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THE CONTRIBUTION OF COMPUTERIZED TECHNOLOGY TO THE DIAGNOSIS AND THERAPY OF ORAL-MAXILO-FACIAL DISEASES

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Digitalization in dentistry is a key development that positively influences the quality of diagnosis and the efficiency of treatments. This study examines the perception and use of computerized technologies in dental practice in Romania. The aim was to assess how these technologies contribute to diagnosis, planning, treatment and monitoring. The results show a wide acceptance of digitalization, considered a clinical and organizational necessity. The main advantages include increasing diagnostic accuracy, personalizing treatments and improving patient satisfaction. Digitalization also facilitates the efficient management of medical data, reducing bureaucracy and the risk of errors through the use of electronic records. Technologies such as intraoral scanning and 3D printing also optimize material consumption and clinical processes. However, the adoption of digital technologies faces important obstacles: high costs and the lack of adequate practical training of staff. The level of training varies significantly, with emerging technologies being used more often by professionals with advanced training, while other tools require additional educational support. The study also highlights the importance of secure IT infrastructure for data protection and regulatory compliance.

In conclusion, digitalization in dentistry is a catalyst for optimizing medical and administrative processes. A systemic approach is needed, including investments, support policies and continuous training, to ensure an effective transition to a digitalized practice, beneficial for both professionals and patients.

Keywords: Digital technologies, digitalization, dentistry, oral health, continuing education

INTRODUCTION

The importance of this topic stems from the rapid evolution of information technologies in medicine, especially in dentistry. It is therefore necessary to deepen the understanding of how these innovations can transform clinical practice: improving the accuracy of diagnoses and personalizing treatments [1]. These aspects can lead to superior results and better management of orodental conditions. Computerized technologies have developed greatly. Among these, we mention 3D scans, digital radiography and image analysis software that have innovated the way in which orodental conditions are diagnosed and treated. In addition to the revolution brought about in the diagnosis and treatment of patients with orodental conditions, the use of new computerized technologies also allows for the efficient monitoring of results, with patients being satisfied with the improvement in the quality of care [2]. Digitalization and the use of computerized technologies in medicine represent priorities at international level, being promoted by health organizations and desired by governments around the world. In Romania, the integration of new technologies into the health system is considered essential for the modernization of the infrastructure. At the local level, demographic and economic particularities influence the speed and manner of implementation of computerized technologies.

In dentistry, the general trend is to adopt and integrate innovative solutions into daily practice to improve the efficiency and effectiveness of orodental treatments [3,4,5,6].

OBJECTIV

This study aimed to evaluate several diagnostic tools used in dentistry: 3D scanning, digital radiography and image analysis software, along with computer-aided diagnosis systems. The evaluation aimed to examine how these technologies can improve both diagnosis and treatment planning, procedure execution and monitoring. One of the objectives was to briefly analyze the technical, financial or training limitations that these technologies have, trying to propose solutions to overcome them.

MATERIALS AND METHODES

The present analysis was conducted within the framework of a cross-sectional study, conducted in 2024, using a questionnaire applied to a group of 50 Romanian specialists in the field of dentistry. The study approaches the research problem using a combined methodology, which included the collection of quantitative and qualitative data, with the aim of generating an overview of how technologies are perceived in dental practice and how they are used. The target population is represented by dental professionals from Romania who have had access to digital technology in the last 5 years.

The exclusion criteria were membership in other professional categories, inability to access digital technologies

in the last 5 years to form an opinion, and residence outside the country. Thus, we selected a group of 50 dental professionals: generalists, orthodontics specialists, prosthodontics or implantology specialists, and dental technicians, some of whom were students in specialized programs.

Although the number of participants is sufficient to draw relevant conclusions, it is not representative. All participants were informed about the purpose of the study and the voluntary and anonymous nature of participation. Informed consent was obtained before completing the questionnaires. No sensitive data of an identifiable nature were collected, and the results are presented in aggregate, respecting confidentiality.

The study has a main direction, using a quantitative survey based on a questionnaire.

The questionnaire completed by professionals was designed to assess the following dimensions:

- demographic profile;
- professional profile of respondents;
- level of exposure to digital technology;
- perception of benefits;
- types of computerized technologies used;
- frequency and purpose of use (diagnosis, planning, treatment, monitoring);
- perception of impact on quality of medical care;
- self-assessed level of training;
- preferences regarding measures to support digitalization;
- perceived barriers to technology adoption;
- availability or willingness for future investment and continuous training.

