VILNIUS UNIVERSITY

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ODONTOGENIC MAXILLOFACIAL INFECTIONS, EVALUATION OF DETERMINANTS AND TREATMENT MODALITIES

Summary of Doctoral Dissertation

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VILNIAUS UNIVERSITETAS

Rūta Rastenienė

ODONTOGENINIAI VEIDO IR ŽANDIKAULIŲ SRIČIŲ PŪLYNAI, JUOS ĮTAKOJANČIŲ VEIKSNIŲ IR GYDYMO ĮVERTINIMAS

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ABBREVIATIONS

AOMI – acute odontogenic maxillofacial infection
ADs – Lithuanias regional Administrative Districts
AIRs – Adjusted incidence ratios
K12.2 – Cellulitis and abscess of mouth
K 10.2 – Inflammatory conditions of jaws
K10.3 – Alveolitis of jaws
K05.2 – Acute periodontitis
L03.2 – Cellulitis of face
NHCIF – Lithuanian National Health Care Insurance Fund
OPUC – Outpatient Primary Urgent Care
R-SEI – Regional Socio-economic Index
R-BDCI – Regional Basic Dental Care Index
R-SCDI – Regional Specialized Dental Care Index
R-ISD – Regional Index of Systemic Diseases

1. INTRODUCTION

1.1. Research question and it's relevance

Despite advancements in medicine, life threatening infections of odontogenic origin are still prevalent in many countries (1–3) and treatment of these infections is challenging because potentially fatal complications such as septicemia, airway obstruction, cavernous sinus thrombosis, necrotizing fasciitis and mediastinitis may occur (4,5). The standard principle for emergency treatment of these infections has not changed since Hippocrates, i.e. purulent infections have to be drained. However, there is no consensus concerning antibiotic use, as evidenced by the variety of treatment protocols for treating odontogenic infections (6–8).

Acute odontogenic infections develop due to advanced dental diseases (8) and they are the most serious infections in the orofacial region (9). Maintaining oral health is important to an individual's well-being (10). Some individuals are more likely to develop advanced dental diseases and they are also more likely to delay dental treatments for their acute dental conditions (11). It has been reported that oral pain is more prevalent among low-income groups, those with untreated dental diseases and those who avoid dental care because of its related costs (12). It is important to consider that individuals who can't access or afford regular dental care tend to delay regular dental appointments and consequently may need to visit emergency clinics when they develop acute dental problems (11). Acute odontogenic infections impact not only individuals who suffer from these infections but also a population at large that has to cover the costs related to treatments of acute oral infections through taxes (13) .

Lithuania has a two-tier system including both private (fee for service) and public (free or partly subsidized) professional dental care. To improve access to primary care, the Lithuanian National Health Care Insurance Fund (NHCIF) has established multiple contracts with private and public

treatment facilities to provide primary dental care for patients with acute odontogenic maxillofacial infections. This allows patients with acute infections to receive free or partly subsidized medical care in a dental care facility of their choice and in their neighborhood. This infrastructure also encourages patients to seek professional help in a timely manner, i.e. patients with acute conditions are not forced to allocate time and resources necessary to travel to big centers as they can receive medical care for their urgent health condition in local treatment facilities.

The Lithuanian Primary Health Care Model including both private and public sectors is different from models found in countries where provision of urgent medical care is mainly centralized in hospitals. In Lithuania, primary urgent care is provided in different geographical locations within the country and in different types of treatment facilities. This publicly supported infrastructure for urgent oral health care may reduce or eliminate disparities in accessing professional care for patients with acute odontogenic infections.

Considering the health challenges facing vulnerable population groups, it is important to examine the total as well as the specific dental treatment needs of patients in whom dental diseases have advanced to the level of acute odontogenic infections. Towards the reduction of oral health disparities, it is also important to know if the occurrence of acute odontogenic infections in high-risk individuals is part of a bigger picture indicating overall high levels of unmet dental treatment needs. Knowing which factors explain high treatment needs will also help us to better understand how to deliver professional dental care to this high-risk population.

Dental diseases are mostly preventable or relatively inexpensive to treat at early stages (14). Disparities in oral health still exist in many countries (15,16) and have commonly been associated with some types of dental health care systems, as well as socio-demographic and behavioral variables (17). It is well known that patients from higher socio-economic groups and those with dental insurance are more likely to seek regular professional help and have better oral health as compared to those who

have no insurance or who are worse off socio-economically (18). Thus, it is important to acknowledge that private dental care may be a barrier for families without insurance, with limited financial resources and without access to public clinics (19). In addition, poor oral health has been associated with limited access to free or partly subsidized public dental clinics (20). Social deprivation for individuals with limited or no financial resources is further aggravated because public clinics, due to their limited resources, need to focus on urgent care and give less attention emphasis to preventive or maintenance dental care (21).

1.2. The goal and objectives

The goal of the present study was to evaluate the prevalence of acute odontogenic maxillofacial infections in Lithuanian patients and examine different treatment modalities.

The specific objectives were as follows:

1. To estimate the overall prevalence of acute odontogenic maxillofacial infections (AOMI) in Lithuania and examine how different outpatient and inpatient treatment facilities across the country provide care for patients with AOMI.
2. To associate acute odontogenic infections with the following determinants: social, access to health care, and different clinical oral health-related aspects.
3. To examine patients with acute odontogenic infections clinically: assess their functional dentitions, evaluate their total and specific dental treatment needs and identify factors (determinants) explaining their dental treatment needs and retention of functional dentitions.
4. To identify the most common microorganisms involved in acute odontogenic maxillofacial infections and their susceptibility to antimicrobial agents.

