



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Teaching strategies and outcomes in 3 different times of the COVID-19 pandemic through a dynamic assessment of medical skills and wellness of surgical trainees



Fanny Rodriguez Santos, MD^{a,*}, Esteban González Salazar, MD^a, Agustin Dietrich, MD^a, Virginia Cano Busnelli, MD^a, Carolina Roni, PhD^{b,c}, Clara Facioni, BSS^b, Agustina Mutchinick, PhD^b, Martin Palavecino, MD^{a,c}, Axel Beskow, MD^a, Marcelo Figari, MD^{a,d}, Juan Pekolj, MD, PhD^a, Martín de Santibañes, MD, PhD^a

^a Department of General Surgery, Hospital Italiano de Buenos Aires, Argentina

^b Department of Education, Instituto Universitario Hospital Italiano de Buenos Aires, Argentina and Hospital Italiano de Buenos Aires, Argentina

^c University Center for Simulation based Education, Instituto Universitario Hospital Italiano de Buenos Aires, Argentina and Hospital Italiano de Buenos Aires, Argentina

^d Rector, Instituto Universitario Hospital Italiano de Buenos Aires, Argentina and Hospital Italiano de Buenos Aires, Argentina

ARTICLE INFO

Article history:

Accepted 14 August 2021

Available online 24 August 2021

ABSTRACT

Background: The coronavirus disease 2019 pandemic had a substantial impact on surgical training programs. This study describes the teaching strategies and outcomes in 3 different times of the coronavirus disease 2019 pandemic through a dynamic assessment of medical skills and well-being of trainees.

Methods: Three surveys were administered during 2020 to general surgery residents and fellows in a university hospital in Argentina. Perceptions on the impact of coronavirus disease 2019 were described. The stress rate and risk factors were analyzed.

Results: The study included 124 answers. In total, 59% were men, 82% of trainees reported concerns about the loss of surgical skills in early phase 1. Time spent with academic activities increased in 94.5% of the cases. Owing to the prompt implementation of changes, by the end of 2020, 73% participated in a greater number of procedures ($P = .003$); personal protective equipment use related problems dropped from 40% to 14% ($P = .031$), and the lack of adequate spaces where trainees could express reduced from 28% to zero. Half of the trainees felt stressed, and 18% required psychological assistance; reporting problems with personal protective equipment use was identified as a risk factor ($P = .012$).

Conclusion: Assessing trainees' perceptions at 3 different times of the coronavirus disease 2019 pandemic enabled the implementation of dynamic changes. The negative impact on surgical training was partially offset by the optimal use of virtual learning. Half of them felt stressed, identifying problems in the use of personal protective equipment as a predisposing factor.

© 2021 Elsevier Inc. All rights reserved.

Introduction

Nowadays, coronavirus disease 2019 (COVID-19) has infected more than 100 million people worldwide and has caused more than

2 million deaths.^{1,2} The pandemic has broken health care systems, prompting world leaders to take extraordinary social, political, and economic measures with an uncertain outcome. Moreover, thousands of health professionals around the world contracted the severe acute respiratory syndrome coronavirus 2 infection, suffering severe clinical illness in a considerable percentage and even death. In addition to the risk of being infected with COVID-19, overwork has caused physical, mental, and emotional problems in health professionals.^{3–6} Consequently, healthcare centers were forced to make profound changes in their activities with the main objective of ensuring patient care while preserving the safety and health of

Fanny Rodriguez Santos and Esteban González Salazar share the first authorship of this work.

* Reprint requests: Fanny Rodriguez Santos, Pres. Juan Domingo Perón 4190, C1199 ABH, Buenos Aires, Argentina.

E-mail address: fanny.rodriguezsanatos@hospitalitaliano.org.ar (F. Rodriguez Santos).

their professionals. In this context, university hospitals had the additional challenge of guaranteeing and supervising the fulfillment of the academic and teaching activities of their physicians-in-training. While many strategies were suggested to solve educational demands of general surgery training programs in the midst of this sanitary emergency,^{7–11} the first step to achieve their effective adaptation and face the subsequent phases of the pandemic was to know the opinions and concerns of residents and fellows.

Thus, the aim of this study was to describe the teaching strategies and outcomes in 3 different phases of the COVID-19 pandemic through a dynamic assessment of medical skills and well-being of surgical trainees at a university hospital in Argentina.

Methods

The Hospital Italiano de Buenos Aires (HIBA) is a teaching hospital affiliated with the University of Buenos Aires and Instituto Universitario Hospital Italiano de Buenos Aires (IUHIBA). The HIBA General Surgery Service (GSS) is a high-volume referral center including liver, pancreas, small bowel, and lung transplants. The surgical team is formed by 18 staff members organized in 9 different subspecialty teams: hepatobiliary surgery and liver transplantation, colorectal, upper gastrointestinal and bariatric, head and neck, abdominal wall, thoracic, phlebolympology, image-guided surgery, and trauma, with the corresponding fellowship programs. The GSS has a 4-year residency program with a total of 31 general surgery residents, 10 to 15 first-year residents from other specialties, and up to 20 fellows.

