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ORIGINAL RESEARCH

Analyzing the Impact of COVID-19 Pandemic on Different Educational Aspects of Surgical Specialties' Residency Program: A Preliminary Report

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Abstract: Introduction: The lifestyle and learning of trainees from different surgical specialties have been severely affected by the COVID-19 pandemic. Despite the growing body of research, the extent to which their surgical or educational performance is affected is not yet well-understood. We investigated the Iranian multi-specialty surgical residents nationwide to clarify the extent this new pandemic's has affected their surgical and educational activities. Material and Methods: Our specialized board designed a questionnaire which was sent to residents from the 18th of May to 12th of Jun 2020. The questionnaire comprised demographic data, questions on the clinical, surgical, and educational activities during and before the pandemic. Results: Out of 700 eligible residents, 543 (77%) submitted their answers to all questions. 417 (76.8%) of the respondents declared they had spent their residency program at a hospital that was the main referral center for patients with COVID-19 infection. The weekly number of the outpatient and emergent visits decreased by one third (P<0.001) and one-half (P<0.001), respectively, following the pandemic. Also, the amount of surgeries has dramatically decreased (P<0.001). The median weekly hours devoted to face-to-face activities decreased, while the study time increased and the share of virtual education has a five-fold increase (P<0.001). Conclusion: This pandemic had a significant impact on many aspects of training in surgical specialties' residency program in Iran. Increasing the time available to study is an opportunity, and online education, despite its challenges, has been effective.

Keywords: COVID-19; Education; Iran; Internship and Residency; Surgical specialties; Teaching

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1. Introduction

The COVID-19 pandemic, manifested as Severe Acute Respiratory Syndrome Coronavirus 2, has had profound effects on people's lives and has imposed threats to our health and way of life, worldwide (1, 2). Iran is one of the most affected countries in the world where the pandemic broke out on the 18th of February 2020, initially with the identification of six definite COVID-19 cases. Currently, it has risen to 395,488 confirmed cases and 22,798 confirmed deaths reported to the World Health Organization (WHO) until 10th of September 2020 (3). The multidimensional burden of this new pandemic has engulfed a variety of occupations and activities, including surgical procedures. In Iran, like the rest of the world, medical practitioners and health care providers are uncertain about the best ways of dealing with this uncontrollable situation. One of the groups whose lifestyle and learning has been severely affected by this unprecedented situation is trainees from different surgical specialties. Most patients in need of surgery are withholding their operations since the lockdown, social distancing has significantly reduced trauma, and some patients have postponed their semi-urgent surgeries in fear of developing COVID-19. On the other hand, elective surgeries are canceled due to the instructions issued by the Ministry of Health (4-6). Intensive care units with beds that were previously available for major surgical patients are now serving COVID-19 patients. Furthermore, along with residents' stress about infecting themselves and their families, some training hospitals have been completely dedicated to the care of patients with COVID-19 infection and residents are completely transferred from the operation rooms to work in the COVID-19 section. On the other hand, many surgical residents are not fully trained to use personal protective equipment (PPE) and the use of PPE causes dehydration and excessive fatigue. It all eventually leads to a reduction in surgical residents' efficiency (7-9). In addition, surgical specialties' residency program has undergone changes in a response to the current situation, so that the world has turned to changing the curriculum through online training, webinars, and virtual educational courses (10, 11). Although there is a growing body of research on the impact of COVID-19 pandemic on various facets of training in surgical specialties' residency program (7-13), the extent to which surgical or educational performance has declined is not yet well-understood, especially in Iran. Thus, to propose some solutions to maintain the quality of training and education in various specialties of surgical residency during this critical global situation, for the first time, we investigated the impact of this pandemic on Iranian multi-specialty surgical residents nationwide to clarify the extent it has affected their surgical and educational activities.

