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Economic impact of new biosafety recommendations for dental clinical practice during COVID-19 pandemic

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YWC, EHGL, DFBC and ACP conceptualized and designed the study. ROS, LFF, AMLBS and DFBC collected data. YWC, EHGL, MCM and ACP analyzed and interpreted data. ROS, LFF, AMLBS and DFBC drafted the manuscript. YWC, EHGL, MCM and ACP revised and edited the manuscript for important intellectual content. All authors approved the final version of the manuscript.

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Abstract

COVID-19 pandemic implied new biosafety recommendations to avoid dissemination of SARS-CoV-2 virus within healthcare centers. Changes on recommended personal protective equipment (PPE), decontamination protocols and organization of patient demand resulted may result in cost variation. Based on this, the present study aimed to evaluate the economic impact of new biosafety recommendations for oral healthcare assistance during COVID-19. An Activity Based Costing evaluation was used to calculate the acquisition of PPE and decontamination solutions recommended for dental practice during COVID-19 pandemic in Brazil. PPE and decontamination solutions quantity and frequency of use were based on the newly COVID-19 recommendations. Costs (in Brazilian Real – R$) for biosafety recommendations pre- and post-COVID-19 were outlined and calculated for each patient, service shift and year. A sensitivity analysis considered 20% to 50% variation of direct costs. Previously to COVID-19 pandemic, direct costs of biosafety recommendations consisted of R$0.84 per patient, R$6.69 per service shift and R$3,413.94 per year. Post-COVID-19 costs of biosafety recommendations resulted in R$16.01 per patient, R$128.07 per service shift, and R$32,657.96 per year. Yearly costs can vary between R$26,126.37 and R$39,189.56. The annual budget increase necessary to adopt post-COVID biosafety recommendations was R$29,244.02. Newly biosafety recommendations increased significantly the costs of oral healthcare assistance during COVID-19 pandemic. Decision making of healthcare managers must consider rational and equity allocation of financial resources.

Keywords: Costs and Cost Analysis. Health Care Costs. Oral Health. Personal Protective Equipment. COVID-19.

Introduction

New coronavirus (SARS-CoV-2) infection is associated with a serious and acute respiratory disease, which has rapidly spread around the world between the end of 2019 and the first quarter of 2020 (1,2). The disease caused by SARS-CoV-2 became known as COVID-19 and was recognized by the World Health Organization as a global pandemic (3,4). A rapid spread of COVID-19 has overcrowded hospital medical services and caused the collapse of health systems around the world (5).

COVID-19 pandemic has infected around 7.8 million people and caused 430 thousand deaths worldwide, by middle of June 2020 (6). Besides life losses and health system collapse, fighting COVID-19 outbreak also implied economical challenges for many countries. Isolation, Quarantine, Social Distancing and Community Containment were drawn as protective measures to avoid COVID-19 spread and this have been causing a worldwide reduction of economical activity (7).

Nevertheless, people are still getting sick from other ordinary diseases and prevention within healthcare centers is more than necessary. Community-use of facemasks has been suggested as a protective measures for every people and changes within personal protection of healthcare professional have also been recommended (7-9).

Considering dental caries is one of most prevalent diseases worldwide (10) and dental pain demands urgent assistance (11), healthcare must be prepared to deal with dental urgency and emergency needs, even under a pandemic scenario (12). In order to give proper assistance in the context of COVID-19 pandemic, it is necessary that dentists and healthcare centers adopt the use of level-2 or level-3 personal protective equipment (PPE), in addition to strategies for controlling aerosols (9).

Based on that, apart from regular PPE used by a dentist, new equipment and disinfection protocols are recommended for a safe practice within dental offices (8,13,14). The incorporation of those newly recommended biosafety practices might impact significantly the costs of a dental consultation during the COVID-19 pandemic. Therefore, this study aimed to evaluate the economic impact of new biosafety recommendations for dental clinical practice during COVID-19.

Materials and Methods

This study consisted on a partial economic evaluation in which the Activity Based Costing appraisal was used for calculating the acquisition of PPE and

decontamination solutions recommended for dental clinical practice during COVID-19 pandemic in Brazil. The ABC is used for strategic cost analysis that affects an organization's resource consumption, by using a micro-costing technique with a bottom-up approach (15). The methodology followed the practices recommended by CHEERS (16) and REBRATS (Brazilian Health Technology Assessment Network) (17).