In response to the pandemic, in April 2020 the HIBA GSS formed a COVID-19 task force focusing on the trainees' learning and well-being. The task force was composed of the chairman of the unit, the resident program directors (2), the simulation center director, the resident committee coordinators (2), junior staff surgeons (with high interest in medical education [3]), and the chiefs of residents (3). To have a more comprehensive perspective, 3 representatives from different educational areas of the university also joined: education (1), psychopedagogy (1), and sociology (1).

Starting from the hypothesis that acquiring ongoing knowledge of the impact of the pandemic in the residency would allow for the implementation of measures to tackle its detrimental aspects, therefore enabling a better adaptation to an unprecedented context, the task force carried out the design, implementation, and analysis of 3 surveys in different times of the pandemic.

Anonymous online surveys were created and administered using the Google Forms tool during the months of May, July, and November 2020. The surveys (annexed 1) included a mean of 47 questions concerning 7 main fields related to the impact of COVID-19 in surgical education: (1) profile of participants; (2) surgical training; (3) academic performance; (4) supervision and evaluation; (5) habits and relationships; (6) mental health and emotional state; and (7) future perspectives. All surgeons in training from the HIBA GSS were invited to participate voluntarily by email and were included in the study analyses. A deadline of 15 days was considered for participants to complete the survey, and a reminder was sent subsequently. This study was approved by the ethics committee of the IUHIBA (IRB Approval No 0026-20).

The same cohort of residents and fellows responded to all 3 surveys. A new curricular year began on October 1, 2020, and incoming residents were not included in the third survey.

A preliminary analysis was carried out after each survey to detect red flags and act accordingly as part of the dynamic work carried out by the task force. This final report shows the results of the 3 measurements.

Descriptive analysis of the entire cohort of respondents were performed, followed by a comparative analysis between the 3

different surveys. Lastly, factors associated with personal feelings of stress were determined. For qualitative data, open responses were analyzed identifying themes and patterns. Words and phrases were organized into codes, and finally a Word document was created with the resulting nominal results. For quantitative data, descriptive statistics were reported with mean and standard deviation or median and interquartile range for continuous variables, and absolute frequencies and percentages for categorical variables. In the univariate analysis of the different factors analyzed in the 3 surveys, simple linear regression tests, logistic regression, χ^2 , Student's *t* test, and Fisher exact tests were performed. To better determine factors predictive of stress, a multivariable stepwise logistic regression was performed after controlling for covariates identified on the univariate. Statistical analyses were performed using Stata 13 version software (StataCorp, College Station, TX). All tests were 2-tailed, with significance established at $P < .05$.

Results

The study included 124 answers analyzed from 3 surveys with a response rate between 65% and 92% (Table 1).

Impact of COVID-19 pandemic in surgical training

The HIBA bed occupancy by COVID-19 patients at the time the 3 surveys were administered is shown in Figure 1, as well as the number of COVID-19 cases and deaths in the the country.

In phase 1 surgical activity was restricted to urgent cases in a situation that was progressively recovered throughout the year. Eighty-two percent of trainees (45 of 55) reported concerns about the loss of surgical skills in the first survey. A contingency surgical simulation program was established, and trainees were allowed to operate on polymerase chain reaction negative patients according to a safety algorithm.⁷ In addition, the curricular year was postponed for 4 months, and fewer physicians were admitted into residency and fellowships programs.¹² By November 2020, 73% of residents and fellows reported having participated in a greater number of surgeries than at the beginning of the pandemic ($P = .003$). In addition, 45% stated to regain their usual work rhythm, and while 32% noted to be working less, 23% perceived that they increased their activity compared with the pre-pandemic period. In accordance with the reduction in the number of surgeries performed in 2020 by the HIBA GSS owing to the pandemic, residents performed a smaller number of procedures ($P = .8$), (Fig 2). Regarding changes in standard of care, in the first survey, 37% of trainees mentioned having applied differences in surgical algorithms of treatment; however, they perceived a similar quality of care provided in the emergency department (ED) in relation to normal situations in more than 70% of the cases. Concerning the use of personal protective equipment (PPE), although more than 90% of the trainees mentioned sufficient availability of PPE in the surveys, at first almost 40% of them reported problems when having to use them, either in relation to the indication of level of PPE or the dressing/undressing instructions. This rate dropped to 14% in the last survey ($P = .031$) (Table II).

Impact of COVID-19 pandemic in academic performance

At the beginning of the pandemic, 95% of trainees had increased the time spent with academic activities, and 82% reported spending more than 3 hours per day, a percentage that dropped to 27% later in the pandemic ($P < .01$). In the first survey, 71% declared to be involved in 2 or more research studies, and 6 months later, 82% finished or published at least 1 of them. New virtual interactive

Table 1
Surveys' aspects and demographic characteristics

	Survey 1	Survey 2	Survey 3
Surveys			
Date	05/14/2020	07/23/2020	11/25/2020
No. of questions	51	36	44
Response rate	91.7% (55/60)	83.9% (47/56)	65% (22/34)
Demographics			
Male sex	56.4%	51.1%	63.3%
Age	29.4	29	28.9
Trainees (responders)	- 35 residents: - 13 PGY1 - 7 PGY2 - 7 PGY3 - 5 PGY4 - 3 Chiefs - 20 fellows	- 37 residents: - 14 PGY1 - 7 PGY2 - 7 PGY3 - 6 PGY4 - 3 Chiefs - 10 fellows	- 19 residents: - 0 PGY1 [†] - 6 PGY2 - 5 PGY3 - 7 PGY4 - 1 Chief - 3 fellows [†]

PGY, postgraduate year.

