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Original Contribution

Is there need for technical investigations in order to predict potential length of hospital stay of oral infections?

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ABSTRACT

Objective: Oral and maxillofacial infections are generally treated by primary dental or medical caregivers. Nevertheless, because these infections are known to have life-threatening complications, there is a need of clear indicators for emergency services medical staff, particularly in determining when morbidity can be expected and when in-hospital treatment is required. This retrospective study aimed to identify variables that were observable at admission, which could indicate high complication rates, long hospital stays, and/or a need for tracheostomy.
Materials and methods: We examined data from all cases of severe oral and maxillofacial infections that were treated at the University Hospital of Leuven, between January 2013 and June 2017. 64 cases were identified after applying exclusion criteria. Uni- and multivariate analyses were performed.
Results: A univariate analysis showed that body temperature, C-reactive protein (CRP) levels, white blood cell counts, and positive bacterial cultures were significantly associated with longer hospital stays, which indicated potential future morbidity. A multivariate analysis showed that dyspnoea, age, and CRP comprised the most significant combination for predicting the length of hospital stay.
Conclusion: Based on the statistical analysis of this population, the research group concludes that a thorough anamnesis and clinical examination should be accompanied by a blood analysis of CRP and white blood cell counts. Only then can a well-founded decision be reached on the severity of the case and the need for hospital admission. In an acute setting, radiological imaging is not required for assessing future morbidity, but it should be performed when accessible.

1. Introduction

Oral infections are commonly encountered by most primary health care workers. Unfortunately, the course of oral infections may be difficult to predict, and they can be life-threatening, when not treated at an early stage. The most common life-threatening complications include airway obstruction, descending mediastinitis, pneumonia, pericarditis, intraorbital infection, multiple organ failure, intracranial infection, and sudden cardiac death [1]. Therefore, for primary caregivers (dental or medical) and emergency services staff, it is highly important to have 'red flags' that signal the need for a hospital referral to provide adequate therapy. Most oral infections are relatively easy to treat, when the infection has not spread extensively into the soft tissues.

In serious cases, hospitalization cannot be postponed, which emphasizes the need for detailed, significant indications of when hospital admission is necessary. Very few primary health care workers have access to technical equipment, such as blood sample tests or computed tomography scans for examining the affected spaces. Furthermore, although emergency services often have access to relevant technical equipment, more research is necessary to identify factors that can predict the need for surgical drainage and hospital admission, with or without the help of technical investigations.

Few previous studies have focused solely on severe oral and maxillofacial infections with analyses of the population demographics and their associations with increased morbidity. This study aimed to develop a realistic approach, amenable for day-to-day use in general practice, which could provide a means for predicting future morbidity in patients with oral and maxillofacial infections, at an early stage of diagnosis.

2. Materials and methods

This retrospective study retrieved data from patient records stored at the Department of Oral and Maxillofacial Surgery at the University Hospital of Leuven, Belgium. Data from all patients admitted to this department over a period of 54 months was reviewed, from January 2013 to June 2017.

Abbreviations: LOS, length of hospital stay; CRP, C-reactive protein levels; WBC, white blood cell count.

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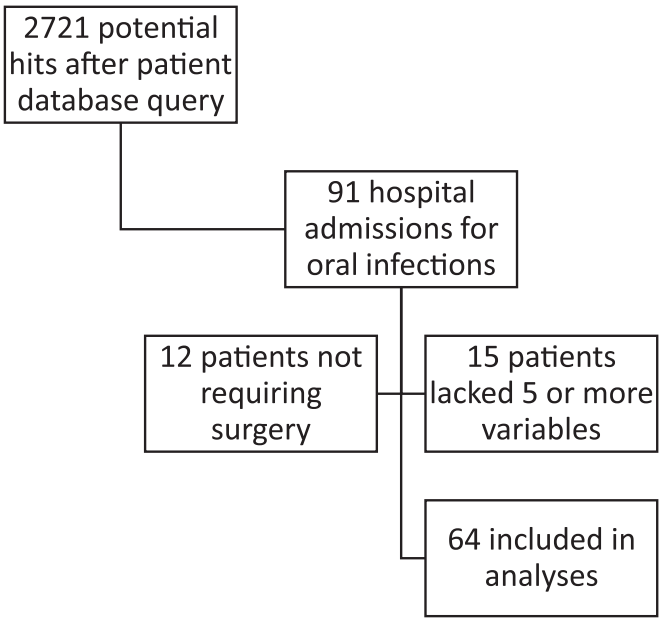

Fig. 1. Overview of the collection process of included patients.

