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ANALYSIS FROM TECHNOLOGICAL APPLICATIONS ON POST PANDEMIC DENTISTRY: AN ANALYSIS OF COSTS AND FEES IN PERU

ANTONIO ARMANDO AGUIRRE-AGUILAR[1] , DANIEL ALONSO JUÁREZ MERINO[1] , FRANZ TITO CORONEL-ZUBIATE[2], TERESA ETELVINA RÍOS-CARO[1] , AUGUSTO ALBERTO AGUIRRE-AGUILAR [1]

[1] Universidad Nacional de Trujillo, Peru
[2] Universidad Nacional Toribio Rodriguez de Mendoza de Amazonas, Peru

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Dental Economics
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ABSTRACT

After the COVID-19 pandemic, attempts have been made to return to the old normality, but the changes have affected dental services. It was sought to determine the production cost and rate proposal for a restoration with 1.2 resin in a permanent tooth and to make a rate proposal. The results obtained from 26 samples indicated an average direct cost of $2.42 and an average indirect cost of $4.02 in an average execution time of 21:39 minutes. The average production cost is $6.45 and a fee amount of $14.65 is proposed.

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1. Introduction

The world economy was considerably affected by the consequences of the COVID-19 health emergency. In Europe, the European Commission (EC) and the European Investment Bank (EIB) reported that the effects of the pandemic had a strong impact on trade and job creation (Albino et al., 2022). On the other hand, in Latin America there was already a depleted public exercise that not only had an impact on the economic and commercial level, but also on health, leading in some countries to the collapse of health systems (Gangas, 2022) (Pereira et al., 2022). The International Labor Organization (ILO) stated that Latin America and the Caribbean were the most affected in terms of labor income (Gonzales et al., 2022).

Peru was no stranger to the effect of the pandemic, the arrival of COVID-19 only further dazzled the reality of our precarious health and economic system, in addition to exacerbating the impact on the country's most vulnerable population (Garcés, 2022). By 2018-2019, prior to the pandemic, Peru presented a score of 55 in the International Health Regulations Annual Self-Assessment Report, placing it 108th out of 183 countries (Gozzer et al., 2020). In addition, many health services were forced to limit their activities to emergency and urgent procedures, including dental services, which, given the way in which the profession is practiced, was rated as one of the professions with the highest risk of contagion during the pandemic Bastidas (2019), (Pares & Castro, 2020).

The National Institute of Statistics and Information (INEI), in its document "Peru: Evolution of Monetary Poverty 2011 - 2022", reports that in 2022, 9 million 184 thousand people, 27.5% of the country's population, will be living in poverty. According to this study, the cost of the basic consumption basket is $111.90 per person per month. It also states that about 72% of the population works directly in the informal sector. All this contextualized in a region where there is a high cost of medical care, most of which is privatized and inaccessible and unaffordable for a large number of Peruvians, whose last option is the limited and forgotten public health system. This condition causes people to prioritize spending on food to the detriment of health care (INEI, 2022).

Peru is one of the most afflicted countries in terms of oral health, being dental caries the most prevalent disease with 90.4% according to the Ministry of Health (MINSA) in a study conducted in 2002, a value that is very high among Latin American countries, which according to the WHO is 60% prevalence (MINSA, 2005), which makes dental restorations as the most frequent procedures performed in dental offices in Peru.

This demand has generated that patients are increasingly attracted to the idea of preserving and saving an affected tooth, seeking harmony and esthetics in their restorations and that, together with a correct prevention, they develop a preventive conscience, changing the old prejudices of extracting a tooth at the slightest symptom of discomfort or pain (Saldarriaga & Peláez, 2003). Thus, dentistry has developed an increase in the demand for resin restorations, becoming one of the dental treatments with the greatest supply and demand, but still manifesting a notorious deficit of accessibility to vulnerable populations and elderly people of low economic resources (Meller, 2008) who, affected even more by the pandemic, see every day more distant the possibilities of being able to access a quality dental service.

