

Impact of COVID-19 on the production of Dental Specialty Centers in Brazil

Impacto da COVID-19 na produção dos Centros de Especialidades Odontológicas do Brasil

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Resumo

Introdução: A pandemia de COVID-19 impactou significativamente os sistemas de saúde globalmente, destacando-se assim a importância de compreender seus efeitos na oferta de cuidados odontológicos. **Objetivo:** Avaliar o impacto da pandemia de COVID-19 nos procedimentos realizados pelos Centros de Especialidades Odontológicas (CEOs) no Brasil de 2019 a 2022 e sua relação com a Atenção Primária à Saúde (APS). **Material e método:** Estudo ecológico utilizando dados secundários da Produção Ambulatorial do SUS (SIA/SUS). A variável de interesse foi a produção dos CEOs, incluindo CEOs habilitados no Brasil de janeiro de 2019 a dezembro de 2022, dos tipos I, II ou III. As variáveis independentes incluíram: a) período de tempo; b) região do Brasil; c) tipo de CEO; e d) porcentagem de cobertura da atenção primária (PCP). Foram utilizadas estatísticas descritivas, gráficos de controle e análise de regressão binomial negativa. Análises de correlação de Spearman foram aplicadas entre a produção dos CEOs e a PCP. **Resultado:** Observou-se uma queda na produção em abril de 2020 em todas as regiões do país. A produção dos CEOs diminuiu de 327.206 procedimentos em março de 2020 para 37.742 em abril do mesmo ano. A produção nacional dos CEOs permaneceu baixa até dezembro de 2020. A recuperação das quantidades de procedimentos odontológicos especializados acima da média começou no início de 2022. Nos anos de 2021 e 2022, houve uma correlação positiva significativa, mas muito fraca, entre a produção dos CEOs e a PCP ($p < 0,05$). **Conclusão:** O período de redução na produção dos CEOs em 2020, seguido por uma recuperação gradual, reflete o impacto da pandemia de COVID-19 na produção de cuidados odontológicos especializados. **Descritores:** Sistema Único de Saúde; Brasil; COVID-19; atenção secundária à saúde.

Abstract

Introduction: The COVID-19 pandemic has significantly impacted healthcare systems globally, emphasizing the importance of understanding its effects on the provision of dental care. **Objective:** To assess the impact of the COVID-19 pandemic on the procedures conducted by the Specialized Dental Centers (CEOs) in Brazil from 2019 to 2022 and its relationship with Primary Health Care (PHC). **Material and method:** An ecological study using secondary data from the Outpatient Production of the SUS (SIA/SUS). The variable of interest was the production of CEOs, including accredited CEOs in Brazil from January 2019 to December 2022, of types I, II, or III. The independent variables included: a) time period; b) region of Brazil; c) CEO type; and d) the percentage of coverage of primary care (PCP). Descriptive statistics, control charts, and negative binomial regression analysis were used. Spearman correlation analyses were applied between CEOs production and PCP. **Result:** A decline in production was observed in April 2020 across all regions of the country. CEOs production decreased from 327,206 procedures in March 2020 to 37,742 in April of the same year. National CEOs production remained low until December 2020. The recovery of specialized dental procedure quantities above the average began in early 2022. In the years 2021 and 2022, there was a significant but very weak positive correlation between CEOs production and PCP ($p < 0.05$).



Conclusion: The period of reduced CEOs production in 2020, followed by a gradual recovery, reflects the impact of the COVID-19 pandemic on specialized dental care production.

Descriptors: Unified Health System; Brazil; COVID-19; secondary health care.

INTRODUCTION

Oral diseases are characterized by their high prevalence and substantial burden on both public health and the economy¹. Before the COVID-19 pandemic, it was estimated that globally, there were 3.5 billion people with oral health issues, including 2.3 billion with untreated dental caries in permanent teeth, 796 million affected by severe periodontitis, and 267 million with missing teeth².

In Brazil, these numbers also reveal a concerning reality. Data from a national epidemiological survey unveiled the widespread prevalence of oral diseases in the population³. As an illustrative example, the National Health Survey reported an alarming figure of 16 million Brazilians affected by tooth loss. Additionally, the National Oral Health Survey (SB Brazil 2012), conducted by the Ministry of Health, revealed that a significant 56% of 12-year-old children had experienced, at least once, dental caries, tooth loss, or dental restoration (DMFT)⁴. Given the substantial impact of dental caries over time on tooth loss, the unimpeded access to dental care becomes unquestionably important.