* On October 1, 2020 a new curricular year began. Incoming first-year residents were not included in the survey.

[†] Owing to a pandemic, the number of vacancies for residents and fellows was reduced.

lectures and courses schedule were carried out with 75% of acceptance (Table II).

Impact of COVID-19 pandemic in supervision and evaluation

Only 60% (33 of 55) felt adequately supervised during the first months of the pandemic, and 58% (32 of 55) did not perceive evaluations in their performance by that time. Although highlighting larger academic supervision, trainees mentioned remarkable differences in the ED work, which motivated the implementation of a formal evaluation instance after the on-call week shift and a global evaluation through a semistructured individual interview. Toward the end of the year, for 45% the degree of evaluation had remained the same, and for 36% it had increased; while 59% considered having been supervised in a similar way, 32% perceived an increase in supervision.

Impact of COVID-19 pandemic on habits and relationships

Fifty nine percent were forced to abandon a sport, and 18% a medical training course. Instead, they incorporated new habits such as physical activity at home, cooking, starting a virtual medical course, foreign language classes by Zoom, yoga, or meditation and stated that several of these new activities will continue in the long term. Whereas 44% (24 of 55) of trainees spent the quarantine with their partners, 29% (16 of 55) stayed alone. On the one hand, 65% to 80% said they lost contact with colleagues or loved ones, but on the other, 40% to 46% believed their ties to others close to them strengthened. As a consequence of the pandemic, 74% had to stay away from their family, and almost a year later only 50% were able to meet with them again.

Impact of COVID-19 pandemic in mental health and emotional state

Communication was rated as sufficient in more than 90% of the cases. However, in the first survey 27% of the residents and fellows reported not having opportunities to share their concerns, a percentage that dropped to 0 in the last survey. They identified the use of WhatsApp groups and attendance at virtual meetings with the chiefs of residents, supervisors, and the chairman as the spaces where they could express themselves.

In early phases of the pandemic, when residents and fellows were asked about how they felt as healthcare professionals, 53% admitted to

being frustrated and 38% felt safe. However, toward the latest phases of the first wave, only 14% remained frustrated and 55% felt safe. On the contrary, motivation was reported by 27% of trainees (Fig 3). By November 2020, 2 trainees contracted COVID-19 disease with mild symptoms. However, 50% of the trainees had to be tested for COVID-19, and while 46% of them reported to feel indifferent, the other 45.5% were afraid of the possibility of having spread the virus to family or friends. More than half of the residents and fellows reported feeling stressed in the first 2 surveys, decreasing in the third one ($P < .05$). In the univariate analysis, having contact with COVID-19 patients ($P = .015$) or reporting problems with PPE use ($P = .012$) were risk factors associated with stress. In the multivariate analysis, only reporting difficulties with the use of PPE had statistical significance ($P = .09$) (Fig 3). Eighteen percent (4 of 22) of the trainees admitted requiring psychological assistance owing to the pandemic, and 68% (15 of 22) declared the need for urgent vacations.

As a final balance of the first wave, the trainees had experienced negative feelings of uncertainty, anxiety and fear, distancing from family, and awareness of the economic crisis. However, they also highlighted positive aspects such as developing introspective learning, imagination, perspective, and resilience, appreciating time at home, caring for family members, and incorporating healthier habits.

Future perspectives

Seventy-seven percent of the trainees considered their feedback was taken into account to implement changes in the contingency, and 82% would adopt the same measures implemented in each phase of the first wave to face an eventual second wave in 2021.

Delaying the end of the curricular year by 4 months impacted trainees' projects. Senior residents and fellows considered this measure to interfere with a future work project in 46% of the cases, compared with 14% of the junior residents. Fifteen percent of both groups responded that it would negatively influence future training projects.

Regarding prospects, 35% of the trainees plan to emigrate from Argentina in the coming years, considering the decision as a consequence of the pandemic in 32% of the cases and seeking better economic compensation, improving their lifestyle, or professional development. In contrast to the impossibility of carrying out personal projects and the loss of surgical training opportunities, trainees mentioned other favorable consequences of the pandemic, such as teamwork with the aim of optimizing human resources and time, making better use of digital platforms, and having more academic development, posing the challenge of maintaining them in the long term.

Measures implemented by the task force

The surveys allowed the task force to detect red flags and implement measures as well as to assess their impact. Table III summarizes the most important changes implemented according to the trainees' feedback.