Unfortunately, one of the main problems is the economic value that is given to this procedure, which is often established with empirical references, discounts or promotions in order to get more attention, in an economic situation where patients give little or no priority to dental treatment basically because of their limited financial resources (Carrillo, 2021). This becomes a permanent problem in the dental society, given the constant experience of the repetitive cycle of dental fillings, taking into account that they are the procedures that represent a greater part of the dentist's working time (Bardales, 2019). This is why it is important to establish costs through an analysis to guarantee the transparency and sustainability of our services and that also represents a fair profit margin for the professional, without affecting the quality of the service provided to the patient (Alva & Aguirre, 2009).

However, the implementation of these supplies also meant making greater investments in terms of material, which led to an increase in the price of most treatments, which resulted in a price difference so marked that it was beyond the possibilities of most patients and forced the professional to make a measured use of financial resources (Cázeres et al., 2021).

Offering affordable prices to users implies reducing the amount of each of the treatments we offer, reducing our operating costs; a lower operating cost will mean a decrease in our fees offered for

treatments, thus reducing the gap between people and our profession, reflected in an increase in the number of patients who can afford our services (Alva & Aguirre, 2009).

Some authors (Madrid et al., 2006), argue that these cost studies should be considered as a tool to support management when planning our services and not be seen as a simple treatment fee schedule for the public. This requires a series of evaluations of expenditures to determine how the available resources have been handled and spent.

The dentist is a health professional who is prepared and trained to provide services to the community in a systematic, technical and above all scientific way for the promotion, prevention, treatment and rehabilitation of oral health, which he/she obtains during a stage of undergraduate preparation. (Bardales, 2018) However, despite all the knowledge obtained, the professional, upon graduating from university, does not know how much to value the services he/she will provide, much less why and on what basis. It is then when the professional begins to generate his own work fees, but taking as a reference outside models that do not have any system or fee determination program, and it is then when the rates and prices begin to be established without a correct analysis (Gamarra 2020).

Cost studies seek to determine the exact costs that are used for the execution of a utility or procedure. In dentistry, the direct cost represents the monetary value of the inputs that are invested for the direct execution of a dental treatment. While the indirect cost would represent all the money that goes out as an element surrounding the execution of the treatment, this implies the monthly payment for the premises, electricity, water, telephone service, salaries of the workers, etc. (Alva & Aguirre, 2009).

The cost of a dental procedure has a direct connection with the expense of the material and to obtain the maximum performance of a material, it is necessary to reduce all those occasions in which it is used too much, this rate of material use is going to be conditioned by the skill of the dentist to manipulate it and the amount of material needed according to the type of restoration (Lamas et al., 2015).

To identify the types of resin restoration there are various classifications; Mount and Hume propose a classification scheme taking into account not only the location but also the size of the lesion. Thus, according to their location we can find zone 1, zone 2 and zone 3, which indicate a lesion on occlusal surfaces, proximal lesions and cervical lesions respectively.17 As for the depth, they differentiate 5 levels. Size 0 for an initial lesion, size 1 for superficial lesions in enamel, size 2 for lesions in dentin, but without cusp involvement, size 3 for lesions in dentin with cusp undermining and size 4 for advanced lesions with cusp destruction (Mount et al., 1997).

The Dental College of Peru, performs in the period 2017 - 2018 an analysis of costs and fees for dental treatments in a total of 230 simple resin restorations, obtaining an average list price cost of $12.04, with a minimum of $6.72 and a maximum of $53.77 (COP, 2018).

In Cuenca (Villavicencio et al., 2017), they point out that the rate of use of dental inputs in dental treatments, including dental operatory materials is 31 servings, with a rate ranging from US$0.40 to US$1.58 per serving. dental adhesive with 221 applications and phosphoric acid with a rate of use of 35 servings equivalent to US$0.20 per serving.

