

Cost-benefit and fee proposal for emergency treatment protocol Covid-19 in private dental practice

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Abstract

Objective: To carry out a cost-benefit analysis of one of the most frequently performed emergency procedures in dentistry, namely restorations, using the protocol for COVID-19, and to propose a fee for the procedure. **Materials and methods:** The costs of restorations performed in a private dental center with characteristics 1.3 according to the Mount and Hume classification were analyzed, recording the direct and indirect costs, as well as the time related to the procedure. **Results:** The results show a cost-benefit ratio of 1.00/1.51. The direct cost amounts to \$ 10.29 ± 0.82, the average time used is 45 minutes and the indirect cost equals \$ 832.02, being the total cost of a 1.3 lesion resin \$ 6.52. The fee for resin in a 1.3 carious lesion is proposed to be \$25.14. **Conclusions:** The cost-benefit ratio is positive in the case study, since taking into account the new COVID-19 protocols that require the use of elements that were not commonly used before and the increase in direct and indirect costs, profitability can be achieved in the dentist's consulting room.

Keywords: Cost-Benefit Analysis; Clinical Protocols; Emergency Treatment; Coronavirus Infections; Dentist's Offices.

1. Introduction

Peru and almost all countries in the world have been affected by the SARS-CoV-2 virus, implementing biosecurity protocols for health care to control the spread of this virus. Dental care is no stranger to this demand and the establishment of specialized protocols limited to emergency treatment has had an economic impact on dentists and patients requiring care.

COVID-19 has greatly affected the population. A comparative analysis per million

inhabitants of confirmed cases and mortality due to COVID-19 in South America 107 days after the first case was reported in each country showed that Brazil has the highest number of infected persons, but in cases per million inhabitants it is below Peru (8000) and Chile (14000), and Peru and Chile have 270 deaths per million inhabitants (Berrocal et al., 2020). Micro, small, and medium-sized enterprises, which are often of vital economic importance to countries, have been particularly affected by the pandemic (Jain & Siddiqui, 2022). Declining tax

compliance has been reported in Indonesia, despite tax incentives set by the government (Mahpudin et al., 2022). Another aspect to consider is the effect on mental health. A systematic analysis looked for the effect of the pandemic on psychological health and found that confinement and social isolation by quarantine impacted the physical and mental health of people with an increased prevalence of various mental health problems such as anxiety and depression (Barde et al., 2022; Barros-Bastidas, Turpo, 2020). Concerning the psychological impact of COVID-19 on Generations X, Y, and Z, Generation X was the most prepared to cope with social distancing and quarantine (Mutreja & Patil, 2022).

It has been interpreted that there is a greater risk of COVID-19 transmission in dentists due to the proximity of face-to-face work with patients, exposure to saliva, blood, and other body fluids, and the use of sharp instruments in their daily care (Ge et al., 2020; Bennadi, 2022). In addition, the stomatological practice is potentially at risk in the COVID-19 pandemic because of the body area where they work, despite this, it is the duty of the stomatologist to fulfill his role as a health professional considering the biosafety standards established in by health institutions (Meng et al. 2020). A COVID-19 occupational risk estimation with case data by an occupational group in Washington USA highlighted that half of the riskiest occupations are in the dental field (Zhang, 2021).

The current situation, at the national and international level, created by COVID-19, leads the entire dental community to seek scientific information to generate useful protocols for the prevention and control of the disease in the dental clinic, considering that the transmission of SARS-CoV-2 is mainly by air, and the correct use of personal protective equipment, proper hand washing, disinfection of the dental environment and proper sterilization of the instruments used help to drastically reduce the transmission of the virus (Peng et al., 2020). Patients who require some type of oral care have found it necessary to use new methods for the management of their oral ailments such as teleodontology (Rahman et al., 2020). One of

the most important concerns is the early detection of this disease, with the use of non-invasive tests such as viral count in saliva being quite promising (To et al., 2020; Sabino-Silva et al., 2020). However, this same saliva is the most common means of transmission of COVID-19, making stomatological work the riskiest due to the aerosols that are frequently produced (Ge et al., 2020; Peng et al., 2020, Izzetti et al., 2020; Coulthard, 2020).

