

Coronavirus Pandemic

Self-perceived knowledge level of epidemic management in medical residents prior to the start of the COVID-19 pandemic in Mexico

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Abstract

Introduction: COVID-19 was declared a pandemic in March 2020, requiring a comprehensive response from all healthcare systems, including Mexico's. As medical residents' training did not involve epidemic response, we decided to evaluate their level of training on this subject, specifically self-perceived knowledge level and capacity to respond to epidemiological crises.

Methodology: Medical residents from two hospitals belonging to PEMEX (Mexico's state-owned petroleum company) were included in a cross-sectional study. All participants answered a modified version of the survey developed by the University of Lovaina's Center for Research and Education in Emergency Care. Participants were analyzed according to their relevant "clinical" or "surgical" residency tracks. Data were analyzed using through Chi-square tests, t-tests, Mann-Whitney U tests, Kruskal-Wallis tests, and Pearson and Spearman correlation coefficients with significance established at $p < 0.05$.

Results: Of a total of 94 resident participants in this study, 56.7% self-perceived themselves as being poorly prepared to confront the pandemic. Only 25.5% of the participants referred previous experience in medical responses to public health emergencies, and only 35.1% reported ever receiving education on this topic.

Conclusions: Medical residents—who have been involved with caring for victims of the pandemic—are under the general perception that they are not prepared, experienced, or educated enough to respond to such a widespread massive public health emergency.

Key words: Emergency health services; pandemic; medical residency.

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Introduction

Following an outbreak of pneumonia of unknown cause in December 2019 in the city of Wuhan, China, SARS-COV-2 was identified as the causative agent in 2020 [1]. By March 2020, the COVID-19 outbreak was declared a pandemic by the World Health Organization. This declaration set off a series of response and mitigation strategies, including social distancing and lockdowns in more than 170 countries [2,3]. These response strategies involved educational institutions of varying levels, including tertiary education [4]. From the very first moments of the pandemic, world medical schools adopted these strategies and restricted medical students' access to areas of hospitals dedicated to patient care [5]. The pandemic crisis eventually led to hiring and mobilizing medical students and retired doctors to take care of the health care problem caused

by the pandemic in the country. England accelerated the graduation of last-year medical students to integrate them into the labor force, although this strategy showed some fears like students becoming an unnecessary transmission source [6]. While medical residents are graduated medical doctors, they remain students [7] of a national program for the training of specialized doctors.

All 9,671 graduated medical doctors who have been residing in Mexico since 2020, exposed to COVID-19 during this sanitary contingency [8]. The Mexican residency program takes place in numerous health institutions all over the country, all of which receive endorsement and financial support from both private and public universities and institutions.

One such health institute is that belonging to PEMEX (the abbreviation for Petroleos Mexicanos,

Mexico’s state-owned petroleum company). PEMEX’s health system provides patient services to petroleum industry workers and their families, with approximately 64,000 users spread throughout the country. In addition to providing patient care, PEMEX’s healthcare system is part of the national residency program and trains an average of 480 specialized doctors annually. The PEMEX provides 22 specialization courses in two regional hospitals—one in Salamanca (state of Guanajuato) and one in Ciudad Madero (state of Tamaulipas)—and in two central hospitals in Mexico City (the Hospital Central Norte and Hospital Central Sur de Alta Especialidad).

As medical residents’ training in the hospital do not involve epidemic response, we decided to evaluate prior their level of training on this subject, specifically self-perceived knowledge level and capacity to respond to epidemiological crises.

Methodology

Medical residents from the Salamanca regional hospital in Guanajuato and PEMEX’s highly specialized north central hospital in Mexico City were included in this descriptive cross-sectional study. All participants filled out a modified version of the survey developed by the University of Lovaina’s CREEC

Table 1. Survey validity analysis.