The tool was initially tested on a pilot group of 5 respondents to check the clarity and validity of the content. Subsequently, the responses were collected anonymously and the analysis was carried out using the Excel application from the Microsoft Office package. The analysis was structured by response categories.

RESULTS

- Analysis of demographic characteristics in the group of respondents

The gender distribution of respondents was uniform: 25 (50.0%) women and 25 (50.0%) men.

The distribution by age group, made according to age ranges, is as follows: under 30 years old – 17 respondents (20.0%), 30–39 years old – 17 respondents (34.0%), 40–49 years old – 10 respondents (34.0%), over 50 years old – 6 respondents (12.0%).

The distribution of respondents according to their profession is as follows: dental technician – 19 respondents (38.0%), general dentist – 18 respondents (36.0%), specialist dentist – 10 respondents (20.0%), student/master student – 3 respondents (6.0%).

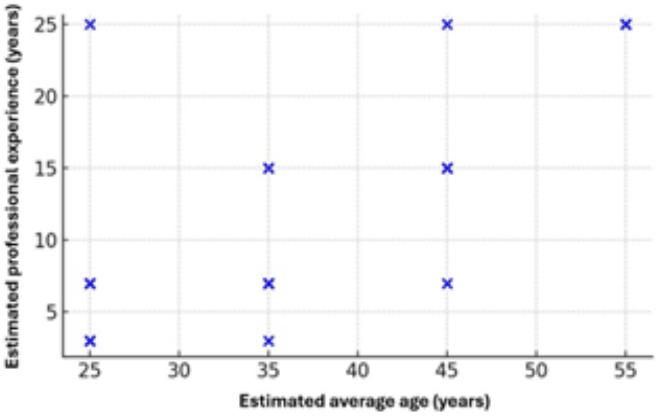
Another question was related to professional experience, expressed in number of years of activity.

Depending on the years of experience, intervals of 5 years of experience were defined. Thus, the distribution of respondents was as follows: less than 5 years of experience – 8 respondents (16.0%), between 5-10 years of experience – 23 respondents (46.0%), and between 11-20 years of experience were reported by 11 respondents (22.0%).

Respondents also had to specify in which type of medical unit they work: Individual practice – 22 respondents (44.0%), Laboratory – 15 respondents (30.0%), University clinic – 13 respondents (26.0%).

Within the study group, the existence of a statistical correlation between the age of the respondents and the number of years of professional experience (converted into average numerical values and estimated based on the declared intervals) was verified. The calculated Pearson coefficient was r=0.79, p=0.0000. Below we have created the scatter plot that highlights this trend of alignment along an upward direction with advancing age. (Figure 1)

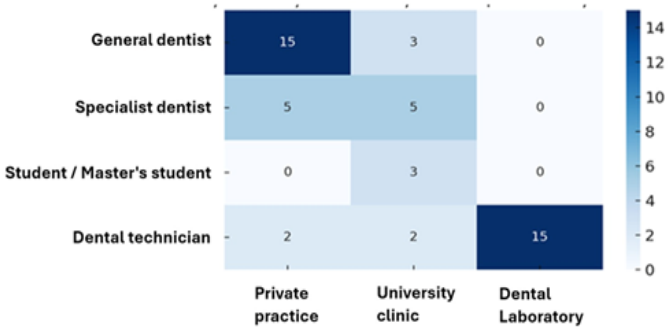
Figure 1. The correlation between biological age and participants' experience



The relationship between professional function and the type of medical unit in which the respondent works.

A cross-tabulation was used to allow observation of the frequency with which each professional function is associated with a specific type of medical unit. (Figure 2)

Figure 2. Distribution of participant functions by type of medical facility *(Values reprezent the number of participants in each category.)*



The relationship between professional function and age

The analysis focused on differentiating groups of professionals according to the average age of the group (assessed by the mean value and standard deviation calculated with a 95% confidence interval).

Table no. 1 shows the average age, the standard deviation of age and professional experience in

Table 1. Demographic and professional characteristics of participants by function

Function	Average age (years) ± SD	Average experience (years) ± SD
General dentist	37,22 ± 10,03	13,22 ± 7,73
Specialist dentist	35,00 ± 8,16	8,40 ± 5,97
Student / master student	25,00 ± 0,00	3,00 ± 0,00
Dental tehnician	37,11 ± 11,34	11,53 ± 7,21

years, respectively the average and standard deviation of experience, for each professional function.