A query of the hospital's medical electronic records was obtained, collecting 2721 potential hits for abscesses or severe infections in the oral and maxillofacial regions. Of these patients, 91 had potentially severe infections of the facial region and neck. The following data were collected for each patient: age, gender, signs and symptoms (dysphagia, pus, dyspnoea, temperature over 38 °C, elevation of the flour of the mouth, lateral pharyngeal oedema, fluctuant swelling, trismus, and swollen lymph glands), smoking, medical history, microorganisms and their resistance to antibiotics, administered antibiotics, surgery, aetiology, affected facial spaces, the length of hospital stay (LOS), postoperative complications, laboratory values (C-reactive protein [CRP] and white blood counts), and the need for a tracheostomy.

After collecting these data, the following predefined exclusion criteria were applied: no surgical intervention required and data missing for five or more variables. These criteria excluded 27 patients from the study, as 12 patients did not require surgery and 15 lacked 5 or more variables. Thus, 64 patients were included in the data analyses (Fig. 1). Severe oral infections were defined as infections that required surgical drainage and intravenous antibiotics during hospitalization. This definition eliminated ambiguity on patient eligibility for inclusion in this retrospective analysis. Morbidity was defined in three ways, namely a longer hospital stay, later complications and need for a tracheostomy. All anonymized data were imported into Microsoft Excel

Table 1
Analysis of all predictors before the use of technical examinations with the potential to predict morbidity (defined as length of hospital stay; complications; or tracheostomy).

Signs and symptoms	N/total (%)	Length of hospital stay (days)		Complications, N	Tracheostomy, N
		Average	SD		
Dysphagia					
Yes	38/58 (65.52%)	7.9474	10.2534	6	4
No	20/58 (34.48%)	4.55	5.2763	0	0
Pus					
Preoperatively	16/58 (27.59%)	8.25	14.0689	4	2
Peri-operatively	29/58 (50%)	6.4483	6.3159	3	2
Pre- or peri-operatively	45/58 (77.59%)	7.0889	9.9320	7	4
None	13/58 (22.41%)	5.2308	6.2203	1	0
Dyspnoea					
Yes	6/55 (10.91%)	7.3333	5.3166	0	1
No	49/55 (89.10%)	5.3673	5.2785	4	2
Temperature > 38 °C					
Yes	42/64 (65.63%)	4.7	3.4731	5	3
No	22/64 (34.37%)	10.6	13.1861	3	1
Floor of the mouth					
Elevation (A)	5/34 (14.71%)	8	4.3012	0	0
Induration (B)	5/34 (14.71%)	5.8	3.5637	1	0
A + B	10/34 (29.41%)	6.9	3.9001	1	0
Normal	24/34 (70.59%)	5.5417	5.2252	2	0
Lymphadenopathy					
Yes	37/43 (86.04%)	6.4054	5.9696	4	3
No	6/43 (13.95%)	7.3333	5.5377	1	0
Lateral pharyngeal oedema or deviation of the uvula					
Yes	8/38 (21.05%)	6.75	2.7124	0	2
No	30/38 (78.95%)	5.1667	5.3568	3	0
Fluctuant swelling					
Yes	18/39 (46.15%)	5.5556	5.0202	4	1
No	21/39 (53.85%)	6.3810	4.9948	1	0
Trismus					
Yes (no specification)	8/56 (14.29%)	10.5	20.0926	2	1
<10 mm	10/56 (17.86%)	6.8	5.4119	4	0
10–19 mm	12/56 (21.43%)	7.5	7.1159	0	2
20–34 mm	11/56 (19.64%)	5.4545	3.7779	2	0
0–34 mm	41/56 (73.21%)	7.3659	9.8888	8	3
35 mm or more	15/56 (26.79%)	4.6667	4.6667	0	0
Medical history					
Diabetes mellitus II	8/64 (12.5%)	5.5	3.0237	1	0
Major cardiovascular	4/64 (6.25%)	7.25	5.1235	1	0
Malignancy	5/64 (7.81%)	6.8	5.0200	2	0
No significant history	48/64 (75%)	6.5625	9.3965	4	4
Smoking					
Yes (A)	25/39 (64.10%)	7.68	11.5424	4	2
Stopped (B)	3/39 (7.69%)	5	4.5826	1	0
Current or past (A + B)	28/39 (71.79%)	7.3929	10.9860	5	2
Never	11/39 (28.21%)	5.1818	4.4904	0	1

(Microsoft Corporation). Statistically significance after univariate analysis was obtained with the Student *t*-test.

