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PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS ODONTOLÓGICAS

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**CONHECIMENTO, PERCEPÇÃO E CONFIABILIDADE DE CIRURGIÕES
DENTISTAS EM RELAÇÃO AO DIAGNÓSTICO REALIZADO ATRAVÉS DA
INTELIGÊNCIA ARTIFICIAL**

Santa Maria, RS
2021

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Dissertação apresentada ao Curso de Pós-Graduação em Ciências Odontológicas, área de concentração em Odontologia, ênfase em Radiologia Odontológica, da Universidade Federal de Santa Maria (UFSM) como requisito parcial para a obtenção do título de **Mestre em Ciências Odontológicas**.

Orientadora: Prof^a. Dr^a. Gabriela Salatino Liedke

Santa Maria, RS
2021

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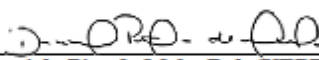
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RESUMO

CONHECIMENTO, PERCEPÇÃO E CONFIABILIDADE DE CIRURGIÕES DENTISTAS EM RELAÇÃO AO DIAGNÓSTICO REALIZADO ATRAVÉS DA INTELIGÊNCIA ARTIFICIAL

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Introdução: O tratamento de saúde começa com o diagnóstico correto, baseado nos sinais e sintomas clínicos e exames complementares. Nesse contexto, a inteligência artificial (IA) vem apresentando potencial para reduzir a variabilidade decorrente do examinador, melhorando, assim, o diagnóstico obtido com os exames de imagem. **Objetivo:** O objetivo deste estudo foi avaliar o conhecimento, a percepção e a confiabilidade dos dentistas brasileiros em relação ao diagnóstico realizado por meio da IA. **Materiais e métodos:** Foi realizado um estudo observacional transversal por meio do envio de questionários eletrônicos. Dentistas cadastrados no Brasil foram convidados a participar. O recrutamento foi realizado por meio de convite nas redes sociais (*Facebook, Whatsapp e Instagram*), permitindo maior heterogeneidade dos participantes. Os questionários, desenvolvidos no '*Google Forms*', incluíam questões demográficas, qualificação profissional e afirmações sobre conhecimento, utilidade e confiança sobre IA. Após avaliação descritiva dos dados, a variável nível de conhecimento sobre IA foi comparada com as demais variáveis por meio do teste do qui-quadrado. **Resultados:** Um total de 635 questionários foram respondidos. A maioria dos dentistas era do sexo feminino (64,5%), com média de idade de 40 anos (23 a 81 anos) e com alguma formação complementar. A maioria dos entrevistados acredita que a IA está sendo usada no cotidiano (89,5%) e na odontologia (87,9%), mas 69,3% dos participantes responderam que têm pouco ou muito pouco conhecimento sobre IA e 84,6% afirmaram nunca ter tido aulas sobre IA. A maioria dos participantes concordou com o uso de IA para tornar o diagnóstico mais confiável (89,7%), principalmente quando usada em conjunto com o diagnóstico realizado pelo clínico (94,5%). Porém, 76,3% dos participantes responderam que em caso de discordância entre o diagnóstico do profissional e o IA, eles não aceitariam o diagnóstico da IA como definitivo. Maior nível de conhecimento sobre IA mostrou associação com disposição para incorporar IA na Odontologia ($P = 0,002$), aceitação do diagnóstico da IA como definitivo em caso de discordância com o diagnóstico do profissional ($P = 0,001$), indisponibilidade de dados digitalizados ($P = 0,004$) e falha na proteção de dados ($P = 0,007$); menor conhecimento relatado foi relacionado ao aumento de despesas ($P < 0,001$) e redução no número de empregos ($P = 0,004$). **Conclusão:** A maioria dos dentistas acredita que a IA é uma ferramenta para tornar o diagnóstico ainda mais confiável se usada em conjunto com o diagnóstico do profissional. Profissionais que possuem mais conhecimento sobre IA estão mais dispostos a incorporar essa tecnologia em sua prática e são mais propensos a aceitar o diagnóstico da IA como definitivo em caso de discordância com o diagnóstico do profissional. Assim, o presente estudo adverte quanto à necessidade de fornecer mais conhecimento sobre IA aos dentistas brasileiros.

Palavras-chave: Inteligência Artificial. Diagnóstico. Conhecimento.

ABSTRACT

KNOWLEDGE, CONFIDENCE, AND ATTITUDE OF BRAZILIAN DENTISTS IN RELATION TO ARTIFICIAL INTELLIGENCE DIAGNOSIS

AUTHOR: Gleica Dal' Ongaro Savegnago
ADVISOR: Prof^a. Dr^a. Gabriela Salatino Liedke

Introduction: Health treatments begin with the correct diagnosis, based on clinical signs and symptoms and complementary exams. In this context, artificial intelligence (AI) is showing potential to reduce the variability resulting from the examiner, thus improving the diagnosis obtained with imaging exams. **Objective:** The aim of this study was to evaluate the knowledge, confidence, and attitude of Brazilian dentists regarding the diagnosis made through AI. **Materials and methods:** A cross-sectional observational study was carried out by sending out electronic questionnaires. Dentists registered in Brazil were invited to participate. Recruitment was carried out through invitation on social networks (Facebook, Whatsapp and Instagram), allowing greater heterogeneity of participants. The questionnaires, developed in 'Google Forms', comprised demographic questions, professional qualification, and statements regarding knowledge, usefulness, and confidence about AI. After descriptive evaluation of the data, the variable level of knowledge about AI was compared with the other variables using the chi-square test. **Results:** A total of 635 questionnaires were answered. The majority of dentists were female (64.5%), with a mean age of 40 years (23 to 81 years) and with some additional education. Most respondents believe that AI is being used in everyday life (89.5%) and in Dentistry (87.9%), but 69,3 % of the participants answered that they have little or very little knowledge about AI and 84,6% stated that they had never attended lectures about AI. Most participants agreed with the use of AI to make diagnosis more reliable (89.7%), especially when used together with the diagnosis performed by the clinician (94.5%). However, 76.3% of the participants answered that in case of disagreement between the diagnosis of the professional and the AI, they would not accept the AI diagnosis as definitive. Higher level of AI knowledge showed association with willingness to incorporate AI in Dentistry ($P = 0.002$), accepting AI diagnosis as definitive in case of disagreement with the professional's diagnosis ($P = 0.001$), unavailability of digitized data ($P = 0.004$), and data protection failure ($P = 0.007$); less reported knowledge was related to increasing expenses ($P < 0.001$), and reduction in the number of jobs ($P = 0.004$). **Conclusion:** Most dentists believe AI is a tool to make diagnosis even more reliable if used in conjunction with the professional's diagnosis. Professionals who have more knowledge about AI are more willing to incorporate this technology into their practice and are more likely to accept the AI diagnosis as definitive in case of disagreement with the professional's diagnosis. Thus, the present study raises the concern in order to provide more knowledge about AI to Brazilian dentists.

Keywords: Artificial Intelligence. Diagnosis. Knowledge.

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1 INTRODUÇÃO E REVISÃO DE LITERATURA

Todo tratamento em saúde inicia pelo correto diagnóstico da patologia, baseado em sinais e sintomas clínicos do paciente e em exames complementares. Dentre os exames complementares disponíveis, radiografias e tomografias possuem um papel fundamental na Odontologia (SEDEXCT, 2012). Entretanto, o tipo de exame e a experiência do examinador têm impacto direto no resultado da interpretação, e resultados falso-positivos e falso-negativos estão presentes, com consequências para o diagnóstico e o planejamento clínico.

A literatura mostra que, de uma maneira geral, exames tomográficos apresentam maior acurácia do que exames radiográficos para o diagnóstico das alterações dentárias e ósseas (ESLAMI et al., 2017; LEONARDI DUTRA et al., 2016; SABERI et al., 2019; TALWAR et al., 2016). Da mesma forma, radiografias intrabucais apresentam maior sensibilidade do que radiografias panorâmicas para a visualização de alterações em estruturas dentárias (ABDINIAN et al., 2015). Além do tipo de exame, o nível de experiência do observador também tem influência na interpretação do exame e na consistência dos examinadores (FORTES et al., 2019; PARKER et al., 2017; PELEKOS et al., 2019). Assim, pode ser sugerido que parte das diferenças na acurácia dos exames é devido ao examinador que interpreta o exame, e não propriamente ao tipo de exame que está sendo avaliado. Neste contexto, a inteligência artificial (IA) vem ganhando atenção como meio para diminuir a variabilidade resultante do examinador, melhorando assim o diagnóstico obtido com os exames por imagem (MUNIR et al., 2019).

John McCarthy, o pai da inteligência artificial, descreve a IA como a ciência e a engenharia de fabricação de máquinas inteligentes, as quais imitam funções "cognitivas" humanas como "resolver problemas" e "aprender" (JAISWAL et al., 2019; RUSSELL; NORVIG, 2009). A IA possui dois subconjuntos importantes: o aprendizado de máquina (*machine learning* – ML) e o aprendizado profundo (*deep learning* – DL). Os algoritmos de ML clássico refere-se à capacidade do computador de processar informações a partir de bases de dados categorizados com precisão pelo profissional (ILHAN et al., 2020). Já no DL, o qual é um subconjunto do ML, muitas camadas de algoritmos são utilizadas para interpretação, gerando suas próprias conclusões e categorias quando expostos a um grande número de dados (ILHAN et al., 2020).