A similar table was created to highlight *the relationship between the type of medical facility in which professionals work and their average age*, respectively experience in years (Table no. 2).

Table 2. Demographic and professional characteristics of medical staff by type of medical facility

Medical facility	Average age (years) ± SD	Average experience (years) ± SD
Private dental practice	36,82 ± 9,07	12,27 ± 7,19
University dental clinic	34,23 ± 11,15	8,54 ± 8,05
Laboratory	36,33 ± 11,25	11,27 ± 6,80

- Descriptive and correlational analysis of options related to computer technology.

To identify the most common types of technology used by respondents in their daily practice, the analysis included a frequency analysis of responses: 16 respondents (32.0%) use CAD/CAM, 11 respondents (22.0%) use the electronic patient health record (EHR), 5 respondents (10.0%) use digital radiographs, another 5 respondents (10.0%) admitted to using implant planning software, 4 respondents (8.0%) are familiar with intraoral scanning, 3 respondents (6.0%) reported using 3D printing technology, 2 respondents admitted using artificial intelligence, 2 respondents admitted using telemedicine and 2 respondents (4.0%) responded that they do not use such technologies (table no. 3).

Table 3. Top of the most frequently used technologies (absolute and percentage frequencies)

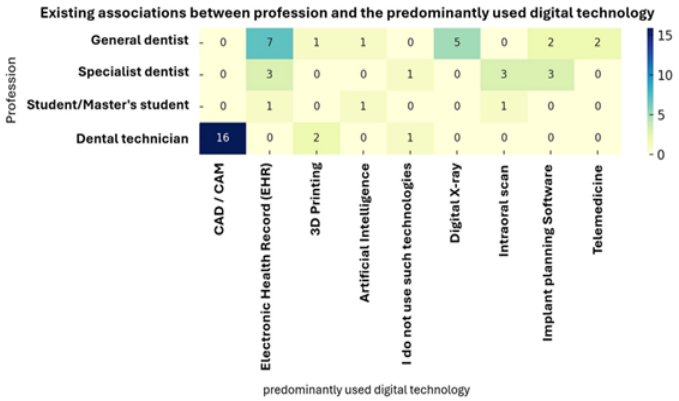
The main technology they use	No. of respondents	Percentage (%) of total respondents
CAD/CAM	16	32,0
EHR	11	22,0
Radiografie digitală Digital radiography	5	10,0
Implantology planning software	5	10,0
Intraoral scan	4	8,0
3D printing	3	6,0
Artificial intelligence	2	4,0
Telemedicine	2	4,0
Does not use such technolo-	2	4.0

The main purpose for which they use computer technology in the office

The main purposes declared by the 50 respondents highlight the use of technology for case treatment - 30 respondents (60.0%), for archiving - 8 respondents (16.0%), for communication - 4 respondents, for therapeutic planning - another 4 respondents (8.0%), and 2 of them (4.0%) for diagnosis. For 2 of the respondents, the answers were not valid.

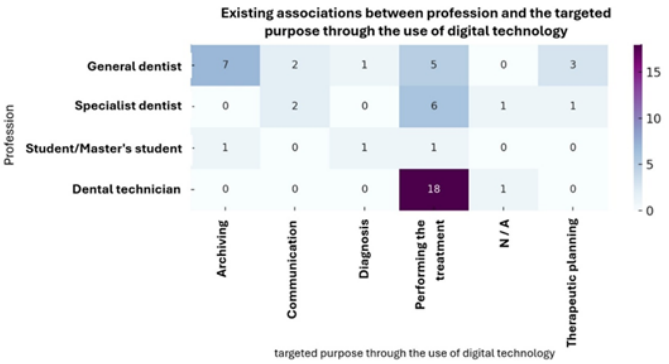
The use of technology to treat the respective condition represented the main declared purpose in a significantly higher proportion than the other declared purposes (the Chi-Square test applied between the professional function and the computerized technology used revealed a coefficient $\chi^2 = 74.14$ and with a degree of freedom of 24, $p = 0.0000$). The association between the two variables is, therefore, statistically significant. (Figure 3)

Figure 3. Existing associations between the profession and the predominantly used digital technology



For the association between professional function and the main purpose of using computer technology, we applied the Chi-Square test again. The calculated coefficient is $\chi^2 = 35.20$ and with 15 degrees of freedom, $p = 0.0023$. This association is statistically significant. (Figure 4)

Figure 4. Existing associations between the profession and the goal targeted by the use of digital technology



Professionals' attitudes towards the impact that digital technology has on their clinical practice.