Objective	Basis	To describe the comprehension (appreciation) of a particular event, such as an epidemic outbreak.
Understandability	Applicability	Designed to be applied to medical residents working at PEMEX health services.
	Simplicity	It evaluates three different categories. The subject has to choose the answer for each question. The first part evaluates the previous epidemic outbreak experience of medical residents. The second part evaluates self- perception and knowledge level about epidemic management. Finally the third part is designed to find out the perception of the ability to react.
	Oligo variability	Some of the ability and perception questions were removed and binomial characteristics were given instead, to simplify the questioned variables and make it more comprehensible to respondents.
Response scale	Replicability/ Clearness of instructions	An e-mail with specific instructions was given. It pointed out not to leave unanswered questions and to mark just one answer. No special training is needed to apply the survey.
	Impartial test (without bias)	It was specified to each medical resident that the answers are personal and there won’t be clarification of any doubt that has to do with the questions. The survey was applied before the training of the health workers from “ <i>Protocolo PEMEX</i> ” hospitals for the COVID-19 pandemic management.
	Understandability	The answers are mutually exclusive, however they can be combined with the other questions.
Appearance validity	Discrimination	The purpose of the answers is to discriminate between two events: residents that have approbatory perception from those who don’t. This scale has sufficient classes in order to distinguish.
	Interpersonal Exchange approach	Is self-applicable and the pilot test shown the questions are explicit enough in order to get the required answers.
	Primary data approach	The phenomenon to be identified is the perception of the subject, not taking into account its effect in the daily clinical work and its interference against the pandemics because every action to fight it became part of a protocol.
	Content validity	A bibliographic revision allowed to find out the most frequent students perception and the considerations made by different authors. It was not found any similar study focused on medical residents.
	Component consideration	Two scales were implemented: a binomial (yes or no) and a continuous quantitative (0 to 10) in the auto response qualification.
	Satisfactory elemental scales	The scales to each question has elemental components included in the survey and are appropriate, as well as adequate graded, there are no omissions and are mutually exclusive.
Survey consistency evaluation	Elemental data quality	The information acquired is adequate, quality satisfactory and straight from the subject, without side interpretations. The scales are designed to this purpose.
	Ease of use	The survey is easy to apply and respond
	Consistency analysis	The survey was initially applied to 10 medical residents, and they were asked to answer the same survey a second time at the night, the very same day and give it back the next day. Repeatability indexes were calculated through weighted kappa for questions with three option answers. An almost perfect correlation of 1 was obtained in all the questions. For the questions with two answers a Cronbach alfa test was used.

(Center for Research and Education in Emergency Care) by Mortelmans *et al.* [9] (Supplementary Table 1).

The department of teaching and research at these two participating hospitals sent out an email invitation to all medical residents at these hospitals. The survey collects information on demographic data prior education, and self-estimated ability to handle a public health emergency, student’s disposition to work under these circumstances. The score of each item ranged between 0-10.

The surveys were carried out on two groups of participants including a group of students enrolled in clinical specialties (pathology, cardiology, anesthesiology, diagnostic and therapeutic imagenology, critical medicine, environmental and occupational health, internal medicine, nephrology, and pediatrics), and another group that was applicants of surgical specialties (general surgery, reconstructive and plastic surgery, obstetrics and gynecology, neurosurgery, ophthalmology, orthopedy, otorhinolaryngology, and head and neck surgery). Chi-square tests, t-tests, Mann–Whitney U tests, Kruskal–Wallis tests, and Pearson and Spearman correlation coefficients were used. Significance was established at $p < 0.05$.

Feinstein’s Clinimetric criteria were used to assess the survey through a sensibility analysis (Table 1).

Ethics declarations

This study was approved by our Research Ethics Committee (CONBIOETICA-09-CEI-007-20180529).

Results

Demographic characteristics

A total of 251 medical students were enrolled in the residency programs of the regional hospital of Salamanca and the South-Central Hospital at the time of the survey. Of these 25,194 of the residents answered the survey, representing a participation rate of 37.4%. Slightly more than half (53.1%) of the participants were enrolled in surgical residency programs whereas the remaining 46.8% belonged to clinical residency programs. The most represented specialization was general surgery, with 12 respondents (12.7% of the total), while critical medicine was the least-represented specialization with only one participant (1.06% of the total). The average age of the respondents was 28.4 ± 2.5 years, and 60.6% of the participants were men (57 students) and 39.3% female (37 students).

