients with COVID-19.

Based on UK registries, the vast majority of COVID-19-associated mortality occurs in patients over working age (>70% of deaths occur in people >75 years of age) and 57% are men,<sup>19</sup> while of employees of the National Health Service in the United Kingdom health system 77% are women.

In Mexico, due to the work they carry out in the health sector, women are on the front line against COVID-19 and, therefore, also exposed to greater risks of contagion and physical and emotional exhaustion. As official reports show, as of June 16,

**Table 2** Regression analysis of variables in health personnel during the SARS-CoV2 pandemic

| Variables (N=323)                                  | Non-standardized coefficients |                | Standardized coefficients | t      | Sig.   |
|----------------------------------------------------|-------------------------------|----------------|---------------------------|--------|--------|
|                                                    | B                             | Standard error | Beta                      |        |        |
| (Constant)                                         | -0.797                        | 0.236          |                           | -3.379 | 0.001  |
| Age                                                | -9.19E-06                     | 0.001          | -0.001                    | -0.018 | 0.986  |
| Sex                                                | -0.011                        | 0.007          | -0.034                    | -1.735 | 0.084  |
| Marital status                                     | 0.012                         | 0.009          | 0.037                     | 1.303  | 0.194  |
| Confinement                                        | -0.13                         | 0.039          | -0.103                    | -3.32  | 0.001  |
| Economic dependents                                | 0.019                         | 0.022          | 0.022                     | 0.844  | 0.399  |
| Public attention                                   | -0.005                        | 0.041          | -0.003                    | -0.13  | 0.897  |
| Contact with COVID patients                        | -0.007                        | 0.011          | -0.012                    | -0.597 | 0.551  |
| Vaccinated                                         | 0.016                         | 0.011          | 0.028                     | 1.453  | 0.147  |
| Worked with symptoms                               | 0.011                         | 0.012          | 0.018                     | 0.93   | 0.353  |
| Symptomatic                                        | 0.002                         | 0.007          | 0.006                     | 0.297  | 0.767  |
| Hospitalization                                    | -0.033                        | 0.014          | -0.055                    | -2.334 | 0.02   |
| Return to work                                     | 0.407                         | 0.032          | 0.454                     | 12.913 | ≤0.001 |
| With children under 12 years old                   | -0.019                        | 0.028          | -0.014                    | -0.693 | 0.489  |
| > 60 years                                         | 0.189                         | 0.036          | 0.164                     | 5.193  | ≤0.001 |
| Diabetes                                           | 0.149                         | 0.031          | 0.139                     | 4.825  | ≤0.001 |
| Hypertension                                       | 0.222                         | 0.042          | 0.137                     | 5.305  | ≤0.001 |
| Obesity                                            | -0.058                        | 0.024          | -0.054                    | -2.407 | 0.017  |
| Lactation                                          | 0.229                         | 0.056          | 0.082                     | 4.102  | ≤0.001 |
| Suspected COVID                                    | -0.011                        | 0.022          | -0.01                     | -0.508 | 0.612  |
| Quit the job                                       | 0.013                         | 0.02           | 0.014                     | 0.617  | 0.538  |
| Other chronic disease                              | 0.018                         | 0.021          | 0.024                     | 0.835  | 0.405  |
| Allergies                                          | -0.001                        | 0.008          | -0.003                    | -0.147 | 0.883  |
| Worker within the parameters to not return to work | 0.230                         | .016           | .551                      | 14.285 | ≤0.001 |
| Type of transport (own or public)                  | -0.018                        | 0.019          | -0.058                    | -0.993 | 0.322  |
| Time spent to arrive at work                       | 0.006                         | 0.016          | 0.019                     | 0.378  | 0.706  |
| Internet at home                                   | -0.017                        | 0.014          | -0.055                    | -1.263 | 0.207  |

a. Dependent variable: survival vs death. Sig: significance.

**Table 3** Analysis of variance of two factors survival vs death, including all the independent variables

| Model      | Sum of squares | Degrees of freedom | Mean square | F       | Sig.               |
|------------|----------------|--------------------|-------------|---------|--------------------|
| Regression | 7.031          | 26                 | 0.27        | 101.712 | 0.000 <sup>b</sup> |
| Residual   | 0.766          | 288                | 0.003       |         |                    |
| Total      | 7.797          | 314                |             |         |                    |

a. Dependent variable: survival vs death. Sig: significance.