1.3. Scientific novelty and relevance

There have been no previous national Lithuanian studies about odontogenic maxillofacial infections. In Lithuania, severe maxillofacial odontogenic infections are prevalent and advanced treatments for them are provided in three central specialized hospitals. The hospital-related costs for treating these severe infections are covered by public medical insurance, thus patients do not have any out-of-pocket costs. After such treatments are completed, the related documentation is archived centrally. This centrally accumulated information about the treatments of different type of odontogenic maxillofacial infections allows us to study time trends regarding the disease incidence as well as examine the risk factors and different aspects of disease management. This national data presents a unique opportunity for a retrospective analysis, which has both scientific value as well as clinical implications.

The present work consisted of three studies and evaluated different aspects related to management of Lithuanian patients with AOMI:

- **Study 1:** A national 2009-2013 follow-up study of treatment of acute odontogenic maxillofacial infections in Lithuania.
  Having data for the whole country from the National Medical Register System about patients with acute maxillofacial infections allowed us to evaluate the Lithuanian Primary Urgent Care Model implemented for the treatment of patients with AOMIs. This study examined the time trends regarding the incidence of acute odontogenic infections (AOMI) and the country's distribution of different dental treatment facilities which provide primary as well as advanced dental treatments for patients with AOMI. Subsequently, acute odontogenic maxillofacial infections were associated with regional social, access to care and different disease-related determinants.
- **Study 2:** A 10-year retropective analysis regarding treatments of acute severe odontogenic maxillofacial infections.
  This study performed a medical chart review of treatments provided to patients at the Department of Oral and Maxillofacial Surgery of Vilnius

University‘s Žalgirio Clinic Hospital, one of the country‘s hospitals specializing in treating advanced acute odontogenic oral infections.

- **Study 3:** A clinical epidemiological prospective cohort study of patients with acute severe odontogenic maxillofacial infections treated at the Department of Oral and Maxillofacial Surgery of Vilnius University‘s Žalgirio Clinic Hospital.

  This clinical epidemiological prospective cohort study examined different AOMI-related determinants (social, clinical and access to primary dental care) and associated them with varying lengths of hospitalization. In this study, the status of oral health, total dental treatment needs, specific dental treatment needs and factors explaining (determinants) the length of hospitalization were examined. In addition, common microorganisms responsible for acute odontogenic maxillofacial infections and their susceptibility to antimicrobial agents was evaluated.

2. MATERIAL AND METHODS

The study was approved by the National Lithuanian Ethics Board (#158200-02-281-66).

Three independent studies were completed:

- **Study 1: A National 2009-2013 Follow-up Study - treatment of acute odontogenic maxillofacial infections in Lithuania.**

The information about treatments and health care institutions providing care for patients with acute odontogenic infections was acquired from the Lithuanian National Health Care Insurance Fund (NHCIF). The present study included group-based data, focused on time trends and examined potential determinants of acute maxillofacial infections at two levels: the treatment institution level and the regional level. Table 1 presents the variables of Study 1 and their operationalization.

Table 1. Operationalization of the study variables

Variable (type of determinant)	*Operationalization*
Type of Acute Odontogenic Infections (clinical).	Based on the codes (ICD-10)# acquired from the Lithuanian National Health Care Insurance Fund: Code K12.2: cellulitis and abscess of mouth Code K 10.2: inflammatory conditions of jaws Code K10.3: alveolitis of jaws Code K05.2: acute periodontitis Code L03.2: cellulitis of face
Regional Administrative Districts (demographic).	Regional administrative districts based on the geographical location (N=10).
Type of Treatment Facility	1=Private Dental Clinics (outpatient, local), 2=Central Polyclinics (outpatient, big cities), 3=Regional Hospitals (outpatient or hospital, big cities), 4=Local Public Clinics (outpatient, local).
Follow-up periods	1=2009 year, 2=2010, 3=2011, 4=2012, 5=2013.
Hospitalization (clinical).	0= treatment of infections in an outpatient institution, 1= treatment of infections in a hospital.
Regional Socio-economic Index (socio-economic).	Regional Socio-economic Index (R-SEI) was based on the following information: 1) natural population growth, 2) averaged regional individual income, 3) regional average level of migration (inside country), 4) regional average level of emigration, and 5) regional level of criminality (severe cases only). Low R-SEI=0, Medium R-SEI=1, High R-SEI=2.
Regional Basic Dental Care Index (socio-demographic).	Regional Basic Dental Care Index (R-BDCI) an adjusted number of dentists per 1000 inhabitants. R-BDCI Lowest=0, R-BDCI medium=1, R-BDCI highest=2.
Regional Specialized Dental Care Index (R-SCDI) (social determinant).	Regional Specialized Dental Care Index (R-SCDI) -a regional adjusted number of specialists (oral surgeons and/or maxillofacial surgeons) per 1000 inhabitants. R-SDCI Lowest=0, R-SDCI medium=1, R-SDCI highest=2
Regional Index of Systemic Diseases (R-ISD), disease determinant (clinical).	Regional Index of Systemic Diseases (R-ISD) an adjusted number of systemic diseases/conditions per region (N of diseases per 1000 inhabitants). R-ISD Lowest=0, R-ISD medium=1, R-ISD highest=2.

ICD-10 Codes# according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Classification system (ICD-10).

Lithuania has a total of ten regional Administrative Districts (ADs). A five-year follow-up data was available for all of them from the NHCIF. In the NHCIF database, acute odontogenic maxillofacial infections are coded following the International Statistical Classification of Diseases and Related Health Problems 10th Revision Classification system (ICD-10). According to the ICD-10 system, five codes of acute odontogenic maxillofacial infections are: K12.2–cellulitis and abscess of mouth, K10.2–inflammatory conditions of jaws, K10.3–alveolitis of jaws, K05.2–acute periodontitis and L03.2–cellulitis of face (Table 1).

In preparation for the statistical analyses, the numbers of regional incidences of acute maxillofacial infections were adjusted per 10.000 inhabitants. This way, Adjusted Incidence Ratios were calculated separately for each type of acute odontogenic infection (K12.2, K10.2, K10.3, K05.2 and L03.2) and for each follow-up year (2009, 2010, 2011, 2012 and 2013). This way, the standardized ratios adjusted for the number of cases treated in each type of treatment institution and for the size of a district.