Dentre os algoritmos desenvolvidos para a IA, as redes neurais convolucionais (*Convolutional neural network* – CNNs) têm se mostrado particularmente interessantes para avaliação de imagens. Esses algoritmos fazem uma “varredura” na imagem, identificando linhas, formas, limites, cantos e regiões específicas, e buscando elementos conhecidos para identificação e então classificação da imagem. Assim, vêm sendo utilizados para avaliação, identificação e diagnóstico de regiões e patologias em exames de radiografias, tomografias e fotografias (TANG et al., 2018).

O treinamento dos algoritmos é etapa fundamental para o bom desempenho de um sistema de IA. Para a realização desse treinamento, principalmente o que envolve DL, é necessária a presença de fatores como bom poder computacional, grande quantidade de dados e rotulação dos dados por um especialista. Na medicina, o processo de coleta de dados é considerado uma tarefa complexa e cara, o que limita a quantidade de dados disponíveis. Além disso, em relação à rotulação dos dados, é importante enfatizar que a rotulagem por especialistas fornece uma referência necessária para treinar e avaliar o modelo, mas não representa necessariamente o padrão ouro (CASALEGNO et al., 2019; POEDJIASTOETI; SUEBNUKARN, 2018; RICHARDSON et al., 2021; XUE et al., 2017).

Na medicina, a IA tem sido utilizada para o diagnóstico automatizado de câncer de pulmão (acurácia de 91%) (SONG et al., 2017), pólipos colorretais (acurácia de 94%) (BYRNE et al., 2019), câncer de próstata (acurácia de 84%) (WANG et al., 2017), câncer de mama (acurácia de 81- 82%) (BECKER et al., 2017), retinopatia diabética em fotografias do fundo da retina (acurácia de 99%) (GULSHAN et al., 2016) e osteoartrite do quadril (acurácia de 93%) (XUE et al., 2017). Para regulamentar a criação de softwares que utilizam a IA, a Food and Drug Administration (FDA) dos Estados Unidos criou uma categoria chamada "Software as Medical Device". Dessa forma, em 2018, foi aprovado o primeiro dispositivo médico utilizando IA, o qual tem o objetivo de detectar retinopatia diabética (ABRÀMOFF et al., 2018; BENJAMENS; DHUNNOO; MESKÓ, 2020).

Na odontologia, os artigos vem mostrando a aplicabilidade da IA na avaliação de radiografias e tomografias para detectar lesões cáries (acurácia de 84-91%) (LEE et al., 2018), lesões periapicais (acurácia de 85%) (EKERT et al., 2019), erupção e numeração dentária (precisão de 0,90 – 0,98) (CHEN et al., 2019) fraturas radiculares verticais (acurácia de 53%-96%) (KOSITBOWORNCHAI; PLERMKAMON; TANGKOSOL, 2013), alterações na morfologia radicular (acurácia de 85-87%) (HIRAIWA et al., 2019), reabsorção periodontal (acurácia de 89-94%) (KROIS et al., 2019), sinusite maxilar

(acurácia de 87%) (MURATA et al., 2019) e osteoporose (acurácia de 97-99%) (LEE et al., 2019). A cefalometria automatizada, com o intuito de diminuir a variabilidade na identificação dos pontos cefalométricos e tornar as análises mais rápidas, vem sendo proposta desde Rudolph, Sinclair e Coggins (1998) e os estudos mais recentes já mostram valores de erro iguais ou menores do que quando a marcação é realizada pelo profissional, tanto em radiografias quanto em tomografias (LINDNER et al., 2016; SCHWENDICKE et al., 2021). Além disso, a utilização de software como auxiliar ao diagnóstico do profissional mostra valores de sensibilidade e de especificidade maiores para o grupo que utilizou a ferramenta durante o diagnóstico tomográfico (EZHOV et al., 2021).

Os bons resultados observados nos estudos, comparando o diagnóstico realizado pela IA com aquele realizado por profissionais, torna tentador pensar que, com a evolução dos sistemas automatizados, o papel do radiologista diminuirá em breve. Existem, no entanto, controvérsias em relação ao uso de IA para diagnóstico em ambientes clínicos. As preocupações dos profissionais em relação a IA incluem a possibilidade de erros, a falta de transparência do sistema (falta entendimento sobre o trabalho das redes neurais, muitas vezes visto como uma caixa preta) e as incertezas em relação à segurança dos dados digitais compartilhados em grandes bancos de dados (CATH, 2018; HOLZINGER et al., 2017; LAU; STACCINI, 2019; REYES et al., 2021; SCHWENDICKE; SAMEK; KROIS, 2020).

Stai *et al.* (2020) avaliando a percepção de pacientes sobre IA e robótica na medicina, apontaram que, diante da discordância entre a IA e o médico a respeito da benignidade ou malignidade de uma massa tumoral, a maioria dos participantes (144 de 254) teria mais confiança no diagnóstico dado pela IA. Em relação à cirurgia robótica, 18% dos participantes apontaram total desconforto em relação a essa prática e 37% dos participantes indicaram um pouco de desconforto. Jutzi *et al.* (2020), em um estudo avaliando a perspectiva de pacientes em relação ao diagnóstico de câncer de pele pela IA, verificaram que 91% dos participantes concordaram que a IA deveria ser usada para deixar o diagnóstico médico ainda mais confiável. Porém, esses participantes ainda possuem algumas preocupações em relação ao uso da IA como proteção dos dados, mau funcionamento do algoritmo, relação médico-paciente diminuída e perda de habilidade diagnóstica do médico devido ao uso contínuo do software.

Poucos estudos avaliaram as percepções e as preocupações dos profissionais e dos pacientes em relação à IA na Odontologia. Singh *et al.* (2020) verificaram que dentistas e estudantes de odontologia na Índia têm interesse, algum conhecimento e algumas

preocupações sobre a IA; quando questionados se a incorporação da IA levaria à redução do número de empregos, mais participantes discordaram do que concordaram com essa afirmação. Os autores interpretaram esse resultado como uma resposta positiva à incorporação da IA na prática clínica diária. Pauwels e Del Rey *et al.* (2020), avaliando IA e Radiologia, observaram uma percepção positiva de profissionais e estudantes, especialmente após palestra sobre o tema. Com relação à percepção de pacientes, apesar da maioria ter algum conhecimento sobre IA, não possuem compreensão sobre sua utilização para a tomada de decisão clínica (JAISWAL *et al.*, 2019).

Desse modo, fica claro que as pesquisas para utilização da IA no diagnóstico odontológico apresentam-se em pleno desenvolvimento, porém a confiança e a segurança com o diagnóstico obtido por meio da IA, bem como o conhecimento sobre a IA, foram pouco investigados. Assim, o objetivo desse estudo foi avaliar o conhecimento, a percepção e a confiabilidade de cirurgiões dentistas em relação ao diagnóstico realizado através da inteligência artificial.

2 ARTICLE

Esta dissertação está apresentada em formato de artigo científico, conforme periódico *Journal of Dental Education* – Qualis A2 (Anexo D).

**KNOWLEDGE, CONFIDENCE, AND ATTITUDE OF BRAZILIAN DENTISTS IN
RELATION TO ARTIFICIAL INTELLIGENCE DIAGNOSIS**

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ABSTRACT

Purpose: Artificial intelligence (AI) is increasingly prominent in Dentistry and dental radiology. The purpose of this study was to evaluate the knowledge, confidence, and attitude of Brazilian dentists regarding the diagnosis made through AI.

Materials and methods: A cross-sectional study was carried out with electronic questionnaires distributed to Brazilian dentists, through social networks. Demographic and professional data and knowledge, usefulness, and confidence about AI were sought. After data descriptive evaluation, the variable level of AI knowledge was compared with the other variables using the chi-square test.

Results: A total of 635 questionnaires were answered between June to December of 2021. Most dentists believe AI is being used in everyday life (89.5%) and in Dentistry (87.9%), but 69.3% have little or very little knowledge about AI and 84,6% stated that they never attended lectures about AI. Higher level of AI knowledge showed association with willingness to incorporate AI in Dentistry ($P = 0.002$), accepting AI diagnosis as definitive in case of disagreement with the professional's diagnosis ($P = 0.001$), unavailability of digitized data ($P = 0.004$), and data protection failure ($P = 0.007$); lower reported knowledge was related to increasing expenses ($P < 0.001$), and reduction on jobs opportunities ($P = 0.004$).

Conclusion: Dentists who have more reported knowledge about AI are more willing to incorporate this technology into their practice and are more likely to accept the AI diagnosis as definitive. This study also raises the concern in order to provide more education about AI to Brazilian dentists.

Keywords: Artificial Intelligence. Diagnosis. Knowledge.