Discussion

We have presented the results of 3 surveys for a dynamic evaluation of the educational situation of surgical trainees and their perceptions at different times of COVID-19 pandemic during 2020. We selected 3 main findings from the analysis with respect to surgical training, academic performance, and personal experiences.

As previously described, the pandemic has had a negative impact on the surgical training of residents and fellows.^{13–17} Our trainees reported being aware of the loss of surgical task skills in 81.8% of the cases. Although there is no substitute for hands-on learning through operative experience, surgical simulation

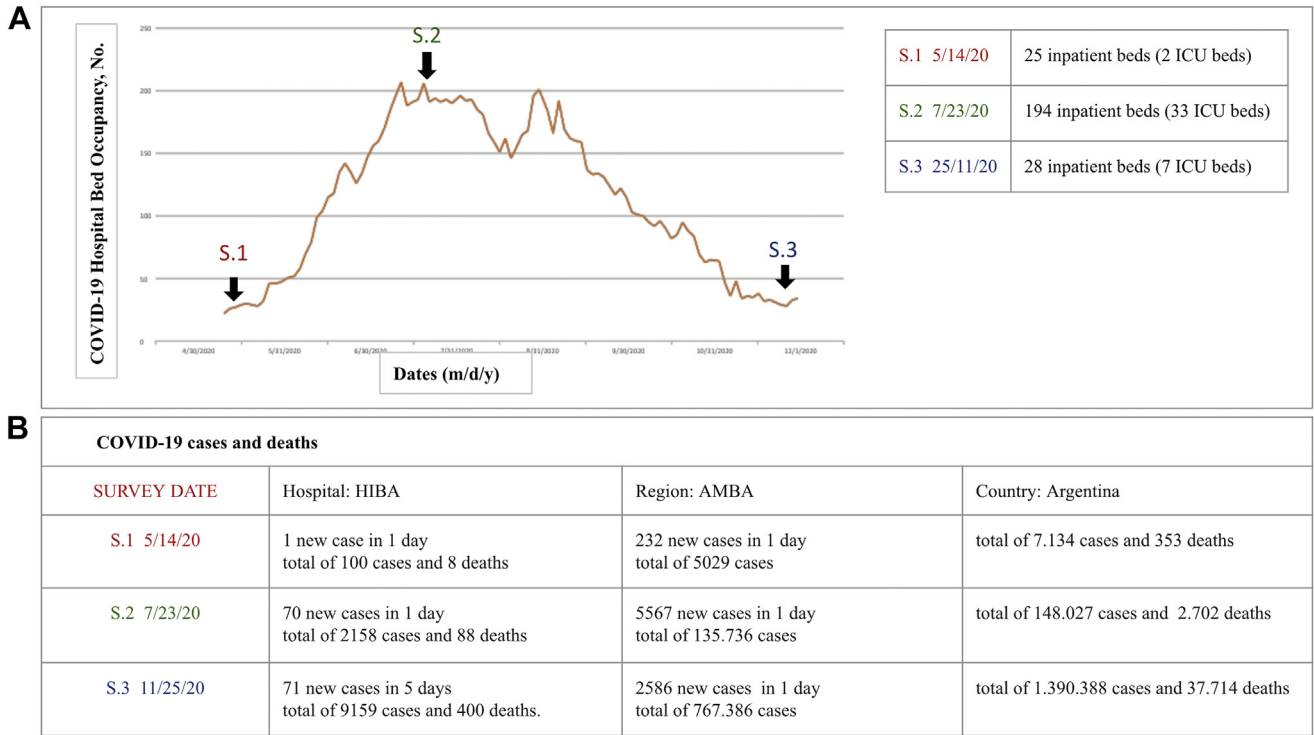


Fig 1. Hospital bed occupancy (A) and COVID-19 cases and deaths reported in the hospital, region, and country (B) at the time the 3 surveys were administered. S.1, Survey 1; S.2, Survey 2; S.3, Survey 3; HIBA, Hospital Italiano de Buenos Aires; AMBA, Region of Buenos Aires.

