The impact of the COVID-19 pandemic in Brazil: a study in tertiary dental care

João Mykael Alves XAVIER[a]
Ramon Targino FIRMINO[a]
Igor Figueiredo PEREIRA[a]
Myllena Alves XAVIER[b]
Mário César Furtado da COSTA[c]
Renata de Souza Coelho SOARES[d]
Ana Isabella Arruda Meira RIBEIRO[d]

[a]Universidade Estadual da Paraíba – UEPB, Center for Biological and Health Sciences, Department of Dentistry, Campina Grande, PB, Brazil.

[b]Faculdade Unidas do Norte de Minas - Funorte, School of Dentistry, Montes Claros, MG, Brazil.

[c]Hospital de Emergência e Trauma Dom Luiz Gonzaga Fernandes, Campina Grande, PB, Brazil.

[d]Universidade Estadual da Paraíba – UEPB, Health Strategic Technologies Center, Campina Grande, PB, Brazil.

Corresponding Author:
João Mykael Alves Xavier
E-mail: joaomykael99@gmail.com

Abstract: The pandemic caused by coronavirus has resonated throughout different levels of health care in Brazil and, in this context, the present research aimed to evaluate this impact on tertiary dental care provided by the Unified Health System (SUS). Therefore, an ecological study was conducted with data obtained from the Hospital Information System processed by the Portal of the Department of Informatics of SUS. The sample consisted of patients of all sexes and age groups, whose Hospital Admission Authorizations (AIHs) were approved for dental tertiary care procedures from January 2015 to December 2020. Descriptive analyses and the ANOVA test with a significance level set at $p < 0.05$ were used. When the annual mean numbers of AIHs approved were evaluated, findings showed that on an average, the Southeast region authorized a higher number of procedures (p-value < 0.001), however, in the pandemic year (2020), a reduction of approximately 24.5% of these hospitalizations occurred throughout Brazil, with the Midwest being the region most affected (32.12%). A percentage increase occurred in the Surgical Treatment of Oral sinus/Oral nasal Fistula (16.1%), in addition to a significant decrease in performing procedures for Resection of Mouth Lesion (33.4%). In the pandemic year, there was a reduction of 14% in expenditures related to hospital services and 23.26% related to professional services. It was concluded that the data presented demonstrated a significant reduction in AIHs for tertiary dental care in the pandemic year.

Keywords: COVID-19; Hospital Information Systems; Epidemiology.

Introduction

The pandemic caused by SARS-CoV-2 (COVID-19) started one of the greatest crises in health worldwide, given the high transmissibility of this disease in a short period of time.[1] Individuals hospitalized or with chronic comorbidities are considered a group at risk for COVID, since they may be immunosuppressed. In view of this, investigations that develop an epidemiological profile are necessary to define patients with more potential for contagion and to enable effective action in the treatment of this population. It is essential for institutions and health professionals to conduct research and report their experiences for the purpose of verifying the impact of the pandemic on different areas of health.[2]

Tertiary dental care involves a multidisciplinary team with the aim of assisting individuals with comorbidities, who need physical and human resources in the hospital environment. Furthermore, this care has to receive users referred from primary and secondary care services, urgent/emergency care related to the orofacial region, and management of patients with special needs.[3] Among the procedures performed at this level of care, the treatment of neoplasms, traumatology, deep infection in the head and neck regions, hemorrhages, or serious pathologies of the temporomandibular joint are those that occur most commonly.[4]

The COVID-19 pandemic directly interfered with emergency services in dentistry and, in this context, epidemiological studies with more representative samples should be conducted.[5] In Brazil, the panorama regarding research that provided information on the impact of the pandemic on dental services was found to be limited to information regarding primary and secondary care procedures.[6-8] Thus, investigations in a hospital environment are necessary since this is where severe cases of patients infected with the coronavirus are treated.[9]

In this context, the present study aimed to evaluate the impact of the pandemic caused by COVID-19 on tertiary dental care provided by the Unified Health System (SUS), by using information contained in the Hospital Information System (SIH-SUS) for all Brazilian states.