Prior experience of medical residents

Twenty-four medical residents (25.5%) referred previous experience in medical organizations of medical urgent care the most common of this were first-aid groups (13.8%), followed by Mexican Red Cross (8.5%) and finally the fireman department (1.06%); 2.06% referred participation on urgencies groups but they didn’t specified the nature of the urgent response.

Table 2. Distribution results of perception and previous knowledge by clinical courses.

Clinical course	Number	Participation on medical organizations of medical urgent care	Previous education on the management of epidemics and disasters	Necessity of having a course of management of epidemics and disaster medicine	Knowledge level of contagious epidemic management	Knowledge level of very dangerous infections
		n (%)	n = 94 (%)	n = 94 (%)	n = 94 (%)	(Mean)
Pathology	4 (4.2)	0 (0)	1 (25)	4 (100)	4.2	4.2
Anesthesiology	8 (19)	2 (25)	2 (25)	7 (87.5)	5.4	4.5
Cardiology	4 (4.2)	1 (25)	1 (25)	4 (100)	5.5	4.3
General surgery	12 (12)	3 (25)	3 (25)	11 (91.6)	5.4	4.5
Plastic surgery	4 (4.2)	2 (50)	2 (50)	4 (100)	5.6	4.8
Obstetrics/Gyn	7 (7.4)	0 (0)	2 (28.5)	7 (100)	5.5	4.7
Imagenology	7 (7.4)	1 (14.2)	1 (14.2)	7 (100)	5.5	4.5
Critical medicine	1 (1.06)	0 (0)	0 (0)	1 (100)	7.0	3.0
Occupational health	9 (9.5)	3 (33.3)	5 (55.5)	9 (100)	5.5	4.4
Internal med	5 (5.3)	2 (40)	3 (60)	5 (100)	5.4	4.4
Nephrology	7 (7.4)	2 (28.5)	1 (14.2)	7 (100)	5.5	4.6
Neurosurgery	2 (2.1)	0 (0)	0 (0)	2 (100)	0	1.5
Ophthalmology	4 (4.2)	2 (50)	2 (50)	4 (100)	5.5	4.5
Orthopedy	7 (7.4)	3 (42.8)	5 (71.4)	7 (100)	5.6	4.5
Othorinolarng	8 (8.5)	1 (1.2)	3 (37.5)	8 (100)	5.4	4.5
Pediatrics.	5 (5.3)	2 (40)	2 (40)	5 (100)	5.5	4.6
Total	94 (100)	24 (25.5)	33 (35.1)	90 (95.7)	5.1 ± 1.4	4.2 ± 0.8

Seventy medical residents (74.5%) did not refer previous experience on this matter.

Exploring previous education on the management of epidemics, 23 (24.4%) referred university courses on this matter, 10 (10.6%) extracurricular education on this matter and 67 (71.2%) denied having education on this matter.

Questioning their opinion about the necessity of having a course of management of epidemics and disaster medicine on their specialty study plans, 45 (47.8%) responded necessary, 47 (50%) as useful and 2 (2.1%) not useful.

Self-perception of epidemic management knowledge

On a scale of 0 to 10, respondents rated their self-perceived knowledge of contagious disease management at a 5.1 and of “very dangerous infections” at a 4.2. Ninety-two students (97.8%) referred a need for training on this matter. Table 2 shows how critical medicine students have the highest score in the contagious disease knowledge area but one of the lowest scores on very dangerous infections knowledge. Neurosurgery students had the lowest self-perception on both matters. Other specializations presented homogeneous scores but they were not approbatory; this means that the distribution of the self-perception of the knowledge level and previous education must be consider to include courses on the study plans (Table 2)

Comparison between clinical and surgical specialties

Demographic data was obtained from both groups, there is non-significant difference (Table 3).

Uptake of preventive measures and self-perception of response capacity

Eighty-four (89.3%) of the medical residents who took the survey referred receiving an immunization against influenza in 2019. Surgical residents were overrepresented in the ten participants who did not report having received a flu shot: 80% were from surgical residencies and 20% from clinical residencies.