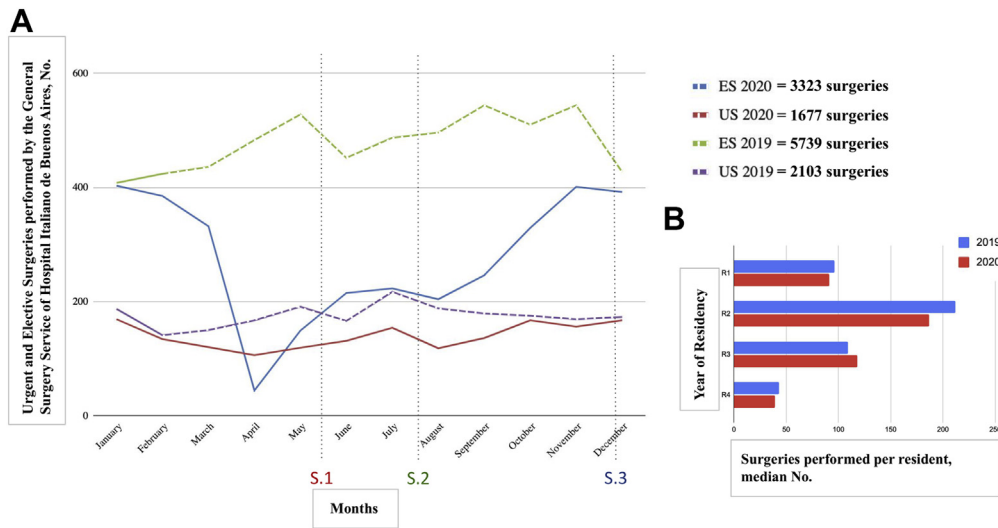


Fig 2. Surgeries performed by the General Surgery Service (A) and median number of procedures performed per resident (B) during 2019 and 2020. ES, elective surgeries; US, urgent and emergency surgeries; S.1, Survey 1; S.2, Survey 2; S.3, Survey 3; R1, first-year resident; R2, second-year resident; R3, third-year resident; R4, fourth-year resident.

strategies have been implemented to prevent decay of surgical skills.^{18–22} A contingency simulation program was established with a schedule considering the shift weeks and quarantine. Despite the postponement of the curricular year and the reduction of admission to residency and fellowships programs, the number of surgical procedures performed was reduced compared with previous years.

In many institutions, residents were reassigned to other departments to support COVID-19 efforts.^{23–25} Although elective rotations outside the hospital were cut, our trainees did not perform duties different from their usual clinical activities. The only new

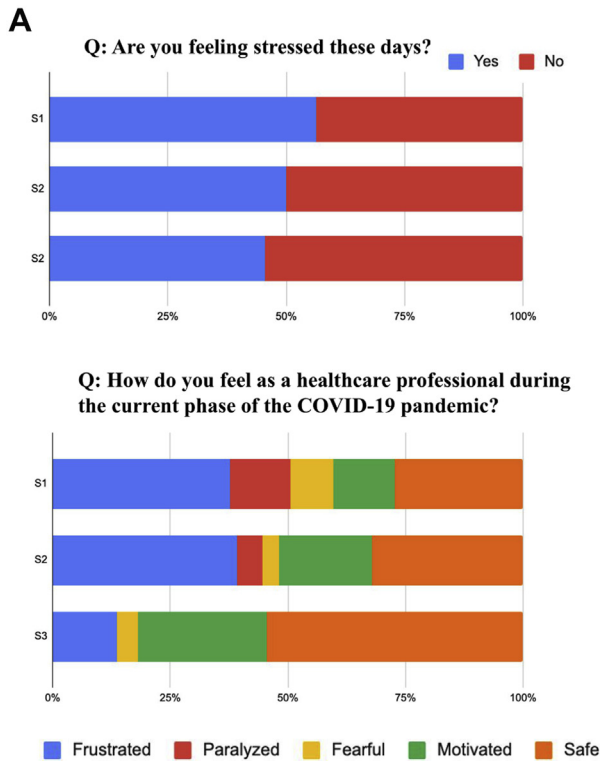
task added was to perform the COVID-19 swab test on surgical patients admitted to the ED.

Conversely, the effect on academic performance was the opposite. The mandatory quarantine allowed the rise of virtual education as an opportunity to compensate for the loss of real-time surgical learning.^{15,20,26,27} In our institution, a new schedule of virtual interactive lectures was conducted with an acceptance of more than three-quarters of the residents. They considered it very positive to have the protective time to carry out and publish research projects in which they were involved. As in other surveys,

Table II
Trainees' responses to surveys about effects of COVID-19 pandemic in surgical training and academic performance in three different times (quantitative data)

	Survey 1		Survey 2		Survey 3	
	n	%	n	%	n	%
Surgical Training						
1. Sufficient information related to updates about hospital functioning provided by the hospital.	54	98.1	45	95.7	21	95.5
2. Adequate Information related to COVID-19 provided by the hospital.	54	98.1	46	97.8	20	90.9
3. Adequate PPE acces	51	92.7	45	95.7	22	100
4. Reported problems with PPE use:	16	38	7	15,9	3	13,6
- Availability	5	31,2	1	14,2	0	0
- Indication of use	9	56,25	3	42,8	3	100
- Instructions for dressing/undressing	2	12,5	3	42,8	0	0
5. Participated in a surgical treatment performed differently than standard	20	36.6	0	0	0	0
6. In relation with surgeries performed in phase 1 of the pandemic you are currently performing			21	44,7	16	72,7
- a larger number of procedures	-	-	10	21	2	9,1
- fewer number of procedures	-	-	16	34	4	18,2
- same	-	-	16	34	4	18,2
7. Agreed with ED shifts schedule (fixed teams -12 h 7 days)	52	92,5	41	91,3	3	13,6
8. Perceived similar care provided to patients in the ED than pre-pandemic (survey 1)/in phase 1 of the pandemic (surveys 2, 3)	40	72,72	15	28,3	7	31,7
Academic Performance						
1. Increased time dedicated to academic activities	52	94,5	-	-	-	-
2. In relation to phase 1 of the pandemic, your time spent in academic activities ...						
- increased	-	-	13	27,7	2	9,1
- decreased	-	-	13	27,7	16	72,7
- continued the same	-	-	21	44,7	4	18,2
3. Hours spent in academic work per day:						
- >6 h	17	30	11	23,4	2	9,1
- 3–6 h	29	52,7	24	51,1	4	18,2
- <3 h	9	16	12	25,5	16	72,7
4. Number of research projects recently finished:						
- 0	-	-	22	46,8	4	18,1
- 1	-	-	9	19,1	9	40,9
- 2	-	-	11	23,4	6	27,2
- 3 or more	-	-	5	10,6	3	13,6

PPE, personal protective equipment; ED, emergency department.