The direct cost estimates, including PPE and room cleaning supplies, involved three stages: identification; quantity; and cost of the resources consumed. The resources were identified and quantified in accordance with their use in the treatment, with monetary values being attributed.

The Microsoft Excel program was used to list the items needed for performing dental treatment. A panel of specialists composed of five experienced professionals aligned and standardized the technique for public health system. The estimated portions and times were based on the responses of the expert panel and on national sanitary agency recommendation (18). There was no need to return to the experts (2nd review) to make a decision on the items surveyed.

This study considered 2 scenarios: pre-COVID and post-COVID pandemic. For pre-COVID scenario, the following assumptions were defined: a total of 8 consultations per period of 4 working hours; 2019 pricing values extracted from the Health Price Bank of the Ministry of Health. A maximum of 4 consultations per period of 4 working hours were defined for post-COVID scenario (8,13,14,18). Pricing values for post-COVID scenario were obtained from at least three online quotations made in May/2020.

Pre-COVID scenario considered the standard use of gloves, disposable mask, disposable cap, disposable gown and goggles (14). A pair of gloves is used for each patient, whilst mask, head cover and gown are used during the whole period of 4 working hours. Post-COVID scenario considered the use of standard PPE and level-2 PPE. Post-COVID scenario recommends the use of gloves, N95/FFP2 mask, disposable mask, disposable cap, disposable shoe cover, waterproof medical coat, disposable gown, goggles and face shield (8,14,18). Every disposable item is switched after each patient within the post-COVID scenario. Since a disposable mask is used over a N95/FFP2 mask, this later is used for a whole day (18).

First step detailed necessary PPE. For this purpose, the micro-costing technique was used, where the inputs were attributed to the treatment, according to

the quantity spent. In addition, the values of specific PPE were diluted according to their useful life, taking into consideration the values suggested by the manufacturers and panel of specialists.

The second step consisted of consulting the most assertive sources of information to obtain a realistic and unique national value for each item. In this step, web search involved two websites: the Health Price Bank (http://portalms.saude.gov.br/gestao-do-sus/economia-da-saude/banco-de-precos-em-saude) and the Price Panel from Ministry of Economy (https://paineldeprecos.planejamento.gov.br/). These websites present summary of prices derived from bids for material acquisition throughout Brazil. Additionally, current online quotation (May/2020) was obtained from widely used websites for professional dental products.

Costs were adjusted according to the number of PPE items used per consultation, as well as for diluted costs for permanent long-term use items (i.e.: goggles and face shield). Costs (in Brazilian Reais – R$) for biosafety recommendations pre- and post-COVID-19 pandemic were outlined and calculated for each patient, service shift (4 h) and year. A whole year consisted of 255 working days.

No discounts and corrections for inflation were used because this economical evaluation has not a temporal context. A sensitivity analysis was carried out in the two scenarios (pre and post-COVID). Pre-COVID scenario considered 20% variation. For post-COVID scenario, some items have experienced exponential price rise due to increased demand and speculation. The following items were subjected to 50% variation: gloves, N95/FFP2 mask, disposable mask, disposable cap, waterproof medical coat and fenestrated surgical field. These items most affected the cost calculation. The remaining items are considered subjected to 20% cost variation.

Results

Table 1 shows the pre-COVID values, in which daily practice required a low amount of PPE and products for personal hygiene and cleaning of the dental office. Previously to COVID-19 pandemic, direct costs of biosafety recommendations consisted of R$0.84 per patient, R$6.69 per service shift and R$3,413.94 per year (from R$ 2,731.16 to R$ 4,096.73) (Table 1). The values shown in Table 2 illustrate the scenario post-COVID, in which new PPE, equipment and cleansing solutions were

added to the scenario. Post-COVID costs of biosafety recommendations resulted in R$16.01 per patient, R$128.07 per service shift, and R$32,657.96 per year (costs can vary from R$26,126.37 to R$39,189.56).

The annual budget increase necessary to adopt the biosafety recommendations in dental healthcare post-COVID-19, was R$29,244.02. According to sensitivity analysis, this impact ranged from R$23,395.21 (more optimistic) to R$35,092.82 (more pessimistic).

