

# E-learning on medical emergencies for Dentistry students: a randomized controlled trial

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Received: 11/11/2020. Approved: 11/12/2021.

## ABSTRACT

This study compared two teaching pedagogies to address medical emergencies in dental office visits and evaluated dental school students' knowledge about medical emergencies. This randomized controlled trial involved 54 senior undergraduate dental students at the Federal University of Santa Maria divided in two groups: students who received instruction via face-to-face traditional expository class; and students who received the same instruction via distant learning format. The students were randomly allocated to the groups by the randomiser.org website. Data were obtained by comparing the scores students received from answering to a semi-structured questionnaire containing inquiries on ethical and legal implications, and diagnosis and management of medical emergencies in a dental office before and after the instruction. Before the instruction, 96% of students from the two groups lacked knowledge about the ethical and legal implications related to the dentist obligation to deal with medical emergencies. After the instruction, both groups increased their knowledge similarly as there was no significant difference in the comparison between learning about medical emergencies through lectures and thorough an e-learning format. Both teaching methods presented satisfactory results, which makes the e-learning method an option as a didactic strategy.

**Descriptors:** Medical Emergencies. Dentistry. Distance Learning.

## 1 INTRODUCTION

Medical emergencies during a dental appointment can pose a severe health risk that can result in acute suffering and even death; syncope, seizure or choking require immediate attention<sup>1</sup>. More than a decade ago, a study shown that almost 50% of dentists would likely have a patient with a medical emergency during a dental appointment in a given year due to the use of local anesthesia for a tooth extraction or an endodontic treatment<sup>2</sup>.

Although most of these emergencies tend to be mild and involve syncope and hyperventilation in most cases, dental professionals need to be knowledgeable about these emergencies and promptly manage them<sup>1,3</sup>. The treatment of medical emergencies in a dental office requires preparation, prevention and prompt management to reduce the chances of sequelae and to increase survival<sup>1</sup>. However, studies have shown that dental professionals in general and undergraduate

students in particular, are not prepared to address medical emergencies during a dental appointment<sup>4,5</sup>. Most dental professionals have insufficient knowledge of this subject due to inadequate training and lack of regular continuing education courses after graduation<sup>6</sup>. Undergraduate dental education surfaces as an alternative venue to train and educate future oral health care providers on preventing and managing medical emergencies<sup>7</sup>.

As dental education moves toward competency-based curricula, it requires expanding what constitutes meaningful knowledge generation and what pedagogies best support its curricula<sup>8</sup>. Undergraduate dental education consists mainly of teaching pedagogies employed to address a particular subject area at a pre-established scheduled time through direct communication between student and instructor<sup>8</sup>. Such interaction usually takes place via lectures, problem-based case studies, small group learning, clinical care, and so on. Distance or e-learning, also employed by some dental schools, is a pedagogy fundamentally based on the use of technologies to establish the relationship between instructor and student, mostly via an online environment where the content is distributed within a more flexible time<sup>9</sup>. Both face-to-face and e-learning pedagogies are valid and should foster the development of practical and emancipatory knowledge to provide efficient and effective education for future practitioners<sup>9,10</sup>. Inadvertently, the COVID-19 pandemic has rapidly promoted online learning to comply with physical distancing; there is still the need to ensure the knowledge and clinical-based competency of the graduating students<sup>9,11</sup>.

This study aimed to compare two teaching pedagogies to address medical emergencies in dental office visits, one employing on-campus face-to-face instruction and the other employing distance e-learning instruction. A secondary objective was to evaluate undergraduate dental

students' knowledge about these medical emergencies. We hypothesize that face-to-face instruction was better than at-distance for learning medical emergencies in dental office visits. Although this study was developed pre-COVID-19 pandemic, it remains even more relevant given that most, if not all, dental schools across the globe have to imbed online learning into their curricula.

## 2 METHODS

The institutional Research Ethics Committee approved the present study (CAAE 59926516.0.0000.5346). A randomized controlled trial was conducted at the Federal University of Santa Maria (UFSM) involving undergraduate senior dental students enrolled in the last year of their undergraduate education, which is year five at that university. The research data were collected through a 20-item semi-structured questionnaire applied before and after the instruction. The questionnaire contained information about ethical and legal implications of medical emergencies (10 questions) and about diagnosis of medical emergencies and execution of rescue maneuvers (10 questions). The maximum score is 80, which demonstrates that the respondent is very knowledgeable about identifying and managing medical emergencies during a dental appointment. Perceptions about learning medical emergencies in dental office visits were collected through a structured questionnaire.

