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## ASSESSING THE ORAL HEALTH STATUS OF PATIENTS HOSPITALIZED IN INTENSIVE CARE UNITS

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### ABSTRACT

**Aim:** Assessing the oral and systemic health of patients hospitalized in intensive care units. **Methods:** Cross-sectional study focused on examining the oral health and associated systemic conditions, as well as general data collected from medical records of a convenience sample encompassing 175 critical patients. Procedures were performed by a single examiner for 21 months. Collected data were recorded in individualized forms for further tabulation (Excel software) and descriptive statistical analysis in percentages (R software). **Results:** Most of the sample comprised white male elderly patients (mean age = 63.2 years) hospitalized for 15 days, on average, who were unconscious (40% were intubated and 27.43% were subjected to tracheostomy), subjected to nasoenteric feeding therapy (73.14%) and who have received support from dental surgeons. The main reasons for hospitalizations were lung diseases (34.31%), associated systemic conditions were pneumonia and respiratory issues (57.71%). Patients subjected to oral hygiene 2 times a day corresponded to 56.57% of the total sample, 72.57% of them presented oral injuries; 80% presented coating on the dorsal surface of the tongue - mean DMFT index was 16.6; 63% of dental prosthesis users (28%) presented unsatisfactory oral hygiene. **Conclusion:** It is necessary implementing routines to assess the overall oral health condition of ICU patients, as well as developing guidelines focused on preventing oral injuries and on providing clear instructions about the proper way to clean the dorsal surface of the tongue and dental prostheses used by ICU patients.

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## INTRODUCTION

Intensive care units (ICU) are featured by the effective and constant integral systemic support provided by interdisciplinary teams to highly-complex patients (Gosselink, 2012; Blum, 2017; Montgomery, 2018; Takahama, 2020). It is essential providing effective care to hospitalized patients, mainly to ICU patients, in order to promote and improve their oral health throughout the hospitalization period. It must be done to help preventing disease development, stomatognathic system-specific complications and their direct association with systemic conditions, such as hospital infections capable of leading to high mortality rates (Montgomery, 2018; Miranda, 2015; Alecrim, 2019). These critical patients may be unconscious and unable to perform effective self-care focused on promoting oral health.

In other words, they require support and care by ICU teams, with emphasis on dental surgeons, nursing staff, nursing technicians and family members (Hua, 2016; Alecrim, 2019 and Shi, 2013). Given the passive state of patients hospitalized in ICUs, which is often associated with the fact that they are under mechanical ventilation (tracheostomized and intubated), interdisciplinary teams providing care to these patients still have a hard time understanding the importance of maintaining their oral health in a satisfactory way, as well as properly investigating their oral condition and implementing plans focused on educational, preventive and interventionist procedures, whenever necessary (Lee, 2019; da Cruz, 2014; Muscedere, 2017; Bellissimo-Rodrigues, 2018). Critical patients hospitalized in ICUs overall present impaired oral hygiene condition, a fact that leads to increased amount and

complexity of biofilm found on patients' teeth, tongue and artificial breathing tube, due to longer hospital stay; to increased patient susceptibility to the onset of clinical inflammatory gingival conditions; to deficient or lack of hygiene in dental prostheses; and to oral injuries during hospitalization or associated with systemic conditions. In addition, their teeth can be considered likely infection sources that have direct influence in their systemic health (Shi, 2013; da Cruz, 2014; da Silva, 2016; Chipps, 2016 and Araújo, 2019). It is necessary formalizing effective guidelines focused on enabling proper dental care in hospital environments, with emphasis on ICUs, based on results of descriptive and clinical studies. It must be done to help improving knowledge about the reality in healthcare and oral care needs associated with systemic health conditions in hospital environments in the public and private sectors (Miranda, 2016; Cao, 2018 and Warren, 2019). The aim of the present study was to assess the oral and systemic health of ICU patients to help better understanding this reality, as well as patients' main needs and features, and the care provided to them during hospitalization time.

