Research note

Brazilian National Health System dental x-ray coverage in Southern Brazil in 2016: an ecological study

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Luiz Alexandre Chisini[1] – orcid.org/0000-0002-3695-0361
Alissa Schmidt San Martin[1] – orcid.org/0000-0002-2094-774X
John Victor Júnior Batista Ferreira Silva[1] – orcid.org/0000-0003-1829-6594
Nicole Brambatti[1] – orcid.org/0000-0002-9665-2411
Fernanda Silva de Pietro[1] – orcid.org/0000-0001-9250-5820
Marcus Cristian Muniz Conde[2] – orcid.org/0000-0003-2662-3305
Marcos Britto Correa[1] – orcid.org/0000-0002-9808-2715

[1]Universidade Federal de Pelotas, Faculdade de Odontologia, Pelotas, RS, Brasil
[2]Universidade do Vale do Taquari, Centro de Ciências Biológicas e da Saúde, Lajeado, RS, Brasil

Abstract

Objective: to investigate the coverage of dental radiographic equipment provided by the Brazilian National Health System (SUS) in South Brazilian municipalities in 2016 and to investigate radiographic procedures in the municipalities that have this equipment. **Methods**: this was an ecological study conducted with data from the SUS Outpatient Information System (primary healthcare units with a dental surgery, radiographic equipment available and operational and X-rays being performed) and Brazilian Institute of Geography and Statistics data (population); the chi-square test and variance analysis were performed. **Results**: 984 items of dental radiographic equipment were identified in 479 out of 1,191 municipalities analyzed; 60% of the municipalities had no equipment, 68% had less than the recommended coverage, and 52% of the municipalities with equipment did not perform any radiography examination during 2016. **Conclusion**: less than half of the municipalities had radiographic dental equipment; among those that did have this equipment, half did not perform any procedures.

Keywords: X-Rays; Radiology Information Systems; Radiology; Brazilian National Health System; Ecological Studies.

Correspondence:
Luiz Alexandre Chisini – Universidade Federal de Pelotas, Faculdade de Odontologia, Rua Gonçalves Chaves, No. 457, Sala 501, Pelotas, RS, Brasil. CEP: 96015-560
E-mail: alexandrechisini@gmail.com

Introduction

X-rays are the main complementary examinations used in the clinical practice of dentists[1,2] and their availability is indispensable in order to carry out correct diagnosis.[3-7] Unavailability of such complementary examinations may compromise diagnosis of oral diseases in health care service users. In 2009, 84% of dental x-ray equipment belonged to private services, while equipment availability was low (16%) for users of the Brazilian National Health System (SUS).[8,9] These data were collected shortly after the beginning of National Oral Health Policy (PNSB), deployed in 2004.

PNSB implementation required an initial investment of 2.6 billion dollars,[10] enabling expanded access to oral health services as a result of the increase in the number of SUS dental clinics and dentists.[10,11] In this context, there are no studies showing that this expansion has resulted in greater supply and availability of dental radiographic equipment. Nor are there are consistent investigations demonstrating that such equipment is actually being used.

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The objective of this study was to investigate: (i) the coverage of dental radiographic equipment provided by the Brazilian National Health System in South Brazilian municipalities in 2016; and (ii) to investigate the performance of radiographic procedures in those municipalities that have this equipment.

Methods

An ecological study was conducted with data from the SUS Outpatient Information System (SIA/SUS)/ SUS Information Technology Department (DATASUS) and data from the Brazilian Institute of Geography and Statistics (IBGE), corroborating proposals from previous studies.[12-14] Data relating to the year 2016, were collected in March 2017.

The databases (tabnet.datasus.gov.br) were consulted to identify how many primary health care units (PHU) in the three Southern Brazilian states had dental clinics available, as well as the quantity of radiographic equipment installed in each municipality. We only included radiographic equipment registered as being 'in operation' by SIA/SUS. As such, our study considered equipment that was technically available for use in SUS services. Data was collected on interproximal and periapical dental x-rays performed in each municipality in the period from January to December 2016.