Adjusted incidence ratios (AIRs) were calculated per 10.000 inhabitants as follows:

*AIR (type of institution in a specific administrative region) = a number of infections treated in an institution at a follow-up * 10.000 / a number of inhabitants per region at a follow-up.*

In Table 1 the following potential risk determinants for a higher incidence of acute odontogenic infections are presented: hospitalization (outpatient vs. inpatient care), a regional socio-economic index (R-SEI), a Regional Access to Basic Dental Care Index (R-BDCI), a Regional Access to Specialized Dental Care Index (R-SDCI) and a Regional averaged number of systemic diseases (R-ISD). The R-SEI was a combined regional socio-economic index calculated considering several social deprivation aspects employing data from the National Statistics Register. The R-SEI was calculated based on five area-based social parameters and each of ten administrative districts were allocated a R-SEI score (0=lowest

R-SEI, 1=medium R-SEI or 2=highest R-SEI). Area-based groupings of administrative districts were also used considering the potential determinants related to regional access to either professional basic dental care (R-BDCI) or to specialized dental care (R-SDCI). The Regional Index of Systemic Diseases (R-ISD) grouped 10 Lithuanian Administrative Districts into three groups: lowest R-ISD, medium R-ISD or highest R-ISD based to the averaged regional number of systemic diseases/conditions.

All statistical analyses were performed employing the SPSS Version 21.0 software and the threshold for statistical significance was at $P<0.05$. Univariate statistics was used to test the data for normality in preparation for the inferential bivariate or multivariate statistics. Given that most of the data was non-normally distributed, nonparametric tests were mainly chosen for all the bivariate analyses.

Bivariate analyses were used to compare proportions of patients with acute odontogenic infections treated in different types of treatment facilities (Kruskal Wallis Test), to explore time trends concerning the incidence of different type of odontogenic infections (Friedman's Test) and to associate potential risk determinants with the adjusted incidence ratios of acute odontogenic infections (Kruskal Wallis Test/Mann Whitney U Test). The multivariate linear regression analysis examined the joint effect of the following potential risk determinants: the type of treatment modality (outpatient vs. hospital), the density of basic dental care (R-BDCI), the density of specialized dental care (R-SDCI), the regional socio-economic index (R-SEI) and the regional occurrence of systemic diseases (R-ISD).

- **Study 2: A 10-year retropective analysis regarding treatments of acute severe odontogenic maxillofacial infections**

A total of 3215 medical records from the Department of Oral and Maxillofacial Surgery of Vilnius University's Žalgirio Clinic Hospital of patients treated from January, 2003 to December, 2012 were reviewed, of which 2182 records contained information about patients who had maxillofacial infections of odontogenic origin. In Lithuania, hospitalization

costs for dental treatment are reimbursed from public funds; this requires a thorough documentation which is regularly audited by health authorities. Thus, the medical charts from the University's Hospital comprised the reliable and valid information necessary for the present study. The general criteria for a hospital admission for patients with odontogenic maxillofacial infections were: impaired function including mouth opening less than 40 mm, dysphagia, dyspnea, a fever above 38°C, inflammation of soft tissues which has spread into different anatomical spaces and a serious general health condition. All patients underwent a drainage of the underlying infiltrates and extraction of a causal tooth either under a local or general anesthesia. In addition, the following data was collected: patient's age, gender, presence of systemic diseases, smoking history and treatment related information such as time of the first appointment, length of hospital stay, causal tooth, type of treatment provided, microbiological examination including sensitivity testing to the following antibiotics: penicillin, metronidasol, cefasolin and gentamicin. Complete data including the information as listed above was available from 1077 medical records.

The SPSS 21.0 software was used for all statistical analyses with a threshold for statistical significance set at $P<0.05$. Only the information available for all patients with acute odontogenic infections was included in the bivariate and multivariate analysis. The bivariate analysis (Spearman's correlation) was used to explore the interrelationships among the potential predictors for the length of hospitalization such as: involvement of multiple teeth in such infections, multiple spaces infected, presence of systemic diseases, type of antibiotics used for treatment, change in treatment and whether bacteria growth was observed or not.

For the multivariate analysis, binary logistic regression analysis was chosen and the outcome was seven days or less of hospitalization versus more than seven days of hospitalization. In order to explore age-related effects to the length of hospitalization, separate regression analyses were employed for three age groups: those younger than 18 years, those 18-64

years-old and those 65 years or older. To evaluate all potential determinants and compare their role regarding the length of hospitalization, the "enter" method was chosen for variable selection into the logistic regression models.

- **Study 3: A clinical epidemiological prospective cohort study of patients with acute severe odontogenic maxillofacial infections treated at the Department of Oral and Maxillofacial Surgery of Vilnius University's Žalgirio Clinic Hospital.**

During the 2009-2013 period a total of 365 adult patients with acute odontogenic maxillofacial infections (AOMIs) were treated in an inpatient hospital (N=285) or in outpatient (N=80) university's clinic. The data was collected by means of a comprehensive evaluation including clinical assessment, radiographic examination and a survey employing the structured questionnaire. The clinical examination included a detailed assessment of dentition status and evaluated the specific treatment needs for restorations, endodontic treatments, extractions and periodontal treatments. In order to allow standardized comparisons among patients with AOMIs who retained different numbers of teeth, all treatment need related measurements were transformed into standardized ratios, each of them indicating the specific treatment need as a percentage of the remaining dentition.

Ratios for the specific dental treatment needs were calculated based on the following equation:

$$\textit{Ratio of specific treatment need} = \frac{\textit{No of teeth in need of this treatment}}{\textit{28 (total number of teeth)}} \times 100$$

This way, each ratio of a specific treatment need presents the percentage of the remaining dentition that needs a specific dental treatment, e.g. a patient who retained 15 teeth, of which five teeth need restorations will have a 33.3% ratio of restorative treatment needs.