## MATERIAL AND METHODS

Cross-sectional and prospective study focused on evaluating and better understanding the oral health profile of patients hospitalized in intensive care units. All ethical and legal measures were adopted to organize and prepare the study, which was authorized by all hospital directors and heads of all intensive care units. All conscious patients, and legal guardians of non-conscious patients, who have agreed in participating in the study have signed the Informed Consent Form (ICF). All ethical and legal requirements were in compliance with the Declaration of Helsinki. Since individuals investigated in the current study were at risk, incapacitated and fragile, conscious patients and their legal guardians were informed about the research aims and purpose. They were assured about data confidentiality and privacy, about the use of collected information for technical-scientific purposes, as well as that there would be no prejudice to participants who did not agree to participate in the study. The study was approved by the Research Ethics Committee of the Dentistry School of University of São Paulo (FOUSP – University of São Paulo), under CAAE number 82611418.7.0000.0075 - opinion number 2.584.984. Convenience sample comprised 175 patients hospitalized in 3 (three) intensive care units in 1 private and 2 public institutions. Inclusion criteria comprised adult individuals (conscious and unconscious) hospitalized in the intensive care units participating in the study. Exclusion criteria comprised hospitalized individuals subjected to clinical isolation and who could contaminate the examiner during the clinical research activities; as well as patients hospitalized in hospital sectors other than ICUs. Standardized form comprising patients' general and systemic data, as well as information about their oral health condition, was prepared. Patients were assessed by a single examiner, who was helped by a nursing technician who worked in the ICU of each investigated hospital. This technician helped inserting collected information in the standardized forms and provided support to the researcher in any need associated with study-related activities performed at the hospital. Data collection in the investigated ICUs was carried out at pre-determined days and times, from April 2018 to December 2019, in order to avoid interference in the daily care routine and in multiprofessional visits carried out by their respective medical staffs. Medical records of ICU patients were evaluated based

on the assessment of variables associated with patient identification, and clinical and systemic condition. Demographic (age, sex, race), temporal (ICU stay), clinical (intubation, tracheostomy, normal conditions), dietary (normal, pasty, mixed and nasoenteral feeding tube) variables were evaluated; as well as consciousness (conscious and unconscious) and causal (reasons for hospitalization in the ICU, systemic conditions) levels. The oral condition of conscious and non-conscious patients hospitalized in the ICU was assessed based on variables associated with extra- and intra-oral examinations (incidence of lesions, inflammatory processes, coating on the dorsal surface of the tongue, DMFT index, use of dental prostheses and prosthesis hygiene). Prior to any clinical oral cavity assessment, patients were placed in appropriate position on the ICU stretcher (at 45°) and had their diet delivered via nasoenteral feeding tube (whenever applicable) suspended (shutdown) to avoid regurgitation (vomiting) during clinical examination. All biosafety and individual protection measures were adopted by the examiner, the by the assistant and by patients themselves in order to avoid cross-contamination.

Initially, a lip protector provided by each hospital was used on patients' upper and lower lips, and labial commissures, to enable greater comfort and lesser traumatic clinical examination to patients. Mouth expander was used to allow better visualizing patients' oral cavity, mainly in the most posterior regions. Artificial light (mobile focus) was used in association with the ICU's own lighting; it was done to better visualize the inner parts of patients' oral cavity. Orosopic examination was performed by observing and palpating the upper and lower lips, labial commissures, inserted gingiva, gingival edges, labial frenulum (upper and lower), tongue (back, lateral, ventral regions and extremities), floor of the mouth and palates (hard and soft) in order to investigate the incidence, or not, of oral injuries. Patients' oral cavity was examined, in details, based on descriptive dental examination (decayed, missing and filled teeth - DMFT index) and on the evaluation of visible gingival inflammatory processes. It was visually done under constant and effective lighting to avoid any discomfort, unnecessary contact and trauma to patients. Incidence of coating (biofilm) on the dorsal surface of the tongue, use of dental prostheses and satisfactory oral hygiene conditions were also evaluated (Takahama, 2020; Hua, 2016; da Cruz, 2014; Chipps, 2016). Gauze, wooden spatulas, mouth opener made of gauze + wooden spatula + tape, mouth expander, mouth mirror and tweezers were used in all clinical evaluation activities. This procedure was in compliance with all biosafety and sterilization standards and norms adopted by each hospital. All collected data were recorded in individualized forms for later tabulation organization (Excel software) and descriptive statistical analysis expressed in percentages (R software).

## RESULTS

Tables 1 and 2 were elaborated with general data and data about the oral health condition of 175 critical patients assessed in intensive care units, respectively, in order to help better understanding and analyzing the results. Most ICU patients were men (54%), elderly (older than 60 years - 60.57%), at mean age of 63.2 years, and white (46%). Individuals hospitalized in the investigated ICUs presented mean hospital stay of 15 days; most of them had access to hospital services through the public health system.