Discussion

COVID-19 pandemic has seriously modified the dynamics of healthcare provision worldwide (5,8,13,14). In addition to the health and sanitary crisis, COVID-19 outbreak resulted in new biosafety protocols and novel routine of healthcare services. Such "new normal" scenario is characterized by extensive use of telemedicine, flexible deployment of the workforce, rationale use of triage, and outmost concerns to biosafety (19). Nevertheless, assistance to urgent and emergency dental needs is still frequent and necessary. In a short period of time, elective health procedures will also be resumed (19). Based on that, it is urgent to discuss the economical impact of new biosafety recommendations to dental care assistance during COVID-19 pandemic.

Results from this study shows that changes in biosafety protocols during COVID-19 pandemic increased significantly the costs of dental consultations. It was observed that costs for a unique dental consultation increased 19.05 times, based on changes between pre- and post-COVID protocols. Yearly cost of oral healthcare assistance increased 9.5 times. The increase in the number of PPE explains the increase in the price per period and, consequently, greater impact on the budget. Regardless the rise of PPE values, the post-COVID scenario imposed an increase in the number of PPE to be used. The purchase of new equipment such as a thermometer or oximeter is optional. However, they are of great importance for triage of the COVID-19 symptoms. Changes on biosafety recommendations within the dental practice may persist until a vaccine can be obtained and active circulation of the virus decrease.

This is of relevance to both public and private practices. Costs from this study were obtained from both public and private quotations. In addition, biosafety

protocols do not differ between public and private practices. Based on that, scenarios discussed in this paper are relevant to both sectors. The economical impact for the adequacy of the changes presented in this study considers only 1 dental office that previously treated 8 patients per period in the pre-COVID and will now assist 4 in the post-COVID. For private clinics, there will be an increase in expenses and a lower financial return, in view of the reduction in the number of dental consultations. For public health services, there will be a reduction in resoluteness, being a challenge for managers to organize the new demand.

Within the private practice, the costs are often transferred to the patient, which deserves to be informed about the efforts necessary to achieve efficiency under "new normal" biosafety routine. In Brazil, a public and universal health system also include oral healthcare (20). Nowadays, there is evidence of around 25 thousand dental offices in primary care and an estimated number of 58 thousand dentists within the public healthcare sector (20). The large number of healthcare centers and professionals within the public sector can imply in a huge economic investment, considering the post-COVID scenario. Seems reasonable that many municipalities are likely to close their oral healthcare services if there is no further support and increase of incentives from the federal government.

Therefore, results from this study may impact significantly the budget of public health system in Brazil. Apart from the emergency of acquiring PPE for health-workers that fight COVID-19 directly, the public health system is expected to deal the increased price of PPE. In addition, the new biosafety recommendations imply the need of acquiring more quantity and new type of PPE. This study may therefore contribute to policy makers and healthcare managers for driven a more efficient and reasonable allocation of economic resources.

This study has limitations with regards to low comparability to other countries, since prices collected for this study reproduces the economic scenario in Brazil. It is possible that prices vary according to market availability, purchase demand and taxes fluctuation. To mitigate biased analysis due to price variation, we performed a sensitivity analysis. Even though, results have shown that direct costs of post-COVID scenario are still very high compared to pre-COVID scenario, even considering the most optimistic price variation.

Future investigations might evaluate evidence on how increasing direct costs during post-COVID scenario contributed to limit population access to oral healthcare.

This study suggests that regular oral healthcare assistance during COVID-19 pandemic can become prohibitive to public health sector. Ensuring access to only urgency and emergency cases is transitory, being necessary to economically plan the resume of elective procedures in dentistry.

Conclusion

New biosafety recommendations increased significantly the costs of oral healthcare assistance during COVID-19 pandemic. Decision making of healthcare managers must consider rational and equity allocation of financial resources.