Patient data were then entered in a multivariate model to test their ability to predict the complication rate and the LOS in the presence of multiple variables. These analyses were performed with the SAS program (UNIVERSITY EDITION 2.7 9.4 M5). An exploratory univariate analysis, with forward and backward selection, was performed to identify variables with the strongest ability, based on odds ratios, to predict later morbidity. This approach allowed us to select only variables with the highest odds ratios, in an unbiased manner, for inclusion into the multivariate analysis. The most significant parameters were identified with the p-value.

This study was approved by the Ethics Commission of the University of Leuven, on September 9, 2017. The collection, processing, and disclosure of personal data, such as a participant's health and medical information, was performed in a manner compliant with current applicable legislation on personal data protection and the processing of personal data (Directive 95/46/EC and Belgian law of December 8, 1992 on the Protection of the Privacy in relation to the Processing of Personal Data).

3. Results

3.1. Univariate analysis of variables obtained from anamnesis or clinical examination

All observational variables, except those related to antibiotics, were examined in univariate analyses to determine the ability of each variable to predict the risk of morbidity. Morbidity was defined as one or more of the following outcomes: postoperative complications, a tracheostomy during admission, and a prolonged LOS. The specific complications encountered in this population were: osteomyelitis ($n = 3$), newly diagnosed osteonecrosis of the jaw ($n = 2$), secondary blood loss after surgery ($n = 2$), and infection expansion to the brain ($n = 1$).

Table 1 shows the prevalence of all variables that can be collected from anamnesis and clinical examination in order to predict the future morbidity. Due to the limited number of patients with tracheostomies and postoperative complications, the statistical power to detect significant associations in the univariate analysis lacked. Table 2, on the other hand, proves the statistical significance of body temperature for predicting LOS in the univariate analysis (Table 2). No other variable was statistically significant on a level of 5% before any technical investigation was executed.

3.2. Univariate analysis of variables obtained from technical investigations

An analysis of technical variables (Table 3) also showed that these data provided limited statistical power for identifying predictors of morbidity based on later complications and tracheostomies.

However, the univariate analysis (Table 4) highlighted the importance of some variables that could potentially predict the LOS. High CRP levels were significantly associated with LOS ($p \leq 0.01$). So, CRP levels above 100 mg/L were significantly linked to longer hospital stays. In addition, white blood cell counts of $12{,}000 \times 10^6$ cells/L or more were significantly associated with longer hospital stays ($p < 0.001$). Positive cultures of pus, obtained from the point of drainage, were also significantly associated with longer hospital stays. No significant differences were found between different positive cultures, but significant differences were observed when comparing the LOS of patients with positive cultures to the LOS of patients with negative cultures. In particular, all patients with *Streptococcus anginosus* cultures, all patients with streptococci, and all patients with positive cultures had significantly longer hospital stays than patients with negative cultures. An antimicrobial sensitivity test was always performed with positive cultures, but no significant differences in resistance to antibiotics between results were observed. Moreover, no significant associations between the LOS and the aetiology or the number of spaces affected were found. Mandibular molars were the causal agents in 68.25% of all 64 cases, particularly lower wisdom teeth (18/64 cases, 28.13%).

Table 2
Univariate analysis of associations between individual observational variables (without the need for technical investigations) and the length of hospital stay.