In the Unified Health System (SUS) of Brazil, access to oral health care is facilitated through a multi-level care system⁵. The primary level includes Primary Health Care (PHC), mobile care units, and emergency services. The secondary and tertiary levels encompass specialized care, including Specialized Dental Care Centers (CEOs) and hospitals, respectively⁶. CEOs primarily aim to expand and enhance the population's access to specialized dental treatments, including oral diagnosis with an emphasis on oral cancer detection, periodontics, endodontics, minor oral surgery, and care for individuals with special needs, thereby contributing to the comprehensive oral care of the served population⁷.

In 2020, in response to the COVID-19 pandemic, the World Health Organization advised the suspension of dental procedures due to aerosol production and the risk of SARS-CoV-2 virus transmission, coupled with a shortage of personal protective equipment, necessitating the postponement of elective dental procedures while maintaining only emergency care⁸. Consequently, dental health services were compelled to reorganize.

There was a drastic reduction in dental procedures in Brazil⁹⁻¹², with notable repercussions on PHC¹³, including a reduction in preventive and oral health promotion activities¹⁴, potentially contributing to an increase in untreated oral diseases. Additionally, the need to implement strict biosafety protocols altered the routine of dental offices¹⁵, limiting their capacity to provide care.

As for CEOs, it is plausible to assume that specialized services faced similar challenges, with cancellations and rescheduling of procedures due to the prioritization of resources for pandemic response. This situation may have led to a decrease in procedures, and it is necessary to investigate its extent and the time required for a return to normal activities. Monitoring the continuity of specialized dental care provided in the country will help identify the adaptability of CEOs and suggest ways to minimize the negative impacts of the COVID-19 pandemic on oral health.

Therefore, the aim of this study is to evaluate the impact of the pandemic on access to dental services in CEOs from 2019 to 2022 and its relationship with PHC.

METHODOLOGY

This is an ecological study that utilized secondary data from the SUS database¹⁶ for the period 2019 to 2022. The production data were obtained from the Outpatient Production of the SUS (SIA/SUS) records, available on the Datasus-Tabnet website¹⁶, based on the location of service, with quantities presented by state and year of data processing in the system.

The study variable was the production of Specialized Dental Care Centers (CEOs), with inclusion criteria covering both accredited and discredited CEOs in Brazil, from January 2019 to December 2022, including types I, II, or III. The independent variables considered were: a) time period; b) region of Brazil; c) type of CEO; and d) the percentage of Primary Health Care coverage (PHC). To calculate the Primary Health Care coverage, data from the Primary Care Information System (SIAB) and the Information System in Health for Primary Care (SISAB) were used, covering the period from 2019 to 2022.

The data were analyzed using the R program¹⁷. Descriptive statistics, control charts, and negative binomial regression analysis were employed. To study the pattern of variation in the production of Specialized Dental Care Centers (CEOs) over time, control zones (A), alert zones (B), and central zones (C) were graphically defined. The limits of each of these zones were calculated considering the negative binomial distribution. The CEO production was then analyzed over time, examining the following aspects of control chart methodology: months with production above the upper or lower control lines, at least six consecutive months with increasing or decreasing production, at least nine consecutive months on the same side (above or below) of the mean, two out of three consecutive months in any of the A zones, and four out of five consecutive months in any of the B zones or beyond¹⁸.

These characteristics indicate non-random patterns, signaling a trend of variation over time. Additionally, Spearman correlation analyses were conducted between CEOs production and PHC coverage over the four years analyzed. The correlation coefficients were interpreted following Mukaka¹⁹. Moreover, negative binomial regression models were adjusted to analyze the relationship between Specialized Dental Care Centers production and Primary Health Care coverage (PHC). The model fit quality was evaluated using the deviance. The research obtained an ethics committee exemption since the data used is from a publicly accessible system.

RESULTS

The analysis of national production over time, using the control chart (Figure 1), reveals a pattern of variation. A significant drop in CEO production in April 2020 is visible, followed by a period of very low production until May 2020 and subsequently low production until February 2021.