INTRODUCTION

Imaging evaluation is the most used complementary exam in Dentistry to reach patients' diagnosis. In general, tomography is more accurate than radiography for dental and bone diagnosis.¹ Likewise, intraoral radiographs have greater sensitivity than panoramic radiographs for dental evaluation.² The level of qualification and experience also influences the interpretation process and the consistency of the examiners.³⁻⁵ Thus, the type of exam and the examiner's experience have a direct impact on image evaluation, and false-positive and false-negative results might be present and have consequences for clinical management. In this context, artificial intelligence (AI) has gained attention as an instrument to decrease the variability from the examiner and improve imaging exams diagnosis.⁶

John McCarthy, the father of AI, in 1956, described AI as the science and engineering of making intelligent machines that mimic human "cognitive" functions such as "problem solving" and "learning".⁷ AI is a broad term, with an important branch that seeks to provide knowledge to machines (with subfields named machine learning and deep learning) by using different algorithms that generates their own conclusions and categories when exposed to large amounts of data.⁸ One of those algorithms, the Convolutional Neural Network (CNN), has proven to be particularly interesting for the identification of lines, edges, and shapes, and thus has been used for the identification of regions and pathologies in imaging exams.⁹

In medicine, some devices have been FDA-approved to aid in clinical practice.¹⁰ In dentistry, AI is a research topic since the 1990s, mainly involving cephalometric landmark identification¹¹ to improve exam reproducibility and decrease examiner time-consuming. More recently, other clinical tasks are under investigation, showing promising results, such as the diagnosis of carious lesions (accuracy 84-91%),¹² periapical lesions (accuracy 85%),¹³ vertical root fractures (accuracy 53%-96%),¹⁴ periodontal resorption (accuracy 89-94%),¹⁵

maxillary sinusitis (accuracy 87%),¹⁶ osteoporosis (accuracy 97-99%),¹⁷ tooth identification (accuracy 0.90 - 0.98),¹⁸ and root morphology evaluation (accuracy 85-87%).¹⁹

The satisfactory results observed in studies comparing the diagnosis performed by AI with that performed by professionals make it tempting to think that the process of imaging interpretation will soon become automated. There are, however, controversies regarding the use of AI for diagnosis in clinical settings. Professionals' concerns include the possibility of errors, the lack of system transparency (in most of the situations how the algorithm reach a conclusion is not fully explainable), and uncertainties regarding digital data security shared in large databases.²⁰⁻²³ On the patients' side, most participants agreed that AI should be used to make medical diagnosis even more reliable.^{24,25} However, some concerns regarding the use of AI such as data protection, malfunction of the algorithm, decreased doctor-patient relationship, and loss of the diagnostic ability of the physician due to continuous use of the software were raised.²⁴

Another issue to be considered is how dentists perceive and understand AI role in their clinical practice. Singh et al.²⁶ found that dentists and dental students in India have interest, some knowledge, and some concerns about AI; when asked whether incorporating AI would lead to a reduction in the number of jobs, more participants disagreed (29,7%) than agreed with this statement. The authors considered this a positive response to incorporating AI into daily clinical practice. Pauwels and Del Rey²⁷ also observed a positive perception of professionals and students, especially after a lecture on the subject.

Thus, it is clear that research on the use of AI in dental diagnosis is in full development, but the knowledge and confidence of dentists about AI have been little investigated. Hence, the aim of this study was to evaluate the knowledge, confidence, and attitude of Brazilian dentists regarding the diagnosis made through artificial intelligence.

MATERIALS AND METHODS

Ethical Aspects

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee from UFSM (CAAE: 42857721.0.0000.5346). An invitation and electronic informed consent form for voluntary participation in the research were available before the survey. The right of non-participation and waiver was safeguarded for the participants before submitting the form. Respondent anonymity was guaranteed.

Study Type and Sample

A cross-sectional observational study was carried out. Dentists registered in Brazil were invited to participate in the survey. Considering an estimated population of 348.000 dentists in Brazil, a confidence level of 95%, and a margin of error of 4%, 600 participants would be required.

Questionnaire

An electronic questionnaire was developed using 'Google Forms' (Google LLC, Googleplex, Mountain View, California, USA). The survey addressed demographic information (gender, age, and Brazilian state of residence), professional background (additional education, and workplace), knowledge about AI, confidence regarding the use of AI for diagnosis, and attitude regarding the impact of AI in dentistry (Tables 1 to 3 present more information regarding the questionnaire). The questions regarding AI were answered based on a 5-point Likert scale (1, strongly disagree; 5, strongly agree).

Recruitment was carried out by invitation through different communication platforms, such as e-mail, social media (Instagram, Facebook), and instant messaging

application (Whatsapp). The participant could answer the questionnaire using the device (computer, notebook or smartphone) that seemed more comfortable.

Statistical Analysis

After descriptive evaluation of the data, the variable level of knowledge about AI was compared with the other variables using the chi-square test. For statistical analysis, the categories ‘agree entirely’, ‘rather agree’, and ‘undecided’ were summarized as agreement while ‘disagree entirely’, and ‘rather disagree’ were summarized as disagreement.

Data were analyzed using Microsoft Office Excel (Microsoft Corp, Redmond, WA, USA) and SPSS (SPSS Inc., Chicago, IL, USA) programs. The significance level considered was $P < 0.05$.

RESULTS

Over a six-month period, 635 questionnaires were answered, from all five Brazilian regions. Table 1 presents the demographics and self-assessment of AI proficiency. Having attended a lecture about AI ($P < 0.000$) and having a Ph.D. degree ($P = 0.001$) were related to reporting a higher knowledge about AI.

Tables 2 and 3 show the association of reported knowledge and other AI related variables. The level of knowledge about AI showed significant association with the variables use of AI in daily life ($P < 0.000$), willingness to incorporate AI in dentistry ($P = 0.002$) and accepting the diagnosis of AI as definitive in case of disagreement with the professional’s diagnosis ($P = 0.001$). However, 76.3% of the participants answered that, in case of disagreement between the diagnosis of the professional and the AI, they would not accept the AI diagnosis as definitive. More reported AI knowledge was also related to some AI disadvantages (data protection failure, and unavailability of digitized data), while less

reported AI knowledge was related to increase in expenses, and reduction in the number of jobs for dentists. AI advantages had no association with the participants' level of AI knowledge.

DISCUSSION

AI is increasingly prominent in Dentistry and dental radiology.⁶ Traditionally, in radiology, trained professionals visually evaluate images for disease detection, characterization, and monitoring. Today, AI models are capable of automatically recognizing complex patterns in image data, identifying changes, providing quantitative rather than qualitative assessments of features, and even presenting diagnoses.²⁸ Therefore, knowledge about AI will become essential among health professionals. However, the literature still reports a lack of studies on the perceptions and concerns of physicians²⁹ and dentists^{26,27,30} regarding diagnosis performed by AI. With this in mind, this study evaluated the knowledge, confidence, and attitude of Brazilian dentists regarding the diagnosis performed by AI.

Most of the participants recognize AI as a positive tool being used in everyday life and Dentistry. AI has several applications in everyday life such as facial recognition, speech recognition, e-mail filtering and spam identification, and analysis of social networks, astronomical data, computer finance, and traffic.³¹ In Dentistry, AI applications include cephalometric analysis, orthodontic planning, data mining and decision trees, and segmentation and identification of anatomical structures, among other diagnostic tasks.^{11,23,32}

However, in spite of the positive response towards AI, the majority of the participants affirmed having little or very little knowledge about AI. Reported knowledge was related to

having attended lectures about AI and having a Ph.D. degree. Pauwels and Del Rey,²⁷ evaluating the perception of AI in radiology by dentists and dental students, found that the perception of AI became more positive and concerns about the possible replacement of oral radiologists decreased after a lecture on the topic. Sit et al.,³³ evaluating medical students' perceptions on AI and radiology, found that students who were taught about AI were more likely to consider radiology as a specialization. AI is not yet part of the dental curriculum in Brazil.³⁴ AI education in Brazil seems restricted to few professionals, most in PhDs, which urge the need to update the dental curriculum.

Regarding the use of AI for diagnosis, most participants agree with using an AI system as a complementary tool along with the professional's report, but would not accept the AI diagnosis as definitive. However, reported AI knowledge was statistically related to accepting AI diagnosis as definitive in case of disagreement with the professional's diagnosis. The study by Sur et al.³⁰ pointed out that 87% of the participants would like to use a software to help in the diagnosis process; however, in the hypothesis of disagreement between the AI and the professional diagnosis, only 7% of the participants would follow the diagnosis provided by the AI. In Dentistry, although studies show that diagnosis by AI can achieve excellent accuracy,¹²⁻¹⁹ few systems are available for clinical use. Moreover, important topics still need improvement.

Most studies comparing AI diagnosis with that from the professional have been performed through image evaluation in an experimental setting. Most of these algorithms have not been tested in a real clinical setting, together with patient clinical examination, which is complicated, unpredictable, and multifactorial.³⁵ Despite considered a promising technology, many challenges that guide the implementation of AI in clinical practice remain, such as the secure sharing of data, protecting patient confidentiality and privacy, quality control of the software created, and data quality.³⁶ In this way, the Food and Drug

Administration (FDA) of the United States has created a category called "Software as Medical Device" to regulate the development and use of AI software.¹⁰ Data protection was mentioned a disadvantage of AI software by participants with a higher level of AI knowledge.

