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Asociación de la infección por COVID-19 en médicos internos de pregrado de una facultad de medicina del norte de México

Association of COVID-19 infection in undergraduate medical interns of a medical school in northern Mexico

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Abstract

Undergraduate medical interns are a risk group exposed to COVID-19. Adequate preventive measures must be guaranteed to minimize the risk of infection and disease spread.

This retrospective study included 173 medical students in clinical scenario training. The RT-PCR test for SARS-CoV-2 was performed for symptomatic and asymptomatic participants. The information was registered in a structured questionnaire. To estimate the association of COVID-19 and identify exposure characteristics related to infection in undergraduate medical interns.

The risk of COVID-19 infection was significantly higher in undergraduate medical interns **(**63.0%, p = 0.003). The highest risk of infection after exposure to patients and colleagues confirmed to COVID-19 occurred in the undergraduate medical intern study group (67.1%, p = 0.002 and 69.8%, p = 0.003, respectively).

We found a high frequency of COVID-19 among undergraduate interns despite protective measures.

Key words: Undergraduate Medical Interns, Covid-19, infection

Resumen

Los médicos internos de pregrado están expuestos al COVID-19. Se deben garantizar medidas adecuadas para minimizar el riesgo de infección y propagación de la enfermedad.

Se incluyen 173 médicos en etapa formativa clínica. La información se recogió en un cuestionario estructurado. La prueba RT-PCR SARS-CoV-2 se realizó para participantes sintomáticos y asintomáticos a COVID-19. Los objetivos del presente estudio fueron asociar la presencia de COVID-19, e identificar características de exposición relacionadas con la infección en médicos internos de pregrado. El riesgo de infección por COVID-19 fue mayor en los médicos internos de pregrado (63.0%,

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p = 0.003). El mayor riesgo de infección después de la exposición a pacientes y colegas confirmados a COVID-19, ocurrió en el grupo de estudio de médicos internos de pregrado (67.1%, p = 0.002 y 69.8%, p = 0.003, respectivamente). Encontramos alta frecuencia de COVID-19 entre los médicos internos de pregrado.
Palabras clave: Médicos internos, infección, COVID-19

Introduction

There is still significant uncertainty about the epidemiological, clinical, and virological characteristics of the Coronavirus disease (COVID-19). The first disease cases reported in the province of Wuhan, in China, were described as atypical pneumonia in December 2019 (Li y col., 2020).

The transmission is mainly through the airway and less frequently through contact with contaminated surfaces (Lewis, 2021). The main factors for the spread of the disease are non-compliance with sanitary measures (proper hand washing, social distancing, crowding people in hospital settings, and contact with body fluids and contaminated surfaces). For this reason, health workers are a potential infection risk group (Chan y col., 2020).

Healthcare workers play a critical role in patients' care and clinical management and are exposed to confirmed cases and subclinical or undiagnosed COVID-19 individuals. Therefore, adequate preventive measures must be guaranteed to minimize the risk of infection, outbreaks in the hospital, and the spread of the disease (Wu & McGoogan, 2020).

Li y col., reported a considerable percentage (86.2%) of non-symptomatic carriers of COVID-19 in Chinese population; however, 86% of the patients diagnosed with COVID-19 were infected from contact with non-symptomatic carriers; in this way, medical students may become asymptomatic carriers and spread the disease to family and friends, thus aggravating the pandemic. (Li y col., 2020). Additionally, many patients undiagnosed for SARS-CoV-2, with associated comorbidities, usually

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go to the emergency department for symptoms other than respiratory symptoms, increasing the risk of infection. (Huang y col., 2020; Zhou y col., 2020).

Infection rates in healthcare personnel have also been reported for other infectious diseases.

Middle East Acute Respiratory Syndrome due to coronavirus (MERS), Ebola, and severe acute respiratory syndrome (SARS), have been previously reported to range from 1% to 27%, 2.5% to 12%, and 11% to 57% of all cases, respectively. (Suwantarat & Apisarnthanarak, 2015).