The first dental procedures to be reactivated were those considered emergency and urgent with new care protocols, using the American Dental Association (ADA) protocol adopted by the Peruvian Ministry of Health (2020), which announced that only emergency cases should be limited to dental care. The use of alcohol-based disinfectants and sodium hypochlorite is considered to be effective against the SARS-CoV2 virus on surfaces (Kampf et al., 2020; Kratzel et al., 2020). The mandatory use of personal protective equipment (PPE), preventive measures such as displaying communication posters about COVID-19, adoption of mechanisms to establish potential patients with symptoms before dental visits, interruption of dental treatment for people with COVID-19, and reduction of routine checkups, as well as extreme measures for the disposal of waste from dental care have also been considered, reaching these recommendations to university dental practices (Barabari & Moharamzadeh, 2020).

Multiple studies have identified that the COVID-19 pandemic was negatively affecting their dental practices due to lack of clarity in COVID-19 protocols, lack of patient awareness, high cost of personal protective equipment (PPE), increased overhead, difficulties in ergonomics when treating patients while wearing PPE, the unwillingness of patients to pay higher charges for treatment according to the new protocols, and fear of contracting COVID-19 (Aurlene et al., 2021).

Schwendicke et al. (2020) evaluated the economic impact of policies to combat COVID-19 on German dental practice between March and April 2020, showing a reduction in care in several specialties: prevention (-80 %),

periodontics (-76 %), and prosthetics (-70 %), indicating that overall revenues decreased by 30 %. Çelik & Cansever (2021), evaluated the working conditions of dentists and the policies implemented specifically during the COVID-19 pandemic, including the effects of working in private or governmental practice in Turkey, 734 dentists participated in the study, of which 47% examined five or fewer patients per day during the pandemic, furthermore 80.8 % experienced anxiety when examining patients during the pandemic.

Taking into account the above, the study was proposed to determine the cost-benefit for the treatment of a Peruvian dental emergency using the COVID-19 protocol, using it as a means to perform a composite restoration in a carious lesion 1.3 in a private dental center and to make a proposal for a fee for this procedure.

2. Article structure

2.1. Cost-benefit analysis

The payment of services such as rent, electricity, water, telephone, personnel salaries, and others are known as indirect costs. The total cost or production cost of dental treatment is the sum of the direct cost plus the indirect cost for the execution of the service. The cost-benefit is obtained by adding the expenses generated by the provision of professional services, adding a percentage of profit, and dividing the number of hours worked by the number of hours worked.

2.2. Treatment scheme

Mount and Hume presented an alternative classification to that of G. V. Black, which had been used for more than a century. They used two types of indicators: sites and stages. There are three caries susceptibility sites ranging from 1 to 3, which are areas where bacterial plaque accumulates more easily. Each site can have five stages ranging from 0 to 4, according to the extent and progression of caries based on anatomical and radiographic findings (Mount & Hume, 1997):

Zone 1: Caries starting in pits and fissures; pits on occlusal, vestibular, and lingual surfaces on

all teeth, and any other defects on coronal plane surfaces (except proximal surfaces).

Zone 2: Caries with onset on proximal sides of all teeth.

Zone 3: Caries with onset on the crown or root at the cervical level of all teeth.

The 5 stages of caries progression are:

Stage 0: Active lesion without cavitation, which does not require intervention.

Stage 1: Lesion with superficial alterations that have advanced to a level where remineralization is not possible and restorative treatment is indicated.

Stage 2: Moderate lesion with localized cavitation that has advanced into the dentin, without weakening of the cusps, and that will require restorative treatment.

Stage 3: Enlarged lesion with extended cavitation that has advanced into the dentin causing cusp weakness and will require restorative treatment.

Stage 4: Lesion that has advanced and destroyed one or more cusps and needs restorative treatment.

For this work, lesion 1.3 was considered according to the classification of Mount and Hume (1997), so that carious lesions rehabilitated with composite restorations evaluated in the clinic are common or of the same class and that due to the discomfort they produce can be considered urgent (Figure 1).