A total of four ratios were calculated for the specific treatment needs: $Ratio^{restorative}$ for the restorative treatment needs, $Ratio^{Endo}$ for the endondontic treatment needs, $Ratio^{extractions}$ for the extraction needs and $Ratio^{perio}$ for the periodontal treatment needs.

Ratio of total treatment needs summed all ratios of specific dental treatment needs:

$$Ratio\ of\ total\ treatment\ needs = Ratio^{\ restorative} + Ratio^{\ Endo} + Ratio^{\ extractions} + + Ratio^{\ perio}$$

The ratio of remaining functional dentition was calculated as follows:

$$Ratio\ of\ functional\ dentition = \frac{No\ of\ sound\ and\ filled\ teeth}{28\ (total\ number\ of\ teeth)} \times 100$$

The structured questionnaire comprised multiple variables from the following domains: the domain of socio-demographic characteristics, the domain of dental care seeking behaviors, the domain of systemic conditions and the domain of health/disease related lifestyle. The other four domains of potential AOMIs related determinants were: 1) The Outpatient Primary Urgent Care (OPUC) domain included determinants related to different aspects of the outpatient urgent care provided to patients with AOMIs prior to their hospitalization. The OPUC domain included the following determinants: accessing or not accessing OPUC prior to the hospitalization, waiting time prior to accessing OPUC, time when OPUC was received, costs of OPUC, seeking hospitalization after referral from OPUC and admission to a hospital. 2) The AOMIs severity domain included the following determinants: a number of anatomical spaces involved in AOMIs, extension of AOMIs (unilateral or bilateral), type of anesthesia used (local or general), type of incision to drain AOMIs (intraoral or extraoral) and occurrence of complications. 3) The lifestyle domain included information about smoking, oral self-care, self-treatment when in oral pain and if dental care was sought only for the emergency. 4) The diseases domain comprised information about the presence of systemic diseases, experience of dental diseases and periodontal health status.

The SPSS version 21.0 software was employed. Univariate analyses described (mean ± SD, min, max) of the following six outcomes: 1) total dental treatment needs, 2) dental treatment needs for restorations, 3) dental treatment needs for endodontics, 4) dental treatment needs for extractions, 5) dental treatment needs for periodontal treatments and 6) the status of the remaining functional dentition. Univariate analyses were used to examine distributions of the aforementioned outcomes and to prepare for the subsequent bivariate statistics that compared different patient groups (explanatory variables/determinants from four domains) regarding the aforementioned outcomes.

Univariate statistics was used to test the data for normality in preparation for the inferential statistics. Given that data were normally distributed, the parametric tests were used for subsequent analysis. The bivariate analysis included the independent sample t test for the comparison of two groups and ANOVA with Post Hoc Bonferroni Adjustment for the comparison of three or more groups. Multivariate analyses assessed the joint effect of explanatory variables from all four domains and selected the best explanatory variables for two outcomes: total dental treatment needs and remaining functional dentitions. Linear multiple regression (LMR) models were used for the multivariate analysis. The threshold for significance for all tests was set at $P<0.05$.

3. RESULTS

During the evaluation period, the Lithuanian NHCIF had established contracts with a total of 482 treatment facilities, of which 421 were with outpatient and 61 were with inpatient facilities. There were four types of such facilities providing either free or partly subsidized primary dental care for patients with acute odontogenic infections. Treatment facilities providing urgent care for patients with acute maxillofacial infections were widely distributed across the country, among which Private Dental

Clinics (outpatient) located across the country provided subsidized care (N=235), Central Polyclinics (outpatient) located in big cities provided free care (N=27), Regional Hospitals (outpatient/inpatient) located in big cities provided free care (N=61) and Local Polyclinics (inpatient) located across the country provided free dental care (N=159). Although more treatment facilities were established around city areas, there were many treatment facilities located in multiple geographical locations throughout the country.

Figure 1 illustrates the numbers of odontogenic infections treated per 10.000 inhabitants.

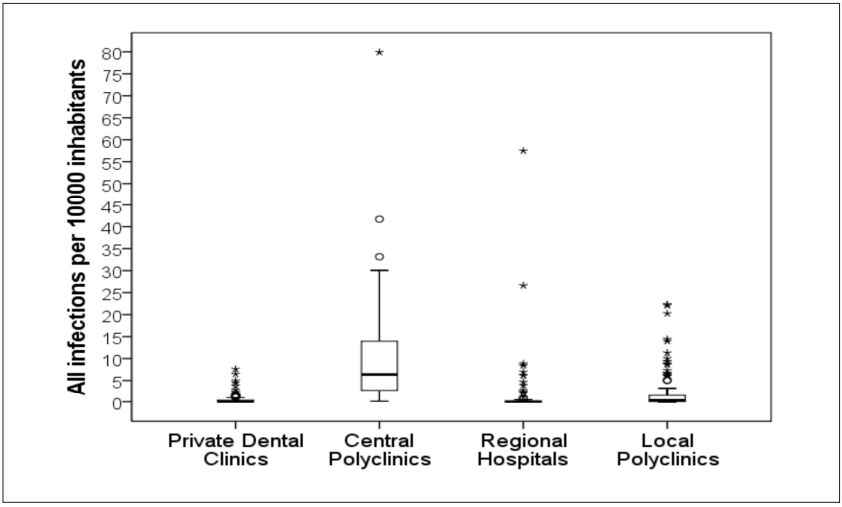

Fig. 1. Treatment of acute odontogenic infections in different treatment institutions in Lithuania

Proportionally, the Central Polyclinics provided the most of primary care for patients with acute odontogenic infections followed by Local Polyclinics. Concomitantly, one can see that there was a substantial inter-variation within the same type of treatment institutions as it relates to care provision to such patients.

Time Trends – Comparison of Annual Incidence Ratios of Acute Odontogenic Infections

Within a 5-year evaluation period, a total of 150.254 cases (an average of 1.0% of the Lithuanian population) were diagnosed and treated for acute odontogenic maxillofacial infections. The corresponding annual proportions were as follows: 29.362 cases in 2009 (0.9%), 27.937 in 2010 (0.9%), 30.390 in 2011 (1.0%), 30.058 in 2012 (1.0%) and 32.057 cases in 2013 (1.1%).