2. Materials and Methods

In this cross-sectional study, ten members of Iranian specialized board committee in various surgical specialties designed a 24-item open questionnaire using PorsOnline web application (Appendix). All members' opinions were put into the application by two elected representatives. The questionnaire was approved by the entire committee, and was completed as a pilot survey on urology residents. The validity and reliability of the questionnaire in the pilot study were confirmed by this board. This questionnaire was used to assess the impact of COVID-19 pandemic on different educational aspects of surgical specialties' residency program, and was justified for all participants. Residents' participation in the survey was entirely anonymous and voluntary. Moreover, informed consent was initially obtained from all participants. This study was approved by the Medical Research Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.REC.1399.004). As shown in the appendix, the questionnaire comprised an introduction section followed by demographic information. Then, open-ended questions about the weekly numbers of outpatient and emergent (what do you mean? Do you mean emergency?) patient visits as well as elective (minor and major) and emergent surgeries during and before the pandemic. The rest of the questions covered weekly hours of physical presence in the hospital and on call activities, i.e. on call duties, morning report sessions, studying and virtual education. The questionnaire was sent to the residents via Email and/or WhatsApp from 18th of May to 12th of Jun 2020. Residents of surgical disciplines including obstetrics and gynecology, orthopedics, urology, general and neurosurgery, in all residency years were eligible to enter our study analysis. Given that we now have about 2280 active residents in the mentioned fields throughout Iranian medical academic centers, the purpose of our sample was to reach approximately 30% of this community (n=700). The questionnaires were collected, and then analyzed using SPSS software, version 22.0 (Statistical Package for the Social Sciences, IBM Corp., Armonk, New York, USA). Demographic data were reported based on their frequency (N) and percentages (%). Kolmogorov-Simonov and Shapiro-Wilk tests were applied to examine the quantitative data distribution normality. Furthermore, histogram charts were used to observe and evaluate the degree of skewness and kurtosis. Given that the data distribution was not normal, they were reported by median (Q1-Q3), where Q1 and Q3 were the first and third quartiles, respectively. The Wilcoxon signed-rank test was used to compare the studied parameters in the pre-COVID-19 usual conditions with those during the pandemic. P-values lower than 0.05 were considered significant.

3. Results

Out of 700 eligible residents to whom the questionnaires were sent, 543 respondents submitted answers to all questions and completed our study analysis. Therefore, the response rate in the present study was 77%.

3.1. Background characteristics of the respondents

As Table 1 shows, the respondents were from 15 different cities across Iran, most of whom were from the capital (49.2%). The responding residents in the present study were mostly junior and mid- level residents, while only 21.6 % were senior residents (4th and 5th year). Most of the specialties were obstetrics and gynecology (34.8%) and general surgery (30.9%). About 77% of the respondents declared they had spent their residency program at a hospital that was the main referral center for COVID-19 patients.

3.2. Amount of patient visits and surgical cases

As seen in Figure 1, and based on the residents' responses, the number of outpatient visits per week at the clinic decreased by one third following the pandemic compared to before COVID-19. This value was one-half for the number of emergency patient visits. Furthermore, the elective and emergent surgeries (both minor and major) were dramatically affected by this pandemic. All differences in the weekly number announced by residents were statistically significant (Table 2). On the other hand, according to the residents' estimates approximately 4 (range: 2-6) patients per week who underwent surgery suffered from COVID-19 with a positive polymerase chain reaction test result.

3.3. Effects on residents' educational activities

The median weekly attendance of residents at the medical centers before COVID-19 was 90 (range: 60-120) hours, with about 6 (range: 4-8) hours per week devoted to morning report sessions. While the median of on call activities was 60 (range: 36-93) hours weekly. These values significantly decreased during the COVID-19 pandemic (Table 3). The median weekly hours of study was 10 (range: 4-15) hours, and 1 (range: 0-5) hour for online study consisting of video conferences, didactic-PowerPoint, webinar, etc., significantly increased during the COVID-19 pandemic (Table 3, Figure 2).