A pilot study involving 54 junior UFSM undergraduate dental students was conducted to test the questionnaire. No changes were needed in the pilot questionnaire. The sample size was calculated using the following parameters: power of 80%; confidence interval of 95%, group ratio of 1/1; standard deviation for group 1 of 4,89; standard deviation for group 2 of 4,04; and minimum difference of 3,5. The required sample size was 52 participants, and the regular enrollment of the last year of Dental School at UFSM

comprised 65 students on average.

The inclusion criteria were to be enrolled in the senior last year of the undergraduate education at the time of application of the questionnaire; to volunteer to participate in one of the two learning processes (face-to-face or online sessions); and to be present in the classroom at the time of application of the questionnaire. Students who declined to participate and who started the study but left before the end of the intervention (e.g., drop-outs) were excluded.

Student randomization was conducted through the randomiser.org website. Students were allocated into two groups: Group 1 (G1), with on-campus face-to-face education in the format of an expository class; and Group 2 (G2), with an at-distance e-learning format through video lessons with the same duration and content of the face-to-face instruction of 60 minutes. Both groups received instruction from the same trained lecturer, reducing the chances of bias. The G1 instruction spanned over 3 sessions, and covered ethical and legal issues pertaining to medical emergency situations, types of medical emergency situations that may occur during a dental appointment, and to how to act when these emergencies do occur. The

G2 experienced the same content presented through 3 videos. Participants from both groups responded to a 20-item questionnaire before and after the educational session.

Absolute and relative frequencies were calculated, as well as stratification aimed at a better understanding of the distribution of the study variables. Shapiro-Wilk test was employed to verify if the data were normally distributed. Mean and standard deviation were used. For the hypothesis testing, the paired Student's t-test was used to verify if there were differences between mean scores in the two groups. A *p*-value of less than 5% was considered for statistically significant differences. Stata software version 11 (Stata Corporation, College Station, TX, USA) was used for all analyzes.

### 3 RESULTS

All the 65 students from the final senior undergraduate year at the UFSM volunteered to participate and were allocated into the two groups as shown in figure 1. Eleven students were excluded as they dropped-out before the finalization of the study (5 students from G1 and 6 students from G2).

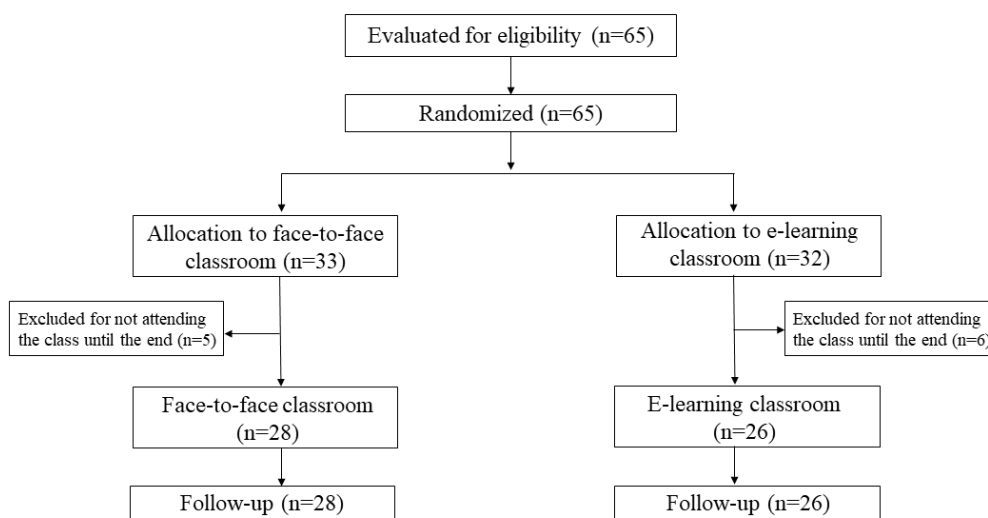


Figure 1. Intervention flowchart

The mean age of the students was 23 years, and the sample distribution is presented in table 1; there was no statistical age difference between the groups. The majority of sample was female and 96% of the students had no previous training in medical emergencies, in both groups. Most students were not satisfied with the extent to which they were knowledgeable about medical emergencies (74% from G1 and 61.5% from G2), and did not feel technically prepared to perform salvage maneuvers (90.5% and 91.3% from G1 and G2, respectively). There was no statistical difference between Group I and II responses.