In 2003, when the SARS outbreak in Hong Kong occurred, infection in medical students was reported. (Belingheri, Paladino, & Riva, 2020; Lee y col., 2003).

Xiaoquan Lai y col., reported that non-first-line health workers had a high risk of infection during the initial stage of COVID-19 disease. Interestingly, 70 (63.6%), 7 (6.4%), and 14 (12. 7%) out of 110 health workers with Covid-19 were possibly infected in general clinics or hospitalization rooms, fever care clinics, and at the community level, respectively. Thus, the authors proposed to evaluate interventions aimed at these vulnerable groups (Lai y col., 2020).

Recently, Yamamoto y col., described an increased frequency of COVID-19 among health workers in Tijuana city, Mexico. The results of that study showed that being an intern had a protective factor (unadjusted Prevalence Odds Ratios = 0.345, 95% CI 0.099, 1.179 and 0.253 95% CI 0.085, 0.758) (Yamamoto-Moreno, Pineda-Aguilar, Ruiz-Pérez, Gortarez-Quintana, & Ruiz-Dorado, 2020).

Due to the COVID-19 outbreak, authorities have recommended different sanitary policies to increase protective measures for medical students in clinical rotations and to avoid contact with potentially contagious patients of COVID-19.

Medical schools have recommended avoiding any interaction of medical students on hospital rotations with confirmed Covid-19, as this increases the likelihood of developing acute respiratory distress syndrome (SDRA) (Wu y col., 2020).

In this way, on March 17, 2020, the Association of American Medical Colleges provided guidelines and instructed that medical students were not involved in caring

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for patients with suspected or confirmed COVID-19 and suspended clinical rotations for medical students (Menon, Klein, Kollars, & Kleinhenz, 2020).

In Mexico, the Dirección General de Calidad y Educación en Salud (DGCES) instructed to increase the protection measures for undergraduate medical and community social service interns. Unfortunately, despite the health measures implemented, the COVID-19 pandemic has caused severe effects in Mexico. The increase in the number of cases has also extended to health workers. As of October 11th, 2021, more than 280,000 cumulative suspected cases of COVID-19 and 4,484 confirmed deaths were reported on healthcare workers. (Esquivel-Chirino y col., 2021).

Due to those mentioned above, the objectives of this study were to estimate the frequency of COVID-19 and identify clinical, sociodemographic, and exposure characteristics associated to the risk of contagion in undergraduate medical interns.

MATERIALS AND METHODS

This retrospective observational study included 173 participants in clinical scenario training, both in public and private healthcare centers, grouped as follows: undergraduate medical interns (sixth year clinical), community social service undergraduate students (seventh year), and medical specialty residents of the Faculty of Medicine of the Autonomous University of Coahuila, Mexico.

All the information included in this study was obtained from reports after an event of potential risk of contagion by COVID-19 from March 17, 2020, to April 30, 2021; this report was a structured questionnaire with information regarding category, demographic data, clinical symptoms, hospital and community scenarios, including contact with a confirmed COVID-19 case (within the past two weeks).

Additionally, several comorbidities, such as diabetes, high blood pressure, obesity, pulmonary disease, and smoking, were included. The Real Time Polymerase Chain Reaction for SARS CoV-2 (RT-PCR SARS-CoV-2 test) for symptomatic or

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asymptomatic participants exposed to environments, patients, colleagues, and family confirmed COVID-19 infection was performed.

All participants symptomatic or asymptomatic for whom COVID-19 was confirmed positive were classified as cases; otherwise, were considered as having no COVID-19 disease.

The RT-PCR test for SARS-CoV-2 was carried out in different public and private health institutions, following the indications of the World Health Organization (WHO), and endorsed by the corresponding local health authority. Trained personnel obtained samples using nasopharyngeal and oropharyngeal swabs with the standard technique already described. The swabs were immediately placed in a transport medium, in a portable refrigerator, and delivered to the corresponding laboratory. The tests used were Kits Superscript III platinum one-step quantitative rt-PCR system; Kit QuantiFast Probe RT-PCR (Qiagen) (Control & Prevention, 2020a; RT-PCR, 2020; Sung y col., 2020).