When a human diagnostic error occurs, an attempt is made to identify the cause of the error and amend to avoid repeating that same error. In the case of AI, where systems train on their own and in ways that are often beyond human understanding, it is difficult to adequately explain why the AI is wrong when it is wrong. This may lead the system to repeat the same mistakes.³⁵ Thus, it is necessary to ensure that AI decisions are explainable, transparent, reliable, and reproducible.³⁷ In this way, a field of study called Explainable AI has emerged, which aims to help humans to understand how an AI system performs its actions, why a certain decision was made by the machine, and whether or not that decision is reliable.³⁸

The possible replacement of professionals by AI is a hotly debated topic in the literature.^{26,27,33,39,40} In this study, dentists with less reported AI knowledge had higher chances to believe that the incorporation of AI will result in a reduction in the number of jobs. AI can assist the professional in performing tasks more efficiently, but that in no way replaces the ability of the human brain (i.e. natural intelligence) to perform a successful diagnosis. Senders et al.⁴¹, in a systematic review of natural and artificial intelligence in neurosurgery, found that studies in which clinical decision-making was a collaborative effort between the professional and the machine achieved higher accuracy scores than studies in which the diagnosis was made individually by the clinician or by the machine. In addition, the authors point out that any AI system is dependent on humans, as the clinician is responsible for both training the machine and making the final clinical decision for the patient.

Thus, it is considered that jobs will not be lost; rather, roles will be redefined. Healthcare professionals should not fear artificial intelligence but adapt to it. In this way, certain tasks can be automated and then reviewed by experts in a short period of time, allowing these professionals to focus on tasks that are cognitively challenging and cannot be performed by machines. This highlights the fact that humans and machines need each other to increase the efficiency of the healthcare system.^{40,42}

To our knowledge, this study has the largest sample size compared to other similar studies. In addition, dentists from all dental specialties and all five Brazilian regions participated, reinforcing its magnitude. Some limitations, such as the tendency of the respondents to be researchers, should be considered in the interpretation of the results.

Finally, the present study raises the concern in order to provide more knowledge about AI to Brazilian dentists. For this to occur, it is necessary to implement topics related to AI in the curriculum of Dentistry courses. In possession of knowledge, professionals will find it easier to adapt to AI and to use this technology to their advantage, leading to greater effectiveness in the health system. Further research should be undertaken to investigate the impact of lectures on dental professionals' knowledge, confidence, and attitude towards AI.

CONCLUSION

Most Brazilian dentists believe AI is a tool to make diagnosis even more reliable, especially if used together with the professional's report. Moreover, professionals who reported having more knowledge about AI are more willing to incorporate this technology into their practice and are more likely to accept the AI diagnosis as definitive in case of disagreement with the professional's diagnosis. This study also raises the concern in order to provide more education about AI to Brazilian dentists.

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TABLES:**Table 1.** Demographics and self-assessment of AI proficiency

Variable	N (%)
<i>Gender</i>	
Female	410 (64.6%)
Male	224 (35.3%)
Other	1 (0.2%)
<i>Age (Mean [Min-Max])</i>	
	40.6 [23-81]
<i>Professional background</i>	
Specialist degree	437 (68.8%)
Master's degree	381 (60%)
PhD degree	262 (41.2%)
<i>Professional workplace</i>	
Postgraduate/PhD student	117 (18.4%)
Dentist (Private practice)	345 (54.3%)
Dentist (Public practice)	118 (18.6%)
Teaching (Private Institution)	101 (15.9%)
Teaching (Public Institution)	194 (30.6%)
<i>How do you rank your knowledge regarding AI?</i>	
Excellent	8 (1.3%)
Good	51 (8%)
Fair	136(21.4%)
Poor	204(32.1%)
Very Poor	236(37.2%)
<i>Was AI a topic studied in any lecture during your education?</i>	
Always	0 (0%)
Often	3 (0.5%)
Sometimes	38 (6%)
Rarely	57 (9%)
Never	537(84.6%)

Table 2. AI general and diagnostic-related applications

<i>Questions</i>	Agree	Disagree	P-values (reported vs. non-reported AI knowledge)
AI is being used in everyday life	568 (89.4%)	67 (10.6%)	0.000
AI is being used in Dentistry	558 (87.9%)	77 (12.1%)	0.66
Are you willing to incorporate AI into Daily clinical practice?	579 (91.2%)	56 (8.8%)	0.002
The use of AI would make dental diagnosis more reliable	570 (89.8%)	65 (10.2%)	0.76
Do you agree with the inclusion of the AI diagnosis together with that made by the clinician?	600 (94.5%)	35 (5.5%)	0.77
In the hypothesis the AI has a degree of error similar to that of humans, would you entrust the execution of the diagnosis to the machine?	399 (62.8%)	236 (37.2%)	0.18
In case of disagreement between AI and professional's diagnosis, would you accept the AI diagnosis as conclusive?	150 (23.6%)	485 (76.4%)	0.001

Table 3. AI advantages and disadvantages.

<i>Questions</i>	Agree	Disagree	P-values (reported vs. non-reported AI knowledge)
<i>AI advantages</i>			
Acceleration of clinical workflow	459 (72.3%)	176 (27.7%)	0.053
Improvement in the productivity of health research	440 (69.3%)	195 (30.7%)	0.14
Reduction of the Dentist's workload	253 (39.8%)	382 (60.2%)	0.90
Reduction of negligence in care practice	259 (40.8%)	376 (59.2%)	0.06
Facilitation of specialized level service in remote locations	407 (64.1%)	228 (35.9%)	0.28
Reduction of chances of misdiagnosis	363 (57.2%)	272 (42.8%)	0.19
Increase in diagnostic agreement among professionals	367 (57.8%)	268 (42.2%)	0.10
<i>AI disadvantages</i>			
Increase in expenses	365 (57.5%)	270 (42.5%)	0.000
Shortage of available experts in the field	277 (43.6%)	358 (56.4%)	0.22
Unavailability of digitized data	246 (38.7%)	389 (61.3%)	0.004
Data protection failure	370 (58.3%)	265 (41.7%)	0.007
Reduction in the number of job for dentists	82 (12.9%)	553 (87.1%)	0.004

3 CONSIDERAÇÕES FINAIS

Este foi o primeiro estudo a avaliar o conhecimento, a percepção e a confiabilidade de uma amostra representativa de cirurgiões-dentistas brasileiros em relação ao diagnóstico realizado através da inteligência artificial. Os resultados mostraram que a maioria dos dentistas brasileiros possui pouco conhecimento sobre IA e nunca teve contato com o assunto durante sua formação. A maioria dos profissionais também acredita que a IA é uma ferramenta para tornar o diagnóstico ainda mais confiável, mas somente se usada juntamente com a avaliação do profissional. Além disso, profissionais que possuem mais conhecimento sobre IA estão mais dispostos a incorporar essa tecnologia à Odontologia e são mais propensos a aceitar o diagnóstico da IA como definitivo em caso de discordância com o diagnóstico do profissional.

Os últimos anos foram marcados por um crescimento exponencial no número de publicações sobre IA na Odontologia, salientando a evolução dos algoritmos para a realização de diagnósticos automatizados. Cabe salientar que o processo de desenvolvimento e treinamento dos algoritmos apresenta desafios, como alto poder computacional, grandes bancos de dados e supervisão de especialistas que garantam a acurácia do modelo. Ainda, a maior disponibilidade dos sistemas de IA para utilização clínica e o conhecimento por parte dos profissionais sobre estes sistemas irão favorecer a mudança de visão de um modelo ‘homem contra a máquina’ para um novo modelo ‘homem com a máquina’, contribuindo ainda mais para a assistência à Saúde. Independentemente do tempo que este processo demore, é importante reiterar que qualquer sistema de IA dependerá de humanos, pois o profissional clínico é o responsável pelo treinamento e supervisão da máquina e pela tomada de decisão clínica final para o paciente.

Este estudo mostra também que é necessário fornecer mais conhecimento sobre IA aos profissionais de Odontologia. Para isso, faz-se necessária a implementação de tópicos relacionados à IA na grade curricular dos cursos de graduação e/ou pós-graduação de Odontologia. Assim, de posse desse conhecimento, os profissionais terão mais segurança e facilidade para trabalharem com os sistemas de IA e tirar proveito dessa tecnologia, levando a uma maior eficácia no sistema de saúde.

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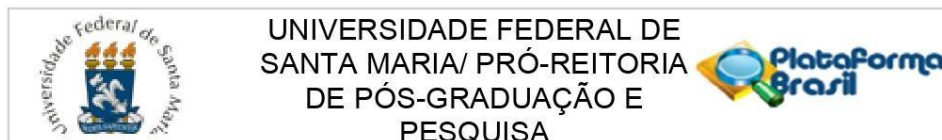
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ANEXOS

ANEXO A – Aprovação no Comitê de Ética em Pesquisa (CEP)



PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: CONHECIMENTO, PERCEPÇÃO E CONFIABILIDADE DE CIRURGIÕES DENTISTAS EM RELAÇÃO AO DIAGNÓSTICO REALIZADO ATRAVÉS DA INTELIGÊNCIA

Pesquisador: Gabriela Salatino Liedke

Área Temática:

Versão: 2

CAAE: 42857721.0.0000.5346

Instituição Proponente: Departamento de Estomatologia

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

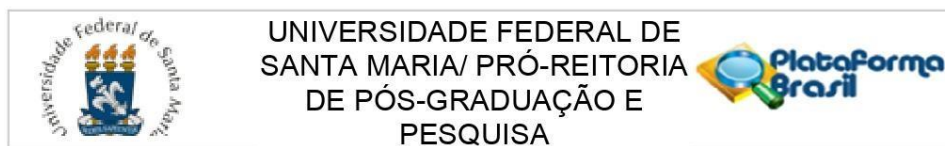
Número do Parecer: 4.602.671

Apresentação do Projeto:

O projeto se intitula "Conhecimento, percepção e confiabilidade de cirurgiões dentistas em relação ao diagnóstico realizado através da inteligência artificial" e se vincula ao curso de Odontologia.