Methodology

The present study was reported according to the guidelines entitled Strengthening the Reporting of Observational studies in Epidemiology.[10]

This was an ecological study with an inductive approach, comparative-descriptive procedure, and indirect documentation technique. We used open access and public domain data obtained from the SUS Hospital Information System (SIH-SUS) processed in the Portal of the Informatics Department of the Unified Health System (Datasus).[11]

The sample was composed of patients whose hospitalizations had been approved according to tertiary dental care procedures of the SUS. We included all records of individuals of both sexes, without age restriction, registered in hospital institutions contracted to the Unified Health System in the period from January 2015 to December 2020. Variables such as groups and subgroups of procedures, Public Management, Legal Sphere and Contractual Rules were excluded.

For data collection, three previously trained researchers independently consulted the DATASUS platform (http://www2.datasus.gov.br/DATASUS/index.php). When accessing the homepage, the icon "Health Information (TABNET)" was selected, and then "Health care" was chosen to consult the data on "Hospital Production (SIH/SUS)". In the following platform, the filters that generated information related to characteristic variables of hospitalization of patients treated during the study period were applied: approved AIH (number of hospitalizations), Type of Procedure (Examples: surgical treatment of oral sinus/oral nasal fistula, osteosynthesis of complex fracture of the mandible); Region of Brazil (North, Northeast, South, Southeast and Central-West); Year of processing (2015-2020); Value of hospital services (in Brazilian currency, real); Value of professional services (in Brazilian currency, real).

Descriptive statistical analysis was performed to characterize the sample, absolute and percentage frequencies were calculated for categorical variables (Type of procedure and Brazilian regions), and measures of central tendency and variability for quantitative variables (AIH approved; Year of Processing; Value of hospital services; Value of professional services). To verify the normality of the data, the Shapiro-Wilk test and normal distribution of the variables were used. ANOVA was used to test whether there was a statistically significant difference in the number of AIHs approved (dependent variable) among the Brazilian regions (independent variable). SPSS software version 20.0 was used with a significance level set at 5%.

Results

The mean number of hospitalizations per year ranged from 8,822.20 (2019) to 6,426.8 (2020) and in the pandemic year, a percentage reduction
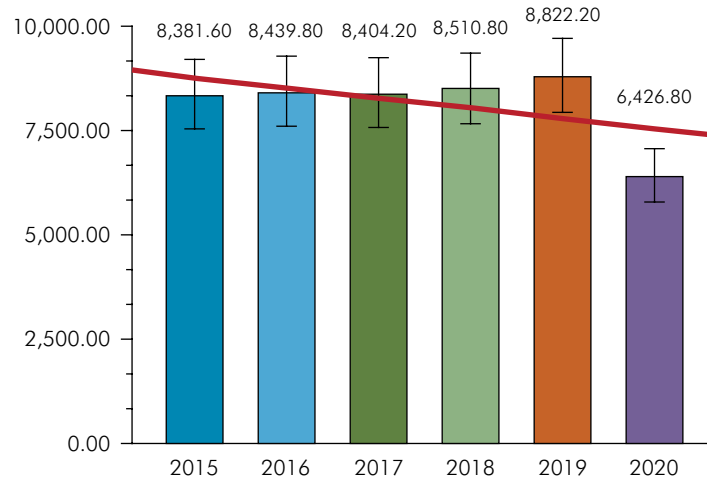
Caption: Calculation of the absolute frequency of annual mean numbers of AIHs in the period prior to the pandemic (2015-2019) in comparison with the annual mean numbers of 2020, with a reduction of 24.5% in hospitalizations in the pandemic year.

Figure 1. Annual mean numbers of AIH approved to perform tertiary dental care procedures (2015-2020).

of approximately 24.5% of these AIHs was verified (Figure 1).

The percentage of dental procedures performed in each region of Brazil during the study period (2015–2020) was analyzed. The Southeast was observed to authorize a higher number of procedures (p-value < 0.001), on an average, when compared with the three other Brazilian regions. Moreover, the Midwest authorized fewer procedures, showing statistically significant values in comparison with the other regions, except the North (Table 1).