To evaluate the influence of the medical rotation services on the risk of infection, we grouped them as described below: clinical services (internal medicine, pediatrics, and community medicine) and surgical services (surgery, obstetrics and gynecology, emergencies, and anesthesiology).

This study was approved by the bioethics committee of the Torreón School of Medicine with reference number: C.B / 02-08-20 by January 25th, 2021, and carried out following article 17 of the general health law on research matters to health in Mexico, Declaration of Helsinki. All participants gave informed consent, and all data was secured and confidential.

STATISTICAL ANALYSIS

For this study, continuous variables were described as means and standard deviations; categorical variables were described as frequencies and percentages. For analysis, comparisons were first performed among the three study groups; moreover, community social service and medical specialty residents were grouped

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as ¨no medical interns¨ for comparison with the undergraduate medical intern group. Pearson's X2 test was used to compare frequencies. Mann-Whitney U test was performed for non-parametric values. For risk calculation, odds ratios (OR) and CI 95% were estimated using logistic regression.

Additionally, we tested for the association of symptoms between study groups positive for COVID-19. All statistical analyses were performed using IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). A significant bilateral $p< 0.05$ with respective 95% confidence intervals was considered significant.

RESULTS

This study included one hundred and seventy-three participants (82 females and 91 males, 47.4% and 52.6% respectively); also, eighty-eight participants (50.9%) corresponded to undergraduate medical interns, fifty-one (29.5%) to community social service and thirty-four (19.7%) to medical specialty residents. Eighty-one participants (46.8%) reported a positive RT-PCR SARS-CoV-2 test, and ninety-two (53.2%) were negative for RT-PCR SARS-CoV-2 test. The mean age was 25.36 years (SD ± 4.61). The mean age for undergraduate medical interns was 23.85 years (SD ± 1.12), 24.88 years (SD ± 0.95) for community social service, and 30.02 (SD ± 8.79) for medical specialty residents ($p<0.0001$).

Three participants reported being carriers of systemic arterial hypertension (1.7%). Pulmonary chronic disease, including asthma, was not associated with COVID-19 ($p=0.332$). None of the participants reported being carriers of type 2 diabetes or requiring hospitalization. There were no deaths related to COVID-19 infection among the participants.

Table 1 depicts the general demographic, clinical, and COVID-19 exposure characteristics of all the participants in this study. Sex and obesity were significantly associated with COVID-19 infection (OR 1.448, CI 95% 1.087 - 1.929 $p= 0.010$ and OR 6.247, CI 95% 1.427-27.353; $p=0.005$, respectively). No significant differences were observed in the frequency of infection after comparing the groups by the

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systematic use of appropriate PPE and medical rotation services. The frequency of COVID-19 disease was significantly higher in subjects exposed to colleagues, patients and family members confirmed positive for COVID-19 infection (p=0.00045 p= 0.00005, and p=0.044, respectively).

Notably, the frequency of COVID-19 infection was significantly higher for undergraduate medical interns than in community social service undergraduate students and medical specialty residents (63.0%, 23.5%, and 13.6%, respectively; p= 0.010). After grouping subjects, the frequency of COVID-19 infection remained consistently higher for the group of undergraduate medical interns. (63.0% versus 37.0%; OR 1.642; 95% CI 1.171 – 2.303, p = 0.003). This finding could also be observed in public and private health care centers (p=0.035, OR 1.568, 95% CI 1.009 – 2.439; p=0.015, OR 1.938, 95% CI 1.152 – 3.263, respectively).