Table 2 presents time trends separately for each type of odontogenic infection and for each type of treatment facility.

When different follow-up years were compared, none of the adjusted incidence ratios differed statistically significantly among private clinics. An overall trend that fewer infections were treated in private clinics as compared to other type of treatment institutions can be observed with Central Clinics treating most of the acute maxillofacial infections. Although there were some statistically significant differences among different follow-up periods, there was no consistent trend of either an increase or decrease in the incidence rates of acute infections throughout a five year-follow-up period. Table 2 also presents numbers of treatment institutions providing care for patients with acute odontogenic infections. Numbers of regional hospitals and local public clinics treating such patients increased from 2009 to 2013.

When adjusted, summative incidence ratios (all years combined) were compared across the country's 10 administrative districts; only one administrative district treated significantly more infections as compared to the other nine administrative districts ($P<0.040$).

Table 3 presents two types of comparisons; results and their significance of time trends in different population subgroups are reported horizontally and time trends and their significance for the within group differences are presented vertically. Dependent outcomes in both comparisons are Adjusted Incidence Ratios (AIRs) per 10.000 inhabitants.

Table 2. Time trends - incidence of acute odontogenic infections in Lithuania (2009-2013)

ICD-10 Codes#	*Adjusted Incidence Ratios per 10.000 inhabitants*															
	2009			*2010*			*2011*			*2012*			*2013*			*P values^*
	mean	*sd*	*n*	*mean*	*sd*	*n*	*mean*	*sd*	*n*	*mean*	*sd*	*n*	*mean*	*sd*	*n*	
Private Dental Clinics (Outpatient, across the country)																
K10.2	3.1	6.3	111	2.6	5.4	118	2.9	5.7	122	3.0	6.2	131	3.3	6.2	127	0.217
K12.2	0.5	0.4	51	1.7	2.5	52	0.7	1.2	67	0.9	1.8	57	0.7	0.9	71	0.053
K10.3	1.5	3.0	57	2.0	3.9	45	1.7	2.6	58	1.9	3.1	70	2.5	4.9	73	0.437
K05.2	2.4	3.7	104	3.1	6.2	106	3.3	9.8	112	2.9	7.2	123	2.6	5.9	123	0.613
L03.2	0.6	0.9	29	0.7	0.5	34	0.6	0.5	46	0.5	0.5	39	0.6	0.6	59	0.592
Central Polyclinics (Outpatient, Big cities)																
K10.2	83.1	157.8	25	80.9	149.7	24	87.2	116.9	25	92.3	172.8	26	93.1	158.2	25	0.002
K12.2	3.2	5.7	26	3.4	5.1	23	3.1	5.2	24	3.2	5.5	23	3.5	6.4	22	0.296
K10.3	25.2	34.9	25	24.6	33.8	24	27.6	34.2	23	28.3	31.1	23	22.2	21.4	25	0.036
K05.2	22.0	29.1	26	22.8	28.4	24	24.7	40.1	26	32.7	66.1	26	29.3	49.0	25	0.739
L03.2	0.5	0.8	13	0.9	1.2	16	1.1	1.0	14	0.7	0.9	18	1.3	1.3	18	0.509
Regional Hospitals (Outpatient/Inpatient, Big cities)																
K10.2	13.4	27.9	37	17.0	24.6	27	20.1	38.5	25	16.2	32.9	27	17.4	55.3	37	0.517
K12.2	6.5	10.4	32	7.3	11.1	28	6.2	11.6	32	7.5	12.0	25	4.3	9.7	54	0.335
K10.3	4.9	6.7	10	3.5	3.1	10	4.0	3.9	8	1.9	2.9	10	2.5	7.3	15	0.663
K05.2	33.6	129.1	22	49.2	72.2	17	55.6	188.3	16	35.8	107.8	14	5.9	17.8	26	0.663
L03.2	1.3	2.0	54	1.1	2.0	49	1.5	2.2	51	1.5	1.5	50	2.2	2.7	66	0.001
Local Polyclinics (Outpatient, across the country)																
K10.2	10.8	21.7	126	10.9	20.4	124	11.6	23.7	124	11.8	25.6	126	12.8	24.9	127	0.030
K12.2	0.9	1.0	67	1.5	2.0	67	1.1	1.3	68	1.0	1.1	67	1.1	1.3	74	0.186
K10.3	5.8	10.2	83	5.1	7.7	83	5.8	7.8	81	6.4	9.4	81	7.0	12.8	90	0.195
K05.2	9.7	25.9	92	9.1	27.1	96	8.1	22.0	102	8.5	23.0	104	7.3	16.8	114	0.974
L03.2	0.6	0.8	43	0.7	0.8	35	0.8	0.9	39	1.0	1.0	41	1.0	1.3	52	0.010

ICD-10 Codes: International Statistical Classification of Diseases and Related Health Problems 10th Revision: K12.2- cellulitis and abscess of mouth; K10.2- inflammatory conditions of jaws; K10.3- alveolitis of jaws; K05.2- acute periodontitis; L03.2- cellulitis of face. ^ Friedman's Test; N=number of treatment institutions.