All Southern Brazilian municipalities were considered to be eligible. They were stratified according to their respective states - Rio Grande do Sul, Santa Catarina and Paraná - and also by population size: up to 20,000 inhabitants; from 20,001 to 50,000; 50,001 to 150,000; and more than 150,000 inhabitants.[15]

The variables analyzed and their categorizations are presented below:

a) Availability of radiographic equipment - variable dichotomized into: (i) availability of dental radiographic equipment (municipalities with at least one dental radiographic equipment in operation); and (ii) non-availability of such equipment.
b) Dental radiographic equipment by PHU – quantity of dental radiographic equipments per Primary Health Care Unit.
c) Recommended radiographic coverage - recommended coverage (1 dental radiographic equipment per 25,000 inhab., recommended by Interministerial Decree MS/GM No. 1,101, dated 12 June 2002); and coverage below recommended (less than 1 equipment per 25,000 inhab.).[16]
d) Radiographic examinations performed - absolute number of procedures per 10,000 inhab., according to estimated population for each municipality in 2016.[14]

The 'availability of radiographic equipment' and 'dental radiographic equipment per PHU' indicators were built using SIA/SUS data. Recommended radiographic coverage and radiographic examinations performed were estimated based on SIA/SUS and IBGE data.[14]

All data were retrieved independently by two researchers (San Martin AS; Silva JVJBF), with the aim of minimizing errors in data retrieval. Inconsistencies were checked by a third researcher (Chisini LA).

This study is a census of South Brazilian municipalities. The data collected were tabulated using Tabnet and subsequently exported to Stata 12.0. The relative and absolute frequencies of the variables, as well as the means and standard deviations (SD) for the numerical variables were obtained.

Categorical variables were analyzed using Pearson's chi-squared test; continuous variables were analyzed both by analysis of variance (ANOVA) and also by the Bonferroni test. In order to analyze the 'dental radiographic equipment per PHU' variable, it was converted into a logarithmic scale. This conversion was done owing to non-normal distribution. A significance level of 5% ($p<0.05$) was adopted.

As this study used only secondary data, it was exempt from appraisal by a Research Ethics Committee, in accordance with National Health Council Resolution No. 510, dated 7 April 2016.

Results

A total of 984 dental radiographic equipments were identified in the three states of Southern Brazil. However, 60% of the municipalities (n=712) did not have at least one dental radiographic equipment. The quantity of dental radiographic equipments available per PHU was 0.21 (SD=0.4) in Rio Grande do Sul state, 0.29 (SD=0.4) in Santa Catarina state and 0.22 (SD=0.4; $p<0.001$) in Paraná state. Municipalities in the state of Paraná with up to 20,000 inhabitants had, on average, 0.4 (SD=0.7) equipments per municipality, while in the state of Rio Grande do Sul municipalities with the same population size had an average of 0.3 (SD=0.7; $p<0.001$) (Figure 1). Municipalities with a large population had higher availability, a higher average of dental radiographic equipments and a greater quantity of equipments per PHU than municipalities with lower population size in the three states analyzed ($p<0.001$; Table 1).

Municipalities with up to 20,000 inhabitants had the lowest proportion of equipments per PHU (mean=0.6; SD=0.6) and this pattern was found in all three states. We also found that 68% of South Brazilian municipalities (n=815) had below recommended coverage: Santa Catarina had 43% coverage, Paraná, 31%; and Rio Grande do Sul, 24%. Recommended radiographic coverage was not found to be associated with population size ($p=0.095$).

In more than half of the municipalities (52%) with dental radiographic equipment, no radiographic examinations were performed during 2016. Municipalities in the state of Santa Catarina had the highest number of radiographic examinations performed per 10,000 inhab. (mean=1.5; SD=4.1), followed by municipalities in Rio Grande do Sul (mean=0.4; SD=1.3) and in Paraná (mean=0.3; SD=1.3; $p<0.001$).