No resumo do projeto o seguinte texto: "Todo tratamento em saúde inicia pelo correto diagnóstico da patologia, baseado em sinais e sintomas clínicos e em exames complementares. Nesse contexto, a inteligência artificial (IA) vem ganhando atenção como meio para diminuir a variabilidade resultante do examinador, melhorando assim o diagnóstico obtido com os exames por imagem. Assim, o objetivo desse estudo é avaliar o conhecimento, percepção, confiabilidade e opinião de cirurgiões dentistas em relação ao diagnóstico realizado através da inteligência artificial. Materiais e métodos: Será realizado um estudo observacional transversal, através do envio de questionários eletrônicos. Serão convidados a participar desta pesquisa cirurgiões dentistas registrados no Brasil. O recrutamento será realizado por meio de convite nas redes sociais, permitindo assim maior heterogeneidade dos participantes. Os questionários serão desenvolvidos no 'Google Forms' e serão estruturados em duas seções, uma para o TCLE, que após consentido, passará à segunda seção, sobre IA. Esta segunda seção compreenderá dois blocos de perguntas: um que aborda questões gerais sobre IA e outro destinado a cirurgiões dentistas Ortodontistas ou Radiologistas, abordando questões relacionando IA e análise

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UF: RS **Município:** SANTA MARIA
Telefone: (55)3220-9362 **E-mail:** cep.ufsm@gmail.com



Continuação do Parecer: 4.602.671

cefalométrica. Será realizada uma avaliação descritiva dos dados obtidos dos questionários respondidos. As respostas serão agrupadas conforme o nível de formação e a especialidade dos profissionais, sendo comparadas utilizando o teste Mann-Whitney. A análise estatística será realizada no programa SPSS. Será estabelecido um nível de significância de 5%. Resultados esperados: A partir dos resultados desse estudo, espera-se demonstrar se existe conhecimento dos cirurgiões dentistas a respeito de inteligência artificial e qual a opinião destes em relação à incorporação da inteligência artificial na prática clínica geral e nas análises cefalométricas."

No projeto constam revisão bibliográfica, descrição da metodologia, instrumentos de coleta de dados, cronograma e orçamento.

Objetivo da Pesquisa:

Avaliar o conhecimento, percepção, confiabilidade e opinião de cirurgiões dentistas em relação ao diagnóstico realizado através da inteligência artificial.

Avaliação dos Riscos e Benefícios:

Tendo em vistas características do projeto a descrição de riscos e benefícios pode ser considerada suficiente.

Comentários e Considerações sobre a Pesquisa:

.

Considerações sobre os Termos de apresentação obrigatória:

Os termos de apresentação obrigatória podem ser considerados suficientes.

Recomendações:

Veja no site do CEP - <https://www.ufsm.br/pro-reitorias/prpgp/cep/> - modelos e orientações para apresentação dos documentos. ACOMPANHE AS ORIENTAÇÕES DISPONÍVEIS, EVITE PENDÊNCIAS E AGILIZE A TRAMITAÇÃO DO SEU PROJETO.

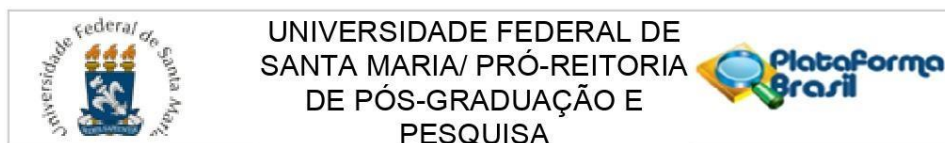
Conclusões ou Pendências e Lista de Inadequações:

.

Considerações Finais a critério do CEP:

Conheça o curso de Qualificação dos Comitês de Ética em Pesquisa que compõem o Sistema

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**UNIVERSIDADE FEDERAL DE
SANTA MARIA/ PRÓ-REITORIA
DE PÓS-GRADUAÇÃO E
PESQUISA**

Continuação do Parecer: 4.602.671

CEP/Conep em <https://edx.hospitalmoinhos.org.br/project/cep>.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1692916.pdf	18/03/2021 19:31:29		Aceito
Projeto Detalhado / Brochura Investigador	PROJETO_COMPLETO_REVISADO.pdf	18/03/2021 19:29:27	Gabriela Salatino Liedke	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.pdf	18/03/2021 19:29:10	Gabriela Salatino Liedke	Aceito
Outros	Convite.pdf	18/03/2021 19:28:52	Gabriela Salatino Liedke	Aceito
Outros	Questionario.pdf	18/03/2021 19:28:31	Gabriela Salatino Liedke	Aceito
Outros	projeto_67689.pdf	18/03/2021 19:27:39	Gabriela Salatino Liedke	Aceito
Declaração de Instituição e Infraestrutura	Autorizacao_Depto_Estomatologia.pdf	04/02/2021 14:11:53	Gabriela Salatino Liedke	Aceito
Outros	Confidencialidade.pdf	25/01/2021 17:17:06	Gleica Savegnago	Aceito
Folha de Rosto	folhaDeRosto.pdf	25/01/2021 16:57:07	Gleica Savegnago	Aceito

Situação do Parecer:

Aprovado

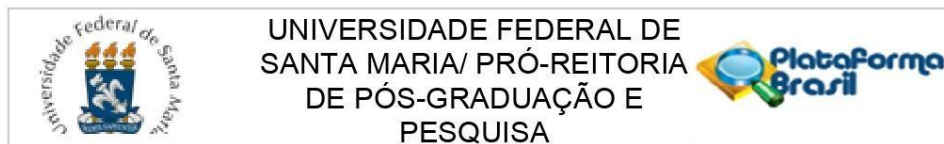
Necessita Apreciação da CONEP:

Não

SANTA MARIA, 20 de Março de 2021

Assinado por:
CLAUDEMIR DE QUADROS
(Coordenador(a))

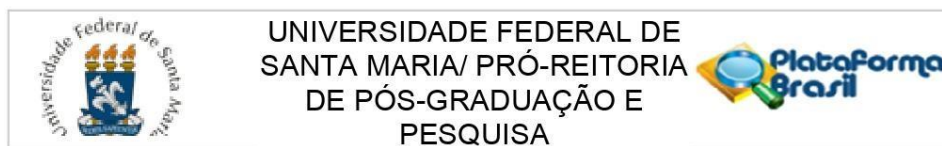
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Bairro: Camobi **CEP:** 97.105-970
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Telefone: (55)3220-9362 **E-mail:** cep.ufsm@gmail.com



Continuação do Parecer: 4.602.671

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UF: RS **Município:** SANTA MARIA
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ANEXO B – Aprovação no CEP – Emenda para extensão do cronograma



PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: CONHECIMENTO, PERCEPÇÃO E CONFIABILIDADE DE CIRURGIÕES DENTISTAS EM RELAÇÃO AO DIAGNÓSTICO REALIZADO ATRAVÉS DA INTELIGÊNCIA

Pesquisador: Gabriela Salatino Liedke

Área Temática:

Versão: 3

CAAE: 42857721.0.0000.5346

Instituição Proponente: Departamento de Estomatologia

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 4.686.313

Apresentação do Projeto:

Pela notificação o proponente apresentou emenda ao projeto intitulado “Conhecimento, percepção e confiabilidade de cirurgiões dentistas em relação ao diagnóstico realizado através da inteligência artificial.”

Por meio dela solicitou-se extensão do cronograma. Em função dos documentos apresentados, a emenda pode ser aprovada.

Objetivo da Pesquisa:

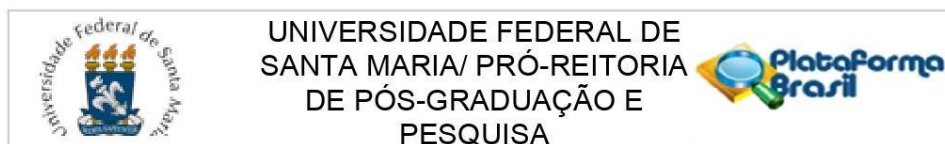
Avaliar o conhecimento, percepção, confiabilidade e opinião de cirurgiões dentistas em relação ao diagnóstico realizado através da inteligência artificial

Avaliação dos Riscos e Benefícios:

Tendo em vista as características do projeto a descrição de riscos e benefícios pode ser considerada suficiente.

Comentários e Considerações sobre a Pesquisa:

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Telefone: (55)3220-9362 **E-mail:** cep.ufsm@gmail.com



Continuação do Parecer: 4.686.313

Considerações sobre os Termos de apresentação obrigatória:

Os termos de apresentação obrigatória podem ser considerados suficientes.

Recomendações:

Conheça o curso de Qualificação dos Comitês de Ética em Pesquisa que compõem o Sistema CEP/Conep em <https://edx.hospitalmoinhos.org.br/project/cep>.