Table 1. Clinical, sociodemographic and exposure characteristics for all study groups

	COVID-19 (+) n=81 (46.8%) %	**COVID- 19 (-) n=92 (53.2%) %**	***p*<0.05**	**OR**	**CI 95%**
Sex					
Female	36.6	63.4			
Male	56.0	44.0	0.010*¥	1.448	1.087 – 1.929
Rotation services					
Internal Medicine	65.0	35.0			
Surgery	76.9	23.1	0.04*¥		
Gynecology and obstetrics	48.1	51.9			
Pediatrics	60.0	40.0			
Emergency department	0	100			
Orthopaedics	50.0	50.0			
Anesthesiology	44.4	55.6			
Family Medicine	38.4	61.6			
Clínical services	44.8	55.2			
Surgical services	50.9	49.1	0.45¥	1.176	0.769 – 1.799
Systematic use of appropriate PPE					
Yes	45.1	54.9	0.20¥	0.933	0.835 – 1.042

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No	60.0	40.0			
Symptomatic					
Yes	84.0	69.6	0.02*¥	1.207	1.023 – 1.424
No	16.0	30.4			
Obesity					
Yes	13.6	2.2	0.005*¥	6.247	1.427 – 27.353
No	86.4	97.8			
Exposure to patient confirmed COVID-19 cases					
Yes	86.4	58.7	0.00005*¥	2.515	1.461 – 4.328
No	13.6	41.3			
Exposure to colleagues confirmed COVID-19 cases					
Yes	77.8	52.4	0.00045*¥	1.955	1.282 – 2.980
No	22.2	47.8			
Exposure to family confirmed COVID-19 cases					
Yes	25.4	10.4	0.04*¥	1.437	1.070 – 1.930
No	74.6	89.6			

*Significative
¥Chi square test

The average time from the appearance of symptoms suggestive of COVID-19 infection to the completion of the RT-PCR SARS-CoV-2 test for undergraduate medical interns and ¨no medical intern group¨ was 5.89 ± 3.8 and 3.9 ± 2.9 days, respectively (p= 0.00002). After confirmation of COVID-19 infection, the average time spent in home isolation was 8.15 ± 4.5 and 10.22 ± 4.4 days for undergraduate and non-medical interns, respectively (p=0.042).

Despite the use of appropriate PPE, the frequency of infection was significantly higher in the undergraduate medical intern group (63.8% versus 36.2%; OR 1.737, 95% CI 1.194-2.527; p = 0.003).

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Additionally, the highest risk of infection after exposure to patients and colleagues confirmed to COVID-19 occurred in the undergraduate medical intern study group (67.1% versus 32.9%; OR 1.683, 95% CI 1.184 – 2.392, p = 0.002 and 69.8% versus 30.2%; OR 1.701, 95% CI 1.158 – 2.498; p = 0.003, respectively).

A significant association was also found by exposure to family members who confirmed COVID-19 infection only for ¨no medical intern group¨ (OR 2.206, 95% CI 1.328 – 3.664, p=0.005).

Overall, sixty-eight participants (84%) with a positive result on the RT-PCR SARS-CoV-2 test manifested symptoms related to the infection; thirteen participants (16.0%) were asymptomatic of COVID-19 disease.

Table 2 shows the association between individual symptoms and COVID-19 infection for all participants. Interestingly, fever was not associated with COVID-19-positive results for any study group.

The highest frequency of symptomatic and asymptomatic COVID-19-positive subjects was also observed in the undergraduate medical intern group (60.3% versus 39.7%, p = 0.037, and 76.9% versus 23.1%, p = 0.014).

Table 2. Symptoms associated to risk for COVID-19 infection for all participants (%)

Symptoms	**COVID-19 (+) n=81 (46.8%) %**	**COVID-19 (-) n=92 (53.2%) %**	***p*<0.05**	**OR**	**CI 95%**
Fever	37	29.3	0.283	1.197	0.869 – 1.650
Cough	35.8	10.9	0.00009*¥	1.916	1.446 – 2.539
Dyspnea	12.3	22.8	0.073	0.645	0.377 – 1.103
Runny nose	59.3	39.7	0.001*¥	1.731	1.248 – 2.400
Diarrhea	32.1	34.8	0.709	0.937	0.665 – 1.321
Headache	67.9	40.2	0.00027*¥	1.862	1.302 – 2.665
Myalgia	46.9	17.4	0.00002*¥	1.947	1.450 – 2.616
Arthralgia	23.5	8.7	0.008*¥	1.657	1.216 – 2.257
Loss of appetite	24.7	8.7	0.004*¥	1.698	1.255 – 2.297
Anosmia	30.9	4.3	0.000003*¥	2.217	1.724 – 2.850
Loss of taste	24.7	23.9	0.905	1.023	0.709 – 1.475

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Fatigue	34.6	13.0	0.001*¥	1.757	1.313 – 2.350

* Significative

¥Chi square test

Table 3 shows the association of individual symptoms between study groups positive for COVID-19 infection. Although undergraduate medical interns report a higher frequency of symptoms, only the cough and runny nose were significantly associated with COVID-19 after comparing groups.