Clasificación de Mount y Hume

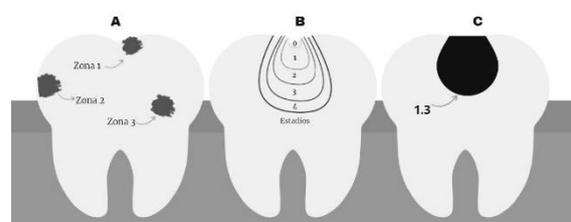


Figure 1: Mount and Hume's classification: A) Zones. B) Stages. C). Type of lesion treated in the study.

3. Method

The quantitative research approach followed a prospective, cross-sectional, descriptive, and observational type of study.

3.1. Sample / Participants

The population consisted of all adults who required composite restorations in carious lesions 1,3 at the Perfect Smile Dental Center in the city of Chachapoyas during the COVID-19 pandemic in the year 2020.

To establish the sample size of the treatment observations, the formula was used to estimate the population mean in a descriptive study with an unknown population size, due to the current pandemic situation, which ended up with a sample equal to 20 patients.

3.2. Data collection procedures

3.3. Permission was requested for the execution of the research project at the institution where the project would be carried out. The dentist in charge of performing the resin treatments was informed of the nature of the research and his or her informed consent to participate in the research was requested. All the materials and instruments used from the time the patient enters the institution until he/she leaves, as well as the time it will take to perform each task besides the treatment to ensure biosafety against COVID-19, were observed and recorded.

3.4. During the resin treatments performed by the operating dentist, all the material used was observed and recorded, as well as the treatment execution time.

Then the average of the material used, personal protective equipment, and the units and/or portions used by the operator at the time of performing the resin restoration on his patients was calculated. Subsequently, a form was filled out with all the data obtained from the clinical history of the Perfect Smile Dental Center.

3.5. Data analysis

Once all the information was obtained, it was processed on an Intel Core i3 laptop with

Windows 10 Pro, using Microsoft Excel 2016 spreadsheets and the SPSS version 26 statistical software.

4. Results

4.1 Cost-Benefit Analysis

The Cost - Benefit for the emergency treatment with COVID-19 protocol of a carious lesion 1.3 with composite in the Centro Odontológico Perfect Smile S.A.C. obtained a profitability index of more than 1, therefore, there is profitability of 1.51 soles for every 1.00 sol. The number of daily visits is assumed to be an average of 10.66, since the time per visit is 45 minutes, and therefore, dividing 8 hours of daily attention by 0.75 hours that each visit lasts, $8/0.75 = 10.67$ is obtained. The cost benefit is what is expected to be collected soon and is related to the investment; a fee of 60 soles for each treatment has been assumed, with 8 daily visits for 22 days (Table 1).

Table 1: Cost - Benefit for emergency treatment with COVID-19 protocol with composite in private practice, Chachapoyas, Peru 2020.

Indicator	
1. Monthly production cost	$39.72 * 10.66 * 22 = 9321$
2. Expected revenues	$60 * 8 * 22 = 14080$
Cost-Benefit	$C/B = \frac{14080}{9321} = 1.51$

Source: Perfect Smile Dental Center, Chachapoyas.

1. Cost per treatment*monthly number of treatments*number of days per month.

2. Treatment fee*expected number of treatments per month*monthly treatments*number of days per month.

C/B = Cost Effectiveness Ratio

3.2. Direct Cost

The unit and/or portion used was divided from the total to obtain the cost of the unit and/or portion used in the treatment. The direct input cost of resin 1.3 averages \$ 6.33 ± 0.11 , which is equivalent to S/. 25.72 ± 0.42 (Table 2).

Table 2: Direct cost in emergency treatment with COVID-19 protocol with composite in private practice, Chachapoyas, Peru 2020.

Indicator	Value: soles	Value: Dollars USD
Mean	25.72	6.33
Standard deviation	0.42	0.11
Minimum	25.10	6.35
Maximum	27.07	6.85

Source: Centro Odontológico Perfect Smile, Chachapoyas

3.3. Production time

The average time used in the repair of a 1.3 resin lesion is 45 minutes with a standard deviation of 2.53 minutes (Table 3).