Stress, associated factor	No Stress		Stress		P value
	n	%	n	%	
Sex, m	22	33	45	67	0.36
Age	28,1		27,2		0.10
Year of Training					0.05
Junior Resident	22	47	25	53	
Senior Resident, Chief of Residents & Fellow	23	30	54	70	
Have been isolated due to suspicion or confirmation of COVID-19 positive	18	52	17	48	0.15
Reporting PPE related problems	9	31	20	68	0.001*
Taking care of a COVID 19 positive patient	42	40	65	60	0.04
Spending quarantine alone	15	39	24	61	0.88

*Statistically significant in multivariate analysis (p<0.01)

Fig 3. Emotional state of trainees at 3 different times of the pandemic (A) and factors associated with stress (B). Q, question; S1, Survey 1; S2, Survey 2; S3, Survey 3. PPE, personal protective equipment.

Table III

Main measures implemented in different phases of the COVID-19 pandemic according to trainees' feedback from the 3 surveys

	Initial Measures	Survey 1	New Measures/Changes	Survey 2	New Measures/Changes	Survey 3
Hospital and GSS functioning (trainees' surgical activities)	- only urgent surgeries -non-urgent consults by telemedicine -COVID-19 triage, exclusive areas -residents only for ED work	81% were concerned about losing surgical skills	- only urgent & oncological surgeries -approval for trainees to operate on polymerase chain reaction-negative patients (routine preop COVID-19 test) -surgical simulation contingency program -postponement of ending of curricular year	-	-urgent & non-urgent surgeries -regular face-to-face consults - regular rotations in subspecialties -reduction in the number of physicians admitted to Residency and Fellowship programs.	72.7% participated in a greater number of surgeries than at the beginning of the pandemic. 45.5% had not recovered the usual rhythm of work 31.8% perceived working less and 22.7% more than pre-pandemic times.
ED work	- ED activities organized by fixed teams per week with 12-hour shifts and quarantine	>90% of residents agreed with schedule 70% perceived similar quality of care in the ED than usual <u>positive</u> : better communication between teams	-	90% of residents agreed with schedule <u>positive</u> : consolidation of covid protocols <u>negative</u> : delay in admission and surgery owing to COVID-19 test.	ED activities organized by fixed teams per week with 12-hour shifts (no quarantine)	13.6% considered appropriate to continue with the same schedule after the pandemic
PPE	- PPE online lessons - online data repository	90% considered the availability of PPE sufficient and 98.1% rated Instructions as adequate. 38% of those who wore PPE reported problems with availability, indication, or instructions.	- PPE hands-on activities - simulation of surgical circuit of a COVID-19 patient.	-	-	13.6% of those who had to use EPP presented problems with indication
Academic performance	- weekly virtual research meetings - new virtual classes schedule	75% considered the virtual classes schedule very useful	-regular schedule of M & M meetings and academic activities virtually	-	-	residents rated virtual classes schedule with 8.6 (1–10)
Supervision	-	60% felt supervised considerably 58.1% did not feel evaluated	-supervision of surgical simulation activities - a formal evaluation after the ED week shift	-	- global evaluation through an semi-structured individual interview with Staff surgeons	31.8% perceived an increase in supervision and 36% in evaluation over the months
Support	- Whatsapp groups and virtual meetings with supervisors and chairman. - Ongoing mentorship program (randomized)	27.8% considered not having spaces to express their concerns	-weekly virtual meetings with supervisors -visibility of a support program carried out by Psychopedagogy	50% had no relationship with assigned mentor	- opportunity for residents to choose a new mentor.	0% considered not having spaces to express their concerns

GSS, general surgery service; ED, emergency department; PPE, personal protective equipment; M and M, morbidity and mortality.

participants mentioned their interest in continuing the recently adopted virtual activities after the pandemic.^{26,28}

Not only with regard to surgical training, residents and fellows also reported negative effects of the COVID-19 pandemic on personal experiences and mental health.^{29–33} A national survey from the United States mentioned that three-quarters of surgeons who began their professional careers mentioned inadequate access to PPE, and also a large number of them reported an increase in symptoms of depression and burnout, pointing as risk factors being a woman, caring for known positive patients for COVID-19, or having inadequate access to PPE.³⁴ In our surveys, more than half of residents and fellows reported feeling stressed in the first 2 surveys, and 18% admitted to needing psychological assistance owing to the pandemic. While our trainees mentioned sufficient availability of PPE in more than 90% of the cases, problems related to indication of PPE level or dressing instructions were reported. These PPE-related problems were the only risk factor associated with stress, highlighting the importance of providing adequate training and protocols for use of PPE.