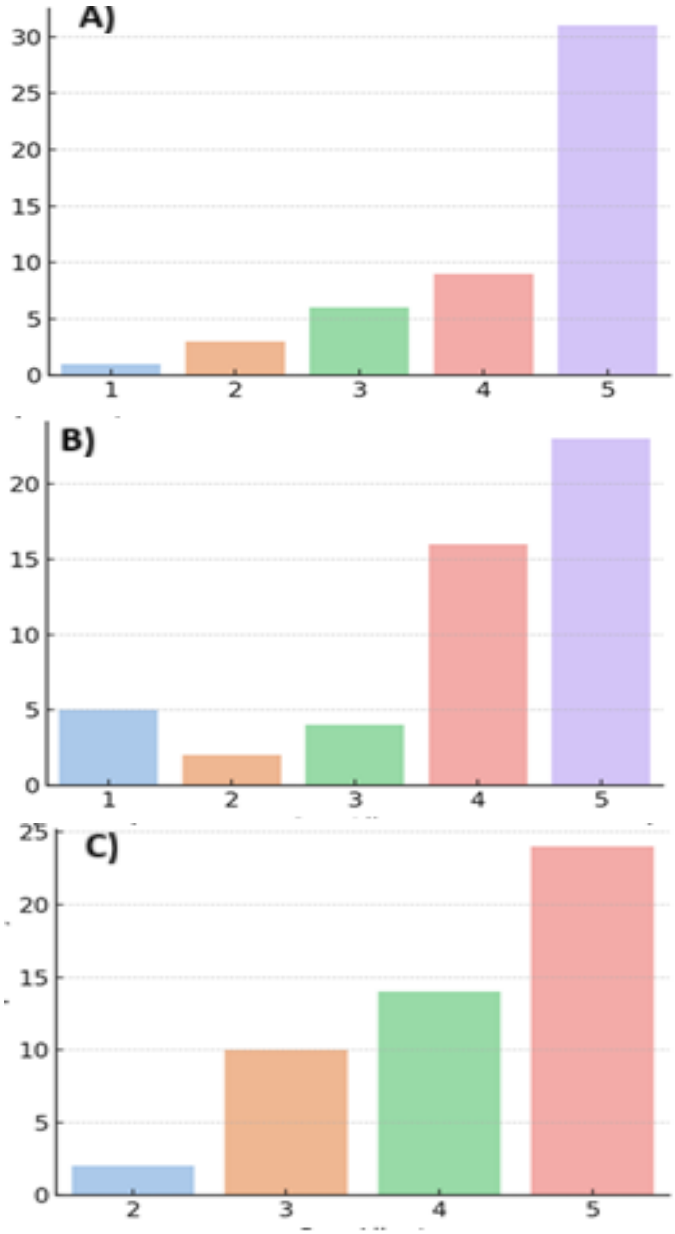
The evaluation of this aspect was carried out based on responses on a Likert scale (5 response levels, from 1 (total disagreement) to 5 (total agreement)), to the

question "To what extent does the digital technology used: Increase the accuracy of the diagnosis, Make the use of time more efficient, and Reduce patient discomfort?" (table no. 4 and figure 5).

Table. 4. Comparative analysis of the advantages identified by professionals

Statement	Average	Min-Max	Standard deviation
A. Increases diagnostic accuracy	4.32	1–5	1.04
B. Makes time use more efficient	4.0	1–5	1.28
C. Reduces patient discomfort	4.2	2–5	0.9