Observational variables	95% confidence interval	p-Value
Dysphagia		
Yes vs. no	−8.3132–1.5186	0.1717
Pus		
Preoperatively vs. no pus	−11.6594–5.6194	0.4794
Peri-operatively vs. no pus	−5.3292–2.8926	0.5526
Pre- or peri-operatively vs. no pus	−7.5532–3.8356	0.5158
Pre- vs. peri-operatively	−4.2482–7.8516	0.5513
Dyspnoea		
Yes vs. no	−2.6097–6.5417	0.3927
Temperature over 38 °C		
Yes vs. no	1.5980–10.2020	0.0080*
Floor of the mouth		
Elevation/induration vs. normal	−2.3898–5.1066	0.4658
Lymphadenopathy		
Yes vs. no	−4.3326–6.1884	0.7235
Lateral pharyngeal oedema or deviation of the uvula		
Yes vs. no	−5.5816–2.4149	0.4272
Fluctuant swelling		
Yes vs. no	−2.4329–4.0839	0.6108
Trismus		
Yes vs. no	−2.5780–7.9766	0.3097
Medical history		
Diabetes mellitus type II vs. no major medical history	−5.7008–7.8258	0.7540
Major cardiovascular history vs. no major medical history	−10.3003–8.9253	0.8864
Malignancy vs. no major medical history	−8.8504–8.3754	0.9561
Smoking		
Active smoker vs. never smoked	−9.8501–4.8537	0.4945
Active smoker/stopped smoking vs. never smoked	−9.1837–4.7615	0.5245

* $p \leq 0.05$.

3.3. Multivariate analysis

The multivariate analysis provided a higher level of explanatory power (Table 5). Based on the odds ratios, the most relevant variables for predicting the complication rate and the LOS were determined. Three clinically accessible variables were significantly associated with future complications: elevations of the mouth floor, dyspnoea, and body temperatures over 38 °C. On the other hand, CRP was the only variable observable in technical investigations with an odds ratio above 1, which indicated that it could predict later complications. Importantly, the broad confidence intervals of fever and CRP, caused by the small number of cases with complications in this population, needs to be stressed. Taken together, these results showed that only dyspnoea reached a significant p-value of 5% for predicting later complications. Furthermore, in addition to the CRP level and a higher patient age, dyspnoea could significantly predict a longer hospital stay ($p < 0.05$).

4. Discussion

In this study, the patients had an average age of 46.1 years and 61.5% of this population were men, which is comparable to those of other studies in this field [2-16]. The fact that a very similar mean age and mean gender was encountered is a factor favouring the quality of the population. It should be noted that the average proportion of active smokers (64.10%) in this study was much higher than that of the average Belgian population (20%).

Although some comparable studies were found in the current literature [8-10,15], this study was unique, because it focused solely on

severe infections [8,10], it included >50 patients [12,13], and used LOS to represent postoperative morbidity [15]. Patients that required hospital admission, surgery, and intravenous antibiotics were selected. This selection might explain why the average LOS of 6.7 days was relatively long compared to similar studies, where hospital stays ranged from 2.7 to 5.5 days [3,4,7-14].

In this population, the most frequently affected maxillofacial space was the submandibular space (37/64 cases, 57.81%; Fig. 2). This finding was consistent with findings in multiple previous studies [3-5,7-9,11,15,16], which supported the relevance of this population. Several previous studies have mentioned that uncontrolled diabetes mellitus was an important indicator of patient outcome. In the present study, only 8 patients with diabetes were included, and could therefore not investigate that association.

For primary caregivers and emergency service medical staff, it is highly important to estimate the potential risk of complications in a patient, based on minimal technical investigation. In this population, the research group found unfortunately that no other clinically accessible variable was found significant for predicting LOS than body temperature of over 38 °C. On the other hand, dysphagia, pus, fluctuant swellings, trismus, and smoking seemed to be linked with future tracheostomy and complications, but this result lacked significance, due to the small size of the population and data overaggregation. Similarly, lateral pharyngeal oedema and deviation of the uvula were associated, but not significantly, with the need for tracheostomy. The research group is convinced that future studies should determine the value of these variables as predictive factors.

This study also examined variables accessible through technical investigations to determine their usefulness in predicting morbidity outcomes. Importantly, inflammatory blood parameters, like the CRP level and the white blood cell count, were the primary factors for predicting LOS. This finding supported the theory that an inflammatory blood sample, in combination with a thorough anamnesis and a clinical examination, is a must when it is accessible for primary caregivers. The importance of the white blood cell count and the CRP level was stressed previously by Wang et al. [10] and Stathopoulos et al. [14], respectively. However, it is important to note that CRP is a positive acute-phase protein.