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Table 1. Description of the products and equipment, prices and sensibility analysis for the Dental Consultation, pre-COVID-19 scenario, Brazil, 2020

Material	Use	Quantity per day	Number of uses	Average price (R$)	Quantity	Net price (R$)	Total cost (R$)	Minimum (-20%) (R$)	Maximum (+20%) (R$)
Glove	PPE for Dentist and OHA	64	1	13.79	100 un.	0.14	8.83	7.06	10.59
Disposable Mask	PPE for Dentist and OHA	4	1	6.00	100 un.	0.06	0.24	0.19	0.29
Disposable Cap	PPE for Dentist and OHA	4	1	10.00	100 un.	0.10	0.40	0.32	0.48
Protective Goggles	PPE for Dentist and OHA	2	4080 (year)	10.82	1 un.	10.82	0.08	0.07	0.10
Plastic film	Protect the Surfaces	32m	16	25.4	300 m	0.08	2.71	2.17	3.25
Liquid soap	Clean Hands and Arms	20mL	32	50.30	5 L	0.01	0.20	0.16	0.24
Paper tower	Drying Hands and Arms	64	1	8.13	1000 un.	0.01	0.52	0.42	0.62
Sodium Hypochlorite Solution	Clean Floors and Walls	50mL	2	7.14	5 L	0.001	0.07	0.057	0.09
70% Alcohol	Clean the Dental Office	30mL	16	55.91	5 L	0.01	0.34	0.27	0.40
						Total per day (R$)	**13.39**	**10.71**	**16.07**
						Total per service shift (R$)	**6.69**	**5.36**	**8.03**
						Total per patient (R$)	**0.84**	**0.67**	**1.00**
						Total per year (R$)	**3,413.94**	**2,731.16**	**4,096.73**

Table 2. Description of the products and equipment, prices and sensibility analysis for the Dental Consultation, post-COVID-19 scenario, Brazil, 2020

Material	Use	Quantity per day	Number of uses	Average price (R$)	Quantity	Net price (R$)	Total cost (R$)	Minimum (-20%) (R$)	Maximum (+20%) (R$)
Glove	PPE for Dentist and OHA	32	1	41.96	100 un.	0.42	13.43	10.74	16.11
Disposable Mask	PPE for Dentist and OHA	8	1	205.67	50 un.	4.11	32.91	26.33	39.49
Disposable Cap	PPE for Dentist and OHA	8	1	24.32	100 un.	0.24	1.95	1.56	2.33
Protective Goggles	PPE for Dentist and OHA	4	2040 (year)	10.82	1 un.	10.82	0.17	0.14	0.20
Waterproof Medical Coat 30g	PPE for Dentist and OHA	2	1	15.15	1 un.	15.15	30.30	24.24	36.36
N95 or PFF2 Mask	PPE for Dentist and OHA	2	4	290.27	20 un.	14.51	3.63	2.90	4.35
Face Shield	PPE for Dentist and OHA	4	2040 (year)	35.63	1 un.	35.63	0.56	0.45	0.67
Fenestrated Surgical Drape	Protection to the face of Patient	1	1	3.78	1 uni.	3.78	30.24	24.19	36.29
Infrared Thermometer	Measuring of Temperature	1	2040 (year)	282.90	1 un.	282.90	1.11	0.89	1.33
Oximeter	Measuring of Oxygen Saturation	1	2040 (year)	141.67	1 un.	141.67	0.56	0.44	0.67
Disposable Shoe Cover	Foot Protection	24	1	39.76	100 un.	0.40	9.54	7.63	11.45
Plastic Film	Protect the Surfaces	16m	8	25.40	300 m	0.08	1.35	1.08	1.63
Liquid Soap	Clean Hands and Arms	20mL	16	50.30	5 L	0.01	0.20	0.16	0.24
Paper Tower	Drying Hands and Arms	32	1	8.13	1000 fl	0.01	0.26	0.21	0.31
Alcohol 70%	Clean Floors and Walls	50mL	8	55.91	5 L	0.01	0.56	0.45	0.67
Sanitizing Carpet	Clean the Foots	1	2040 (year)	66.27	60x40cm	66.27	0.26	0.21	0.31
Saline Solution	Clean the Nasal Cavity of Dentist and OHA	20mL	4	91.47	12 L	0.01	0.15	0.12	0.18
Chlorhexidine solution	Clean Neck of Dentist and OHA	40mL	8	20.68	1 L	0.02	0.83	0.66	0.99
Sodium Hypochlorite solution	Clean the Dental Office	50mL	2	7.14	5 L	0.001	0.07	0.06	0.09
						Total per day (R$)	**128.07**	**102.46**	**153.68**
						Total per service shift (R$)	**64.04**	**51.23**	**76.84**
						Total per patient (R$)	**16.01**	**12.81**	**19.21**
						Total per year (R$)	**32,657.96**	**26,126.37**	**39,189.56**