**Table 1. General features of patients hospitalized in ICUs**

Variables	Critical patients in ICUs	
	n= 175	100%
Personal features	-	-
Sex	-	-
Female	81	46.00
Male	94	54.00
Age	-	-
10 – 19 years	6	3.43
20 – 29 years	7	4.00
30 – 39 years	16	9.14
40 – 49 years	14	8.00
50 – 59 years	26	14.86
60 – 69 years	26	14.86
70 – 79 years	37	21.14
80 – 89 years	35	20.00
90 - 99 years or older	8	4.57
Mean age	63.2 years	-
Race	-	-
White	81	46.0
Black	40	23.0
Brown	54	31.0
Mean hospitalization time in the ICU	15 days	-
Form of access to hospital service - ICU	-	-
Public	125	71.4
Private	49	28.00
Paid by the family	1	0.6
Reasons for hospitalization in the ICU	-	-
Cardiovascular diseases	21	12.00
Lung diseases	60	34.31
Cerebrovascular diseases	23	13.14
Trauma in different body regions	14	8.00
After overall surgical procedures	9	5.14
Clinical support follow-up and systemic monitoring	48	27.41
Systemic conditions associated with ICU patients	-	-
Diabetes / 175	42	24.00
Arterial hypertension / 175	66	37.71
Chronic Kidney Failure / 175	53	30.29
Myocardial infarction and cardiac issues / 175	57	32.57
Pneumonia and respiratory issues / 175	101	57.71
Hepatic complications / 175	19	10.86
Other systemic conditions / 175	73	41.71
Level of consciousness	-	-
Conscious	46	26.29
Non-conscious (subjected to any sedation type)	129	73.71
Patients' hospitalization conditions in ICUs	-	-
Normal conditions	57	32.57
Tracheostomized	48	27.43
Subjected to orotracheal intubation	70	40.00
ICU patients' feeding type (nutritional support)	-	-
Normal	33	18.86
Pasty	7	4.00
Mixed (pasty + solid)	7	4.00
Nasoenteral feeding tube	128	73.14
Presence of caregiver / family member in ICUs	-	-
Present	33	18.86
Absent	142	81.14
Presence of professional interdisciplinary monitoring in ICUs	-	-
Physicians	175	100
Nurses	175	100
Nursing technicians	175	100
Physical therapists	175	100
Speech therapists	121	69.14
Dieticians	175	100
Psychologists	75	42.86
Pharmacists	175	100
Dental surgeons	175	100
Occupational therapists	00	0.00
Social Workers	00	0.00
Frequency of oral hygiene procedures performed in ICUs	-	-
None	1	0.57
01 time a day	75	42.86
02 times a day	99	56.57
03 times a day	00	0.00
More than 03 times a day	00	0.00

The main reasons for hospitalization in ICUs were lung diseases (34.1%), which were followed by clinical support follow-up and systemic monitoring (27.41%), cerebrovascular diseases (13.14%), cardiac diseases (12%), trauma in different body regions (8%) and after overall surgical procedures (5.14%). The main systemic conditions associated with critical patients in these ICUs were pneumonia and respiratory issues (57.71%), other systemic conditions (41.71%), arterial hypertension (37.71%), and myocardial infarction and cardiac issues (32.57%). Most assessed patients were not conscious (73.71%) and subjected to orotracheal intubation (40%). They were followed by patients under normal hospitalization conditions (32.57%) and by the tracheostomized ones (27.43%). Most patients (73.14%) were under nasoenteral nutritional support and their caregivers / family members were not constantly present in the ICUs (81.14%) to accompany them. All patients were followed-up by an interdisciplinary team comprising doctors, nurses, nursing technicians, physical therapists, dieticians, pharmacists and dental surgeons. However, psychological care (42.86%) and speech therapy (69.14%) were not accessible to all inpatients. Patients did not receive care and guidance from social assistance and occupational therapy professionals during hospitalization in the ICU. The care routine in the investigated ICUs comprised actions focused on patients' oral hygiene; most of them (56.57%) performed these procedures 2 times a day.

**Table 2. Oral health of critical patients hospitalized in ICUs.**

Variables	Patients hospitalized in intensive care units	
	n= 175	100%
Oral health of critical patients	-	-
Incidence of oral injuries	-	-
No	48	27.43
Yes	127	72.57
Incidence of gingival inflammation	-	-
No	129	73.71
Yes	46	26.29
Incidence of tongue coating	-	-
Not clinically visible - absent	34	19.44
1/3 of the tongue	43	24.57
2/3 of the tongue	30	17.14
The entire lingual extension	68	38.85
Descriptive dental examination	Mean value	-
Decayed teeth	0.51	-
Missing teeth	14.9	-
Filled (Restored) teeth	1.15	-
Average DMFT	16.6	-
Use of dental prostheses	-	-
No	127	72.57
Yes	48	27.43
(Critical) Patients hospitalized in ICUs wearing dental prostheses (n = 48)	-	-
Dental prosthesis types used by patients	-	-
Full prostheses (upper and lower)	3	6.25
Full prosthesis (upper)	20	41.67
Full prosthesis (lower)	13	27.08
Removable partial prostheses (upper and lower)	6	12.50
Removable partial prosthesis (upper)	1	2.08
Removable partial prosthesis (lower)	3	6.25
Dental implant prosthesis (upper and lower)	1	2.08
Dental implant prosthesis (upper)	0	0.00
Dental implant prosthesis (lower)	1	2.08
Hygiene condition of dental prostheses (n= 48)	-	-
Satisfactory	17	35.42
Unsatisfactory	31	64.58*

