

The impact of COVID-19 on the activities of a hospital for research and rehabilitation of cleft lip and palate

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World Journal of Advanced Research and Reviews, 2023, 19(02), 471–480

Publication history: Received on 01 July 2023; revised on 07 August 2023; accepted on 10 August 2023

Article DOI: <https://doi.org/10.30574/wjarr.2023.19.2.1616>

Abstract

The Hospital for Research and Rehabilitation of Cleft Lip and Palate – HPRLLP-USP is the leading hospital in palatoplasty and cheiloplasty in Brazil. With the onset of the COVID-19 pandemic this scenario was challenged regarding maintaining its services while protecting patients and healthcare workers from this new disease.

The objective of this retrospective and observational study was to identify the consequences of the pandemic in the surgical and outpatient services of HPRLLP-USP. The samples were obtained from public published data of procedures in the years ranging from 2016 to 2021. The academic data on the number of articles published in this same period was also in the scope of this study.

During the pandemic, a decrease in new medical records was found, as well as medical, dental consultations, hospital admissions and surgeries. There was also a decrease in the use of complementary services as medical imaging, laboratory studies and general implants. A steady number of scientific publishing and postgraduate enrollment was found.

A better understanding of healthcare limitations and restrictions during pandemics are necessary to develop public health actions that may improve health and quality of life of the patients during healthcare threatening crisis.

Keywords: COVID-19; Surgicenters; Health Policy; Health Care Rationing; Education; Graduate

1. Introduction

The COVID-19 pandemic began in December 2019 when the first case of pneumonia of unknown origin was reported in the city of Wuhan, China. In January of the following year, China announced to the world the identification of a new coronavirus as the causative agent of this pneumonia, with the first international case being diagnosed in Thailand, followed by the confirmation of human-to-human transmission¹.

The most decisive governmental actions to contain the disease were implemented starting in January 2020 when the entire city of Wuhan entered a lockdown. At the same time, the World Health Organization (WHO) declared COVID-19 as a public health emergency of international concern and later, in March, as a pandemic^{1,2}. The status of global health emergency lasted until May 5, 2023, when it was declared over by WHO²⁷.

Globally, as of May 17, 2023, the WHO reported a total of 766,440,796 confirmed cases of COVID-19 and 6,932,591 deaths³. During the same period, the Brazilian Ministry of Health reported a total of 702,421 deaths from COVID-19 out of 37,553,337 confirmed cases, with a mortality rate of 334.3 per 100,000 inhabitants⁴.

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According to UNESCO, since May 2020, 186 countries or regions have closed schools in an attempt to contain COVID-19, affecting approximately 70% of students⁵. School closures occurred worldwide for approximately 8 months⁶.

From the early weeks of the pandemic, a collapse in healthcare services was observed, with a prioritization of hospital care over primary care, lack of personal protective equipment, testing resource shortages, and a lack of coordinated care, even in highly specialized services, including in developed regions such as Lombardy, Italy⁷.

This pandemic has brought severe restrictions to global healthcare, such as the suspension of surgeries and elective procedures. COVID-19 has surprised most healthcare services with new challenges, such as staffing issues, risks to patients with other pathologies, prioritization of surgeries, and the need for new training⁸. Medical residency programs have been impacted by a decrease in surgeries and patient visits, new shift scheduling strategies, and new techniques for remote teaching and procedures performed on models instead of patients⁹.

The number of surgeries canceled or postponed during the pandemic worldwide is unknown as not all countries have information systems available for third-party access. Global estimates are available through statistical models based on surveys with experts from various countries. A collaboration of researchers from 193 United Nations countries estimated that 28,404,603 surgical procedures were altered during a 12-week period at the peak of COVID-19. Proportionally, a higher cancellation rate was found for procedures related to benign conditions compared to malignant conditions. The estimated cancellation rate for procedures related to malignant conditions was lower in countries with a high Human Development Index (HDI) compared to services located in countries with a low HDI¹⁰.