The mean and standard deviation of baseline and follow-up scores before and after face-to-face classroom and e-learning strategies are shown in table 2 and figure 2. After completion of the two teaching interventions and reapplication of the questionnaire, it was observed that there was a general increase in the scoring in both groups (table 2). In addition, there was a reduction in the number of missing responses by 95.6%. However, there was no statistically significant difference in the mean scores between the groups after the instruction: 73.4 (SD 3.6) for the distant learning group and 72 (SD 3,1) for the face-to-face group,  $p = 0.125$ .

Table 1. Distribution of the sample (n=54)

Variables	(G1)	(G2)
	Face-to-face	E-learning
	n (%)	n (%)
<i>Sex</i>		
Male	8 (30.8)	9 (32.1)
Female	18 (69.2)	19 (67.9)
<i>Previous Training</i>		
No	25 (96.2)	27 (96.4)
Yes	1 (3.8)	1 (3.6)
<i>Satisfaction with the medical emergencies approach in dental graduation</i>		
Very dissatisfied	1 (4.0)	3 (11.5)
Dissatisfied	18 (72.0)	13 (50.0)
Satisfied	5 (20.0)	10 (38.5)
Very satisfied	1 (4.0)	-
<i>The importance attributed to the approach in undergraduate</i>		
Very important	17 (65.4)	20 (71.4)
Important	8 (30.8)	8 (28.6)
Not important	1 (3.8)	-
<i>Technically prepared to perform salvage maneuvers</i>		
Adequate	2 (9.5)	2 (8.7)
Inadequate	19 (90.5)	21 (91.3)
<i>Knowledge acquired in compulsory subjects in dentistry graduation</i>		
Adequate	4 (26.7)	3 (15.8)
Inadequate	11 (73.3)	16 (84.2)

Values lower than 54 due to missing data.

Table 2. Mean and standard deviation of before and after scores (n=54)

Learning strategies	Mean (SD)	Minimum	Maximum	p
<i>Baseline</i>				0.125*
Total	50.6 (7.6)	27	62	
(G1) Face-to-face	52.1 (6.4)	36	60	
(G2) E-Learning	49.3 (8.6)	27	62	
<i>Follow-up</i>				
Total	72.6 (3.4)	65	80	
(G1) Face-to-face	72.0 (3.1)	65	78	
(G2) E-Learning	73.4 (3.6)	65	80	

SD: standard deviation. \*P-value refers to paired Student's t test.

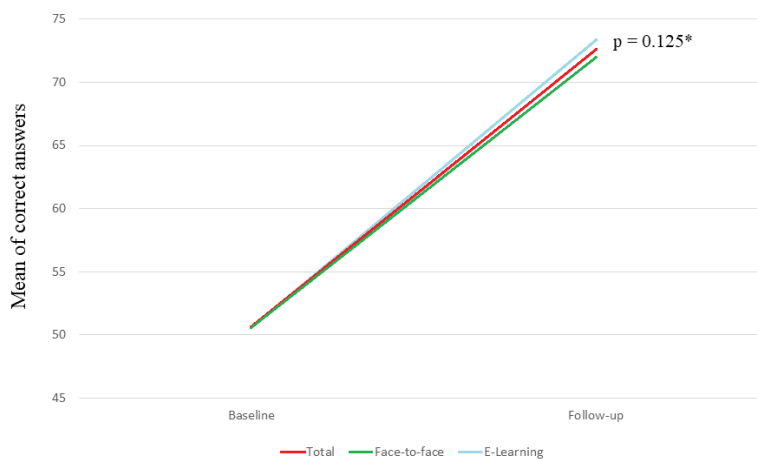


Figure 2. Mean of baseline and follow-up of corrected scores after face-to-face classroom and e-learning. \* P-value refers to paired Student's t test.

#### 4 DISCUSSION

The objective of this study was to investigate whether there was a difference between face-to-face (G1) and distance education (G2) modalities in teaching medical emergencies in dentistry to undergraduate senior dental students. The results showed no significant difference in the acquired knowledge on the subject between the two groups, regardless of the instruction method used.

The present study also found that the students of the last year of the Dentistry course at the Federal University of Santa Maria did not consider themselves capable of dealing with

medical emergencies in a dental office, corroborating other studies<sup>12,13</sup>. These results demonstrate a need to include basic life support procedures in the university curriculum so that future dentists can be better prepared to prevent, diagnose and manage medical emergencies during a dental appointment.