Table 3. Determinants of acute odontogenic infections- bivariate analyses

	Acute Maxillofacial Infections – Adjusted Incidence Ratios per 10.000 inhabitants															
	2009 year			*2010 year*			*2011 year*			*2012 year*			*2013 year*			*P ^*
	mean	*sd*	*(n)*	*mean*	*sd*	*(n)*	*mean*	*sd*	*(n)*	*mean*	*sd*	*(n)*	*mean*	*sd*	*(n)*	
Regional Socio-Economic Index (R-SEI) based on thirds#																
Lowest	20.9	62.2	63	19.3	49.8	63	21.9	57.7	66	23.4	70.4	63	22.7	46.0	65	0.002
Medium	13.4	35.6	195	14.9	36.6	187	14.4	38.0	185	13.5	37.0	199	14.1	34.0	197	0.021
Highest	31.6	108.3	144	30.8	110.3	143	31.8	120.0	153	30.7	115.4	163	28.7	102.2	171	0.159
*P value	0.003			0.257			0.996			0.001			<0.001			
Regional Basic Dental Care Index (R-BDCI) based on thirds#																
Lowes per capita	23.9	73.0	166	24.1	76.0	158	26.3	82.1	159	23.6	66.8	169	22.9	48.3	168	0.097
Medium per capita	35.5	127.2	72	35.8	123.7	73	36.4	138.5	75	38.9	150.8	79	35.5	131.6	80	0.097
Highest per capita	11.8	28.6	164	11.3	27.3	162	12.2	32.3	170	11.9	33.5	177	13.4	44.8	185	0.032
*P value	<0.001			<0.001			<0.001			<0.001			<0.001			
Regional Specialized Dental Care Index (R-SCDI) based on thirds#																
Lowest per capita	31.6	86.7	85	31.8	94.9	84	34.5	101.6	84	31.5	72.8	86	26.7	53.5	94	0.020
Medium per capita	15.6	49.7	125	16.5	45.3	119	16.3	47.0	121	14.9	50.7	133	16.5	35.0	123	0.065
Highest per capita	19.8	80.6	192	19.0	78.3	190	20.6	88.7	199	21.7	97.7	206	21.5	89.9	216	0.020
*P value	<0.001			<0.001			<0.001			<0.001			<0.001			
Regional Index of Systemic Diseases (R-ISD) based on thirds#																
Lowest	26.2	64.0	99	24.7	55.5	96	28.9	64.7	96	30.1	74.6	98	28.9	58.7	104	0.039
Medium	13.7	31.3	163	14.4	33.9	160	14.2	35.0	166	13.2	33.7	184	15.1	43.7	180	0.113
Highest	26.0	107.8	140	26.0	110.9	137	27.1	121.4	142	26.5	118.4	143	23.1	98.9	149	0.070
*P value	<0.001			0.003			<0.001			<0.001			<0.001			
Type of Treatment Facilities																
Private dental clinics	4.7	9.0	154	3.5	8.6	158	5.3	11.8	167	5.3	11.4	182	5.5	11.2	181	0.030
Central Polyclinics	129.7	210.2	26	117.5	195.9	26	136.4	230.6	26	147.7	258.6	27	148.6	220.4	25	<0.001
Regional Hospitals	20.2	81.6	77	13.6	75.4	68	25.0	105.4	68	17.2	61.5	71	14.5	55.6	84	<0.001
Local Policlinics	19.5	39.2	145	16.7	37.1	141	19.9	38.5	143	20.7	42.1	145	22.6	42.6	143	0.413
*P value	<0.001			<0.001			<0.001			<0.001			<0.001			
Hospitalization																
Outpatient care	22.5	77.3	364	22.1	77.2	360	23,1	84.4	377	22.8	83.9	390	22.3	73.3	398	0.010
Hospital care	7.1	18.2	38	8.4	21.3	33	10.4	23.4	27	7.8	20.2	35	8.0	20.1	35	0.096
**P value	<0.001			0.001			0.014			0.003			<0.001			

**Kruskal-Wallis Test, ** Mann-Whitney U Test,* ^Friedman Test

Time Trends (horizontal comparisons in Table 3)

The total number of dental treatment facilities increased between 2009 and 2013. There were statistically significant differences in AIRs among the two socio-economic regions (lowest and medium) throughout the entire five-year follow-up period, but there was no increase or decrease in AIRS in the areas with the highest socio-economic index.

A consistent trend was an increasing number of treatment facilities providing care for acute patients in all areas of the country throughout the entire 2009-2013 follow-up period. Regarding accessibility to professional dental care, a slight statistically significant decrease in AIRs coincided with increasing numbers of treatment facilities, where highest AIRs were in areas with the lowest number of dental specialists per capita. Regarding the density of basic dental care, an opposite trend has been observed, i.e. a statistically significant increase in incidence ratios occurred in areas with the highest number of dental specialists.

Regarding regional occurrence of systemic diseases, there were some statistically significant differences among different follow-up years, but no consistent trends could be observed. Similarly, no clear trends could be identified regarding treatment provision in different type of treatment facilities or regarding treatment of acute odontogenic infections in either outpatient treatment facilities or in hospitals.

Annual comparisons of incidences in population groups (vertical comparisons in Table 3)

Comparisons of AIRs time trends showed that in 2009, 2011, 2012 and 2013, but not in 2010 there were statistically significantly differences in numbers of patients and types of infections treated in different type of treatment facilities. In terms of access to specialized dental care, there was an obvious trend of higher statistically significant incidence rates in areas where there were the lowest numbers of practicing specialists (oral and maxillofacial surgeons). There was a substantial variation in incidence ratios in areas with different densities of specialists per capita.

Regarding the provision of urgent care by general dentists, most patients with acute maxillofacial infections were treated in regions with a medium density of dentists.

There were some statistically significant differences, but no consistent trends in incidence of acute odontogenic infections could be observed when comparing areas with different proportions of people with systemic diseases.

Regarding hospitalization, statistically significantly more patients were treated in outpatient treatment facilities than in hospitals.

Multivariate Analysis

The results of linear multiple regression models are presented in Table 4.

A total of five linear multiple regression models were tested and a total of four potential risk predictors/determinants for higher incidence rates of acute odontogenic infections were examined: treatment mode (outpatient vs. hospital), density of basic dental care (access to basic dental care), density of specialized dental care (access to specialized dental care), regional socio-economic index (social) and regional distribution of systemic diseases (disease determinant).