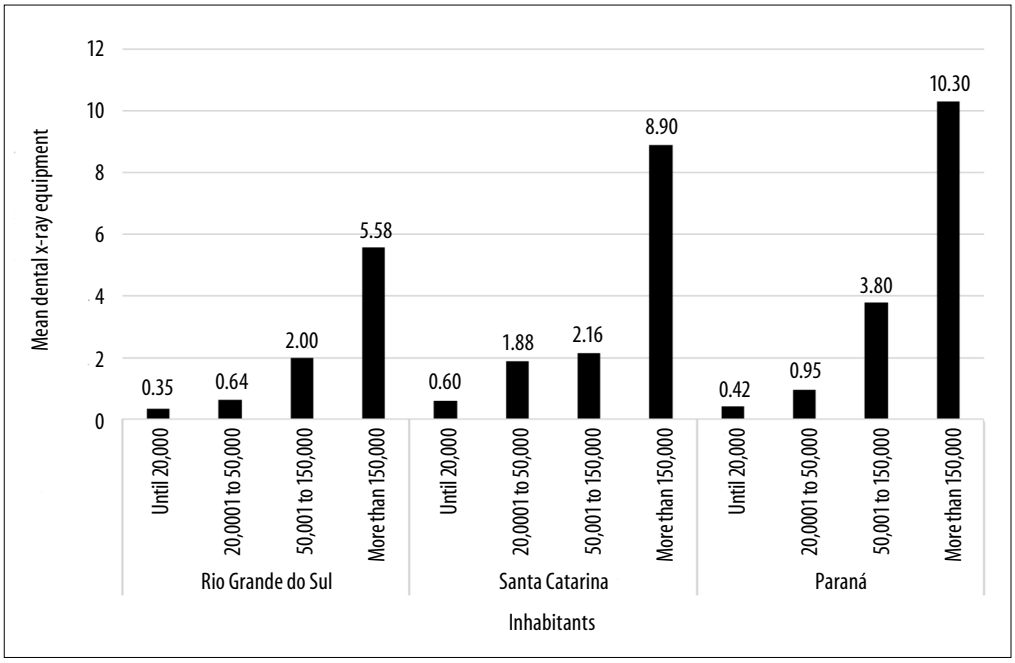

Figure 1 – Mean dental x-ray equipment (N=984 equipments) by state and municipali population size, Southern region of Brazil, 2016

Table 1 – Analysis of outcome variables by state and municipal population size, Southern region of Brazil, 2016

State/Southern region	Municipality population size				P -value[a]
	Up to 20,000	20,001 - 50,000	50,001 - 150,000	More than 150,000	
Municipalities with radiographic equipment available (N=479 municipalities[b])					
Rio Grande do Sul	102 (25.7)	25 (43.1)	19 (63.3)	12 (100.0)	<0.001
Santa Catarina	101 (43.2)	26 (76.5)	19 (100.0)	8 (100.0)	<0.001
Paraná	106 (34.0)	30 (54.6)	22 (95.7)	9 (100.0)	<0.001
Southern Region	309 (32.8)	81 (55.1)	60 (83.3)	29 (100.0)	<0.001
Municipalities with recommended coverage (N=376 municipalities)[a,c]					
Rio Grande do Sul	102 (25.7)	13 (22.4)	5 (16.7)	1 (8.3)	0.371
Santa Catarina	101 (43.2)	19 (55.6)	5 (26.3)	2 (25.0)	0.138
Paraná	106 (34.0)	13 (23.6)	8 (34.8)	1 (11.1)	0.240
Southern Region	309 (32.8)	45 (30.6)	18 (25.0)	4 (13.8)	0.095
Mean and standard deviation of dental radiographic equipment per PHU[d] (N=984 equipments)[e]					
Rio Grande do Sul	0.3±0.5	1.3±0.7	1.6±0.9	1.7±0.6	0.005
Santa Catarina	0.6±0.7	1.4±0.7	1.7±0.9	1.6±0.7	0.006
Paraná	0.7±0.7	1.4±0.7	1.5±1.1	1.8±0.8	0.025
Southern Region	0.6±0.6	1.4±0.7	1.6±0.9	1.7±0.7	<0.001
Mean and standard deviation of radiographic procedures per 10,000 inhab. (N=370,698 procedures)[e]					
Rio Grande do Sul	0.3±1.3	0.5±1.1	0.9±1.4	0.7±0.9	0.040
Santa Catarina	1.2±4.2	2.5±3.5	2.9±3.3	3.4±2.0	0.002
Paraná	0.1±0.7	0.7±1.5	1.4±2.3	2.2±1.3	<0.001
Southern Region	0.4±2.3	1.0±2.1	1.6±2.1	1.9±1.8	0.030