One of the major challenges during the pandemic was the availability of human resources to maintain the proper functioning of hospitals and their surgical centers. In a global survey, it was demonstrated that during the first six weeks of the pandemic, the percentage of staff absences ranged from 20.5% to 24.7%, decreasing to 9.2% to 12.8% from the 7th to the 12th week, respectively. The proportion of surgeons absent due to isolation and family care was higher than absences due to COVID-19 itself¹¹.

Managing surgical centers during the early months of the pandemic was challenging and exposed the unsustainability of the current organizational system. Joint decisions based on clinical reasoning, managerial decisions, staff cooperation, and medical and administrative agility were attempted to maintain a balance between safety and surgical production. The risk of exposure and infection of patients in the perioperative period to SARS-CoV-2 during the pandemic was high. Therefore, various strategies were proposed worldwide regarding the best way to manage this contingency. In England, for example, the Barking, Havering, Redbridge University Trust (BHRUT), serving the National Health Services (NHS), divided the response to the COVID-19 pandemic into four phases^{10,12}:

- Alarm Phase (March 23, 2020, to May 15, 2020): After the national lockdown was declared, elective surgeries were completely suspended. Resources were allocated to increase the number of intensive care units (ICU) beds by 5 times, increase COVID-19 wards from 3 to 20, create and reallocate medical and nursing teams, and provide training, focusing on sustainability and avoiding a potential collapse.
- Resuscitation Phase (May 16, 2020, to June 30, 2020): As surgical patient backlog increased, surgeons were reassigned from General Practice to Surgical Centers. Partnerships were formed with private hospitals, creating what was called the "Green Pathway." The NHS referred public service patients to receive treatment in private services.
- Stabilization Phase (July 1, 2020, to August 31, 2020): With the accumulation of elective patients who were classified as non-priority, those at high risk of COVID-19 contagion, and those who chose to postpone their surgeries, the "Green Pathway" was enhanced, accommodating more clinics, endoscopy centers, imaging diagnostic centers, and cancer screening centers.
- Adaptation Phase (September 1, 2020, to September 30, 2020): To ensure that access to healthcare services remains robust in subsequent waves, a system of grouping was created. Both patients and staff were separated into groups of "untested," "positive," and "negative."

In Brazil, at the beginning of the pandemic, there was a restriction in access to hospital services accounting for a 25% decrease in hospitalizations in general¹³. Surgeries also experienced a decrease of around 34%¹⁴. The impact was not only felt in the public health system (SUS) as the National Association of Private Hospitals reported a 32% decrease in elective consultations and surgeries in 2020¹⁵. In a tertiary service specialized in high-complexity cardiac surgeries, there was a decrease in procedures between March and July 2020 by 65.8% compared to the previous year, reaching 80% in May. Hospital postoperative mortality increased from 4.3% in May 2019 to 23.4% in May 2020. The clinical condition of patients undergoing surgery also changed. In the pre-pandemic period, 66.4% were considered elective, while during the pandemic, emergencies and urgencies accounted for 65.2% of total procedures¹⁶.

Currently, the Hospital for Rehabilitation of Craniofacial Anomalies at the University of São Paulo (HPRLLP-USP) has over 79,000 registered patients in a multidisciplinary service, serving patients from Brazil and abroad. Maintaining a comprehensive and humane treatment philosophy, on average, it receives annually 900 patients with cleft lip and palate. Within the SUS, HPRLLP-USP is a reference for high-complexity surgery in patients with craniofacial deformities and currently has the highest volume of patients undergoing cheiloplasty and palatoplasty in the country^{17,18}.

Patients with craniofacial deformities, especially cleft lip and palate, have complex issues that go beyond aesthetics and functionality to include psychosocial aspects. They face challenges from the beginning, such as breastfeeding difficulties and developmental changes in dentition, facial structure, maxilla, and speech. The treatment of these patients follows an age-dependent protocol, with cheiloplasty, the correction of cleft lip, performed by the third month of life, and palatoplasty, the closure of the palate, performed by the end of the first year¹⁷.