On the other hand (Pereira & Alarcon, 2011) conducted a study of costs and fees for dental services at the Central University of Ecuador. They determined that regular patient care is for 3 hours with income to the dentistry area of $8.22 and does not cover the unit cost per area which is $32.27.

In Trujillo (Coronel-Zubiate et al., 2022) conducted a cost-benefit analysis in COVID times for a 1.3 restoration and determined a direct cost of US$10.29, the indirect cost of US$3.54, obtaining a production cost of US$10.05 in an average time of 45 minutes, proposing a rate of US$25.14.

In the city of Piura (Guevara, 2016), he specified that the direct cost for a class 1.2 resin was US$4.05, the indirect cost was US$4.00, obtaining a production cost of US$8.00, all this with an average working time of 23.33 minutes.

Likewise (Basilio, 2014), obtains the production cost and proposed fee for a restoration with amalgam 2.2, resulting in an actual fee of $6.32 and an average time of 58 minutes for the execution of the treatment.

That same year (Castillo, 2014), in Trujillo, establishes a production cost for a 1.2 lesion resin at the Stomatology Clinic of the National University of Trujillo of US$3.58 and proposes a cost rate for a 1.2 lesion resin of US$8.13.

Finally (Alva & Aguirre, 2009), determine the real cost of a class 2 amalgam restoration at an average of US$4.38, while the ideal cost of treatment is US$8.72. In turn, they propose an actual fee of US$9.97 and an ideal fee of US$19.82.

It is relevant to continuously update this data, taking into account the constant change in the economic situation of the country, a country where cost studies in dentistry are very scarce and where people affected by the pandemic leave oral health as the last priority, mainly due to economic constraints, and where dentists continue to set prices without a correct cost analysis with rates far from the economic possibilities of most people. That is why it is important to propose prices in accordance with reality, especially in the post-pandemic period, in which there is still a certain degree of subjectivity in price setting. With all the above mentioned, this research was carried out with the purpose of determining the cost of production and proposing a rate for a resin restoration in a carious lesion 1.2 in a permanent tooth in a Hospital in the north of Peru.

Methodology

An applied study was carried out because of its orientation and it was prospective, cross-sectional, descriptive and observational. The population consisted of patients who required restorative treatment with 1.2 resin in permanent teeth at the dentistry office of the Hospital Popular Señor Cautivo in Piura in 2022.

To estimate the sample size, the formula provided by sampling was used when the interest is to calculate the population mean in a descriptive study, resulting in a total of 26 procedures to be observed, which were chosen by simple random selection.

In these procedures, the direct cost variables were evaluated, representing the inputs and portions used in the treatment, which were recorded according to quantity, weight and execution time on a numerical data collection sheet.

On the other hand, the indirect cost variable represented all the expenses incurred as a surrounding element during the treatment, which implied expenses for electricity, water, wifi, salaries, insurance, etc., and which were recorded respectively in another numerical data collection sheet. The sum of both costs resulted in the cost of production on which a corresponding rate was proposed.

A letter was sent to the institution requesting permission to carry out the project and the dentists of the dental office were informed of the nature of the research, thus obtaining their permission to participate in the research by means of an informed consent form. After that, the list of appointments for the month was reviewed and the patients were selected, attending each of the appointments to collect the data during the execution of the treatment.

Each patient was asked if they wanted to volunteer for the research and once the informed consent was signed and permission was obtained, the amount of inputs and portions, as well as the execution time used by the dentist during the treatment of a 1.2 resin, were recorded on a numerical data collection sheet, while the indirect costs that were used in the execution time of each restoration were calculated on another sheet.

The data obtained were taken to the Industrial Engineering laboratory of the Universidad Tecnológica del Perú (UTP), where a 4-digit analytical balance, OHAUS model AX 124/E, was used to calculate the portions of inputs used, whose weight was expressed as a monetary value.