4. Discussion

To the best of our knowledge, this was the first questionnaire-based study to evaluate the effect of COVID-19 pandemic on different educational aspects of surgical specialties' residency program in Iran. According to the results of our work, the current pandemic had profound effects on surgical specialties' residency program, so that the median weekly number of outpatient visits and even the emergent visits decreased significantly. This was also true for both elective and emergent surgeries. Furthermore, face-to-face training activities significantly declined, and instead online study activities included in the surgical specialties' residency program increased dramatically. The present study shown about 77% hospitals across the country were as the main centers for patients with COVID-19. Hospitals have been identified as the main site of COVID-19 transmission, with about 45% of hospital-originated cases reported (14, 15). Therefore, all health care providers, patients, and people who deal with an/or work at hospitals are at high risk. Among them, one of the most affected groups that could be under tremendous pressure in terms of health, academic, and professional life, are trainees from different surgical specialties (16). Postoperative condition, as a risk factor similar to elderly, cardiopulmonary disease, diabetes, and obesity, is considered to be a determining factor in increasing the COVID-19 mortality rate (17). This, along with policies to prevent virus transmission, and to relocate the focus of health care system on patients with COVID-19, is a good explanation for the decrease in the amount of surgical cases during this pandemic. In addition to elective surgeries, our study also showed a significant reduction in emergent surgeries. Emergent surgeries, beside most urgent cases, should have remained unchanged during COVID-19 outbreak (18). However, social distancing, lockdown, and staying at home in turn can reduce the occurrence of many traumas, or traffic accidents. Moreover, the fear of hospital-transmitted COVID-19 can be a clear reason for the decline in this category of surgeries. The increase in home deaths under such a terrible situation is a justification for this claim (19). Most previous studies aimed at investigating the effect of COVID-19 pandemic on operative educational experience and clinical activities in various surgical specialties showed a significant reduction in the surgical cases volume and dramatic changes in residency training programs in all parts of the world (7-13). However, Ghermandi and colleagues (20) reported an increase in oncology and degenerative surgery procedures in their spinal surgery department over the same period last year. Altogether, even elective surgeries cannot be postponed for a long time, and nowadays in many medical centers, complete cancellation of surgical procedures is a serious challenge because some procedures are really non-deferrable. It is important that operations are not canceled solely because of COVID-19, and that the surgical team make the best decision under these conditions, given the risk of malignancy and disease progression, vascular disease, and organ failure (14, 21). It is necessary to equip the health care team with PPE. Patients should also use surgical masks and gloves. Furthermore, social distancing should be considered so that physical presence in clinics, and clinic appointments are reduced, and the visiting room

is limited to two to three patients. Moreover, there is strict advice to stay home as long as possible (19, 20). Diokno and co-workers (19) examined the effect of COVID-19 pandemic on urologic practice in different parts of the United States and found that during COVID-19 the outpatient visits in the office reduced by 40-80% compared to before. Also, Hartnett and colleagues (22) investigated the effect of this pandemic on the activities of the emergency departments in the United States. They stated that during the 4 weeks since the outbreak of the pandemic, emergency department visits decreased significantly compared to the same period last year, while emergency visits with symptoms attributed to COVID-19 increased significantly. Thus, the explanation related to our findings about the decrease in the weekly number of outpatient and emergency visits is very clear. Findings from the study of Collins and co-workers (13), like those from our study, showed a significant decrease in the average weekly working hours of surgical residents following pandemic. In addition to what has been said so far, that the main reasons is the severe infectious nature of this contagious disease, it is worth noting that in our study one possible reason for the finding related to reduced working hours and physical presence of surgical residents in the hospitals can be attributed to the fact that most of our sample size consisted of junior and mid-level surgical residents (78.4%). This group of residents are less prepared to take care of themselves than senior residents (8), and still having ample opportunity to gain experience and to reach the number of cases they need to graduate (13). Therefore, obviously it can be a reason that they have more indications for staying at home than senior residents. Furthermore, as a direct result following the reduction in the surgical cases volume, morning reporting sessions also decreased among our study population. These huge and abrupt reductions in training and work-load of surgical residents greatly impaired the preparation of trainees and mentors' educational goals. Hence, there is a necessity for the fundamental guidance and changes in surgical specialties' residency program. Growing evidence shows that these destructive changes in the educational body of residency can be circumvented by shifting to virtual education and participating in webinars, lectures, teleconferencing, and training sessions with the direct presence of the trainees and mentor via the online platforms on mobile phones, tablets, and laptops. Technology and telemedicine inevitably push surgical training to innovation, under this unprecedented pandemic and maybe even later (8, 10, 11, 19). Similarly, in Iran, because of the instructions issued by the Ministry of Health and the Ministry of Communications, functional planning was set in response to the COVID-19 outbreak, which shifts the medical education to virtual learning and facilitated transmission of videos, audios and information with HD quality on online platforms (23). The present study, consistent with previous literature (8, 10, 11, 19), indicated the virtual learning promotion in surgical residency training programs; and COVID-19 pandemic was considered as an opportunity to our residents to increase their study time and update their information. However, virtual education has several disadvantages. For example, Figueroa and colleagues (10) in a survey of orthopedic surgery residents asked them about the pros and cons of online education; residents rated webinars and online presentations as excellent, while they believed that online tests and exams, and video counseling with patients could not be considered as a permanent method, and most opposed it. Other reported pitfalls included connection problems, the lack of sufficient environment in the resident's home, distraction factors, and a high volume of online activities at the same time. They believed that after the pandemic, face-to-face practical learning activities should have more priority and that all training should not be just online. Moreover, albeit exhibition of the surgical procedures based on videos in cyberspace can hopefully minimize the pandemic effect on surgical specialties' residency program (8), but it is a fact that we face challenges, except in knowledge and non-technical skills, in manual practices which are vital to gain experience and achieved the competency to be defined as a surgeon (11, 12). Some studies have stated, changes resulted from COVID-19 can place a heavier burden on junior residents as they are penalized due to loss of more elective surgery cases and related experiences (7). While, Collins and co-workers (13) argued that senior residents are more likely to be harmed because they need to have a quorum of the cases number and to solidify their surgical experience in order to get to the next stage of their career, junior residents still have time to it. This topic is novel, so it takes a long time to examine these controversies. There is a need for further studies, especially to evaluate the types of virtual education and its effects on residents, the impact of the pandemic on different years of residency education and in various specialties, and all of the mentioned effects in the long-term. Also, it seems that to compensate educational deficiencies caused by this unprecedented pandemic, non-COVID operation rooms, and surgical wards, virtual training rounds, skill lab training, standardized patient and simulated clinical environment, training skills videos , virtual and actual reality, clinical interpretation sessions, journal club presentation and virtual case reports, using the related educational applications such as surgical complication applications, drug interactions, and SQL server integration services, application of integrated assessments (educational, research and managerial) such as emergency trolley assessments, patient safety assessment, especially drug safety in the ward, critique and evaluation of medical records , biosafety assessment in the laboratory, assessing hospital environmental hygiene, etc., could be set up. The efficacy of these mentioned solutions should be assessed