It was also observed that students were unaware of the ethical and legal aspects related to medical emergencies, which was also found by Albelaihi et al. (2017)<sup>14</sup>. Knowledge about ethical aspects of medical emergencies that have legal consequences for practicing dentistry must be taught<sup>15,16</sup>. Students from this study were also

not technically prepared to perform rescue maneuvers in case of complications<sup>17</sup>, emphasizing yet again the importance of basic life support content in dental curricula<sup>13</sup>.

Similar to other studies<sup>5,17,18</sup>, the UFSM's undergraduate dental students felt dissatisfied with the amount and breadth of information they received on medical emergencies during their training. Moreover, other studies point out to need to discuss this issue in more detail during undergraduate education<sup>7</sup>.

Although the two teaching pedagogies employed showed no statistically significant difference in learning among students, as found by others,<sup>19</sup> distance e-learning education can be considered as effective as face-to-face education<sup>20</sup>. Well-designed and delivered distance education should contribute significantly to students' learning, even more so during the current COVID-19 pandemic when parts of a course or entire curricula were moved to the online format<sup>9</sup>. Distance learning format focuses on the learner's work and personal lives, with more control on when and where to study. It also has a capacity of unlimited reach<sup>21</sup>, while reducing the costs of education and promoting lifelong learning<sup>21,22</sup>. Therefore, considering the National Curriculum Guidelines for Dentistry that highlight the importance of courses addressing the theoretical and practical contents of emergency care and basic life support, the e-learning format becomes a viable teaching pedagogy<sup>23</sup>. Moreover, the learning experience should foster the development of practical and emancipatory knowledge via different methods, from problem- and case-based education, reflective practice, journaling, storytelling, to critical review and performance-based assessments so that the learning is contextualised<sup>24</sup>. Follow-up studies are required to evaluate the level of preparedness practicing dentists, who experience either instructional

modalities, have to proactively prevent, diagnose and manage medical emergencies during dental appointments.

This study has some limitations. The use of before-and-after knowledge-based evaluation does not imply behavior change and can threaten the internal validity of the study. The pedagogies used might not be conducive to optimal learning in either group as it was assumed the entire group would learn better with the respective method. The single class of senior students from one university might not be representative of all undergraduate students in Brazil or elsewhere. Another limitation is the fact that the 20-item instrument was not validated, and might not accurately captured the information intended. Finally, the research may have left out some critical variables that were not explored in the present data collection instrument, such as psychological characteristics of students.

## 5 CONCLUSION

The participants of this study presented initial superficial knowledge about medical emergencies in dentistry, which improved after either mode of instruction. The material developed for the e-learning is available to students as supporting information. Dentists must be aware of the legal and ethical aspects of a self-regulated health profession. Although there was no difference between the groups, distance learning surfaces as an alternative pedagogy to improve education and train students and dental professionals to manage medical emergencies. Both methods of teaching medical emergencies in dental consultations presented satisfactory results, which makes the e-learning method an option as a didactic strategy.

## RESUMO

### E-learning em emergências médicas para

### **estudantes de Odontologia: um ensaio clínico randomizado**

Este estudo comparou duas pedagogias de ensino para lidar com emergências médicas em consultas odontológicas e avaliou o conhecimento de alunos do curso odontologia sobre emergências médicas. Este ensaio clínico randomizado envolveu 54 alunos do último ano do curso de odontologia da Universidade Federal de Santa Maria, divididos em dois grupos: alunos que receberam instrução por meio de aula expositiva tradicional presencial; e alunos que receberam a mesma instrução por meio do formato de ensino a distância. Os alunos foram alocados aleatoriamente aos grupos pelo site randomiser.org. Os dados foram obtidos por meio da comparação das pontuações recebidas pelos alunos ao responder a um questionário semiestruturado contendo indagações sobre implicações éticas e legais, e diagnóstico e manejo de emergências médicas em consultório odontológico antes e após a instrução. Antes da instrução, 96% dos alunos dos dois grupos desconheciam as implicações éticas e legais relacionadas à obrigação do dentista em lidar com emergências médicas. Após a instrução, os dois grupos aumentaram seus conhecimentos de forma semelhante, pois não houve diferença significativa na comparação entre o aprendizado sobre emergências médicas por meio de palestras e por meio do formato e-learning. Ambos os métodos de ensino apresentaram resultados satisfatórios, o que torna o método e-learning uma opção como estratégia didática.

**Descritores:** Emergências Médicas. Odontologia. Ensino à distância.

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