Conclusões ou Pendências e Lista de Inadequações:

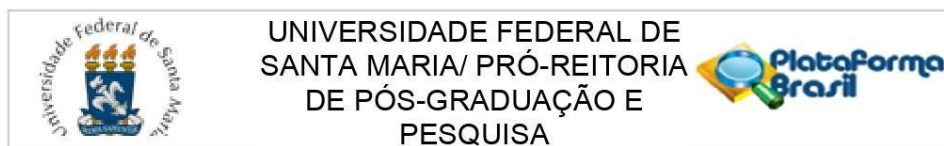
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Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

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Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_174588_2_E1.pdf	30/04/2021 12:31:59		Aceito
Outros	emenda_ICIQ_4285772100005346.pdf	30/04/2021 12:30:59	Gabriela Salatino Liedke	Aceito
Projeto Detalhado / Brochura Investigador	PROJETO_COMPLETO_EXTENSAO_CRONOGRAMA.pdf	30/04/2021 12:29:55	Gabriela Salatino Liedke	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.pdf	18/03/2021 19:29:10	Gabriela Salatino Liedke	Aceito
Outros	Convite.pdf	18/03/2021 19:28:52	Gabriela Salatino Liedke	Aceito
Outros	Questionario.pdf	18/03/2021 19:28:31	Gabriela Salatino Liedke	Aceito
Outros	projeto_67689.pdf	18/03/2021 19:27:39	Gabriela Salatino Liedke	Aceito
Declaração de Instituição e Infraestrutura	Autorizacao_Depto_Estomatologia.pdf	04/02/2021 14:11:53	Gabriela Salatino Liedke	Aceito
Outros	Confidencialidade.pdf	25/01/2021 17:17:06	Gleica Savegnago	Aceito
Folha de Rosto	folhaDeRosto.pdf	25/01/2021 16:57:07	Gleica Savegnago	Aceito

Endereço: Avenida Roraima, 1000 - Prédio da Reitoria - 7º andar - sala 763 - Sala Comitê de Ética - 97105-900 - Santa
Bairro: Camobi **CEP:** 97.105-970
UF: RS **Município:** SANTA MARIA
Telefone: (55)3220-9362 **E-mail:** cep.ufsm@gmail.com



Continuação do Parecer: 4.686.313

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

SANTA MARIA, 03 de Maio de 2021

Assinado por:
CLAUDEMIR DE QUADROS
(Coordenador(a))

Endereço: Avenida Roraima, 1000 - Prédio da Reitoria - 7º andar - sala 763 - Sala Comitê de Ética - 97105-900 - Santa
Bairro: Camobi **CEP:** 97.105-970
UF: RS **Município:** SANTA MARIA
Telefone: (55)3220-9362 **E-mail:** cep.ufsm@gmail.com

ANEXO C - Questionário**Você é dentista?**

Sim

Não

Estudante de Pós-graduação

*Dados demográficos***Gênero:**

Feminino

Masculino

Outro

Ano de nascimento:**Estado que atua profissionalmente:**

Acre (AC)

Alagoas (AL)

Amapá (AP)

Amazonas (AM)

Bahia (BA)

Ceará (CE)

Distrito Federal (DF)

Espírito Santo (ES)

Goiás (GO)

Maranhão (MA)

Mato Grosso (MT)

Mato Grosso do Sul (MS)

Minas Gerais (MG)

Pará (PA)

Paraíba (PB)

Paraná (PR)

Pernambuco (PE)

Piauí (PI)

Rio de Janeiro (RJ)

Rio Grande do Norte (RN)

Rio Grande do Sul (RS)

Rondônia (RO)

Roraima (RR)

Santa Catarina (SC)

São Paulo (SP)

Sergipe (SE)

Tocantins (TO)

Formação complementar:

Especialização

Residência

Mestrado

Doutorado

Ano de conclusão de graduação:**Ano de conclusão de especialização:****Ano de conclusão de residência:****Ano de conclusão de mestrado:****Ano de conclusão de doutorado:****Áreas de atuação:**

Clínica Geral (sem especialização)

Acupuntura

Cirurgia e Traumatologia

Bucomaxilofacial

Dentística

Disfunção Temporomandibular e Dor

Orofacial

Endodontia

Estomatologia
 Harmonização Orofacial
 Homeopatia
 Implantodontia
 Odontogeriatrics
 Odontologia do Esporte
 Odontologia do Trabalho
 Odontologia Legal
 Odontologia para Pacientes com
 Necessidades Especiais

Odontopediatria
 Ortodontia
 Ortopedia Funcional dos Maxilares
 Patologia Oral e Maxilofacial
 Periodontia
 Prótese Bucomaxilofacial
 Prótese Dentária
 Radiologia Odontológica e Imaginologia
 Saúde Coletiva

Local (is) de atuação:

Clínica- Consultório Particular
 Clínica- Serviço Público
 Docência- Instituição Privada
 Docência- Instituição Pública
 Estudante de Pós-Graduação

Questões sobre IA

Qual seu conhecimento sobre Inteligência Artificial (IA)?

Muito pouco Pouco Mediano Bom Excelente

Qual seu conhecimento sobre as redes neurais artificiais de aprendizado profundo ou deep learning?

Muito pouco Pouco Mediano Bom Excelente

Você acredita que a IA esteja sendo utilizada no cotidiano?

Definitivamente não Possivelmente não Possivelmente Provavelmente sim
 Definitivamente sim

Você acredita que a IA esteja sendo utilizada na Odontologia?

Definitivamente não Possivelmente não Possivelmente Provavelmente sim
 Definitivamente sim

A IA foi tema de aulas durante sua formação?

Nunca Raramente Algumas vezes Frequentemente Sempre

Você possui vontade de incorporar a IA à prática clínica diária?

Nenhuma vontade Pouca vontade Indiferente Alguma vontade Muita vontade

Você acredita que a incorporação da IA na prática clínica levaria à redução do número de vagas para dentistas?

Definitivamente não Possivelmente não Possivelmente Provavelmente sim
 Definitivamente sim

Você concorda com o uso da IA para tornar o diagnóstico odontológico mais confiável?

Discordo totalmente Discordo Indiferente Concordo Concordo totalmente

Você concorda com a inclusão do diagnóstico realizado pela IA, juntamente com o diagnóstico realizado pelo clínico, no laudo odontológico?

Discordo totalmente Discordo Indiferente Concordo Concordo totalmente

Na hipótese de que a IA tenha grau de erro semelhante ao do homem, confiaria a execução do diagnóstico à máquina?

Definitivamente não Possivelmente não Possivelmente Provavelmente sim
Definitivamente sim

Em caso de discordância entre diagnóstico do profissional e da IA, você aceitaria o diagnóstico da IA como definitivo?

Definitivamente não Possivelmente não Possivelmente Provavelmente sim
Definitivamente sim

Marque as alternativas que você considera vantagens em relação ao uso da inteligência artificial:

Aceleração do fluxo de trabalho clínico
Melhora na produtividade da pesquisa em saúde
Redução de chances de erro no diagnóstico
Diminuição da carga de trabalho do cirurgião dentista
Redução da negligência na prática assistencial
Aumento na concordância diagnóstica entre profissionais
Facilitação de atendimento de nível especializado em localidades remotas

Marque as alternativas que você considera desvantagens em relação ao uso da inteligência artificial:

Aumento nos gastos
Escassez de especialistas na área disponíveis
Redução do número de vagas de trabalho para dentistas
Indisponibilidade de dados digitalizados
Falhas na proteção dos dados

ANEXO D – Normas para publicação no periódico *Journal of Dental Education*

The Editor will consider the following types of manuscripts for publication:

Submissions for Peer Review:

- Original Articles (see below for categories within this type)
- Review Articles
- Advancing Through Innovation

Solicited or Pre-approved by the Editor:

- Letters to the Editor (solicited or pre-approved by the Editor)
- Guest Editorials (solicited by the Editor)
- Perspectives (pre-approved by the Editor)
- Brief Communications (pre-approved by the Editor)
- Point/Counterpoint (solicited by the Editor)

Special Reports:

- Miscellaneous (submitted by ADEA staff)

Submissions for Peer Review

1. Original Articles

This type of article addresses subject matter in the following categories:

- a. Predoctoral Dental Education;
- b. Advanced Dental Education
- c. Allied Dental Education
- d. Interprofessional Education
- e. Community-based Dental Education
- f. Global Dental Education—Manuscripts pertaining to global health education or issues pertinent to the global dental education community. (Not intended solely for submissions from international authors. International authors should submit manuscripts under pertinent topic areas provided in this section.)
- g. Use of Technology in Dental Education
- h. Assessment
- i. Faculty Issues/Development
- j. Continuing Education

Original Articles should report the results of hypothesis-based research studies and may be either qualitative, quantitative or of a mixed methods nature. Manuscripts must address how the findings advance our understanding of the questions asked in the study and make a novel contribution to the literature. The limitations of the study should also be addressed. Small studies of local relevance/interest, limited to one class/course, or small course/student-based surveys may not meet the criteria to be published as an Original Article.

Original Articles should be no more than 3,500 words, excluding the abstract, illustrations and references. A maximum of six figures and tables can be submitted (the figures can be multi-panel), and the number of references should not exceed 50 (unless the article is a systematic review).

Original Articles should have the following general organization (see "Document Preparation, Organization and Formatting" below for more detailed instructions):

Title: An informative and concise title limited to 15 words with no more than 150 characters. **Abstract:** For research studies, a structured abstract of no more than 250 words should be submitted with the following subheads:

- Purpose/Objectives: Briefly summarize the issue/problem being addressed.
- Methods: Describe how the study was conducted.
- Results: Describe the results.
- Conclusion(s): Report what can be concluded based on the results, and note implications for dental education.

Abstracts for other types of manuscripts should be in paragraph form, with no subheads.