Table 3: Time of care per patient in emergency treatment with COVID-19 protocol with composite in private practice, Chachapoyas, Peru 2020.

Indicator	Value: minutes	Value: hours
Medan	45.00	0.75
Standard deviation	2.53	0.04
Minimum	41.00	0.68
Maximum	51.00	0.85

Source: Centro Odontológico Perfect Smile, Chachapoyas

3.4. Indirect Cost

The indirect cost of emergency treatment with COVID-19 protocol is \$ 832.02 equivalent to S/.3286.47 (Table 4).

Table 4: Indirect cost in emergency treatment with COVID-19 protocol with composite in private practice, Chachapoyas, Peru 2020.

Indicator	Value: soles	Value: Dollars USD
Monthly office expense	3286.47	832.02
Number of hours worked per month in office	176 hours	
Spending/hour, in the office	18.67	4.73
Total indirect cost per treatment (No. hours per treatment * Expense / hour: 0.75 hours* 18.67 soles)	14.00	3.54

Source: Centro Odontológico Perfect Smile, Chachapoyas

3.5. Total Cost

The total cost of a 1.3 lesion resin at the Dental Center is \$6.52, which in soles has a value of S/. 25.72. (Table 5).

Table 5: Total or production cost, in emergency treatment with COVID-19 protocol with composite in private practice, Chachapoyas, Peru 2020.

Indicator	Value: soles	Value: Dollars USD
Direct cost	25.72	6.51
Indirect cost	14.00	3.54
Production cost	39.72	10.05

Source: Centro Odontológico Perfect Smile, Chachapoyas

3.6. Fee Proposal

For the research a tariff was used based on the equation proposed by the Colegio de Odontólogos Distrito I de Buenos Aires (La CORA), Argentina; since it presents a formula that is applicable and necessary for this study (Fuentes et al., 2020).

The price to be offered for a composite filling at the Centro Odontológico Perfect Smile S.A.C.,

under real conditions, was obtained by applying the following equation:

$$\text{Fee} = \text{Cost of Production} \times 100/44$$

The amount of \$25.14, equivalent to S/. 99.30 (Table 6), is proposed as the rate for injury resin 1.3.

Table 6: Fee proposal for emergency treatment with COVID-19 protocol with composite in private practice, Chachapoyas, Peru 2020.

Indicator	%	Value: soles	Value: USD
Cost of production	44.0	39.72	10.05
Fees	56.0	59.58	15.08
Proposed fee	100.0	99.30	25.14

Source: Centro Odontológico Perfect Smile, Chachapoyas

5. Discussion

The pandemic caused by covid-19 has had an impact not only on the health of the population but has also significantly affected the economy of the population, without excluding the work performed by dental surgeons.

When analyzing the results of costs, both direct and indirect, it is observed that the treatments follow the same pattern in the way of repairing a 1.3 resin lesion, which means that the cost is not very dispersed among treatments. It is also observed that the indirect costs, where the covid-19 protocols are considered, influence the price increase.

The direct cost of inputs to make a resin in a 1.3 lesion in the Perfect Smile Dental Center during the pandemic time was \$ 6.33 ± 0.11 which in Nuevos Soles is equivalent to 25.72 ± 0.42. This value is quite different from that obtained by Castillo in 2014, which had a cost of \$ 3.448 (S/. 9.517), and by Guevara in 2016, which considered a cost of \$ 4.05 (S/. 13.76). This shows that the direct cost of restoration, in general, has increased during the pandemic, probably due to the demand for the use of greater biosafety elements and the difficulty of commercialization of supplies, confirming the increase in dental costs indicated by several authors who indicate the same reasons for the variation in cost (Cazares et al., 2021; Pares-Ballasco and Castro-Rodríguez, 2020; Miguelena-Muro et al., 2021). Other dental procedures have also seen their direct costs

increase, such as third molar exodontia, which has increased its costs in general, and per-patient biosafety measures reaching the sum of \$106.00 (Enriquez et al., 2022).