Based on the assessment of critically ill patients' health conditions, most of them presented oral injuries (72.57%) and lack of gingival inflammation (73.71%). Based on the clinical evaluation of the dorsal surface of patients' tongue, 80.56% of the sample presented lingual coating and 38.85% (68 patients) of them had it on the entire lingual extension. Mean descriptive dental examination recorded DMFT of 16.6. The missing teeth component was the one recording the highest mean value (14.9). Forty-eight ICU patients used dental prostheses (28.00% of the sample) and most of them (41.67%) only used full upper dentures; 31 patients (64.58%) who used dental prostheses presented unsatisfactory hygiene conditions.

## DISCUSSION

Interdisciplinary care and assistance are of paramount importance for critical patients hospitalized in intensive care centers. However, oral health condition assessments, which should be conducted as an integral part of the care provided to these patients, are not routinely performed and are often neglected in most hospitals - be them public or private. It happens because they do not have protocols and guidelines established for such a purpose (Blum, 2017; Takahama, 2020; Miranda, 2016; da Cruz, 2014 and Cao, 2018). Older individuals with age-associated systemic impairments are considered the most dependent and fragile patients; they are the most affected hospital patients and require longer hospital stay for care in ICUs (Montgomery, 2018; Sreenivasan, 2018; Lee, 2019; Muscedere, 2017; Gil-Montoya, 2015; Ástvaldsdóttir, 2018). Most patients in the current study were elderly individuals with health issues associated with lung diseases, and such a feature contributed to the association of this cause with pneumonia and respiratory issues as the main reasons for hospitalizations.

It is important emphasizing that 48 hours after hospitalization in ICUs, patients may experience changes in their oral microbiota and biofilm formation; furthermore, they require educational and preventive actions focused on teeth, tongue and dental prosthesis hygiene in order to avoid bacterial accumulation in these regions, which end up working as reservoirs of bacteria associated with systemic infectious conditions, with emphasis on nosocomial pneumonia (Vilela, 2015; Alecrim, 2019; Miranda, 2016; Shi, 2013; Chipps, 2016; Warren, 2019; Guerra, 2016; Zuckerman, 2016 and Rabello, 2018). Hospitalized patients remained in intensive care units for 15 days, on average; much of it may be associated with the need of longer time to recover from their main associated diseases. Patients' consciousness state and effective participation in the recovery process is essential to enable interdisciplinary activities - with emphasis on nutritional support and on procedures focused on promoting oral health - to be performed in a satisfactory way. However, dependent and unconscious patients (tracheostomized and intubated via orotracheal route) under nasoenteral feeding require support and intensive care on a daily basis. These procedures are often performed by nursing teams and nursing technicians (Miranda, 2016; Lee, 2019; Warren, 2019; Gibney, 2017), as observed for most patients assessed in the current study. According to requirements and regulations for the proper functioning of intensive care units, teams holding different health competencies provide better care to critical and fragile patients. In addition, they contribute to exchange experiences and clinical planning carried out in an individualized and integrated way (Gosselink, 2012;

Bellissimo-Rodrigues, 2018 and Cao, 2018). The oral health care provided by dental surgeons in the current study was combined to other healthcare fields and applied to all assessed patients. This finding confirms the current paradigm shift and the need of having hospital dentistry-trained and qualified professionals in ICU teams. However, professional classes such as psychologists, speech therapists, social workers and occupational therapists were not available to all patients in the herein investigated sample. The implementation of oral hygiene routines and protocols depends on the reality of each hospital and on hospital managers' perception about the value of these activities as part of the excellency of differential care provided to patients (Hua, 2016; da Silva, 2016; Cao, 2018; Gibney, 2017). It is worth emphasizing that the oral hygiene procedures analyzed in the current study were mostly performed in critically ill patients hospitalized in intensive care units, either once or twice a day.