Finally, the information was processed in Microsoft Excel 2016 spreadsheets and the statistical package SPSS v.25 using descriptive measures mean and standard deviation using a confidence level of 95%.

4. Results

In this prospective, cross-sectional, descriptive and observational study, a total of 26 restorations made with resins in type 1.2 cavities were evaluated, using as a reference the dentistry service of the Hospital Popular Regional Señor Cautivo de Piura in Peru during 2022.

The average direct cost of consumables used in a 1.2 resin restoration, suggesting that on average $2.17 is spent per restoration, with a minimum of $2.25 and a maximum of $2.90, depending on the amount of material used in each of the restorations (Table 1).

Table 1: Direct cost for a 1.2 resin restoration, Piura 2022.

Cost of inputs	Soles	Dollars
Media	S/. 9.32	$. 2.17
Standard deviation	S/. 0.60	$. 0.15
Minimum	S/. 8.64	$. 2.25
Maximum	S/. 11.11	$. 2.90
Confidential interval	S/. 9.08 - S/. 9.57	

Source: Hospital Señor Cautivo logistics area.
Dollar exchange rate according to BCRP - February 2023: S/. 3.84

The average estimated time spent by the office dentists to perform a restoration from the moment the patient enters the office was 21:39 minutes with a minimum of 15:59 minutes and a maximum of 33:55 minutes, with the understanding that this variation was directly related to extrinsic factors such as the patient's oral anatomy, internal characteristics of the oral environment and the psychosomatic state of the patient (Table 2).

Table 2: Average time for a restoration with Resin 1.2, Piura 2022.

Indicator	Weather
Media	21:39
Standard deviation	3.55
Minimum	15:59
Maximum	33:55

Source: Hospital Señor Cautivo logistics area.

In terms of indirect costs, an average of $4.02 was observed for the cost of carrying out a restoration with resin. The expenses included staff salaries, wifi, water, electricity, telephone, but omitted the payment of rent as it was the company's own premises. It also had a minimum of $2.97 and a maximum of $6.21 (Table 3).

Table 3: Indirect cost for a restoration with Resin 1.2, Piura 2022.

Indirect cost	Soles	Dollars
Media	S/. 15.42	$. 4.02
Standard deviation	S/. 3.25	$. 0.85
Minimum	S/. 11.41	$. 2.97
Maximum	S/. 23.84	$. 6.21

Source: Hospital Señor Cautivo logistics area.
Dollar exchange rate according to BCRP - February 2023: S/. 3.84.

The average production cost for a restoration with resin 1.2, which results from the sum of the direct cost and the indirect cost in an average run time of 21:39 minutes, reached a value of $6.45 (Table 4).

Table 4: Production cost for a restoration with Resin 1.2, Piura 2022.

Cost of Production		Soles	Dollars
Direct cost	S/. 9.32		
		S/. 24.74	$.6.45
Indirect cost	S/. 15.42		

Source: Hospital Señor Cautivo logistics area.
Dollar exchange rate according to BCRP - February 2023: S/. 3.84

Finally, the fee proposal for a 1.2 resin restoration, based on the production cost obtained and using the equation proposed by the Colegio de Odontólogos Distrito I de Buenos Aires, Argentina (Ortiz, 2002), which allows us to calculate the fee per treatment, resulted in a fee of US$14.65 per restoration.

Table 5: Fee proposal for a Resin 1.2 restoration, Piura 2022.