A multivariate model was tested separately for each type of odontogenic infections (Codes: K10.2, K12.2, L03.2, K10.3 and K05.2). When controlled/adjusted for other determinants, the two most important significant determinants for higher incidence ratios of acute odontogenic infections were: lower regional density of basic dental care and lower density of specialized dental care.

The second part of this study involved a medical chart review of 1077 patients who were treated for maxillofacial odontogenic infections. The averaged incidence of all odontogenic infection was 218±17 cases each year, with a maximum 250 cases and minimum 190 cases per year. Incidences of odontogenic maxillofacial infections (number of patients treated) during the 10-years period are shown in Figure 2.

Table 4. Predictors of acute odontogenic infections (Linear Multiple Regression)[#]

Determinants	*β coefficient (standardized)*	*P value*	*Unstandardized coefficients (95%CI)*
1st Model Summary: Outcome: Adjusted Incidence Ratio for the Inflammatory conditions of jaws (K10.2) P=0.750, R Square =0.004.			
Constant		0.024	12.4 (17;23.2)
Hospitalization	-0.033	0.492	-6.4 (-24.8;11.9)
Regional Specialized Dental Care Index	0.018	0.751	-4.5 (-15.1; 6.2)
Regional Index of Systemic Diseases	0.042	0.405	4.0 (-5.4;13.4)
Regional Socio-economic Index	0.019	0.707	2.4 (-10.2;15.0)
2nd Model Summary: Outcome: Adjusted Incidence Ratio for the alveolitis of jaws (K10.3) P=0.186, R Square=0.020			
Constant		<0.001	31.2 (19.0;43.5)
Regional Basic Dental Care Index	-0.125	0.145	-15.4 (-31.0;0.2)
Regional Index of Systemic Diseases	-0.038	0.545	-4.9 (-20.7;11.0)
Regional Socio-economic Index	0.123	0.075	-3.4 (-25.3:18.6)
3rd Model Summary: Outcome Adjusted Incidence Ratio for the cellulitis/abscess of mouth (K12.2) P<0.001, R Square =0.059			
Constant		0.076	0.9 (-0.1;1.9)
Hospitalization	0.242	<0.001	3.7 (2.1;5.2)
Regional Specialized Dental Care Index	0.168	0.006	0.1 (-0.9;1.1)
Regional Index of Systemic Diseases	-0.018	0.213	-0.2 (-1.0;0.7)
Regional Socio-economic Index	0.116	0.046	-0.1 (-1.3; 1.1)
4th Model Summary: Outcome: Adjusted Incidence Ratio for the acute periodontitis (K05.2) P=0.044, R Square =0.021			
Constant		0.001	45.0 (18.6;71.3)
Regional Basic Dental Care Index	-0.143	0.010	-43.4 (-76.5;-10.4)
Regional Index of Systemic Diseases	0.083	0.125	26.2 (-7.3;59.6)
Regional Socio-economic Index	0.094	0.099	-19.7(-66.4;27.0)
5th Model Summary: Outcome: Adjusted Incidence Ratio for the cellulitis of face (L03.2) P<0.001, R Square =0.085			
Constant		<0.001	3.2 (2.1;4.4)
Hospitalization	0.189	0.001	2.4 (1.0;3.8)
Regional Specialized Dental Care Index	0.177	0.009	-1.4 (-2.6; -0.3)
Regional Index of Systemic Diseases	0.013	0.849	-0.4 (-1.4;0.7)
Regional Socio-economic Index	0.023	0.678	1.7 (0.2; 3.2)

All predictors were dichotomized. Collinearity diagnostics showed that Tolerance values in all models exceeded 0.6 indicating that assumption for the independence among predictors was fulfilled.

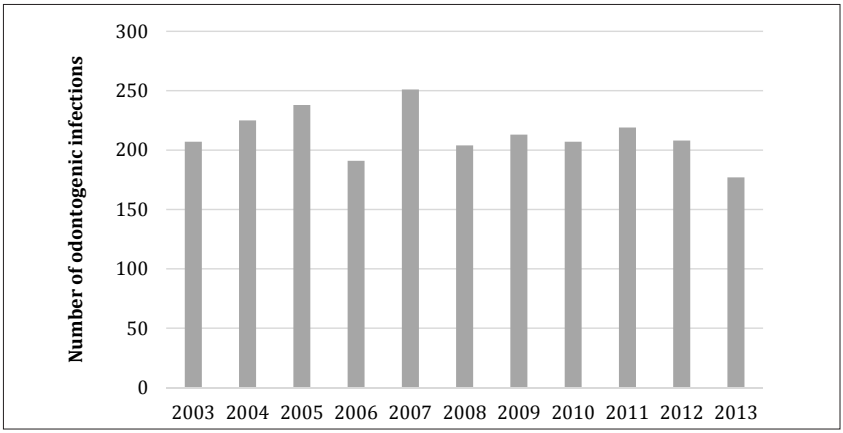

Figure 2. Incidence of maxillofacial infections during the 2003-2013 years

Maxillofacial odontogenic infections accounted for 7.5% of all hospitalized patients at the Department of Oral and Maxillofacial Surgery. Vilnius University Žalgirio Clinic treats around 39.4% of all patients with AOMI in Lithuania. In the present study, the male female ratio was 1.4:1 and the mean age range was 37.0 ± 16.9 years with the youngest patient being four years and the oldest patient being 93 years old. The mean age of males was 38.8 ±16.3 years and the mean age of females was 41.5 ± 17.6 years. Of all, 63 (5.8%) patients were younger than 18 years. The mean hospital stay was 8.7±5.5 days with the shortest treatment lasting a day and the longest treatment lasting 44 days. Of all, 37.2% of the patients stayed in the hospital longer than 8 days. Only 15.0% of patients had their first appointment during the first 48 hours after start of their symptoms; 85.0% delayed seeking medical care with a mean waiting time of 5.5 days. About 40.0% of patients noted self-treatment with mouth rinses and painkillers. After hospital admittance, all surgical procedures were performed within the first six hours and all patients received a specific surgical treatment: an intraoral incision was made in 45 cases (4.1%), extra oral incisions were needed in 974 cases (90.4%) and an intraoral incision combined with an extra oral incision was made in 58 cases (5.3%). A causal tooth was removed