Understanding the overall oral health condition of critical patients can help ICU teams to develop new clinical procedures for interventional approaches and actions focused on these patients, as well as minimize the main systemic effects associated with patients' condition (Takahama, 2020; da Cruz, 2014; Bellissimo-Rodrigues, 2018; da Silva, 2016; Chipps, 2016). Oral injuries resulting from traumas during intubation, from extremely important procedures necessary to provide life support to critical patients or from systemic conditions observed in patients hospitalized in ICUs require dental surgeons to perform the correct diagnosis and procedural activities<sup>27</sup>. Most of the herein assessed patients had oral injuries associated with the aforementioned causes. The use of 0.12% chlorhexidine is the gold standard in hygiene care procedures applied to the oral cavity of ICU patients. Because chlorhexidine has bactericidal and bacteriostatic action, its correct use, under mechanical action for a determined period-of-time contributes to biofilm non-formation or disorganization (Hua, 2016; Alecrim, 2018; Miranda, 2016; Lee, 2019; Shi, 2013; Araújo, 2019; Guerra, 2016; Zuckerman, 2016; Rabello, 2018; Muramatsu, 2019). This outcome may be associated with the current study, since most patients subjected to clinical evaluation did not present gingival inflammatory processes.

According to interdisciplinary teams working in the investigated ICUs, one of the greatest difficulties in caring for the oral health of critical patients lies on enabling the correct hygiene of the dorsal surface of their tongue. It happens because this region accumulates coating (biofilm), which is a microbial niche full of gram-negative bacteria that may be associated with nosocomial pneumonia often acquired after hospitalization (Vilela, 2015; Chipps, 2016; Araújo, 2019; Gibney, 2017). Most patients in the current study presented coating on the dorsal surface of the tongue, likely due to lack of effective and proper oral hygiene performed by the team of nursing technicians or to difficulty in accessing the oral cavity of unconscious, tracheostomized and intubated patients, who could not collaborate to effective clinical intervention, mainly in the most posterior regions. The presence of teeth in the oral cavity of ICU patients with high systemic complexity can mean the presence of likely infectious foci, inflammatory processes and associated pain, which are directly linked to patients' quality of life. Therefore, it is necessary performing a thorough investigation or clinical analysis in these patients right after hospitalization. The implementation of dental care strategies in ICUs enables greater communication with other

health teams, as well as integrated interactions capable of bringing benefits to patients (Bellissimo-Rodrigues, 2018). Most patients in the current study presented tooth loss and used dental prostheses (full and partial). This finding may be associated with patients' age group (mostly elderly), which reflects the mutilating actions taken in dental care procedures adopted in the past (Montgomery, 2018; Muscedere, 2017; Gil-Montoya, 2015; Ástvaldsdóttir, 2018). In light of the need of providing oral care to ICU patients, it is essential emphasizing that routine procedures focused on cleaning dental prostheses should be implemented in these environments. Biofilm and food debris accumulation in dental prostheses of most evaluated patients, fractures and dislocations, and lack of prosthesis removal for hygiene purposes can contribute to patients' discomfort, microbial reservoir formation and emergence of traumatic, ulcerated and, mainly, fungal oral injuries (Hua, 2016; da Cruz, 2014; Gibney, 2017; Muramatsu, 2019). Care procedures focused on oral health promotion must be implemented in all intensive care units, in association with other care needs, in order to enable critical patients to quickly recover (Gosselink, 2012; Blum, 2017; Miranda, 2016; da Cruz, 2014; da Silva, 2016; Gil-Montoya, 2015 and Ástvaldsdóttir, 2018).

## Conclusions

The main reasons for hospitalizations in intensive care units are associated with pulmonary issues and with high mean hospital stay, which lead to a larger number of non-conscious hospitalized patients under mechanical ventilation. The hospital dentistry is part of the interdisciplinary teams taking care of critical patients in the herein investigated hospitals. It is necessary implementing routines to assess the overall oral health condition of ICU patients, as well as developing guidelines focused on preventing oral injuries and on providing clear instructions about the proper way to clean the dorsal surface of the tongue and dental prostheses used by ICU patients. It must be done in order to help reducing biofilm formation and its likely association with hospital infections.

**Conflict of Interest:** The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

**Ethics:** This study was submitted and approved by the Human Research Ethics Committee of the Dentistry School of University of São Paulo (FOUSP – University of São Paulo), under CAAE number 82611418.7.0000.0075 - opinion number 2.584.984, São Paulo-Brazil.

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**Authors' contributions:** Study concept and design: AFM and MGHB. Analysis and interpretation of data: All authors. Drafting of the manuscript: All authors. Critical revision of the manuscript for important intellectual content: All authors. Statistical analysis: EMC. Evaluation of patients: Miranda. Study supervision: AFM and MGHB.

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