In 2019, the HPRLLP-USP performed 4,567 surgical procedures, 3,611 ambulatory surgeries, and 248,362 outpatient consultations. The hospital offers various free postgraduate courses, including *stricto sensu*, *lato sensu*, and extension programs, with a total of 250 enrolled students in that year. During the same period, the teaching hospital graduated 78 professionals, including masters, doctors, and other specialists¹⁹. However, with the arrival of the coronavirus in 2020, there was a drastic change in the hospital's routine, as well as in teaching and research activities. The objective of this study was to evaluate the impact of the COVID-19 pandemic on the activities of HPRLLP-USP.

2. Material and methods

2.1. Ethical Considerations

This research study was submitted to the Research Ethics Committee of HPRLLP-USP and received an exemption from review. This exemption was granted because the study was based on publicly available data and does not involve the exposure or access to individual patient records (Letter No. 23/2021-SVAPEPE-CEP). Despite the heterogeneity of the collected data, all data maintain the characteristic of not exposing the identity of patients.

2.2. Sample Selection and Study Design

The present study is a descriptive documentary research conducted at HPRLLP-USP through the collection of data from the Transparency Portal, Ambulatory and Surgical Production Reports, over the past 6 years. The data collection included publicly available data from 2016 to 2021, specifically related to HPRLLP-USP, including the number of patients treated, surgical procedures performed, Diagnostic and Therapeutic Aid Services (SADTs), orthotics and prosthetics, as well as laundry, nutrition, and dietetics services. Exclusion criteria were applied to exclude data that did not represent HPRLLP-USP, discontinued data, or specific data that could expose individual patient records or identities.

This research study utilized publicly available data from the Annual Activity Reports of HPRLLP-USP, which can be accessed at <http://hrac.usp.br/institucional/numeros/>. The data collected from 2016 to 2021 included the following variables: number of active patients and new cases of cleft lip and palate, craniofacial malformation, and hearing health programs; number of available beds for hospitalization, as well as the number of surgical, clinical, pediatric, and ICU admissions; number of surgical procedures performed in the operating room and outpatient setting; number of consultations and procedures categorized by specialties; data from the nutrition and dietetics service (enteral diets, baby bottles, and meals for patients and companions); data from the laundry service (weight of laundered clothes); numbers of orthotics, prosthetics, and special materials; volume of diagnostic imaging examinations, complementary exams, and laboratory tests.

The annual indices of academic production were also collected, including the number of students enrolled and graduated in Master's in Rehabilitation Sciences, Doctorate in Rehabilitation Sciences, Post-Doctorate, Specializations in Dentistry (*latu sensu*), Medical Residencies, and Multiprofessional Health Residencies. Scientific production was assessed through the number of articles published in journals and proceedings, book chapters, master's dissertations, doctoral theses, and undergraduate and residency projects. All data were tabulated from their respective PDF source files into a Microsoft Excel 365 spreadsheet, which facilitated the descriptive analysis of the past 6 years.

2.3. Statistical Analysis

For each variable observed over time, a multiple linear regression model for time series was fitted to estimate the average change trends in values each year. Three variables were included in the models: a time variable ranging from 1 to 6 for the years 2016 to 2021, a variable called *pandemic.immediate* with a value of zero for the years 2016 to 2019 and a value of 1 for the years 2020 and 2021, representing the immediate change (whether a decrease or an increase)

that occurred in 2020 compared to the expected trend based on previous years, and a third variable called pandemic, which takes on values 0 for the period before 2020 and values 1 and 2 for 2020 and 2021, respectively, representing the change in trend during this period compared to the previous period.