Surprisingly, the resistance level, aetiology, and the number of affected spaces were less important predictive factors. In most cases, the cause of the infection and the affected spaces can only be identified with radiological imaging. However, most of the time, this investigation is too complicated to conduct in private practice, which results in no radiological imaging. This observation was supported by the results in this

Table 3
Analysis of all predictors after technical investigations

Potential predictive factors	N/total (%)	Length of hospital stay (days)		Complications, N	Tracheostomy, N
		Average	SD		
C-reactive protein					
<10 mg/L	2/64 (3.13%)	1.5	0.7071	0	0
10–99.99 mg/L	32/64 (50%)	4.3438	3.0544	2	0
100–199.99 mg/L	15/64 (23.44%)	4.8667	3.1818	1	1
200 mg/L or more	15/64 (23.44%)	14.4	14.7397	5	3
<100 mg/L mg/L	34/64 (53.13%)	4.1765	3.0398	2	0
100 mg/L or more	30/64 (46.88%)	9.6333	11.5445	6	4
<200 mg/L	49/64 (76.56%)	4.3878	3.0674	3	1
200 mg/L	15/64 (23.44%)	14.4	14.7397	5	3
White blood cell count					
<8000 10^6/L	11/64 (17.19%)	3.9091	3.0481	1	0
8000–11,999 10^6/L	21/64 (32.81%)	4.0476	2.7835	2	1
12,000–15,999 10^6/L	18/64 (28.13%)	8.5	7.5712	2	1
16,000–19,999 10^6/L	9/64 (14.06%)	5.8889	3.5862	1	0
20,000 10^6/L or more	5/64 (7.81%)	19.4	23.5330	2	2
<12,000 10^6/L	32/64 (50%)	4	2.8284	3	1
12,000 10^6/L or more	32/64 (50%)	9.4688	11.2422	5	3
Microorganisms					
S. anginosus	18/45 (40%)	9.8333	7.4774	4	1
All streptococci	23/45 (51.11%)	9.3043	6.8585	7	1
S. epidermidis	7/45 (15.55%)	14	20.8726	2	1
Negative culture	17/45 (37.78%)	4.4118	2.7852	0	2
All streptococci or *S. epidermidis*	28/45 (62.22%)	10.3054	11.7457	8	2
Resistance to antibiotics					
Penicillin resistance	4/33 (12.12%)	12.75	11.1168	1	1
Erythromycin resistance	7/33 (21.21%)	4.4286	2.6367	2	0
No resistance	22/33 (66.67%)	10.5910	12.4084	4	1
Aetiology					
Dental, molar mandible	31/63 (49.21%)	7.7742	11.2804	4	3
Dental, non-molar mandible	5/63 (7.94%)	6	4.5277	1	0
Dental, molar maxilla	3/63 (4.76%)	5.6667	5.6862	0	1
Dental, non-molar maxilla	2/63 (3.17%)	1.5	0.7071	0	0
After extr. Molar mandible	12/63 (19.05%)	5.4167	3.1467	2	0
After extr. Non-molar mandible	1/63 (1.59%)	3	/	0	0
After extr. Molar maxilla	1/63 (1.59%)	5	/	0	0
After extr. Non-molar maxilla	0/63	/	/	0	0
After surgery	3/63 (4.76%)	6.3333	7.5056	0	0
Due to confounding factor	5/63 (7.94%)	10.8	8.3487	1	0
Affected spaces					
One	43/64 (67.19%)	5.3721	4.8942	5	2
Two	15/64 (23.44%)	9.7333	15.3179	1	2
Three	5/64 (7.81%)	8.6	5.0794	1	0
Four or more	1/64 (1.56%)	11	/	1	0

Extr = extraction; *S. anginosus* = *Streptococcus anginosus*; *S. epidermidis* = *Staphylococcus epidermidis*; confounding factors present in our case series: osteonecrosis of the jaw (2 cases), peri-implantitis, fracture of the mandible 5 weeks prior to the infection, and sialo-adenitis. / = no average or standard deviation of LOS due to the fact that there is no or only one case affected.

Table 4
Univariate analysis of associations between individual variables from technical investigations and the length of hospital stay.