Participants were asked to rate their self-perceived abilities in response to an outbreak of a new virus causing respiratory difficulties if they were responsible of institutional control policies. Two-thirds (67% or 63%) of the participants did not perceive themselves as capable of establishing preventive measures, 22 (23.4%) considered themselves as capable of establishing preventive measures, 7 (7.4%) thought they would be capable by asking help from persons with better knowledge on this matter, and 2.1% did not respond.

When they were asked to indicate that what role in an epidemic emergency would be their preference, over half percent (52.1%) responded that they would like to provide direct patient care under the supervision of more senior staff. The second most common response was to be involved with proposing solutions (39.3%), whereas 6.3% would rather prefer not to participate due to their lack experience, and 3.1% did not answer.

When they were asked what their preferred role in an epidemic outbreak would be, 61% referred that they would actively participate in Emergency response plan, 30.8% would prefer to isolate at home to avoid close contact with people who are sick, and 7.4% did not answer.

Table 3. Demographic data obtained from both groups.

Variable	Surgeric course (n = 50)	Clinical course (n = 44)
Mean age (SD)	28.3 (2.8)	28.6 (2.2)
Mean years of residency (min-max.)	3.3 (1-8)	3.1 (1-7)
Gender		
Male n (%)	34 (68%)	23 (52.2)
Female n (%)	16 (32%)	21 (47.7)
Perception knowledge of contagious diseases	5.5 ± 2.4	5.8 ± 2.7
Perception knowledge of very dangerous infections	4.4 ± 2.5	4.6 ± 2.9
Previous education on epidemics and disasters		
Yes	13(26%)	11(25%)
No	37(74%)	33(75%)
Knowledge on disaster medicine		
Yes	19(38%)	14(31.8%)
No	31(62%)	30(68.1%)
Necessity of management in disaster medicine		
Absolutely	23(46%)	22(50%)
Useful	25(50%)	22(59%)
Not useful	2(4%)	0 (0%)

Discussion

Despite the diversity and heterogeneity in medical residents' profiles—due to differences in study plans at different universities, and clinical versus surgical specialization—these residents are expected to be capable of help during a public health emergency, regardless of their educational background. However, the results of current study were aligned with other surveys reporting that medical students involved in direct patient care during massive emergencies [9] are under the general perception that they are not prepared or experienced enough to respond to a great scale sanitary contingency [17]. Over half of our surveyed residents (56.7%) perceived their level of preparedness to confront the pandemic as “poor”, only 25.5% had previous experience on medical emergencies response to sanitary emergency and only 35.1% received education on the matter. When comparing our results with previous Middle Eastern studies on MERS, our residents' perception of its readiness is lower. Only 28% of Middle Eastern medical residents perceived themselves as poorly prepared to confront the pandemic.

When specific knowledge was quantified on a scale from 0 to 10, scores were deficient in two different scenarios: level of knowledge on contagious epidemics like influenza (mean score of 5.1) and level of knowledge on very dangerous infections like Ebola (mean score of 4.2). Despite the low results, these scores were higher than the self-estimated by Dutch students: level of knowledge on contagious epidemics (mean 3.9) and the level of knowledge on very dangerous infections (mean 2.4). These differences could be due to the difference in populations, post-graduate medical students participated in our Mexican study while current medical students participated in the Dutch study. Even the differences could be influenced by the near pandemic outbreak in Mexico, the responses could have been influenced by recent lectures on COVID-19 matter, even if the self-perception of knowledge is bad.

These deficiencies in knowledge have been compensated in other regions by sending these students to internships on emergency services and disaster medicine services, where they learn organization, simulation scenarios, and triage systems [20,21]. The pandemic outbreak and these results increased the need to implement an intensive training program for medical residents. This kind of training must be included in PEMEX's COVID-19 contingency protocol in order to emphasize the generalities and panorama of the SARS-COV-2 (COVID-19) infection, use of personal

protection equipment, preventive measures against COVID-19, sanitation and disinfection according to PEMEX protocol, evidence of treatment efficacy against COVID-19, and epidemiologic vigilance for COVID-19.