in future studies. The present study had some limitations; the data came from trainees within different years of residency and in different specialties, which can affect the results. Our study was a cross-sectional study conducted in Iran, so the findings cannot be generalized to other countries. On the other hand, our sample size was small. Furthermore, we had limited time, and we could not gauge the effect for a long time.

5. Conclusion

The present study showed how the unprecedented COVID-19 pandemic was able to significantly suspended the multi facets of training in surgical specialties' residency program, including elective surgeries (minor and major), emergent surgeries, outpatient and emergency department-based activities, and spending time on physical presence and activities in hospitals. Increasing the available time to further study is an opportunity created following this difficult situation. Moreover, to maintain the training and educational integrity in the residency programs, virtual education modifies the defects created following the pandemic situation. Although it is not possible to completely fill the skills and functional gaps of surgeons in this way, and given that it is not clear when this pandemic will end, the education and health care system should prioritize the education of trainees from different surgical specialties along with maintaining maximum compatibility with the existing critical status.

6. Appendix

Questionnaire about the impact of COVID-19 pandemic on different educational aspects of surgical specialties' residency program.

As a polyspecialistic board of surgeons, we invite you to complete the present survey. The purpose of this survey is to investigate the impact of the COVID-19 pandemic on different educational aspects of surgical specialties' residency program in order to better manage current and future conditions. We plan to share the data with our colleagues around the world to keep them informed of current viewpoints and practical patterns. This questionnaire will be very useful.

We sincerely thank you for your cooperation.

Demographics

1. University: ..... Hospital: ..... Specialty: .....

2. What is your residency year?

◦ 1st year

◦ 2nd year

◦ 3rd year

◦ 4th year

◦ 5th year

3. Was your hospital of employment a Corona center?

◦ Yes

◦ No

Patient visits and surgical cases volume

4. Usual number of patients seen per week by the outpatient setting: .....

5. The number of patients seen per week by the outpatient setting in COVID-19 era: .....

6. Usual number of patients seen per week by the emergent setting: .....

7. The number of patients seen per week by the emergent setting in COVID-19 era: .....

8. Usual number of minor elective surgeries done per week: .....

9. The number of minor elective surgeries done per week in COVID-19 era: .....

10. Usual number of major elective surgeries done per week: .....

11. The number of major elective surgeries done per week in COVID-19 era: .....

12. Usual number of emergent surgeries done per week: .....

13. The number of emergent surgeries done per week in COVID-19 era: .....

14. How many patients who underwent surgical procedures suffered from COVID-19?.....

Residents' educational activities

15. How many hours per week were you usually presence in the hospital? .....

16. How many hours per week were you presence in the hospital in COVID-19 era? .....

17. How many hours per week were you usually have standby activity? .....

18. How many hours per week were you have standby activity in COVID-19 era? .....

19. How many hours per week were you usually have morning report sessions? .....

20. How many hours per week were you have morning report sessions in COVID-19 era? .....

21. How many hours per week did you usually study? .....

22. How many hours per week did you study in COVID-19 era? .....

23. How many hours per week were you usually take advantage of virtual education? .....

24. How many hours per week were you take advantage of virtual education in COVID-19 era? .....

6.1. Acknowledgment

Institutional ethics approval/exemption statement

This study was registered in and approved by Iran National Committee for Ethics in Biomedical Research (IR. SBMU .REC.1399.004).