Finally, it is necessary to remark on the relevant role of a teamwork dedicated to guaranteeing continuous surgical education, prioritizing the health and well-being of trainees in an unprecedented situation such as the COVID-19 pandemic. In our experience, the creation of a multidisciplinary task force led by the residency authorities such as the chairman and coordinators was critical as well as having the voluntary participation of junior staff surgeons who fulfilled specific tasks and schedules. It was valuable to have the point of view of specialists from other areas such as education and sociology, which improved the implementation of measures regarding trainees' wellness. Although mental health specialists were not included, the task force worked in an articulated way with a support program carried out by the university's psychopedagogy department. In the future, it would be interesting to have mental health specialists within the working group.

During the different phases, new dynamic organizational models were implemented in clinical and surgical practice. Also anonymous online surveys and their analysis were an essential tool in the contingency that helped detect red flags and develop innovative educational strategies to overcome the loss of surgical

opportunities and respond to the impact on the personal experience of trainees. As a result, part of the negative consequences of the pandemic was reduced toward the later phases. Difficulties regarding the use of PPE decreased from 40% to 13.6%. The lack of adequate spaces where trainees could address their concerns reported as 27.8% at the beginning was reduced to 0, and residents also reported an improvement in supervision and evaluation at the end of the year. In addition, 81.8% of them would adopt the same measures to face an eventual second wave next winter.

The limitations of this study include a small sample size in relation to the number of residents and fellows in a single university hospital, and owing to the end of the curricular year in September, those who finished their program in the GSS did not participate in the third survey ($n = 22$). Furthermore, personal experiences may be influenced by external factors unrelated to training activities that were not analyzed in the study. However, to the best of our knowledge, this is the only study that reports 3 assessments at different moments of the pandemic used as a continuous improvement tool.

In conclusion, we have demonstrated the successful implementation of a contingency plan that took into account the perceptions of surgical trainees at 3 different times of the COVID-19 pandemic during 2020, allowing dynamic interventions and monitoring their response. The negative impact on surgical training was partially offset by the optimal use of technology for virtual learning and simulation. Trainees were emotionally affected, and half of them reported feeling stressed, identifying problems in the use of PPE as a predisposing factor. Increasing training on PPE use with proper instructions and ensuring spaces where trainees can express themselves are mandatory to preserve their well-being while facing a pandemic without a clear end point.

Funding/Support

None of the authors of this article has any direct or indirect commercial financial incentive associated with the publication of this article. The funding involved in this work has been provided by our institution.

Conflict of interest/Disclosure

The authors have no related conflicts of interest to declare.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.surg.2021.08.018>.