The results unveiled that the participation of medical residents should have been on triage filters to detect suspicious cases in the medical care of non-COVID-19 patients. This is congruent with the results obtained and the information referred on literature, where information about medical residents not being suitable to this task is outlined. Nowadays after the first Mexican case of COVID-19, medical residents continue their education programs online, taking care of diseases of their own specialties, they have gradually been phased out of COVID-19 patients care.

Prior analysis of the resources and capacities that have a health system to execute planned actions against a sanitary crisis (as the one triggered by COVID-19 in many countries), is necessary for every healthcare system [11,12]. That's why economic, education and health problems will be the consequence of inadequately prepared countries against COVID-19 [13-15].

Medical residents—who have been involved with caring for victims of the pandemic—are under the general perception that they are not prepared, experienced, or educated enough to respond to such a widespread massive public health emergency. The post-training evaluation will take place as soon as life returns to normal.

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Annex – Supplementary items

Supplementary Table 1. Mortelman’s modified survey.

Please respond the following questions			
1	Gender:	Man <input type="checkbox"/>	Woman <input type="checkbox"/>
2	Age:		
3	Residence year (please take on account specialty, subspecialty and high specialty):		
4	University of basic cycles		
5	Specialty:		
6	Have you participated or participate on emergency medical service or disaster medicine, besides studying medicine?		
	Yes:	First aid groups	<input type="checkbox"/>
		Ambulance services	<input type="checkbox"/>
		Firemen department	<input type="checkbox"/>
		Red cross	<input type="checkbox"/>
		Army	<input type="checkbox"/>
		Other	<input type="checkbox"/>
No		<input type="checkbox"/>	
7	Have you had previous education on management of disaster or epidemics?		
	Yes	University	<input type="checkbox"/>
		Others	<input type="checkbox"/>
No		<input type="checkbox"/>	
8	Do you think that a basic course of disaster medicine or epidemic management should be included on medicine career?		
	It would be useful		<input type="checkbox"/>
	It wouldn't be useful		<input type="checkbox"/>
9	On a 0 to 10 ten scale, please point out the level of knowledge that you have about the following matters:		
	Epidemiologic outbreak of very contagious disease (ex. Influenza)		<input type="checkbox"/>
	Epidemiologic outbreak of very contagious and dangerous disease (ex. Ebola)		<input type="checkbox"/>
10	On a 0 to 10 ten scale, please point out your estimated capacity to manage the following situation:		
	Epidemiologic outbreak of very contagious disease (ex. Influenza)		<input type="checkbox"/>
	Epidemiologic outbreak of very contagious and dangerous disease (ex. Ebola)		<input type="checkbox"/>
11	If during your medical residency you would have to deal with one of the following scenarios. Would you actively participate on the health care of patients? (On a 0 to 10 ten scale)		
	Epidemiologic outbreak of very contagious disease (ex. Influenza)		<input type="checkbox"/>
	Epidemiologic outbreak of very contagious and dangerous disease (ex. Ebola)		<input type="checkbox"/>
12	Did you receive immunization against influenza in 2019?		
	Yes		<input type="checkbox"/>
	No		<input type="checkbox"/>
	Why?		
13	If you were responsible of an institution involved on an epidemic outbreak of a virus that causes respiratory difficulty.		
	Would you be capable of establishment of preventive measures?	Yes	<input type="checkbox"/>
		No	<input type="checkbox"/>
	You would participate by asking help of professionals on the matter:	Yes	<input type="checkbox"/>
No		<input type="checkbox"/>	
14	In the case of an epidemic outbreak, what would be your participation?		
	I would rather no participate, I don't have experience		<input type="checkbox"/>
	I would suggest solutions		<input type="checkbox"/>
	I would take care of patients with someone else's orientation		<input type="checkbox"/>
15	On an epidemic outbreak what would you prefer		
	I would actively participate		<input type="checkbox"/>
	I would isolate myself to avoid getting sick		<input type="checkbox"/>