6.2. Conflict of interest

No conflict of interest.

6.3. Funding support

None.

6.4. Author's contributions

All the authors have the same contribution.

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Table 1: Background characteristics of responders.

Variables	N=543
Region of deployed	
Tehran	267(49.2)
Gilan	18(3.3)
Tabriz	30(5.5)
Mazandaran	12(2.2)
Ahvaz	6(1.1)
Kashan	48(8.8)
Kermanshah	30(5.5)
Arak	9(1.7)
Orumiyeh	9(1.7)
Ardebil	21(3.9)
Shiraz	24(4.4)
Gorgan	30(5.5)
Isfahan	24(4.4)
Hamedan	9(1.7)
Kerman	6(1.1)
Specialty	
Obstetrics and gynaecology	189(34.8)
Orthopaedics	60(11)
Urology	60(11)
General surgery	168(30.9)
Neurosurgery	66(12.2)
Year of residency	
1st year	90(16.6)
2nd year	156(28.7)
3rd year	180(33.1)
4th year	96(17.7)
5th year	21(3.9)
Corona center hospital	
Yes	417(76.8)
No	126(23.2)

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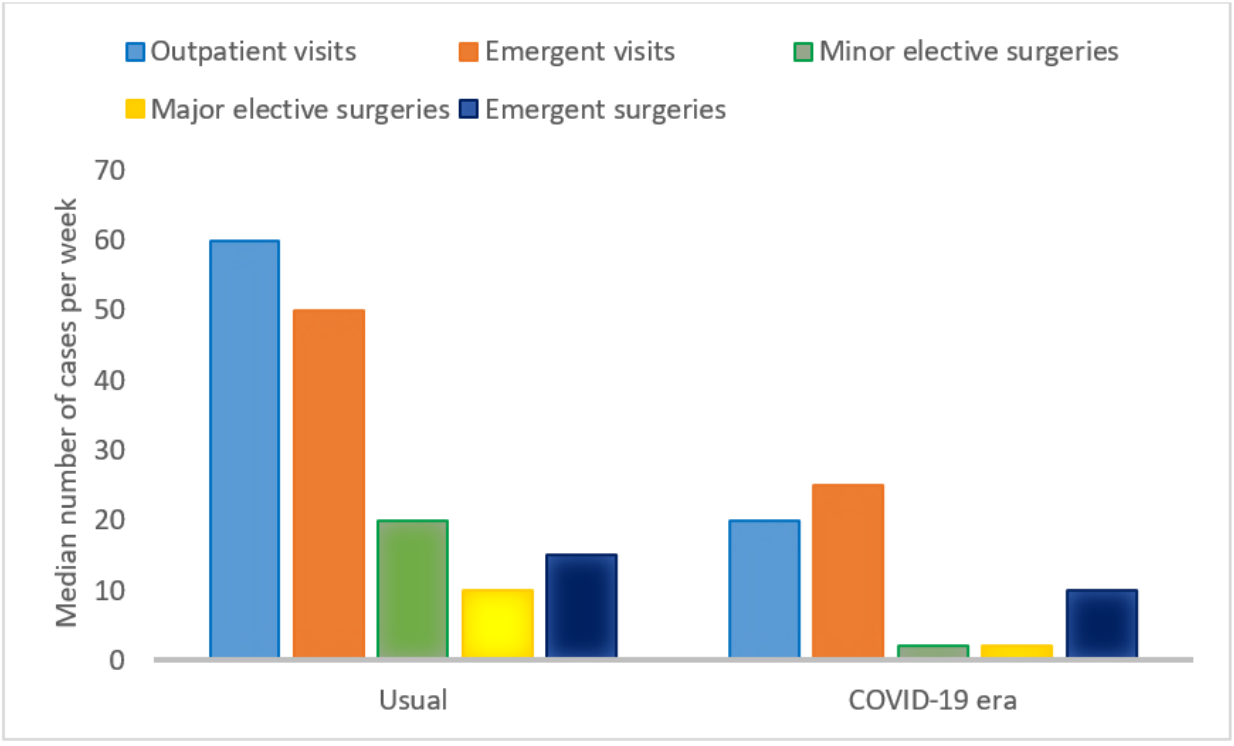

Figure 1: Changes in patient visits and surgical cases volume in COVID-19 era vs. usual circumstances.