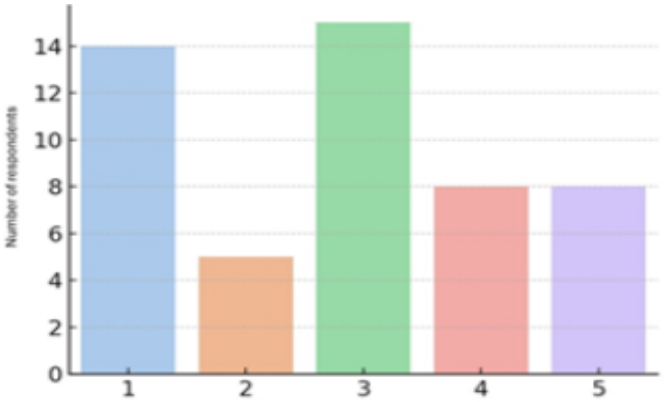
Figure 5. Impact of technology: A. Increases diagnostic accuracy, B. Makes time more efficient, C. Reduces patient discomfort (*average score among respondents*)



Analysis of the ability to use digital technologies

To assess the degree to which dental professionals feel prepared to use computerized technologies, they had to associate the following sentence from 1 (totally disagree) to 5 (totally agree) on a Likert scale: "I am prepared to use digital technology in my daily practice". The mean of the responses was 2.82, with a standard deviation of 1.42. The minimum given by the respondents was 1 and the maximum was 5 (figure 6).

Figure 6. Likert score given by respondents for the statement "I am prepared to use digital technology in daily practice"



Depending on the purposes for which they declared that they use digital technology, the average score they gave to the question: How prepared do they feel to integrate digital technology into their daily practice? was calculated. The average score and the number of respondents are both presented, centralized in table 5:

Table 5. The level of preparedness felt by respondents, depending on the declared purpose of using digital technology

Main purpose stated in the questionnaire	The average degree to which professionals feel prepared	No. of respondents
Diagnosis	4.0	2
Arhive	3.25	8
Treatment	2.83	30
Communication	2.5	4
Therapeutic planning	2.5	4
N-A	1.0	2

We also similarly analyzed the mean for the score they gave to the statement regarding how prepared they feel to integrate digital technology into their daily practice and the type of technology they reported using in the questionnaire. The mean score and number of respondents is presented, summarized in Table 6.

The barriers they perceive in the digitalization of dentistry

Participants were also asked about the barriers they perceive in the digitalization of dentistry, also using a Likert scale from 1 (totally disagree) to 5 (totally agree). The centralization of the scores, comparatively, looks like this (table no. 7 and Figure 7):

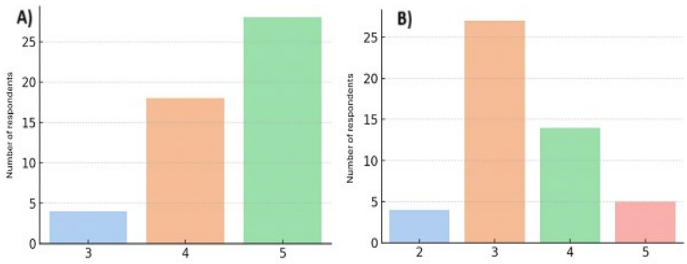
Table 6. The level of preparedness felt by respondents, depending on the main digital technology used

Digital technology used	Average preparedness	No. of respondents
Artificial intelligence	4.0	2
3D printing	3.67	3
Digital radiography	3.2	5
EHR	3.09	11
Intraoral scan	3.0	4
Telemedicine	3.0	2
CAD/CAM	2.5	16
Implantology planning software	2.4	5
Does not use such technologies	1.0	2

Table. 7 Barriers identified in the path of digitalization

Statement	Average	Min-Max	Standard deviation
Insufficient training of staff in the use of digital technology	4.48	3–5	0.65
The high costs of digital equipment	3.4	2–5	0.78

Figure 7. Likert scores obtained for A) Insufficient training of staff in the use of digital technology; B) High costs of digital equipment



The Pearson correlation analysis between the two statements was r = -0.02, with p-value = 0.8675. These values suggest a weak, insignificant correlation.

Subsequently, respondents had to choose from a series of barriers that they consider to be the main ones in implementing computerized technology in dental practice. Their answers were as follows: (Table 8)

Table. 8. – The main barriers identified to digitalization (each respondent chose only one option)

Main barrier	No. of respondents
High cost of equipment	13
Reluctance of the medical team	12
Lack of software compatibility	7
Patient distrust	7
Lack of technical support	6
Lack of training/instruction	5

Analysis of solutions to stimulate implementation

The potential measures to stimulate implementation chosen by respondents from a pre-formulated list were different, the most plausible being, in the opinion of respondents: financial support and access to training courses (see table no. 9).