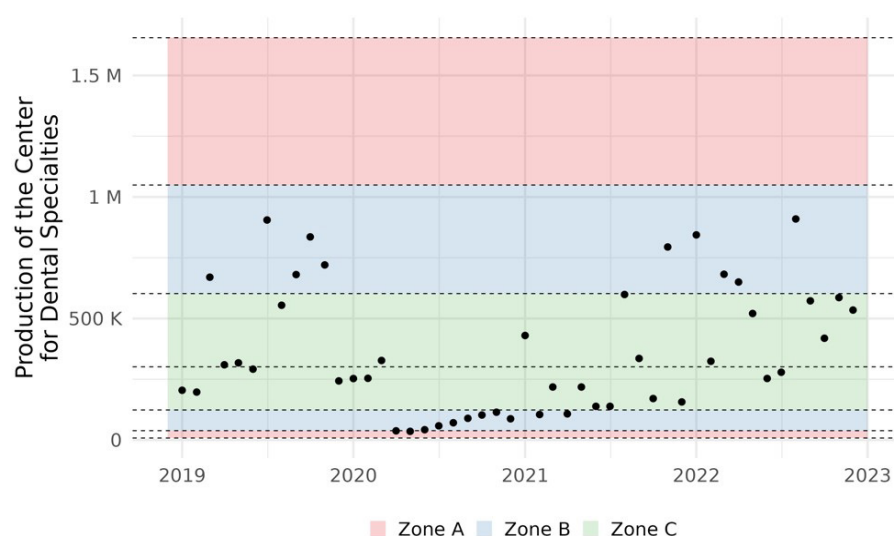


Figure 1. Control chart of the production of Specialized Dental Centers (SDC) in Brazil, between the years 2019 and 2022. Data source: Information System of the Unified Health System (SIA/SUS)²⁰.

When analyzing the trend of CEO production by region of the country (Figure 2), it can be noted that in the Northern region, there was a decline in CEO production in April 2020, remaining below the average until October 2021. In the Northeast region, a drop in CEO production is observed in April 2020, staying below the average until July 2021. The graphical analysis of the South region indicates a considerable drop in production in April 2020, which remained low until July 2020 and below the average until July 2021. Subsequently, there was a recovery, with production returning to values above the average from March to December 2022. Regarding the Southeast region, the results point to a decline in production in April 2020, followed by a recovery, with production returning to values above the average from March 2022. For the Central-West region, the results indicate a drop in production in April 2020, remaining below the average until May 2021, followed by a subsequent recovery, returning to values above the average in February 2022.

Table 1 displays the production of Specialized Dental Care Centers (CEOs) for each region and the entire Brazil, covering the period from 2019 to 2022. Notably, there was a substantial drop in production recorded in April 2020 across all regions of the country. It was observed that CEO production in the country decreased from 327,206 procedures in March 2020 to 37,742 in April of the same year.

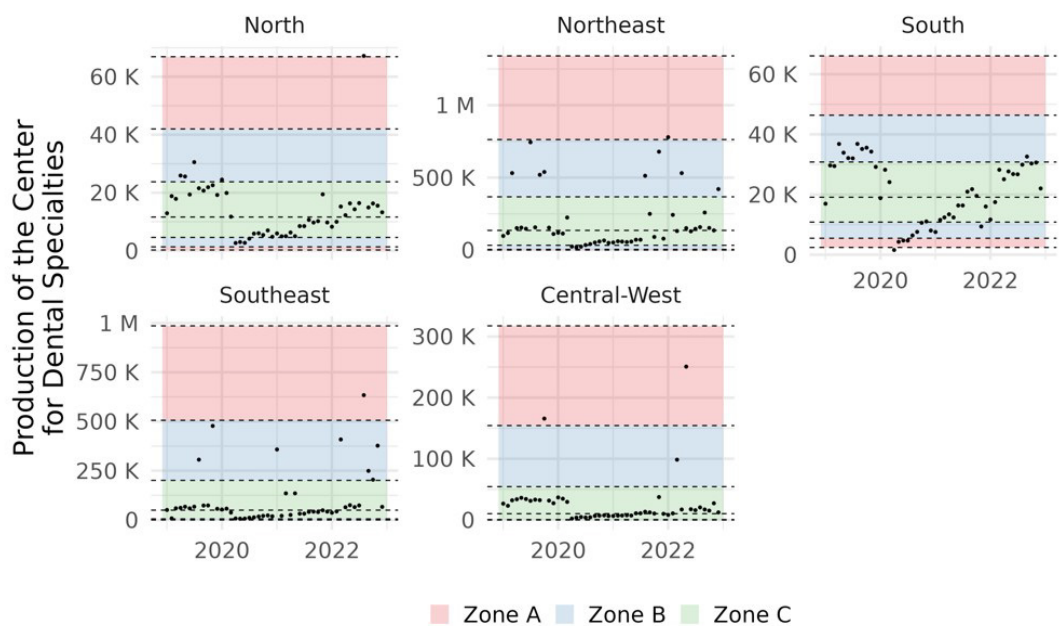


Figure 2. Control chart of the production of Specialized Dental Centers (SDC) in Brazil, between the years 2019 and 2022, by region of the country. Data source: Outpatient Information System of the Unified Health System (SIA/SUS)²⁰.