Furthermore, in the pandemic year (2020) a decrease in care was verified in all the regions of Brazil. These reductions ranged from 8.52% to 32.12% with emphasis on the Midwest region, which showed the highest percentage reduction and the North region where the lowest reduction in AIHs was observed (Figure 2).

When verifying the five procedures most frequently performed prior to the pandemic, compared with those performed during the pandemic year, no change in this variable was noted, *i.e.*, these procedures remained as being those most frequently approved in both periods. However, a descriptive analysis made it possible to observe that there was a percentage increase in the surgical treatment of oral sinus/oral nasal fistula (16.1%). Furthermore, there was a percentage reduction in the approval of 3 of these

5 procedures in the pandemic year (2020), with a significant reduction in the performance of Resection of Mouth Injury procedures (percentage reduction of 33.4%), and a minimum reduction in the performance of osteosynthesis of complex fracture of the mandible (3.26%) , a procedure that was the most frequently authorized type in both periods (Table 2).

As regards analyses of public expenses that were approved in relation to hospital services and costs of professionals for performing procedures in tertiary dental care, there was evidence that the Southeast was the region that required the highest level of expenses throughout the period (2015–2020). However, in the pandemic year (2020), throughout the country, there was a reduction of 14% in costs of hospital services and 23.26% for professional services (Table 3).

Discussion

Tertiary Dental Care is composed of a cross-sectional and multidisciplinary work team, with the objective of meeting the demands of cases referred to it by primary and secondary care, in addition to performing urgent/emergency care involving the orofacial region, and management of patients with special needs, who need a hospital-level alert[3]. The impact of the COVID-19 pandemic was determinant in reducing the number of dental procedures performed

Table 1. Statistical difference in the means of approved procedures between regions (2015–2020).

Variable	AIHs Approved			
	Regions	Mean difference	Standard error	p-value
Southeast	South	7129,667	606,847	< 0,001
	Midwest	11885,167	606,847	< 0,001
	Northeast	4583,833	606,847	< 0,001
	North	10629,333	606,847	< 0,001
South	Southeast	-7129,667	606,847	< 0,001
	Midwest	4755,5	606,847	< 0,001
	Northeast	-2545,833	606,847	-0,003
	North	3499,667	606,847	< 0,001
Midwest	Southeast	-11885,167	606,847	< 0,001
	South	-4755,5	606,847	< 0,001
	Northeast	-7301,333	606,847	< 0,001
	North	1255,833	606,847	-0,49
Northeast	Southeast	-4583,833	606,847	< 0,001
	South	25545,833	606,847	-0,003
	Midwest	7301,333	606,847	< 0,001
	North	6045,5	606,847	< 0,001
North	Southeast	-10629,333	606,847	< 0,001
	South	-3499,667	606,847	< 0,001
	Midwest	1255,833	606,847	-0,49
	Northeast	-6045,5	606,847	< 0,001

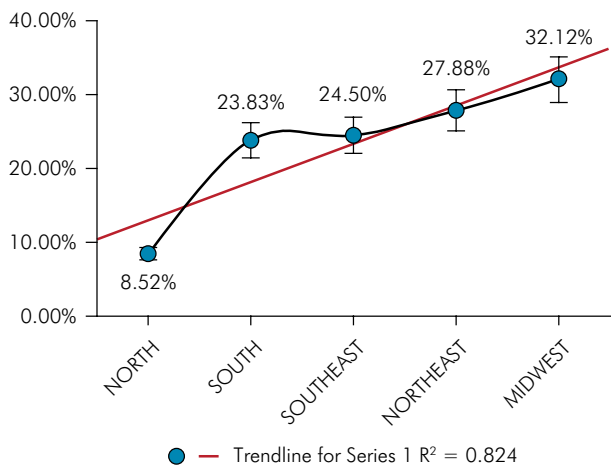ANOVA test (p < 0,05), data followed normality by the Shapiro-Wilk test.