Thus, when the time variable was significant, it indicated that the trend during the period before 2020 was different from zero. When the pandemic.immediate variable was significant, it indicated that the observed value in 2020 and 2021 was different from the expected value based on the previous trend. When the pandemic variable was significant, it indicates that the trend during the years 2020 and 2021 was different from the trend observed between 2016 and 2019. When only the pandemic.immediate variable was significant, but the pandemic variable was not, it can be interpreted that the values observed in the period of 2020 and 2021 were different from the expected values according to the previous period, but the trend, whether decreasing or increasing, that existed between 2016 and 2019, remained in the years 2020 and 2021. When the pandemic.immediate variable was not significant, but the pandemic variable was, it can be said that the year 2020 followed the trend observed in previous years, but this trend changed between the years 2020 and 2021. In this analysis, a p-value <0.05 was considered significant.

3. Results

The numbers related to medical records are detailed in Table 1, where we can highlight a 65.3% decrease in the number of opened medical records in 2020 compared to 2019.

Table 1 Medical records opened during the years 2016 to 2021

	2016	2017	2018	2019	2020	2021
New Medical Records	5,055	4,819	4,443	4,392	1,566	2,673
New patients by program	5,123	4,841	4,689	4,433	1,589	2,716
Cleft Lip and Palate	612	381	221	275	184	265
Auditory Health (Hearing Aids)	1,359	1,339	1,591	1,571	487	778
Auditory Health (Cochlear Implant)	136	29	49	88	86	146
Craniofacial malformations	40	43	36	61	54	61
Otolaryngology Residency	1,750	1,374	1,515	1,312	367	633
External Exams and Diagnostics	1,189	1,638	1,287	1,113	404	824

Sources: HPRLLP-USP Annual Activities Report

The regression analysis for the time series data was performed to estimate the average trends of change for each variable over time. Figure 1 displays a slight decline in the number of opened medical records from 2016 to 2019 ($p < 0.5\%$), followed by a significant drop in 2020 ($p < 0.5\%$), and a partial recovery in 2021 ($p < 0.5\%$). The dashed line represents the trend line for 2020 and 2021 based on the previous years.

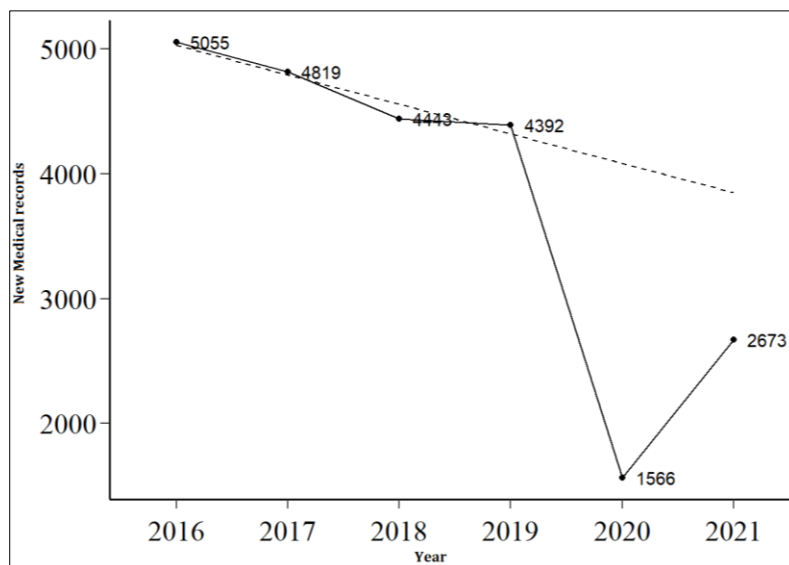


Figure 1 New Medical Records from 2016 to 2021

Table 2 Linear regression data on medical records opened during the years 2016 to 2021

Variable	Coefficient	CI 95%	p-value
time	710	-8,567, 9,987	0.77
pandemic.imediate	-44,174	-93,699, 5,351	0.062
pandemic	18,170	-12,598, 48,938	0.13