Table 2 presents the descriptive analysis of Primary Health Care coverage (PHC) data and the production of Specialized Dental Care Centers (CEOs) in the federal units of Brazil between 2019 and 2020. It can be observed that the average PHC coverage was 78.3% in 2019 and 75.9% in 2022. As for the average production of CEOs, there were 18,530 procedures on average in 2019, decreasing to 4,546 procedures in 2020, and subsequently resuming growth, reaching 20,290 procedures in 2022. However, the adjusted regression models did not show evidence of a relationship between CEO production and PHC ($p > 0.05$), as presented in Table 3.

Table 1. Production of Specialized Dental Centers (CEOs) in each region and across Brazil, between the years 2019 and 2022

Month/Year	North	Northeast	South	Southeast	Central-West	Brazil
January/2019	12.927	97.343	16.957	50.724	26.670	204.621
February/2019	18.829	117.608	29.676	7.871	23.132	197.116
March/2019	17.894	531.243	29.459	59.199	32.069	669.864
April/2019	25.919	151.468	36.817	61.521	33.799	309.524
May/2019	25.610	154.747	33.906	66.984	36.196	317.443
June/2019	19.382	146.954	32.122	58.944	34.164	291.566
July/2019	30.547	744.199	32.034	67.171	31.254	905.205
August/2019	21.555	156.639	36.837	306.256	33.148	554.435
September/2019	20.721	519.385	35.137	73.114	32.291	680.648
October/2019	21.889	538.941	35.568	73.544	165.750	835.692
November/2019	22.596	154.433	34.271	477.511	31.606	720.417
December/2019	19.232	110.809	29.188	56.559	27.330	243.118
January/2020	24.515	119.671	18.803	53.086	36.786	252.861
February/2020	19.915	113.755	28.227	57.303	34.685	253.885
March/2020	11.759	224.449	24.136	37.337	29.525	327.206
April/2020	2.665	23.923	1.574	7.383	2.197	37.742
May/2020	2.993	18.279	4.288	6.282	3.817	35.659
June/2020	2.727	23.210	4.731	6.883	4.786	42.337
July/2020	4.170	34.589	4.705	10.880	4.031	58.375
August/2020	5.909	41.194	6.417	13.044	4.402	70.966
September/2020	6.030	51.747	7.600	17.237	6.600	89.214
October/2020	5.426	59.126	10.616	20.656	7.052	102.876
November/2020	7.011	65.855	11.051	22.978	7.497	114.392
December/2020	4.829	49.498	8.041	18.511	6.423	87.302
January/2021	5.966	52.024	7.551	357.967	6.514	430.022
February/2021	4.981	60.423	11.572	20.906	7.068	104.950
March/2021	5.024	58.359	12.397	135.062	7.216	218.058
April/2021	6.290	54.761	13.436	25.443	7.621	107.551
May/2021	5.024	58.359	12.397	135.062	7.216	218.058
June/2021	8.491	71.027	16.373	31.804	10.847	138.542
July/2021	8.491	71.027	16.373	31.804	10.847	138.542
August/2021	10.652	512.826	20.954	40.902	13.366	598.700
September/2021	9.719	249.622	21.783	42.179	12.321	335.624
October/2021	10.206	90.378	19.543	39.973	10.472	170.572
November/2021	19.455	679.015	9.374	48.905	37.432	794.181
December/2021	9.755	78.451	16.020	42.324	10.035	156.585
January/2022	8.273	779.202	11.684	36.605	8.194	843.958
February/2022	9.987	242.552	17.484	43.225	10.709	323.957
March/2022	15.245	131.288	28.228	408.753	98.541	682.055
April/2022	12.262	531.042	25.089	64.548	17.051	649.992
May/2022	16.335	150.926	27.684	74.815	250.796	520.556
June/2022	14.309	129.306	26.805	65.229	17.503	253.152
July/2022	16.423	146.167	26.731	73.529	15.916	278.766
August/2022	67.172	158.045	29.927	633.901	20.488	909.533
September/2022	14.921	258.836	32.614	249.155	17.081	572.607
October/2022	16.301	152.447	30.327	204.381	15.233	418.689
November/2022	15.537	135.519	30.654	377.117	27.226	586.053
December/2022	13.261	420.579	22.031	66.413	12.352	534.636

Data source: Information System of the Unified Health System (SIA/SUS).