Caption: Calculation of the absolute frequency of annual mean numbers of AIHs in the period prior to the pandemic (2015-2019) in comparison with the annual mean numbers of 2020 in the five Brazilian regions, showing evidence of the rise in the central trend line, which shows a lower percentage reduction in the North and a greater reduction in the Percent-West.

Figure 2. Analysis of percentage reduction in AIHs among Brazilian regions in the pandemic year (2020).

in the Brazilian Public Service[8]. In the present study, evidence of a significant reduction in AIHs was found during 2020, given that restrictive measures imposed by state governments limited dental care at all levels, especially the elective types performed in hospitals. Possible explanations for this could be the need for reducing the circulation of patients in the hospital environment, to decrease the risk of contamination. Moreover, it was necessary to reduce elective orofacial surgeries in the pandemic period, due to the fact that beds in intensive care units were required for the care of patients undergoing treatment for COVID-19.[12]

It was important to evaluate the procedures individually because from this perspective, this enabled visualization of the characteristics in epidemiological surveillance that provided information about the indispensable management and care procedures required?/provided?, and those that were the least

Table 2. Descriptive analysis to verify the reduction / percentage increase in the approval of the 5 most procedures most frequently performed in the study period (2015-2020).

Procedures	Annual mean of AIHs approved prior to (2015-2019)	AIHs approved during pandemic (2020)	Percentage analysis (%)
Osteosynthesis of complex fracture of the mandible	5.669	5.484	Reduction 3,26
Surgical reduction of fracture of the bones of the nose itself	3.966,20	2.749	Reduction 30,7
Resection of mouth injury	3.197,60	2.130	Reduction 33,4
Osteosynthesis of fracture of the orbit zygomatic-maxillary complex	3.002,40	3.038	increase 1,19
Surgical treatment of oral sinus/oronasal fistula	1.750	2.032	Increase 16,1

Calculation of the absolute frequency of the annual mean number of AIHs in the 5 most procedures most frequently performed in the study period (2015-2020) in comparison with the annual mean of 2020, in order to verify the reduction in and the percentage increase in hospitalizations during the pandemic year.

Table 3. Cost analysis for performing tertiary dental care procedures in Brazilian regions.

Regions	Hospital service expenses (2015-2020) (R$)	Professional services expenses
Southeast	9992726,21	3411019,748
Northeast	7002734,26	2296402,025
South	1691997,70	1691997,695
North	2453156,20	1.129.247, 312
Midwest	2539560,43	711140,0533
Annual Average (2015-2020)	28662923,30	9612560,7
Expenditures in the pandemic year (2020)	24643798,45	7376037,52
Percentage analysis (%)	Reduction 14	Reduçtion 23,26

Calculation of the absolute frequency of the annual mean values for the expenses of the last 5 years (2015-2020) in comparison with the 2020 expenditures, with the aim of verifying the percentage reductions in these costs during the pandemic year.

prioritized in this period. Thus, the treatment of osteosynthesis of complex fracture of the mandible was observed to be the procedure with the lowest percentage reduction (3.26%). Because it configures as a predominantly urgent procedure due to trauma,[13] it was possible to justify this fact by prioritizing these care procedures to the detriment of elective surgeries, which, in a similar way, occurred with the approval of procedures for Resection of Lesions in the Mouth, as these are predominantly elective procedures, and showed a more significant percentage reduction (33.4%).

It is worth noting that the distribution of AIH's among Brazilian regions was a result evaluated to the detriment of the pandemic period, however, the functioning of this care network before COVID-19 must also be analyzed. One datum that corroborates this fact is that the Brazilian Southeast has previously

been identified as an effective region. This was determined in a study of hospital technical efficiency, when the volume and distribution of the number of hospitals beds was evaluated.[14] This condition remained in the pandemic period, since this was the region that authorized the highest number of admissions. Whereas when the percentage reductions of AIHs in the pandemic year (2020) were evaluated among the regions of Brazil, there was a higher rate of reduction in hospitalizations in the Midwest (32.12%). This information could be related to worsening of the pandemic in this locality, considering that as from September 2021, this region recorded the highest number of deaths due to COVID-19 (346.8) per 100,000 inhabitants.[15]