Table 3 Consolidated data from 2016 to 2021

	2016	2017	2018	2019	2020	2021
Medical production	45,626	37,720	41,884	46,605	18,730	37,610
Dental production	114,283	142,418	101,033	109,302	26,088	45,900
Complementary areas production	98,688	89,554	88,843	92,455	29,885	70,692
Consultation and Procedures (General)	258,597	269,692	231,760	248,362	74,703	154,202
Surgeries (dental and medical)	9,997	8,676	6,932	4,567	2,225	4,483
Hospital Admissions	3,217	2,279	2,420	2,873	1,423	2,741
Complementary and laboratory tests	83,371	75,810	82,517	88,300	29,311	60,726
Diagnostic imaging	98,188	73,426	65,923	91,594	22,164	65,933
Hearing aids, dental prosthetics, etc	11,207	10,471	14,892	19,580	6,955	13,717
Diets	139,316	88,785	90,746	80,055	11,595	74,161
Enrolled students	216	232	224	250	258	425
Scientific publications	338	325	379	441	305	402
Registered research projects	194	217	179	183	103	169
Laundry (in kg)	132,465	99,848	96,580	105,410	50,905	82,791

Sources: HPRLLP-USP Annual Activities Report

In Table 3, it is highlighted that the number of consultations and procedures decreased from 248,362 in 2019 to 74,703 in 2020. The number of medical and dental surgeries also decreased from 4,567 in 2019 to 2,225 in 2020. The number of surgical hospitalizations decreased by 51.8% in 2020 compared to 2019. However, the number of ICU hospitalizations remained stable, with a slight increase of 2.9% in 2020. There was a recovery in the number of surgical hospitalizations in 2021, reaching 96.4% of the number in 2019.

In Figure 2 we observed a slight decrease in the number of consultations even before the pandemic, followed by a significant drop during the year 2020 ($p < 0.05\%$). The numbers indicate a gradual return to normalcy in 2021, although without statistical significance ($p > 0.05$).

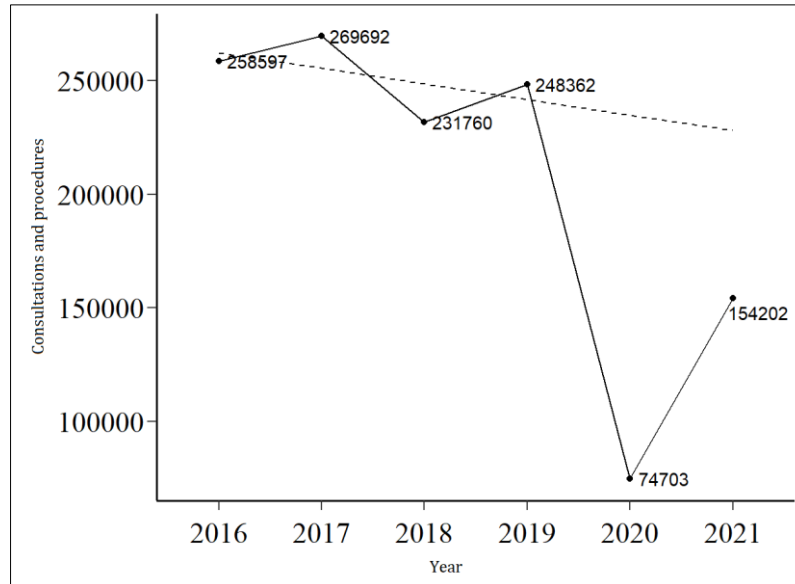


Figure 2 Consultations and procedures by year in HPRLLP from 2016 to 2021

Table 4 Linear regression data on Consultations and procedures from 2016 to 2021

Variable	Coefficient	CI 95% ¹	p-value
Time	-6,864	-38,593, 24,866	0.45
pandemic.imediate	-246,603	-415,994, -77,213	0.025
Pandemic	86,363	-18,873, 191,598	0.072
¹ CI = Confidence Interval			

The surgical procedures categorized by areas, as well as the location where they were performed: ambulatory procedures for less complex cases and surgical center for more complex procedures are shown in Table 5.