Table 3. Association of symptoms between study groups positive to COVID-19 infection

Symptoms	**Undergraduate medical interns 58 % COVID-19 (+) (%)**	**No medical intern 35.3 % COVID-19 (+) (%)**	***p*<0.05**	**OR**	**CI 95%**
Fever	59.5	40.0	0.160	1.320	0.884 – 1.970
Cough	94.4	57.1	0.008*¥	5.862	0.891 – 35.585
Dyspnea	42.1	16.7	0.140	1.527	0.915 – 2.549
Runny nose	71.1	47.1	0.030*¥	1.590	1.004 – 2.518
Diarrhea	50.0	35.0	0.275	1.231	0.851 – 1.781
Headache	66.0	53.3	0.217	1.167	0.866 – 1.572
Myalgia	71.4	68.4	0.817	1.053	0.676 – 1.640
Arthralgia	70.6	70.0	0.974	1.011	0.534 – 1.911
Loss of appetite	78.9	55.6	0.201	1.500	0.717 – 3.137
Anosmia	89.5	80.0	0.482	1.360	0.492 – 3.757
Loss of taste	54.8	27.3	0.116	1.336	0.927 – 1.925
Fatigue	70.0	70.0	1.000	1.000	0.677 – 1.478

* ¥Significative Chi square test

DISCUSSION

In this study, we report cases of COVID-19 infection among medical students who were in their clinical training periods as undergraduate medical interns from March

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17, 2020, to April 05, 2021. Overall, the frequency of confirmed COVID-19 cases was significantly higher for undergraduate medical interns.

This frequency is higher than that of Lee y col., during the 2003 SARS pandemic in Hong Kong. In this report, of 69 infected health workers, 16 (23.18%) were medical students. Also, in a Rios -González y col., study, 9.02% of medical interns reported a history of a positive swab for RT-PCR SARS-CoV-2 test. (Rios-González, Diaz, & Espinola-Canata, 2021).

Despite the protective measures implemented since the pandemic's beginning, the high frequency of COVID-19 infection is noteworthy. Our results showed that performing as an undergraduate medical intern in the hospital scenario was a risk factor for acquiring the infection. A possible explanation is an increase in conditions among healthcare workers during the initial stage of the disease outbreak. (Lai y col., 2020).

In addition, our study showed that the exposure reported by colleagues and patients who confirmed positive for COVID-19 was significantly associated with the infection in this study group, not so for contact with family members.

We also noted that for the group of undergraduate medical interns, the time elapsed from the onset of symptoms to confirmation of infection was significantly longer than in the comparison group; similarly, the average time of home isolation was considerably lower for the group of undergraduate medical interns.

It is essential to highlight that undergraduate medical interns, in many circumstances, have assumed a leading role in hospital patient care since attending physicians with the highest risk factors for COVID-19 infection were separated from their working duties, in addition to the medical commitment assumed for their learning and an inherent hierarchical power applied to medical students during hospital rotations, despite the indications issued by the Dirección General de Calidad y Educación en Salud (DGCES) (Esquivel-Chirino y col., 2021).

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Additionally, the higher frequency of infection could be due to shortages and inappropriate use of PPE, contact with fomites and asymptomatic subjects, as well as inadequate hospital infrastructure, and incorrect application of protocols in respiratory triage areas, among other causes. Indeed, in our study, participants reported inappropriate use of PPE.

Despite this protective measure, the provision of PPE to medical personnel remains inadequate and insufficient, particularly N95 respirators and surgical masks, mainly due to the high costs of this personal protective material (Jain, 2020).