a) Pearson's chi-square test.
b) 712 municipalities lacked radiographic equipment.
c) 815 municipalities did not have the recommended coverage of dental X-ray equipment per inhabitant.
d) PHU: Primary Health Unit.
e) ANOVA one-way test and post hoc Bonferroni test.

Discussion

Less than half of the Southern Brazilian municipalities had dental radiographic equipment suitable for use and more than half of it was not used to perform any radiography examinations during 2016. Therefore, the availability of equipment did not necessarily imply x-rays being performed.

SIA/SUS is a health information system with national coverage containing data on procedures performed at the local level of management. During the data input process, it is possible that radiographs may have been underreported. Nevertheless, given that municipalities must keep these data up to date, underreporting of radiographic examinations alone would not be capable of explaining the underutilization of available equipment and a consequent deficit in complementary examinations.

Due to the low proportion of dental radiographic equipment per PHU in the Southern region, dentists have to refer service users to units where there is equipment available for performing radiographic examinations. Besides the low knowledge of professionals,[17] difficulties with referral logistics[10,18,19] and with performing these procedures could also explain why examinations were not carried out. These are possible hypotheses for explaining, partially but not completely, the low level of radiographs found. As part of their remuneration, dentists are paid an extra allowance for working in insalubrious conditions and if their work involves repeated contact with equipment that emits x-ray radiation, they are entitled to receive a hazard allowance as well.[20] This may represent increased costs for health service management.

Notable differences were observed between the states investigated. Santa Catarina had the best results

for quantity and availability of dental radiographic equipment, as well as for performing dental x-rays. Discrepant results between states and regions may be justified by local and regional social and political inequities. For this reason, decentralized actions are a part of SUS policy, and the development of local public policies is part of its guidelines.[19,21] In the case of oral health, state and regional differences are found in both the need for and allocation of regional dental prosthesis laboratories[22] as well as in the performance of specialized procedures.[23]

In addition, we found a higher concentration of dental radiographic equipment - and greatest performance of radiograph examinations - in cities with more than 150,000 inhab. Locations with a large population provide referral services to smaller municipalities surrounding them, because they have a higher concentration of health professionals, PHU and hospitals, which could explain the greater amount of equipment and higher levels of radiographic examinations in these municipalities. We therefore highlight the importance of the role of local policies in the consolidation and, consequently, in the performance of SUS activities.[10,19,24]

Our study revealed: (i) low SUS coverage of dental radiographic equipment in the Southern Brazilian states; and (ii) low performance of dental radiographic procedures in municipalities that did have such equipment. The availability of radiographic equipment did not necessarily imply that radiographic examinations were carried out. Management and administrative measures therefore need to be taken to ensure that such technologies are effectively employed in the care of the population. Municipalities with greater population size had greater availability of dental radiographic equipment, although its coverage was shown to be below recommended levels.

Authors' contributions

Chisini LA, San Martin AS, Silva JVJBF, Brambatti N, Pietro FS, Conde MCM and Corrêa MB contributed substantially to the conception and design of the study, data analysis and interpretation and drafting the manuscript. All the authors approved the final version of the manuscript and declared themselves to be responsible for all aspects of the study, ensuring its accuracy and integrity.

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