**Table 4** Analysis of variance of two factors survival vs. death, including only the independent variables marital status, confinement, sex and age

| Model      | Sum of squares | Degrees of freedom | Mean square | F      | Sig.               |
|------------|----------------|--------------------|-------------|--------|--------------------|
| Regression | 1.700          | 4                  | 0.425       | 21.606 | 0.000 <sup>b</sup> |
| Residual   | 6.097          | 310                | 0.020       |        |                    |
| Total      | 7.797          | 314                |             |        |                    |

a. Dependent variable: survival vs death. Sig: significance.

2020, women represented 57% of positive cases of the virus and 29% of deaths. Most infected were nurses, who are mostly women.<sup>20</sup>

Time and preparation are crucial to protect HCWs with sufficient access to protective equipment, continuous training, access to technologies and development.<sup>21</sup> In our hospital, the first training for the prevention and mitigation of COVID-19 was given on February 7, 2020, which made it possible to integrate a care protocol for patients with suspected and confirmed cases of COVID-19.<sup>22</sup>

Italy and Spain were among the first and most severely affected European countries by COVID-19 with limited or no time to prepare the health sector and take precautions to reduce the spread of infection among HCWs. 9% of all people who tested positive for SARS-CoV-2 by PCR in Italy and 26% in Spain, where SARS-CoV-2 transmission has been intense, were HCWs.<sup>23-25</sup>

In the UK an analysis of COVID-19 deaths among HCWs and white collar workers was conducted and identified 119 deaths from public reports. In the vast majority of cases, they were able to establish that people had been working before death and the degree to which their work was patient-oriented. However, it was not possible to determine whether the HCWs were infected at work or elsewhere.<sup>26</sup> One element of focus in some studies is that minorities have been overrepresented in early deaths.<sup>27,28</sup>

Government strategies and public responses have led to a "flattening of the epidemic curve", meaning that the total number of cases has not reduced, but is spread over a longer period of time. As a matter of fact, COVID-19 will be with us forever, thus keeping a central registry of these deaths is mandatory. For example, according to the October 2021 Epidemiological Surveillance System for Respiratory Diseases (SISVER) in Mexico, of the total accumulated cases in health personnel by profession with COVID-19, the median age was 37 years. The most affected age group was 30–34 years. 62.6% were women and 37.4% men, with cases with 1 or more comorbidities constituting 32.77% and without comorbidities, 63.23%.<sup>29</sup>

The accumulated deaths in October 2021 in health personnel were 4,484 confirmed and 125 suspected in Mexico City. The State of Mexico, Puebla, Veracruz, Jalisco, Guanajuato, Nuevo León, Chihuahua, Tabasco, and Tamaulipas are the ten Federal States with the highest number of deaths, with 64% of all deaths (68% of registered deaths correspond to men and 32% to women). Of the 4,484 deaths confirmed by COVID-19, 45% corresponded to doctors, 31% to other health workers, 19% to nurses, 3% to dentists, and 2% to laboratory technicians.<sup>13</sup>

The HMPMPS, being a hospital unit attached to the state health system of the State of Mexico, followed and executed the measures implemented by the

Mexican Ministry of Health, which were replicated in each state of the country. The strategy that was carried out both to counteract the pandemic and for prevention and mitigation actions in relation to HCWs, conditioned their behaviour when exposed to the virus.

With the results obtained, a COVID-19 mortality of 2.4% in HCWs was confirmed. The variables marital status, confinement, sex and age were strong enough in a regression model to be significant for survival.

Considering that there are currently variants of COVID-19, new research studies are recommended to estimate the HCWs contagion rate associated with COVID-19 and to provide evidence that will justify the implementation and monitoring of prevention programmes aimed at HCWs to reduce the rate of contagion and additionally the costs of the negative impact on the health system.

#### SUMMARY BOX

The highest percentage of COVID-19 infections occurred among nursing staff.

Having met confinement criteria has a prediction for mortality, being necessary to reconsider when to return to work.

#### Limitations of the Audit

In the population of hospital workers, the health situation of each member was not evaluated in depth.

The policies implemented to send a certain population group home could have distorted the results.

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