There was a 79.2% decrease in outpatient surgeries and a 57.4% decrease in surgeries performed in surgical centers from 2019 to 2020. In the medical field, surgical procedures in the surgical centers had an overall decrease of 48.0%. Outpatient procedures returned to 48.7% of pre-pandemic levels, while in the surgical centers, the return was of 85.8% for dental procedures and 104.6% for medical specialty surgeries.

There was a 65% decrease in presentations in congresses and a 33.3% decrease in registered funded projects. In contrast, the number of articles published in national and international journals increased by 26.0% in 2020. The number of students enrolled in postgraduate programs, master's, and doctoral programs increased in 2020 and 2021, while the number of residents remained stable.

Regarding imaging exams, there was a 75.8% decrease in the total number of exams performed. In 2021, with a 197.4% increase compared to the previous year, reaching 72% of the total production in 2019 before the pandemic.

For complementary exams, which included laboratory tests, electrophysiological exams, and audiology, there was a 66.8% decrease from 2019 to 2020, with a recovery in 2021 to 68.7% of the pre-pandemic levels in 2019.

Table 5 Total surgery procedures from 2016 to 2021

	2016	2017	2018	2019	2020	2021
Ambulatory						
Total	3,358	3,475	3,108	3,611	748	1,759
Maxillofacial	1,821	2,206	2,036	2,313	472	1,049
Restorative Dentistry	36	31	27	33	5	13
Implant Dentistry	354	372	242	314	74	205
Pediatric Dentistry	540	441	385	449	80	220
Orthopedics and Orthodontics	5	26	38	40	4	11
Periodontics	514	355	363	361	80	174
Prosthodontics	88	42	55	101	33	87
Other	0	2	0	0	0	0
Surgical Center						
Total	894	841	1,034	1,557	663	1,337
Maxillofacial	563	553	900	1,408	577	1,175
Restorative Dentistry	39	24	21	25	17	54
Pediatric Dentistry	129	89	113	124	69	108
Other	163	175	0	0	0	0
Medical						
Total	5,745	4,360	2,790	3,006	1,562	3,146
Pediatric surgery	67	34	27	22	10	25
Plastic surgery and neurosurgery	2,515	1,602	1,515	1,696	926	1,802
Otorhinolaryngology	988	833	1,043	1,288	624	1,197
Other	2,175	1,891	0	0	2	0

Sources: HPRLLP-USP Annual Activities Report

Regarding prostheses, which includes a heterogeneous group of implants ranging from individual amplification devices, cochlear implants, osteosynthesis plates for maxillofacial surgery to dental and extraoral prostheses, there was a total decrease of 64.4% from 2019 to 2020, with a recovery to 70% of pre-pandemic levels in 2021.

In complementary sectors, when analyzing the total number of meals, there was an 85.5% decrease in 2020 compared to the previous year. In the laundry sector, there was a 51.7% reduction in the amount of processed clothing in 2020 compared to 2019. When analyzing the load of processed clothing in 2021, there was a recovery to 78.5% of pre-pandemic levels.

4. Discussion

The data revealed that during the pandemic period, there was a decrease in the number of open medical records, consultations, surgeries, and hospitalizations. There was also a reduction in complementary services such as diagnostic

imaging, laboratory tests, and a decrease in the use of implants. Most of these parameters showed improvement after the first year, but without a return to normal levels. There was an increase in the number of students enrolled in postgraduate programs and scientific publications.

The reduction in the number of consultations at HPRLLP-USP during the pandemic period was 70%, which is higher than the values reported in the United States by Mafi et al., who observed a 33% decrease in these procedures in the months of March to April 2020. However, the same study showed that the recovery to pre-pandemic levels was worse for patients with socioeconomic vulnerability, usually assisted by government healthcare programs such as Medicare and Medicaid²⁰.