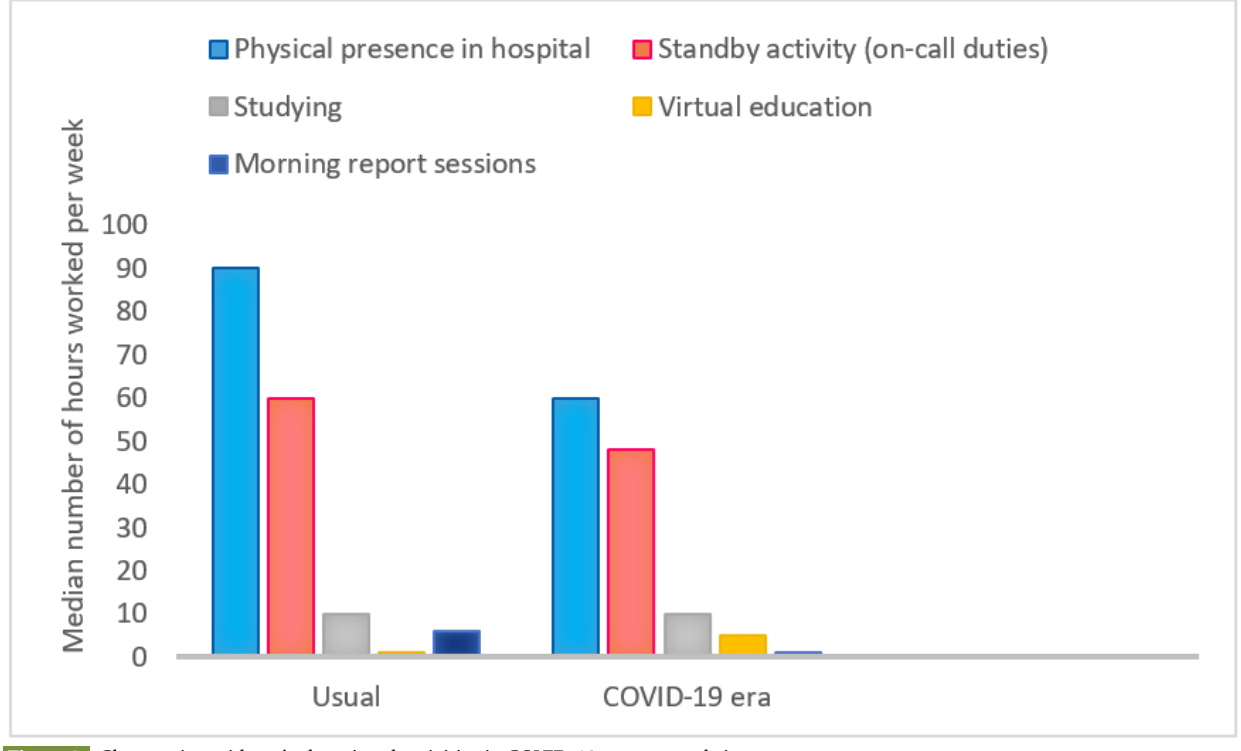

Figure 2: Changes in residents' educational activities in COVID-19 era vs. usual circumstances.

Table 2: Effect of COVID-19 pandemic on patient visits and surgical cases volume.

Activities (Numbers per Week)	Usual	COVID-19 era	p-value*
Outpatient visits	60(40-100)	20(5-50)	< 0.001
Emergent visits	50(20-100)	25(10-65)	< 0.001
Minor elective surgeries	20(14-30)	2(0-10)	< 0.001
Major elective surgeries	10(5-20)	2(0-5)	< 0.001
Emergent surgeries	15(10-30)	10(5-20)	< 0.001

*Data reported based on median (Q1-Q3).
* The results of Wilcoxon Signed Ranks Test.

Table 3: Effect of COVID-19 pandemic on residents' educational activities.

Activities (Hours per Week)	Usual	COVID-19 era	p-value*
Physical presence in hospital	90(60-120)	60(40-100)	< 0.001
Standby activity (on-call duties)	60(36-93)	48(24-72)	< 0.001
Studying	10(4-15)	10(5-20)	< 0.001
Virtual education	1(0-5)	5(1-10)	< 0.001
Morning report sessions	6(4-8)	1(0-5)	< 0.001

*Data reported based on median (Q1-Q3).
* The results of Wilcoxon Signed Ranks Test.