Compared variables	95% confidence interval	p-Value
C-reactive protein		
<100 mg/L vs. 100–199.99 mg/L	−1.2321–2.6125	0.4737
<100 mg/L vs. 200 mg/L or more	4.9617–15.4853	0.0003*
<100 mg/L vs. 100 mg/L or more	1.3504–9.5632	0.0100*
<200 mg/L vs. 200 mg/L or more	5.5846–14.4398	<0.0001*
White blood cell count		
<8,000 10^6/L vs. 8,000 10^6/L or more	−0.2549–9.0783	0.2333
<12,000 10^6/L vs. 12,000 10^6/L or more	1.3723–9.5653	0.0097*
<16,000 10^6/L vs. 16,000 10^6/L or more	0.0252–10.1634	0.0489*
Microorganisms		
S. anginosus vs. all streptococci	−5.0706–4.0126	0.8150
All streptococci vs. *S. epidermidis*	−14.7897–5.3983	0.3488
All streptococci/*S. epidermidis* vs. negative culture	0.0270–11.7602	0.0490*
All streptococci vs. negative culture	1.3167–8.4684	0.0086*
S. epidermidis vs. negative culture	−0.8021–19.9785	0.0687
S. anginosus vs. negative culture	1.4951–9.3480	0.0083*
Resistance for antibiotics		
Penicillin resistance vs. no resistance	−15.9067–11.5885	0.7486
Penicillin resistance vs. erythromycin resistance	−1.2773 - 17.9201	0.0815
Erythromycin resistance vs. no resistance	−3.6440–15.9686	0.2082
Erythromycin or penicillin resistance vs. no resistance	−5.9855–11.5673	0.5210
Aetiology		
Molar of the mandible vs. all other causes	−3.5158–8.0818	0.4332
Number of affected spaces		
One vs. two or more affected spaces	−0.3321–8.6355	0.0689

S. anginosus = *Streptococcus anginosus*; *S. epidermidis* = *Staphylococcus epidermidis*.
* $p < 0.05$.

population, which showed that the LOS could not be predicted by either the causal factor or the number of spaces involved. But it is important to know that surgeons rely on radiological imaging for obtaining the causal dental element and the exact location of pus collection. This indicates the need for radiological imaging after the detection of individual significant variables.

Apart from body temperature and inflammatory blood parameters, positive cultures were also linked to a significantly longer hospital stay. Unfortunately, this piece of information can only be obtained three days after a drainage [17]. Therefore, identifying the bacteria involved is only important in deciding whether to switch antibiotics postoperatively, whilst it cannot be a crucial factor for determining the need of a hospital admission. One explanation for the association between positive cultures and a longer hospital stay might be that the specific antibiotic sensitivity spectrum of a patient's culture often indicates a need to switch antibiotics, and consequently, an extended hospital stay. In this population, after drainage, a swab was taken for cultures. Surprisingly, only 12.12% of all swabs showed resistance to penicillin, which was low compared to findings in previous studies [4,9,12,16].

Table 5
Multivariate analysis results of variables potentially predictive of postoperative complications or the length of hospital stay.

Potential predictive factors	Coefficient	OR	Profile-likelihood confidence intervals of OR estimates	p value
Variables predictive of later complications				
Elevation of the floor of the mouth	0.1832	1.201	0.907–1.604	0.1864
Dyspnoea	0.2949	1.343	1.095–1.722	0.0078*
CRP	0.8872	2.428	0.806–8.782	0.1320
Body temperature over 38 °C	1.2184	3.382	0.465–31.528	0.2397
Variables predictive of LOS				
Age	−0.0305	0.970	0.945–0.995	0.0196*
Body temperature over 38 °C	−0.5589	0.572	0.215–1.502	0.2659
Fluctuant swelling	−0.0694	0.933	0.844–1.030	0.1699
Dyspnoea	−0.1392	0.870	0.764–0.987	0.0360*
CRP	−0.9160	0.400	0.216–0.726	0.0035*
White blood cell counts	−0.3601	0.698	0.454–1.066	0.1037

CRP = C-reactive protein. LOS = length of hospital stay. OR = odds ratio.
* $p < 0.05$.

Multivariate analysis results suggested that a combination of clinically accessible variables and a blood sample could be used to predict LOS. On the other hand, predicting future complications was harder, because only dyspnoea was significantly associated with future complications. Thus, based on these findings, a combination of a thorough anamnesis, clinical investigation, and blood sample tests with inflammatory parameters is primordial for primary health care workers and emergency service staff to assess the need for surgical drainage, intravenous antibiotics, and monitoring. Unfortunately, this model had limited power for predicting the need of a tracheostomy, due to data overaggregation. More specifically, the values of the dependent variables only varied between zero and one. This limited variability resulted from the dichotomous data: patients did or did not have a postoperative tracheostomy. This step function behaviour gave rise to complicated mathematical problems, like heteroscedasticity (variance of the error term was not constant) and inconsistency (violation of biasedness, even with larger sample sizes). On the other hand, the LOS exhibited much wider variability. Thus, a range of numbers was used to fit the linear regression model. This scenario provided a model with greater statistical power, because heteroscedasticity was absent.