We found an overall high frequency of subjects presenting one or more symptoms suggesting potential infection by COVID-19; these symptoms were associated with an increase in the risk for diagnosis as COVID-19 positive. Furthermore, in our study, the presence of symptoms was mainly related to COVID-19 positive in undergraduate medical interns in contrast to that reported by Bani Hani y col. (Hani y col., 2021). Moreover, we identified that the more significant symptoms were cough and runny nose for undergraduate medical interns positive for COVID-19.

The list of symptoms associated with the COVID-19 disease has been modified since the pandemic's beginning; earlier, the most prevalent clinical symptom was fever, followed by cough, fatigue, and dyspnea. A later review reported fever, cough, fatigue, slight dyspnea, sore throat, headache, conjunctivitis, and gastrointestinal as the primary clinical symptoms (Pascarella y col., 2020; Struyf y col., 2022).

Additionally, the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) have recognized three principal symptoms of COVID-19: fever, cough, and shortness of breath (dyspnea) (Control & Prevention, 2020b).

Our results showed that the prevalence of undergraduate medical interns asymptomatic and positive for COVID-19 was higher than in the other study group. This finding is a relevant topic due to the increased risk of transmission and spread of disease, which could have influenced the results of our study (Almadhi y col., 2021).

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A possible explanation for this finding is that this group of health service providers avoided working in high-risk departments, endotracheal intubation procedures, airway management, and the low frequency of comorbidities. The frequency of asymptomatic COVID-19 infection is unclear yet. Recently, Qahtani y col., reported 48.9% of COVID-19 infections in asymptomatic subjects (Al-Qahtani y col., 2021).

Oran y col., described the prevalence of COVID-19 asymptomatic disease in approximately 40% to 45% of subjects. However, prevalence ranges from 6.3% to 96%, which could be a significant factor for the rapid spread of the disease (Oran & Topol, 2020).

Additionally, the frequency of COVID-19 cases with no symptoms among health workers have been variable; in a study by Fakhim y col., 102 healthcare workers (HCWs) were screened, 20.5% of them had a history of suspected infection with COVID-19, and mostly 66.6% asymptomatic (Fakhim y col., 2021).

In another study by Temkin on Israeli health workers, a low prevalence of COVID-19 was reported as well as asymptomatic subjects, highlighting the importance of correctly using PPE (Temkin y col., 2021).

Many studies have a focus on exclusively reporting SARS-CoV-2 positive on symptomatic patients and lacking an uninfected control group who may also exhibit some symptoms; thus, it is crucial to assess the presence of individual or combination of different symptoms (Dixon y col., 2021).

Our study may have some limitations. First, the information collected and provided by the participants does not allow us to identify where the infection occurred (workplace, at home, or in the community); however, we made an attempt to overcome this weakness by knowing the result of the COVID-19 test in the patient, colleague or family member confirmed positive for the disease.

Also, the RT-PCR SARS-CoV-2 tests were carried out in different public and private health institutions endorsed by the corresponding health authority; however, they were carried out with the techniques described and qualified personnel, according to the guidelines specified by the CDC. Additionally, we included the average time

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from the suspected contact and appearance of symptoms suggestive of COVID-19 infection to the completion of the RT-PCR SARS-CoV-2 test for both study groups, according to the recommended. (Beeching, Fletcher, & Beadsworth, 2020).

Another limitation of our study is that no complementary tests were performed, such as chest computed tomography or tests to evaluate hematological or biochemical parameters. However, the participants in this study were classified as having mild COVID-19.

Conclusions

In conclusion, we found a high frequency of symptomatic and asymptomatic COVID-19 positives among undergraduate medical interns. Our finding implies recognizing them as a particular group at risk of infection and promoting the increase of protection measures and the availability of RT-PCR SARS-CoV-2 tests; also, the current availability of vaccines makes it necessary to consider this group of health service providers a priority. Undoubtedly, all of the above described will allow students in clinical cycles to adapt more securely to the challenges they must face with this pandemic and perhaps others in the future.

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