Introduction: Provide a succinct description of the study's background and significance with references to the appropriate published literature. Detailed literature review/discussion should be reserved for the discussion section. Include a short paragraph outlining the aims of the study.

Materials and Methods: A statement that the study has been approved or exempted from oversight by a committee that reviews, approves and monitors studies involving human subjects **MUST** be provided at the beginning of this section, along with the IRB protocol number.

In this section, provide descriptions of the study design, curriculum design, subjects, procedures and materials used, as well as a description of and rationale for the statistical analysis. If the design of the study is novel, enough detail should be given for other investigators to reproduce the study. References should be given to proprietary information.

Results: The results should be presented in a logical and systematic manner with appropriate reference to tables and figures. Tables and figures should be chosen to illustrate major themes/points without duplicating information available in the text.

Discussion: This section should focus on the main findings in the context of the aims of the study and published literature. The authors should avoid an extensive review of the literature and focus instead on how the study's findings agree or disagree with the hypotheses addressed and what is known about the subject from other studies. A reflection on new information gained, new hypotheses and limitations of the study should be included, as well as guidance for future research.

Conclusion: The article should end with a short paragraph describing the conclusions derived from the findings and implications of the study for dental education.

Acknowledgements: The acknowledgments should report all funding sources, as well as any other resources used or significant assistance.

Disclosure: Authors must disclose any financial, economic or professional interests that may have influenced the design, execution or presentation of the scholarly work. If there is a disclosure, it will be published with the article.

Clinical Trials: Any educational research studies that are designed as "clinical trials" must register the trial before submitting to the *Journal of Dental Education*. The registration number must be provided in the manuscript.

The studies can be registered at **U.S. National Institutes of Health Clinical Trials Registry**, **EU Clinical Trials Register**, or **WHO International Clinical Trials Registry Platform**.

2. Review Articles

The *JDE* will not consider articles that consist of a general review of topics or published information that is more appropriate for a textbook. However, systematic reviews that focus on trends, issues, new programs or innovations in dental education that are of global interest are welcome. These reviews should not be exhaustive reviews of the literature, but should be concise and address important and relevant questions that affect dental education. Reviews should be presented in a scientific format and use the methods of a systematic review. Authors can refer to the **Cochrane Handbook for Systematic Reviews of Interventions** for more details. In addition, the Editor asks authors of reviews to make sure they follow the **PRISMA checklist** and **flow diagram** to ensure the highest quality of systematic reviews of meta-analyses.

For review articles, a structured abstract of 250 words or fewer that addresses the question of interest must precede the review. A brief background and significance section with a review of the literature should be provided. The question being asked and the justification for the review should be addressed. As with any systematic review, the search strategy and the inclusion and exclusion criteria should be outlined. The authors should describe the findings of the study to the literature at large. Limitations and future areas of interest/research should be identified. Review articles should be limited to 3,500 words with no more than 80 references. No more than six tables and figures should be included. Acknowledgements and any conflicts of interest should be documented as described in the Original Article section.

3. Advancing Through Innovation

ADEA invites authors to submit articles for consideration for a new feature in the Journal of Dental Education: Advancing Through Innovation. In health care education we often pilot new methods for learning and supporting our teams. Exploring new approaches to a problem often is based on a limited availability of high-quality evidence. Advancing Through Innovation articles are scholarly insights that are not completed research, yet they meet our standards of originality, clarity of approach, and significance through a rapid peer review process. The goal is to present a problem, describe how it was addressed, and discuss the lessons learned from the experience in order to help others replicate, refine, or redirect the approach to similar problems in their local environments. Following are the manuscript specifications and submission information.

Title: A maximum of 90 characters.

Authors: A maximum of four, meeting the **ICMJE author criteria**.

Format: Word count: a maximum of 500 words (not counting reference materials).

Submissions are limited to three sections:

- **Problem - Why?** (*why was the problem addressed*)
- Briefly explain why this is a problem with context to enable the reader to judge the applicability of the concern to their environment.
- **Solution - How?** (*how was the problem addressed; what was tried*) Outline how the solution attempted to address the problem, what resources were required, and how the idea was given a chance to succeed.
- **Results - What?** (*what went well, did not go so well, and what lessons were learned*) Share successes and failures and highlight how your perspective has changed in relation to why the innovation succeeded or failed.

Images: A maximum of three image files, including tables, photos and/or illustrations.

References: A maximum of five references.

Website: A maximum of one website url, if the educational materials described are publicly available.

How to Submit Articles

Submit articles for consideration to mc.manuscriptcentral.com/jdentaled. Select “Advancing Through Innovation” from the list of article types.

Call for Reviewers

If you wish to serve as a reviewer for Advancing Through Innovation submissions, please email Sue Kimner at kimners@adea.org.

Solicited or Pre-approved by the Editor

1. Guest Editorials

Each issue opens with a "From the Editor" note or a Guest Editorial solicited by the Editor, usually consisting of a short commentary on articles in that issue or on critical topics of interest to readers. The Editor's annual report about the journal will be published in the January issue.

2. Letters to the Editor

Letters to the Editor should be responses to articles published in the *JDE* in the previous three-month period. They should add to the discussion in a scientific manner, without being personal reflections or reactions. On occasion, letters that deal with the profession, education and training, as well as issues critical to dental education, will be considered. Letters should be brief, focused on one or a few specific points or concerns, and can be signed by no more than four individuals. The letter should be limited to 400 words and six references in *JDE* format. Authors should submit letters directly to the Editor (JDEeditor@adea.org).

3. Perspectives

Perspective articles should provide an opinion-based but well-supported commentary on controversies, innovations or emerging trends in dental education. On occasion, manuscripts addressing historical figures/perspectives that are impacting current practices will also be considered. Perspectives articles may also be solicited by the Editor on issues that are critical in dental education. Authors who want to independently submit a commentary should contact the Editor ahead of time by e-mail. These articles will be limited to 2,000 words, no more than 10 references, and no more than two figures and/or tables.

Perspectives articles should consist of a) an introduction that addresses why this topic is of general interest to a North American and/or global audience; b) a main section that contains the information relevant to the area being discussed, the author's perspective on it and the grounds for that perspective; and c) a summary that describes the importance of the commentary/perspective to the current and future status of the topic and recommendations concerning how these items can be addressed.

Authors should submit inquiries for submission of perspectives directly to the Editor (JDEeditor@adea.org).

4. Brief Communications

Brief Communications should be used to inform readers about significant findings in studies based on a limited data set, such as a topic of local relevance/interest or limited to one class/course. These communications will typically contain novel items/findings that are time-sensitive. These articles should include an unstructured abstract of 150 words or fewer. This category of article will be limited to 1,000-1,500 words, no more than 10 references and no more than two tables and/or figures. Authors should submit inquiries for submission of Brief Communications directly to the Editor (JDEeditor@adea.org).

5. Point/Counterpoint

Point/Counterpoint articles will be solicited by the Editor, who will provide those authors with information about required length and format.

Special Reports

In addition to the above types of manuscripts, the *JDE* occasionally publishes several types of articles and reports that fall outside the standard peer-review process. These include Association Reports (which are written by ADEA staff members) and special reports/sections/issues (which are the result of special activities or studies conducted by ADEA or other groups and are considered on a case-by-case basis by the Editor). Each year, the ADEA Annual Proceedings and the abstracts of poster and TechExpo presentations at the ADEA Annual Session & Exhibition are also published in the *JDE*. All these types of documents undergo systematic internal review and selected external review as determined by the Editor.

The *JDE* considers only manuscripts that are in MS Word and submitted electronically (see "Submission and Production Procedures" below for the submission process). All manuscripts submitted to the journal should follow the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals," compiled and published by the International Committee of Medical Journal Editors (ICJME). Authors are also encouraged to refer to the code on good publication practice produced by the Committee on Publication Ethics.

No Prior Publication or Duplicate Submissions. Manuscripts are considered for publication only if they are not under consideration by other journals and have not been published previously in the same or substantially similar form. Submitting authors should attest to their compliance with this requirement in their cover letters. Should a prior or duplicate publication be discovered, the Editor will address the matter with the affected author/s and the other journal's editor following guidelines published by the ICJME and by the Committee on Publication Ethics.

Plagiarism. Plagiarism is a violation of scholarly standards and will not be tolerated. If a case of plagiarism is alleged or discovered, the Editor will address it with the affected author/s, following ICJME guidelines. Authors should exercise extreme care in quoting or paraphrasing material from published sources, so as not to risk plagiarism.

Conflict of Interest. A conflict of interest exists when professional judgment concerning a primary interest may be influenced by secondary interests (professional, personal, financial, etc.). Forms declaring any conflict of interest must be submitted for each author when the manuscript is submitted for consideration. The form can be found on ScholarOne Manuscripts in the upper right-hand corner under "Instructions and Forms." **Human Subjects.** It is the author's responsibility to obtain approval or exempt status from his or her institution's Institutional Review Board for studies involving human subjects; this approval or exempt status must be mentioned at the very beginning of the Methods section. Failure to meet these requirements is likely to place the manuscript in jeopardy and lead to a rejection.

Editorial Assistance. Manuscripts considered for submission must be written in standard academic English that is comprehensible to English-speaking readers. The American Medical Writers Association (AMWA) offers a Freelance Directory with contact information for editors who provide assistance in the writing of medical literature, especially for authors whose first language is not English. Please visit their website for further information.