We applied the Chi-Square test applied between the main barrier identified by the respondents and the measure chosen by the majority of respondents and returned χ^2 =

Table 9. Distribution of measures to improve the impact of preferred digital technology

Measure chosen	No. of respondents
Financial support (grants, leasing)	24
Access to training courses	18
Improving interoperability	5
VAT reduction for medical equipment	3

31.51, with p= 0.0075. The result suggests a statistically significant association between the two variables.

Finally, the respondents indicated, by answering two open-ended questions, what advantages they feel since using information technology in their daily practice and what they consider to be a priority to stimulate the expansion of digitalization.

Respondents most frequently mentioned the following as advantages of digitalization:

- Increases the efficiency of the medical act – by reducing working time and streamlining the operational flow;
- Helps to make a diagnosis with superior accuracy – by integrating digital images, 3D scans and computer-assisted systems into the process;
- Reduces human errors – by standardizing and automating some processes;
- The existence of electronic archives helps with patient traceability – which contributes to continuity of care and transparency;
- Improves communication with the patient – especially through digital visualization of treatment plans.
- Respondents propose the following to support digitalization:
- Continuous and hands-on training in the use of modern software and equipment;
- Facilitating access to technology – through financial support programs, discounts or leasing;
- Institutional endowments and public investments – acquisitions especially in state-owned and educational dental health facilities;
- Expanding interoperability between platforms and systems;
- Integrating technology into academic training programs – for future generations of specialists.

The answers to the first question were grouped into 3 categories: increasing quality – 22 respondents (44.00%), more efficient use of time – 16 respondents (32.00%) and increasing the number of patients – 12 respondents (24.00%).

To the question about the proposed ways to make the expansion of digitalization possible, the answers were grouped as follows: university training – 35 respondents (70.00%) and training courses – 15 respondents (30.00%). (Table 10)

Table 10. – Analysis of combinations od responses between Perceived Advantages and Proposed Measures

Perceived advantage	Proposed measure	Number of respondents
Increased quality	University training	16
	Training courses	6
Time efficient	University training	14
	Training courses	2
High number of patients	Training courses	7
	University training	5

We analyzed the combined responses of the respondents and this was the result:

DISCUSSIONS

The study provides a coherent and detailed picture of dental professionals' perceptions of digitalization, highlighting both the benefits and challenges of this process. The research shows that perceptions are influenced by demographic factors (age, experience, type of medical facility) and the purpose of using the technology. The major problems identified are the lack of practical training and the cost of equipment, common to all dental professionals.

At the same time, the study highlights a coherence between what works and what is requested for improvement, demonstrating a pragmatic attitude of professionals. Clear directions are proposed for supporting digitalization through systemic policies, specialized training and technological accessibility, emphasizing that digitalization is not just a trend, but a clinical and organizational necessity.

The results obtained are valid for the analyzed context and can serve as a starting point for possible further research of a larger scope. Also, being a cross-sectional research, the study reflects the perception of the participants at a given moment. This study does not capture the evolution of the digitalization process over time, but wants to provide a basis for formulating practical, strategic and educational recommendations, not just a descriptive radiograph of the current state of digitalization in dentistry.

Overall, the responses obtained suggest that digitalization is not perceived only as a technological trend, but rather as a clinical and organizational necessity. The technological revolution in dental medical units should be seen as a complementary aid in daily practice rather than as something that threatens the jobs of dental professionals [7,8]. Technology is seen as a tool for: improving the quality of medical care, reducing anxiety and increasing patient satisfaction, reducing human vulnerabilities, in line with other works in the specialized literature [9, 10, 11].

The gender distribution was equal. Most respondents (68.00%) are under 40 years old and only 12.00% are at least 50 years old, so the group was quite young. More than half are doctors (56.00%), followed by dental technicians (38.00%) and students (6.00%), so the group is mostly made up of specialized dental medical personnel. Respondents also indicated their years of experience and the medical unit in which they work. The calculated value for the Pearson correlation coefficient indicated a strong positive correlation for an increase in experience with advancing age, for a linear professional path. This confirms that the collected data can be used to analyze the perception of professionals towards digital technology in a reliable and experience-based way. As expected, those with the least professional experience were students/masters. Specialist dentists and dental technicians fall into groups with higher age and professional seniority, which reflects the professional path with progressive specialization and professional maturation. General dentists occupy an intermediate position in both dimensions.