Indicators	TARIFF PROPOSAL		
	%	S/.	$
Cost of production	44	S/. 24.74	$. 6.45
Fee	56	S/. 31.49	$. 8.21
Total fee	**100**	**S/. 56.23**	$. 14.65

Source: Hospital Señor Cautivo logistics area.
Dollar exchange rate according to BCRP - February 2023: S/. 3.84

5. Discussion

The results observed during the development of the research show the drastic change that the area of dentistry has undergone as a result of the consequences of the COVID-19 pandemic in our country. Changes that contrast with the old dental practice and that today demand the need for a reinvention from the educational process to achieve a new education that is in accordance with the new normality that is being experienced in our field (Curay et al., 2021), and that from the economic point of view has generated an instability that directly affects dentists and patients. It is shown, for example, that direct expenses or supplies have definitely increased in value compared to the reports reported by other investigations, and this is basically due to the need to implement biosafety elements such as aprons, caps, hoods and even the change of common masks for KN95 masks, which should not only be used by the professional, but also for all the assisting personnel and incoming patients (Mattos-Vela et al., 2022). This generated an increase in investment, without taking into account the other consumables routinely used in a dental restoration, such as articulating paper, saliva ejectors, microbrush, gloves, etc., which are used in 100% of the treatments and in the same quantity.

Another factor associated with this variable is the economic impact it had, since not only did we have to deal with the purchase of more inputs to carry out a restoration with resin, but we also had to face the increase in price that most materials presented due to the economic instability that occurred in Peru (Yáñez et al., 2022). However, indirect costs were also negatively affected, generating an increase in the cost of rent, water, electricity and other basic services that are used in the dental office, with the exception of those dental offices where there is an omission of rent either because they are their own premises or because of public institutions where indirect costs are covered by the state (Castillo, 2014).

All the new biosafety protocols that had to be installed prior to the start of care also generated an increase in the time taken to perform procedures. However, this variation in execution time is also related to the psychosomatic condition of the patient, such as anxiety, pain threshold, internal anatomy of the oral cavity, limited mouth openings, elevated mouth floors or sialorrhea, and also influenced by the operator's skill during the treatment and the technique used (Castillo, 2014).

In addition, as the pandemic was losing its impact, many clinics and institutions began to discontinue some biosecurity measures, something that can be seen in hospitals and other health centers, where the execution of many resins is performed without using absolute isolation, in order to expedite the care between patient and patient given the high demand and the need to attend to all others waiting.

Therefore, the cost of production found in our research, equivalent to $6.45 was very similar to that reported by other authors during the pandemic period (Coronel-Zubiate et al., 2022), but very different from the cost of production found by research years before the pandemic (Castillo, 2014). This difference between one stage and the other is very marked, and it has also forced us to raise our fees in order to weigh the increased investment we now make in the purchase of materials, and leads us to modify our fees, mainly by raising them and making them mostly inaccessible to the Peruvian population, who in the face of the price increase generated by the pandemic, choose to prioritize food and other periodic charges over their oral health (Gonzales et al., 2022).

Despite this, the proposed fee established for a restoration with resin 1.2 was $14.65, which was generated taking as a reference the equation proposed by the College of Dentists District I of Buenos Aires, Argentina (Ortiz, 2002), which also takes into account the cost of production that would be influenced by a higher expenditure of inputs and adjacent services. It is worth mentioning that the dental fee is obtained from the fees received by the professional in which some professionals also include the different training or studies carried out (COP, 2018).

The consequences of the COVID-19 pandemic have led to a climate of uncertainty in both the economic and health sectors, and have resulted in a limited professional practice where it is difficult to provide quality service to the patient, offering affordable prices without compromising our fair profit margin (Alva & Aguirre, 2009).

6. Conclusions

We find ourselves in a reality where the population is strongly affected by economic instability, which limits us financially to have access to quality dental services, and even less to services where the rates are established conscientiously by means of a cost analysis, but are established with empirical references, generating price speculation and unfair competition among professionals. We concluded that the average direct cost for a restoration with class 1.2 resin at the Hospital Popular Señor Cautivo was 3.44 dollars, the average indirect cost found was 4.02 dollars, so that an average production cost of 6.45 dollars was obtained in an average execution time of 21:39 minutes. Finally, a rate of $14.65 is proposed for each resin restoration 1.2.

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