Table 2. Descriptive analysis of data on Primary Care Coverage (PCP) and the production of Specialized Dental Centers (SDC) in the Federative Units of Brazil, between the years 2019 and 2020

Variable	Year	Mean	Standard Deviation	Minumium	First Quartile	Median	Third Quartile	Maximum
PCP	2019	78,3	10,8	52,9	72,8	77,3	85,7	100,0
	2020	80,5	10,6	51,6	74,6	82,0	87,3	100,0
	2021	68,9	14,0	30,2	60,3	71,1	77,7	95,1
	2022	75,9	12,5	42,6	69,4	76,1	85,0	97,7
CEOs	2019	18.530	60.310	0	2.307	6.172	1.1406	619.082
	2020	4.546	11.921	0	327	1.533	4.541	178.050
	2021	10.694	49.321	0	541	2.356	5.502	644.457
	2022	20.290	69.630	0	1.366	4.485	9.957	728.689

Data source: System of the Unified Health System (SIA/SUS).

Table 3. Results of negative binomial regression analyses between Primary Care Coverage (PCP) in the Federative Units of Brazil (%) and the production of Specialized Dental Centers (CEOs), for each year and overall

Year	Parameter	β (standard error)	Confidence Interval (IC95%)	p-value
2019	Intercept	10,5378 (2,2828)	6,0637; 15,0119	<0,0001
	PCP	-0,0092 (0,0287)	-0,0655; 0,0472	0,7498
2020	Intercept	10,2751 (2,7394)	4,9060; 15,6442	0,0002
	PCP	-0,0236 (0,0330)	-0,0883; 0,0411	0,4752
2021	Intercept	8,8284 (1,4785)	5,9306; 11,7261	<0,0001
	PCP	0,0068 (0,0212)	-0,0348; 0,0484	0,7503
2022	Intercept	10,5450 (2,1302)	6,3699; 14,7201	<0,0001
	PCP	-0,0083 (0,0274)	-0,0619; 0,0453	0,7613
Overall	Intercept	10,1233 (1,6023)	6,9828; 13,2638	<0,0001
	PCP	-0,0080 (0,0202)	-0,0476; 0,0316	0,6921

DISCUSSION

The study's hypothesis regarding the considerable impact of the COVID-19 pandemic on CEO procedures in Brazil was confirmed. It was observed that in all regions of the country, there was a significant drop in CEO production in April 2020, followed by a subsequent recovery in production. National CEO production remained very low until May 2020 and remained low until December 2020. The recovery of procedure quantities above the average began at the beginning of 2022.

Dental procedures within the SUS decreased from 47 million in the first half of 2019 to 15 million in the same period of 2020. Among specialized dental procedures, endodontics and periodontics experienced close to a 52% and 54% decline, respectively¹². Comparing the period from March to August 2019 with the respective period in 2020, a reduction rate of 88% in dental procedures was observed⁹. An investigation into the impact of COVID-19 on national dental consultations identified a significant decrease from 574,221 specialized dental consultations in 2018 to 191,703 in 2020¹¹. Regarding prosthetic procedures, 92,499 dental prostheses were delivered in 2019, decreasing to 59,504 in 2020²¹. There was also an 89% reduction in pediatric procedures (restoration, tooth extraction, and endodontics in deciduous teeth) for April 2019, compared to the respective month in 2020²². These findings reinforce the substantial drop in the numbers of specialized dental procedures, as seen in the present study.

The utilization of CEO services is mediated by referrals from professionals within the PHC⁵. Therefore, it was expected that high PHC coverage would contribute to maintaining access to specialized dental care, which was not confirmed in the analysis. Only in the years 2021 and 2022, there was a significant positive but very weak correlation between CEO production and PHC ($p < 0.05$). A study that analyzed the quantity of dental emergency procedures in the country before

the pandemic (from March to June 2019) and after (from March to June 2020) identified a close likelihood that high PHC coverage in municipalities reduced the chances of reducing dental emergency procedures²³.