It was also correlated that most doctors work in an individual practice or in private clinics and most dental technicians are frequently associated with laboratory work, in university institutions or large clinics. This distribution of professionals according to career stage and activity context provides a framework for a differentiated interpretation of digital technologies.

Regarding the participants' exposure to digitalization, the result indicates a high degree of association between professional duties and the specific use of digital tools. Thus, technicians more frequently use CAD/CAM technology for treatment, while general dentists more frequently use electronic patient records or digital radiographs, for archiving or treatment execution. These results are consistent with the daily activities of the profession. Digital technologies have a major impact in the dental medical field, by automating and digitizing the clinical and administrative workflow. Replacing traditional files with electronic health records (EHR) allows for the efficient management of medical history, treatments, radiographs, payments and appointments. Integrating them into a single platform reduces bureaucracy and errors. At the same time, digitalization contributes to saving resources through standardization and precision: intraoral scanning, milling or digital printing optimizes material consumption [12]. Digital appointment management and automated patient communication improve the doctor-patient relationship and operational efficiency [13, 14].

The results on the perceptions of barriers indicate, through the Pearson coefficient, that there is no direct correlation between the two aspects analyzed – staff training and equipment costs. In other words, some professionals may perceive costs as a major problem, even if the team is well trained, or vice versa. Regarding the measures considered useful to encourage the adoption of digital technologies, the analysis shows that financial support and free access to training courses are priorities, reflecting concerns related to economic resources and professional training [8,15].

The coherence between the identified barriers and the proposed solutions is supported by the paired responses: for example, those who want to reduce errors request equipment improvements, which suggests a logical and realistic approach to the transition to digital.

The highest level of training is reported by professionals who use technology for diagnostic purposes (score 4.00), followed by those involved in archiving (3.25). In contrast, users involved in treatment (2.83), planning or communication (both 2.50) show lower levels of training, indicating the need for more practical educational interventions. Emerging technologies, such as artificial intelligence (4.00) and 3D printing (3.67), are generally used by people with higher levels of training, suggesting either access to advanced training or a high interest in innovation. In contrast, users of more common technologies, such as CAD/CAM (2.50) and implant planning software (2.40), report the lowest levels of training, outlining a priority area for educational support.

These correlations reflect a coherent and integrated perception of the benefits of digitalization in dentistry, highlighting a systemic understanding in which accurate diagnosis, patient comfort and clinical efficiency are perceived as interdependent outcomes. The problems associated with digitalization do not seem to be isolated according to specialization, but are shared across the entire professional community.

Effective digitalization involves equipping practices with modern technologies and professional security solutions. Digital equipment must be supported by high-performance antivirus software, encryption systems, automatic backup and two-step authentication. These measures protect sensitive data and ensure compliance with GDPR. Without a well-established IT infrastructure, the risk of breaches increases, which is why it is essential that investments in digitalization also include cybersecurity [16,17].

These results can be useful for customizing digitalization implementation strategies based on the perceived needs of each professional segment.

CONCLUSIONS

The study highlights the fact that digitalization in dentistry is not perceived as a passing trend, but as a clinical and organizational necessity, with major potential to transform medical practice. Computerized technologies contribute significantly to improving the quality of medical care, the accuracy of diagnoses and the efficiency of treatments, but also to reducing anxiety and increasing patient satisfaction [9, 11]. These benefits are recognized by professionals in the field, who demonstrate a pragmatic and solution-oriented attitude.

The results obtained show that perceptions of digitalization are influenced by demographic factors, such as age and professional experience, but also by the work context – the type of medical unit or the daily duties of professionals, differences that reflect the natural distribution of responsibilities in the dental medical team.

Regarding the perceived barriers, two aspects stand out: the lack of practical training and the high costs of equipment. Also, the level of training is heterogeneous, suggesting that training strategies should be personalized according to the technology used and the professional profile.

Overall, the findings support the idea that digitalization is a catalyst for optimizing the entire dental ecosystem. Technology has a positive impact on both the efficiency of medical activity and the patient experience. At the same time, the results highlight the need for a systemic approach: investments in infrastructure, support policies and training programs are essential to ensure an efficient and equitable transition to a digitalized practice [8,15,16]. This study provides a solid basis for the development of national and institutional strategies to support digitalization in dentistry.

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