The asymmetric flow relative to the demand for hospital beds and the difference in supply between Brazilian regions[16,17] was closely related to management

of the pandemic. Considering that AIHs are issued when the patient is hospitalized, whether for elective or urgent procedures,[11] the organizational network of care centers also underwent changes. For example, these changes included the opening of hospital wards for the treatment patients in serious condition of COVID-19, in hospitals specialized in urgent and emergency trauma care, in addition to the implementation of wards to monitor patients in less complex environments that offered elective care.[18] Thus, these strategies carried out according to the reality of each region may have been a factor of impact on the analysis of the percentage reductions in AIHs during the pandemic year.

It is essential to point out that, based on the analyses of public expenditures, there was evident (14%) reduction in hospital services and 23.26% for professional services in the pandemic year. This data can be analyzed by means of a critical evaluation of the financial health support ordinances published in the months of 2020. These allowed subnational entities to have greater freedom of action, prioritized the qualification of ICU beds and incentive for the extension of hours for care provided in basic health units (overlap of resources for primary and specialized care). Therefore, the untying of resources combined with recharacterization of the funding blocks within the context of the pandemic, expanded the autonomy of local management to meet existing demands,[19] which was probably a determining factor for reducing care and, consequently, the costs for performing Dentistry procedures in a Hospital environment.

Some limitations were found in accessing information from the SIH-SUS regarding the organization of data on the digital platform. Not all the procedures listed were the result of approved AIH, thus requiring manual selection of each procedure in all areas of health, which made it difficult and delayed the complete analysis of data in the present study. Another limitation was the fact that there is no division of care groups according to the level of health care. Thus, dental treatment for patients with special needs is listed in a unique way, with no distinction between secondary and tertiary levels. Therefore, these data were then removed from the analyses to reduce possible bias in the results. In view of these facts, our suggestion is that an update of the application responsible for the systematization of health data in Datasus (Tabnet)[11] is required, so that the information collected can be as complete and reliable as possible, to favor the improvement of research based on the epidemiological surveillance of the country.

The weaknesses related to the present study are the fact that the methodology used was based on the use of secondary data that could be underreported, which may have been affected by the atypical and exhaustive context of the pandemic. Furthermore, due to the study design and the characteristics of the Datasus platform, it was not possible to incorporate other variables and perform a more robust statistical analysis. It is important to highlight that the strengths of this research lie in the presentation of information, which enabled an unprecedented demonstration of the impact that the pandemic had on tertiary dental care, relative to percentage reductions shown in a regionalized manner, characteristics related to procedures that were indispensable during the pandemic period, and analysis of public health spending, based on a five-year evaluation.

References

1. Yan Y, Shin WI, Pang YX, Meng Y, Lai J, You C, et al. The First 75 Days of novel Coronavirus (SARS-CoV-2) outbreak: recent advances, prevention, and treatment. Int J Environ Res Public Health. 2020 Mar;17(7):1-23. https://doi.org/10.3390/ijerph17072323

2. McCreary EK, Pogue JM. Coronavirus disease 2019 treatment: a review of early and emerging options. Open Forum Infect Dis. 2020 Mar;7(4):ofaa105. https://doi.org/10.1093/ofid/ofaa105

3. Ministério da Saúde (BR). Secretarias Estaduais de Saúde. Departamento de Atenção Básica. A saúde bucal no Sistema Único de Saúde; 2018 [cited 2021 Nov 18] Available from: https://bvsms.saude.gov.br/bvs/publicacoes/saude_bucal_sistema_unico_saude.pdf

4. Zimmermann M, Nkenke E. Approaches to the management of patients in oral and maxillofacial surgery during COVID-19 pandemic. J Craniomaxillofac Surg. 2020 May;48(5):521-6. https://doi.org/10.1016/j.jcms.2020.03.011