We found a 75% reduction in the total number of imaging exams in 2020 compared to 2019. This reduction was higher than the one reported also in the United States by Naidich et al., who observed a 25% decrease. However, our data are consistent with the findings of Alelyani et al. (2021) who reported a 76% reduction in imaging exams in Saudi Arabia during the worst months of the pandemic^{21,22}.

Sánchez-Gomez et al. presented data from an otolaryngology service with medical residency in Spain. They observed a significant 75% decrease in the average annual number of surgical procedures compared to the expected numbers in 2020. This decline not only affected the elective care of patients but also had an impact on medical residency training. In comparison to this service, the decrease in medical surgical production at HPRLLP-USP was 48% lower²³.

The dynamics of the scientific publishing process also changed during the pandemic, especially in terms of the review process for articles related directly to COVID-19, which, in some cases, was expedited without peer review²⁴. A scientometric study demonstrated that despite the challenges imposed by the pandemic on scientific research, the urgency of COVID-19 led to an increase in the number of published articles. However, this increase was not observed in publications unrelated to the pandemic²⁵. HPRLLP-USP experienced a 26% increase in overall publications in 2020, but it was not possible to compare this finding with other services due to a lack of data in the literature.

The COVID-19 pandemic has tested the resilience of healthcare systems worldwide, and its impact depends on the interaction between the magnitude of disease spread in a given population and the capacity and organization of pre-existing resources, as well as the appropriate prioritization of these services^{7,26}.

The response of healthcare systems to different conditions during a pandemic varies depending on the type of pathology addressed, particularly in terms of urgency and the time-dependence of treatment. Elective conditions tend to be postponed, while urgent conditions or those with time-sensitive treatments, such as oncological conditions, should be prioritized as usual. At HPRLLP-USP, there was a 65% decrease in the overall number of new medical records, but when isolating cases of cleft lip and palate, the decrease was only 33%, as the treatment for this condition should not be delayed.

As the pandemic approaches its end and healthcare services return to routine, there is a need to develop disease control strategies. A consensus formed by 386 government and non-governmental health researchers from 112 countries has established statements and recommendations for governments and societies to mitigate the impact of COVID-19 on public health. After observing three years of fragmented national and global responses, the focus should be on adopting approaches that involve the entire society and various government sectors, including measures that go beyond vaccination and involve public health actions and financial support. Another significant area of consensus is the improvement of communication between the government and the public, rebuilding public trust, and engaging the community in managing the pandemic response^{2,7}.

Among the strengths of this study, we can highlight the fact that as HPRLLP-USP is a service with a specific scope of practice, makes this survey unique in the literature. The detailed publication of complementary data from hospital, such as the number of complementary exams including radiology and laboratory, laundry services, and nutrition, is uncommon in the literature. Analyzing these parameters provided an additional metric of how the hospital performed during the pandemic period and opens the door for future publications.

As for the limitations of this study, the following aspects should be considered: the data used were publicly available meaning there was no direct contact with the data source, thus relying on the quality of the reports by the departments within the institution. Also, being a retrospective observational study, causality between variables cannot be inferred, and the possibility of other unmeasured variables influencing the data exists. These data guide us on how public policies should be developed to improve the care and quality of life of patients treated in public services during public health crises.

5. Conclusion

This study found a decrease in the number of new medical records, consultations, surgeries, and hospitalizations during the COVID-19 pandemic. There was also a reduction in complementary services such as diagnostic imaging, complementary exams, and a decrease in the use of implants. Most of these parameters showed improvement after the first year but did not fully return to normal levels. The number of enrolled students as well as publications and scientific outputs remained stable.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have no conflicts of interest to declare.

Statement of ethical approval

This research study was submitted to the Research Ethics Committee of HPRLLP-USP and received an exemption from review. This exemption was granted because the study was based on publicly available data and does not involve the exposure or access to individual patient records (Letter No. 23/2021-SVAPEPE-CEP). Despite the heterogeneity of the collected data, all data maintain the characteristic of not exposing the identity of patients.

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