References

- Logunov DY, Dolzhikova IV, Shcheblyakov DV, et al. Safety and efficacy of an rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine: an interim analysis of a randomised controlled phase 3 trial in Russia. *Lancet*. 2021;397:671–681.
- Johns Hopkins Coronavirus Resource Center. COVID-19 map. <https://coronavirus.jhu.edu/map.html>. Accessed March 1, 2021.
- Kang L, Li Y, Hu S, et al. The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. *Lancet Psychiatry*. 2020;7:e14.
- Mira JJ, Carrillo I, Guilabert M, et al. Acute stress of the healthcare workforce during the COVID-19 pandemic evolution: a cross-sectional study in Spain. *BMJ Open*. 2020;10: e042555.
- Dong ZQ, Ma J, Hao YN, et al. The social psychological impact of the COVID-19 pandemic on medical staff in China: a cross-sectional study. *Eur Psychiatry*. 2020;63:e65.
- Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. *JAMA Netw Open*. 2020;3: e203976.
- Mastroianni G, Cano Busnelli VM, de Santibañes M, et al. Changing our training paradigms in general surgery residency during the COVID-19 outbreak. *Ann Med Surg (Lond)*. 2020;59:10–13.
- Potts III JR. Residency and fellowship program accreditation: effects of the novel coronavirus (COVID-19) pandemic. *J Am Coll Surg*. 2020;230:1094–1097.
- Osama M, Zaheer F, Saeed H, et al. Impact of COVID-19 on surgical residency programs in Pakistan: a residents' perspective. Do programs need formal restructuring to adjust with the "new normal"? A cross-sectional survey study. *Int J Surg*. 2020;79:252–256.
- Nassar AH, Zern NK, McIntyre LK, et al. Emergency restructuring of a general surgery residency program during the coronavirus disease 2019 pandemic: the University of Washington experience. *JAMA Surg*. 2020;155:624–627.
- Tolu LB, Feyissa GT, Ezeh A, Gudu W. Managing resident workforce and residency training during COVID-19 pandemic: scoping review of adaptive approaches. *Adv Med Educ Pract*. 2020;11:527–535.
- Boletín Oficial del Gobierno de la Ciudad de Buenos Aires. <https://boletinoficial.buenosaires.gov.ar/normativabani/norma/513266>. Accessed March 1, 2021.
- Collins C, Mahuron K, Bongiovanni T, Lancaster E, Sosa JA, Wick E. Stress and the surgical resident in the COVID-19 pandemic. *J Surg Educ*. 2021;78:422–430.
- Fero KE, Weinberger JM, Lerman S, Bergman J. Perceived impact of urologic surgery training program modifications due to COVID-19 in the United States. *Urology*. 2020;143:62–67.
- Caruana EJ, Patel A, Kendall S, Rathinam S. Impact of coronavirus 2019 (COVID-19) on training and well-being in subspecialty surgery: a national survey of cardiothoracic trainees in the United Kingdom. *J Thorac Cardiovasc Surg*. 2020;160:980–987.
- Johnson J, Chung MT, Stathakios J, Gonik N, Siegel B. The impact of the COVID-19 pandemic on fellowship training: a national survey of pediatric otolaryngology fellowship directors. *Int J Pediatr Otorhinolaryngol*. 2020;136:110217.
- Amparore D, Claps F, Cacciamani GE, et al. Impact of the COVID-19 pandemic on urology residency training in Italy. *Minerva Urol Nefrol*. 2020;72:505–509.
- Hintz GC, Duncan KC, Mackay EM, Scott TM, Karimuddin AA. Surgical training in the midst of a pandemic: a distributed general surgery residency program's response to COVID-19. *Can J Surg*. 2020;63:E346–E348.
- Okland TS, Pepper JP, Valdez TA. How do we teach surgical residents in the COVID-19 era? *J Surg Educ*. 2020;77:1005–1007.
- Chick RC, Clifton GT, Peace KM, et al. Using technology to maintain the education of residents during the COVID-19 pandemic. *J Surg Educ*. 2020;77:729–732.
- Pérez-Escamirosa F, Medina-Alvarez D, Ruíz-Vereo EA, Ordorica-Flores RM, Minor-Martínez A, Tapia-Jurado J. Immersive virtual operating room simulation for surgical resident education during COVID-19. *Surg Innov*. 2020;27:549–550.
- Shah AP, Falconer R, Watson AJM, Walker KG. Teaching surgical residents in the COVID-19 era: the value of a simulation strategy. *J Surg Educ*. 2020. S1931-7204(20)30343-3.
- Breazzano MP, Shen J, Abdelhakim AH, et al. Resident physician exposure to novel coronavirus (2019-nCoV, SARS-CoV-2) within New York City during exponential phase of COVID-19 pandemic: report of the New York City residency program directors COVID-19 research group. *medRxiv*. 2020. 2020.04.23.20074310.
- Ellison EC, Spanknebel K, Stain SC, et al. Impact of the COVID-19 pandemic on surgical training and learner well-being: report of a survey of general surgery and other surgical specialty educators. *J Am Coll Surg*. 2020;231:613–626.
- Wady H, Restle D, Park J, Pryor A, Talamini M, Abdel-Misih S. The role of surgeons during the COVID-19 pandemic: impact on training and lessons learned from a surgical resident's perspective. *Surg Endosc*. 2020;1–7.
- Juprasert JM, Gray KD, Moore MD, et al. Restructuring of a general surgery residency program in an epicenter of the coronavirus disease 2019 pandemic. *JAMA Surgery*. 2020;155:870–875.
- Kanneganti A, Sia CH, Ashokka B, Ooi SBS. Continuing medical education during a pandemic: an academic institution's experience. *Postgrad Med J*. 2020;96:384–386.
- Figueroa F, Figueroa D, Calvo-Mena R, Narvaez F, Medina N, Prieto J. Orthopedic surgery residents' perception of online education in their programs during the COVID-19 pandemic: should it be maintained after the crisis? *Acta Orthop*. 2020;91:543–546.
- Civantos AM, Byrnes Y, Chang C, et al. Mental health among otolaryngology resident and attending physicians during the COVID-19 pandemic: national study. *Head Neck*. 2020;42:1597–1609.
- Khusid JA, Weinstein CS, Becerra AZ, et al. Well-being and education of urology residents during the COVID-19 pandemic: results of an American National Survey. *Int J Clin Pract*. 2020;74:e13559.
- Chew QH, Chia FLA, Ng WK, et al. Perceived stress, stigma, traumatic stress levels and coping responses amongst residents in training across multiple specialties during COVID-19 pandemic: a longitudinal study. *Int J Environ Res Public Health*. 2020;17:6572.
- Lu W, Wang H, Lin Y, Li L. Psychological status of medical workforce during the COVID-19 pandemic: a cross-sectional study. *Psychiatry Res*. 2020;288:112936.
- Mishra D, Nair AG, Gandhi RA, et al. The impact of COVID-19 related lockdown on ophthalmology training programs in India: outcomes of a survey. *Indian J Ophthalmol*. 2020;68:999–1004.
- Coleman JR, Abdelsattar JM, Glocker RJ, RAS-ACS COVID-19 Task Force. COVID-19 pandemic and the lived experience of surgical residents, fellows, and early-career surgeons in the American College of Surgeons. *J Am Coll Surg*. 2021;232:119–135.e20.