We would like to stress that the statistically significant variables found after uni- or multivariate analysis are all individually linked with a future longer hospital stay. But importantly, the combination of multiple of these significant variables in a specific case strengthens the indication for surgical drainage and hospital admission. Furthermore, we like to mention body temperature above 38 °C as significant in univariate but not in multivariate analysis and the opposite for dyspnoea. This difference is caused by confounding. Both results are significant but more relevant results are obtained after multivariate analysis because it holds a lower risk of overfitting.

In this study, antibiotics were not analysed, due to the high variability in therapy durations and the frequent switching to narrow-spectrum antibiotics, based on antimicrobial sensitivity testing. In addition, statistics on antibiotics could not be readily performed, because in most cases, antibiotics were administered by primary caregivers. Thus, it was very difficult to trace the exact dose, duration, and type of antibiotics given. Moreover, the durations of antibiotic treatments depended mostly on the clinical progress, not on measurable variables. However, 73.44% of the 64 patients received metronidazole, in addition to standard therapy with amoxicillin clavulanic acid or clindamycin. The current literature did not support this combination for treating a generally healthy population of patients with oral infections and abscesses [2,18].

5. Conclusion

This study investigated 64 patients with severe oral infections. The average patient age, the male to female ratio, and the most frequently affected spaces were comparable to those reported in other comparable populations studied in the current literature. Univariate analysis showed, that only body temperature, CRP levels, white blood cell counts, and bacterial cultures were significant red flags associated with a significantly longer hospital stay. More importantly, multivariate analysis demonstrated the predictive value of, both, clinically accessible variables (dyspnoea and age) and CRP (available with blood sampling) for predicting the LOS, as a sign of future morbidity. The presence of one significant variable is enough to consider hospital admission and surgical drainage. Hence, when primary dental or medical caregivers, have

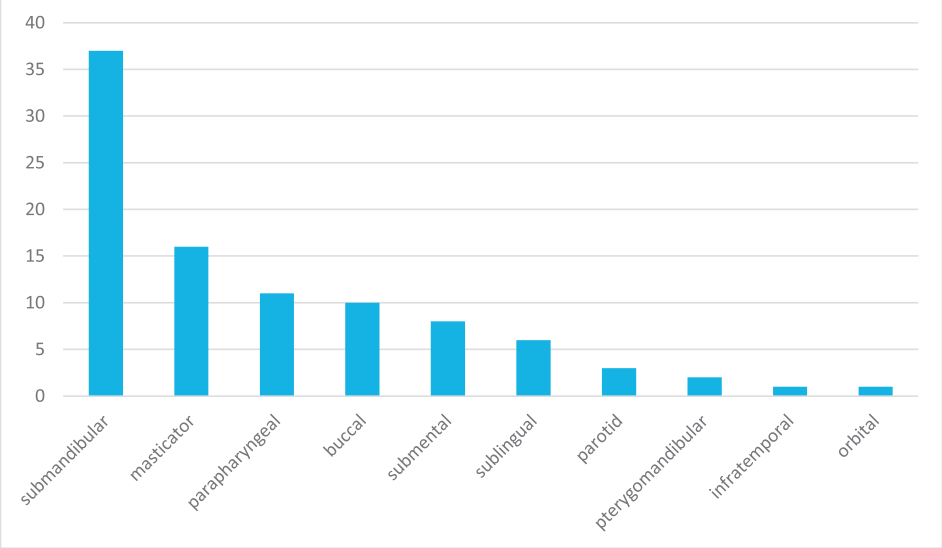

Fig. 2. Frequency of infections in each maxillofacial space in this population of 64 cases.

access to blood sample testing, they can make a well-founded estimation of whether the patient should be admitted to hospital. On the other hand, radiological imaging has no clear association with a longer LOS although it is indicated if multiple variables with a significant longer hospital stay are present. Therefore, CT scans should be used by emergency services in order to assess the expansion of the infectious process.

Conflict of interest

The authors declare no conflict of interest.

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