The indirect cost at the Perfect Smile Dental Center in the city of Chachapoyas was \$ 832.02 (S/. 3286.47). Comparing what was obtained with the \$ 117.75 (S/. 325) obtained by Castillo (2014), it seems that the valuation is out of focus. This is true because this author's research was done in a public institution subsidized by the Peruvian State, while this research was conducted in a private institution. Similarly, Guevara (2016) obtained an indirect cost of \$ 4.00 (S/. 16.74), in the Private Hospital of Peru in Piura, which does not consider costs such as rent because it is private. However, it is important to note that those dentists who engage in private practice have to consider within their expenses the payment of services and others such as rent of premises, which will increase their costs and more so in times of pandemic, where only emergency treatments can be performed. Landaverde (2020) believes that special consideration should be given to fixed costs, since they do not depend on the level of activity of the company, but must be considered even when the company is not working.

The total cost of making a 1.3 lesion resin at the Centro Odontológico Perfect Smile S.A.C. is \$10.05 (S/. 39.72). Castillo (2014) obtained a production cost of \$3,581 (S/. 9.884), while Guevara (2016) \$8.00 (S/.30.50), which compared to this evaluation is a considerably lower figure. Other studies also show that the

increase in costs has been necessary for dental professionals to be able to continue care with the new conditions imposed by the pandemic (Cazares et al., 2021; Pares-Ballasco & Castro-Rodríguez, 2020; Miguelena-Muro et al., 2021; Enríquez, Palacios & Vargas, 2022). Added to this is the fear that people had of undergoing treatment during the pandemic, which caused potential patients to try to postpone any dental treatment, affecting the livelihood of private dentists, despite the closure of public dental services.

The average time required to repair a 1.3 carious lesion with resin was shown to be approximately 45 minutes. In the study by Castillo (2014) where the operators were students with less experience, it was 55 minutes, which turns out to be a similar time. Guevara (2016) in contrast, had an average time of 23.33 minutes for the completion of a resin. This is because the biosecurity measures that have been implemented for patients to enter the care environments have varied and more time is required in preparing the patient, as well as the measures that dental surgeons and their work team must take to prepare for the care and to dismiss patients.

The proposed fee for performing a 1.3 carious lesion resin as an emergency procedure during the pandemic reached \$25.14 (S/. 99.30). This is between 4 and 5 times more than what was proposed by Castillo (2014) who considered \$ 8,138 (S/. 22,463). Similarly, the National Commission for Cost Analysis in Dentistry (CONACEO), indicates in 2018 that the list price of a simple light-curing resin filling is S/. 44.80 and that the fashion is S/. 40.00. The Consumer Price Index Bulletin (2020), conducted by the National Institute of Statistics in the city of Chachapoyas, shows that the average cost for the realization of a restoration in 2020 was 50 soles and for 2021 is 70 Nuevos soles. Similarly, the study by Hilario (2021) to determine the most commonly used dental material in the city of Lima in 2020, in which, in addition to indicating that the most commonly used material in dental restorations are composites, indicated that the prices of dental surgery with resin had an average cost of 70 soles for class I restorations. This difference

shows that, although the results of the study are higher than the averages, dentists have inevitably considered it necessary to increase the cost of general restoration.

6. Conclusions

The new protocols and the restrictions established due to COVID-19 have increased the costs of dental treatment, also considering the increase in time that the application of these protocols demands for the individual attention of the patients. To this has been added the internal crisis in Peru and international economic complications derived from the pandemic. However, despite these difficulties, it is possible to have profitability in the dental office, as shown by the cost-benefit analysis for the emergency treatment with COVID-19 protocol of a carious lesion 1.3 with composite, where a profit of 1.51 soles for every 1.00 dollar is achieved. The proposed resin fee for a 1.3 carious lesion is \$25.14, which is equivalent to S/. 99.30 in pandemic time.

Furthermore, it is proposed to subsidize the cost of PPE and infection control agents to reduce the cost of dental treatment. It is also recommended that the government, through health institutions, should monitor dental offices to ensure compliance with the COVID-19 protocols. Finally, new research should be developed, including the fluctuation of prices derived from the pandemic and the economic instability suffered by Peru and the world.

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