Indeed, dental actions and offerings in PHC were compromised during the pandemic period^{22,24}, subsequently affecting the quantity of specialized dental procedures. However, activities at this level of care were resumed based on the epidemiological situation of COVID-19 in each state. In the state of São Paulo, for instance, elective procedures resumed with recommendations to start with priority groups, vulnerable individuals, and compliance with protocol-based risk criteria. CEO activities were resumed and directly guided by referrals from PHC units starting in October 2020²⁵.

In light of the above, it is noteworthy that it was in 2022 that CEOs regained their productivity and operated above the average, as the results revealed. The new biosafety protocols, such as administering health questionnaires before scheduling dental appointments, temperature measurement, the use of absolute isolation, thorough room and reception area sanitization, and terminal decontamination at the end of the day, and thirty minutes later after high-speed use, were suggested^{25,26}. These are some of the critical aspects for reducing the risk of COVID-19 infection, which also extend the intervals between appointments.

It is important to note that trust in the safety of health services may have increased, encouraging patients to seek treatments that were postponed during the most critical periods of the pandemic, as COVID-19 immunization gained traction and reduced morbidity and mortality from the disease in Brazil²⁷. The reduction in restrictions and social distancing measures also played an essential role, allowing for a gradual resumption of daily activities²⁸, including dental care. Moreover, the improvement in the epidemiological situation may have reduced anxiety regarding virus exposure during visits to CEOs, promoting a more favorable environment for care. Therefore, vaccination progress and pandemic control may have been catalysts for the recovery of CEOs, restoring public and professional trust and providing more favorable operational conditions for specialized dental services.

Despite the significant recovery of CEO procedures in 2022, further studies are needed to monitor this progress and assess how well they are meeting the population's needs and the pent-up demand caused by the pandemic period. In general, before the health crisis, the production and performance of CEOs in Brazil varied depending on various factors, including geographical location and the population size of municipalities^{29,30}, with poorer performance identified in the Northern and Northeastern regions of the country²⁹. Poor performances were also identified in the Southeast, where, out of 151 CEOs evaluated, only 66.9% met the primary care target, 61.6% the periodontics target, 25.8% the endodontics target, and 36.4% the surgery target³¹. In this scenario, the return of the National Program for Improving Access and Quality of Specialized Dental Care Centers (PMAQ-CEO), instituted by Ordinance No. 261 of February 21, 2013, which proposed cycles of evaluation for all CEOs in Brazil and provided incentives for those with better performance, would be a possibility for the continuous monitoring and evaluation of these services, essential for the post-pandemic period.

Finally, this study has some limitations to consider. Firstly, due to its quantitative approach and reliance on secondary data, clarification of crucial nuances related to actions carried out in CEOs is restricted. It would be beneficial to include a qualitative assessment to complement the information obtained, exploring other aspects that may influence the results found. Additionally, it is relevant to mention that the study is of an ecological nature, which may limit the ability to establish direct causal relationships between variables, as the results reflect trends observed in larger groups or populations, rather than individual analyses. It is also worth noting that despite the use of secondary data, which may be subject to underreporting or overreporting, national databases demonstrate quality and have been widely used in studies following this approach.

The results presented can be used by SUS for the development of strategic plans aimed at strengthening the provision of specialized dental services, ensuring greater resilience in the face

of disruptions such as pandemics, and promoting continuous improvements in the oral health of the population served.

CONCLUSION

In conclusion, the intensive recovery of procedures above average after two years of the pandemic's onset may reflect dental procedures postponed or canceled due to restrictions and health concerns. The extensive resumption of services could be a result of the need to address pent-up demand, suggesting a certain flexibility in the oral healthcare system to deal with adverse situations and resume normal operations, but in the long run.

AUTHOR'S CONTRIBUTIONS

Júlia Serafim Nolasco de Moraes, Inara Pereira da Cunha and Silvia Amélia Scudeler Vedovello participated in the conception, design, and data collection. Inara Pereira da Cunha and Marcelo de Castro Meneghim participated in the article writing. Anne Caroline Alves Ramos and Marcelo de Castro Meneghim participated in the critical review. All authors read and approved the manuscript.

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CONFLICTS OF INTERESTS

Authors declares that they do not have any conflict interest.

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