Manuscripts submitted for consideration should be prepared in the following parts, beginning on a new page:

- Title page
- Abstract and keywords
- Text
- Acknowledgments
- References
- Tables
- Figures
- Figure titles if figures are provided as images

Blinding. Both blinded and non-blinded manuscripts should be prepared once the original manuscript has been completed. All institutional references should be removed from the body of the manuscript and the abstract to produce the blinded version; please indicate in the file name which version is blinded. **Document Format.** Create the documents on pages with margins of at least 1 inch (25 mm) and left justified with paragraphs indented with the tab key, not the space bar. Use double-spacing throughout and number the pages consecutively. Do not embed tables and figures in the body of the text but place them after the references; include callouts for each table or figure in the text (e.g., see Table 1). Unless tables vary significantly in size, include all in one document. If any figures are large files, submit them as separate documents. **Title Page.** The title page should carry 1) the title, which should be concise but descriptive, limited to 15 words and no more than 150 characters; 2) first name, middle initial and last name of each author, with his or

her professional and/or graduate degrees (if no professional or graduate degrees, provide undergraduate degree); 3) an affiliations paragraph with the name of each author or coauthor and his or her job title, department and institution, written in sentence style; 4) disclaimers if any; 5) name, address, phone and email of author responsible for correspondence about the article and requests for reprints; and 6) support or sources in the form of grants, equipment drugs, etc. See published articles for examples. Individuals listed as authors must follow the guidelines established by the ICMJE: 1) substantial contribution to conception and design, or acquisition of data or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. It is the submitting author's responsibility to make sure that authors have agreed to the order of authorship prior to the submission. **Abstract and Key Words/MeSH terms.** The second page should carry the title and an abstract of no more than 250 words. For research studies, the abstract should be in the structured form described above. Abstracts should be written in the third person, and references should not be used in the abstract. The abstract should include the year of the study and, for survey-based research, the response rate. Below the abstract, provide three to five key words or phrases that will assist indexers in cross-indexing the article and will be published with the abstract. At least three terms should come from the Medical Subject Headings listed at the **National Library of Medicine**. Guidelines for words found in the Medical Subject Headings can be found **here**. Authors should confirm these terms still exist in the **Index Medicus** or should search for more accurate terms if not found in our list. **NOTE:** Authors will also be prompted to identify Key Words when submitting their manuscripts in ScholarOne. These Key Words may differ from the items presented here. The Key Words identified in ScholarOne are generated from a list that will best match the submitted manuscript to a Peer Reviewer with expertise in the area(s) identified.

Text. Follow American (rather than British) English spelling and punctuation style. Spell out numbers from one to ninety-nine, with the exception of percentages, fractions, equations, numbered lists, and Likert scale numbers. The body of the manuscript should be divided into sections preceded by appropriate subheads. Major subheads should be typed in capital letters at the left-hand margin. Secondary subheads should appear at the left-hand margin, be typed in upper and lower case and be boldfaced. Tertiary subheads should be typed in upper and lower case and be underlined. For authors whose first language is not English, please use a **medical writer** or a native English-speaking colleague to edit the manuscript prior to final submission. Manuscripts will be rejected prior to peer review if there are numerous usage or grammatical errors. Please Note: In preparing the main document for submission, save the original file with the word "unblinded" at the end of the file name. Please also remove all author names and affiliated institutions from the original manuscript, and save this version with the word "blinded" at the end of the file name. **References.** Number references consecutively in the order in which they are first mentioned in the text. Each source should have one number, *so be careful not to repeat sources in the reference list*. Identify references by Arabic numerals, and place them in the text as superscript numerals within or at the end of the sentence. Do not enclose the numerals in parentheses, and be sure to follow American rather than British or European style conventions (e.g., the reference number follows rather than precedes commas and periods). Two important reminders: 1) references should not be linked to their numbers as footnotes or endnotes and 2) references to tables and figures should appear as a source note with the table/figure, not numbered consecutively with the references for the article.

Follow the style of these general examples. Titles of journals should be abbreviated according to the **Index Medicus** style. Do not use italics or boldface anywhere in the references. If the publication has one to four authors, list all of them; if there are more than four authors, list the first three followed by et al.

Book

1. Avery JK. Essentials of oral histology and embryology: a clinical approach. 2nd ed. St. Louis: Mosby, 2000. *Chapter in an Edited Volume*
2. Inglehart MR, Filstrup SL, Wandera A. Oral health and quality of life in children. In: Inglehart MR, Bagramian RA, eds. Oral health-related quality of life. Chicago: Quintessence Publishing Co., 2002: 79-88. *Article in a Journal*
3. Seale NS, Casamassimo PS. U.S. predoctoral education in pediatric dentistry: its impact on access to dental care. J Dent Educ 2003;67(1):23-9.

Report

4. Commission on Dental Accreditation. Accreditation standards for dental education programs. Chicago: American Dental Association, 2010.

Web Source

5. American Dental Hygienists' Association. Position paper: access to care. 2001. At: www.adha.org/profissues/access_to_care.htm. Accessed: November 27, 2012.

Figures. Figures may be charts or graphs, photographs, or scientific images; any illustration that consists of text should be called a table (see below). Each figure should have a title, numbered consecutively with Arabic numerals in the order in which they appear in the text. Figures may be provided pasted into an MS Word document or as a separate TIFF or JPEG. Do not put the title on the image itself. Rather, if the image is in a Word document, place that title below the image; if the image is in a TIFF or JPEG, provide the figure titles in a list at the end of the manuscript. For graphs, be sure to label both axes. Include a key to symbols, patterns or colors in the figure either as a legend on the image or as a note below the figure. Any sources should appear in a Source note below the figure. Remember that the total number of figures and tables submitted with an article must not exceed six.

Figures should be used selectively to illustrate major points that cannot be expressed well in textual format. Authors should be able to articulate (for themselves, not as part of the submission) why a figure is necessary and what it adds to the understanding of the points made in the manuscript. Figures should be of the highest possible quality—typically 1,000 dots per inch (dpi) for monochromatic images and 600 dpi for images including halftones. Illustrations should not exceed 8 1/2 x 11 inches, and all lettering should be at least 1 1/2 mm high. If your article is accepted, we may request illustrations in higher resolution than those you've submitted.

Display of Quantitative Information: JDE readers expect authors to employ the highest standards of information design to display information in figures. It is recommended to review the seminal work by Edward R. Tufte, "The Visual Display of Quantitative Information," before designing figures that display quantitative information: Tufte, Edward R., *The visual display of quantitative information*. 2nd ed. Cheshire, Connecticut: Graphics Press; 2001, ISBN-13: 978-0961392147.

Illustrations: Illustrations should be employed to showcase complex relationships that can be explored by the reader to gain additional insight beyond what was already presented in the manuscript. While illustrations are part of the manuscript, they need to fulfill a purpose for themselves and must have value as standalone elements—telling a particular story or showcasing a relationship not easily expressed in words. It is recommended to review works on information design such as "The Functional Art: an Introduction to Information Graphics and Visualization" by Alberto Cairo, before designing illustration: PeachPit Press, 2012, ISBN-13: 978-0321834737.

Figure Checklist:

1. Planning

- Small, noncomparative and highly labeled data sets belong in tables rather than figures.
- Show data variations, not design variations.
- The number of information-carrying (variable) dimensions depicted should not exceed the number of dimensions in the data; i.e., no 3D bars for pocket depths in mm.
- Above all else show the data (data ink) not design variations.
- Range frame should replace non-data-bearing frame.
- The same ink should often serve more than one graphical purpose.
- Organize and order the flow of graphical information presented to the eye.

(adapted from E. Tufte: *The visual display of quantitative information*.)

2. Design

- Variations in font size reflect importance and have meaning.
- Data sets are labeled directly, avoiding cognitive overhead for the reader to decode patterns or shades.
- All symbols (*, #, etc.) are explained in the legend.

3. Execution

- All source files are available on request, and minimal resolution guidelines have been followed.
- If JPEG images or other compressed formats are used, export has been done with maximal quality setting.
- Vector graphics are preferred (using drawing or illustration programs such as Adobe Illustrator).

Tables. Each table should have a title, numbered consecutively with Arabic numerals in the order in which they appear in the text. All tables should be in column format. Arrange column headings so that their relation to the data is clear. Indicate explanatory notes to items in the table with symbols or letters (note that asterisks should be used only with p-values) or in a general note below the table. Any sources should appear in a Source note below the table. All percentages in tables should include the % sign. Note that tables may be uploaded in PDF form for initial consideration and peer review; however, *tables must be uploaded as MS Word documents for final review and, if accepted, for production*. Remember that the total number of figures and tables submitted with an article must not exceed six. **Permissions.** Any aspect of the article that is not the author's original work (e.g., figures or tables from other publications) must be fully credited to the original publication. It is the author's responsibility to acquire permission to reprint the material and pay any fees. Evidence of required permissions must be in the author's hands before the article can be published.

Manufacturers. Manufacturers of equipment, materials and devices should be identified with the company name and location in parentheses immediately after the first mention.

Commercial Products. Do not use brand names within the title or text, unless the paper is comparing two or more products. If identification of a product is needed, a generic term should be used and the brand name, manufacturer and location (city/state/country) mentioned in parentheses.

Submissions should be made via the ScholarOne system, following these steps:

1. Launch your web browser and go to the JDE's submission homepage at <http://mc.manuscriptcentral.com/jdentaled>.
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