5. Guo H, Zhou Y, Liu X, Tan J. The impact of the COVID-19 epidemic on the utilization of emergency dental services. J Dent Sci. 2020 Dec;15(4):564-7. https://doi.org/10.1016/j.jds.2020.02.002

6. Chisini LA, Sartori LR, Costa FD, Salvi LC, Demarco FF. COVID-19 pandemic impact on prosthetic treatments in the Brazilian Public Health System. Oral Dis. 2022 Apr;28 Suppl1:994-6. https://doi.org/10.1111/odi.13668

7. Cunha AR, Antunes JL, Martins MD, Petti S, Hugo FN. The impact of the COVID-19 pandemic on oral biopsies in the Brazilian National Health System. Oral Dis. 2022 Apr;28 Suppl 1:925-8. https://doi.org/10.1111/odi.13620

8. Chisini LA, Costa FD, Sartori LR, Corrêa MB, D'Avila OP, Demarco FF. COVID-19 Pandemic impact on Brazil's Public Dental System. Braz Oral Res. 2021 Jul;35(082):e082. https://doi.org/10.1590/1807-3107bor-2021.vol35.0082

9. Noronha KV, Guedes GR, Turra CM, Andrade MV, Botega L, Nogueira D, et al. he COVID-19 pandemic in Brazil: analysis of supply and demand of hospital and ICU beds and mechanical ventilators under different scenarios. Cad Saúde Pública. 2020 Jun;36(6):e00115320. https://doi.org/10.1590/0102-311x00115320

10. Malta M, Cardoso LO, Bastos FI, Magnanini MM, Silva CM. STROBE initiative: guidelines on reporting observational studies. Rev Saúde Pública. 2010;44(3):559-65. https://doi.org/10.1590/S0034-89102010000300021

11. Brasil. Datasus. Produção Hospitalar (Sih/Sus). [cited 2021 Nov 18] Available from: https://datasus.saude.gov.br/acesso-a-informacao/producao-hospitalar-sih-sus/

12. Souza AF, Arruda JA, Costa FP, Bemquerer LM, Castro WH, Campos FE, et al. Safety protocols for dental care during the COVID-19 pandemic: the experience of a Brazilian hospital service. Braz Oral Res. 2021 May;35(070):e070. https://doi.org/10.1590/1807-3107bor-2021.vol35.0070

13. Yildirgan K, Zahir E, Sharafi S, Ahmad S, Schaller B, Ricklin ME, Exadaktylos AK. Mandibular fractures admitted to the emergency department: data analysis from a swiss level one trauma centre. Emerg Med Int. 2016; 20 Spec Iss 1:1-7. https://doi.org/10.1155/2016/3502902

14. Silva BN, Costa MS, Abbas K, Galdamez EV. Hospital efficiency of the brazilian regions: a study using the data envelopment analysis (DEA). RGSS. 2017;6(1):76-91. https://doi.org/10.5585/rgss.v6i1.314

15. Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Coronavírus Brasil. Painel coronavírus. 2021 [cited 2021 Nov 18] Available from: https://covid.saude.gov.br/

16. Viana AL, Bousquat A, Melo GA, Negri Filho A, Medina MG. Regionalização e redes de saúde. Cienc Saúde Colet. 2018; 23(6):1791-8. https://doi.org/10.1590/1413-81232018236.05502018

17. Botega LA, Andrade MV, Guedes GR. Brazilian hospitals' performance: an assessment of the unified health system (SUS). Health Care Manage Sci. 2020 Sep;23(3):443-52. https://doi.org/10.1007/s10729-020-09505-5

18. Castro MC, Carvalho LR, Chin T, Kahn R, Franca G, Macario EM, et al. Demand for hospitalization services for COVID-19 patients in Brazil. medRxiv. 2020. https://doi.org/10.1101/2020.03.30.20047662

19. Fernandes GA, Saturnino BL. Os desafios do financiamento do enfrentamento à COVID-19 no SUS dentro do pacto federativo. Rev Adm Pública. 2020;54(4):595-613. https://doi.org/10.1590/0034-761220200290