in 85.0% of cases including 13.2% of cases where teeth were removed prior to hospital admission. Only 2.2% of cases received an endodontic treatment after surgical incision. Systemic antibiotic therapy and anti-inflammatory, non-steroidal medications (e.g. Nimesulidi 100 mg/2 times daily) were commonly used and in 95.2% cases systemic antibiotic therapy was combined with a steroidal drug (dexamethasone). Dexamethasone was given intramuscularly for 48 hours twice a day (4-12 mg based on patient's weight). Complications occurred in 2.1% (N=19) of cases and were as follows: 11 patients had mediastinitis, thus were transferred to the departament of thoracic surgery, three patients had necrotising fasciitis, four patients had major bleeding after an artery usuration in postoperative period and one patient had a cardiovascular deficiency.

A single tooth as a cause of infection was diagnosed in 797 cases (74.0%) and the most frequent causal tooth was the left second molar diagnosed in 189 cases (17.5%).

Of all patients, 379 (36.1%) were smokers among which 128 were females (33.7%) and 251 were males (66.2%). Of all, 30 (2.7%) of patients had diabetes, 59 (5.4%) had arterial hypertension and 41 (3.8%) had B or C hepatitis. Patients with diabetes had longer hospital stays than patients without systemic conditions ($P<0.001$).

The frequency of involvement of the different anatomic spaces in AOMIs is shown in Figure 3. The inflammation was most commonly spread into three or more anatomical spaces with the floor of the mouth being involved in 401 cases (37.2%), of which in 35 cases (8.7%) inflammation was spread to a parapharyngeal space and in 37 cases (9.2%) infection reached the deep neck regions.

Involvement of the floor of the mouth bilaterally (Ludwig's angina) was found in 68 (6.1%) cases. The main complaints according to the spaces involved included: limited mouth opening in 376 cases (35.2%), dysphagia in 255 cases (23.3%), and limited mouth opening and dysphagia in 112 cases (10.3%), with all these patients reporting pain. When more than three anatomical spaces were involved the hospital stay was 18 days or more ($P<0.001$).

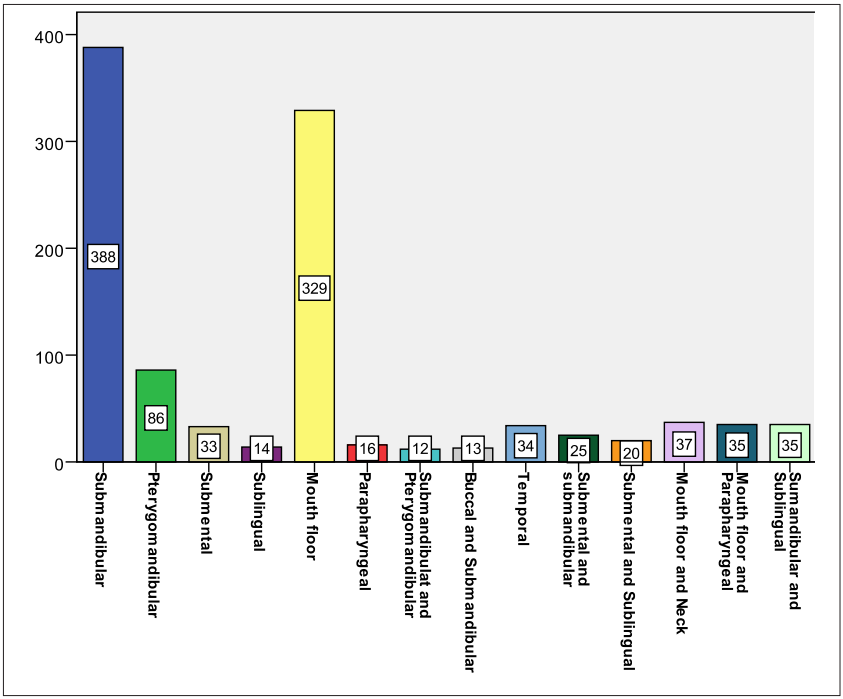

Figure 3. Anatomical spaces involved in maxillofacial and neck odontogenic inflammations

Table 5 presents the results of bivariate testing of associations among different variables to be further tested as determinants of the length of hospitalization. This table presents results of correlation analyses (Spearman's correlation), one for each age group. Overall, all correlation coefficients were relatively low (correlation coefficient <0.300).

In the group of patients younger than 18 years, only two statistically significant associations were observed: 1) between presence of systemic diseases and bacteria growth (coefficient=0.216; P=0.045) and 2) between bacteria growth and use of non-penicillin group antibiotics or antibiotic combinations (coefficient=0.207; P=0.050).

Table 5. Correlations among risk determinants in patients with acute odontogenic infections

	VARIABLES *	*Multiple involved teeth*	*Multiple infected spaces*	*Systemic diseases*	*Antibiotics#*
<18 years N=63	Multiple infected spaces	.007 (0.478)			
	Systemic diseases	.121 (0.172)	.033 (0.399)		
	Antibiotics#	.085 (0.254)	.110 (0.195)	.003 (0.491)	
	Change in treatment*	.175 (0.084)	.028 (0.415)	.064 (0.309)	.056 (0.331)
	Bacteria growth	.060 (0.319)	.188 (0.070)	.216 (0.045)	.207 (0.050)
18-64 years N=903	Multiple infected spaces	.132 (0.001)			
	Systemic diseases	.032 (0.167)	.105 (0.001)		
	Antibiotics#	.015 (0.323)	.118 (0.001)	.104 (0.001)	
	Change in treatment*	.003 (0.465)	.012 (0.364)	.003 (0.495)	.092 (0.003)
	Bacteria growth	.038 (0.125)	.026 (0.217)	.050 (0.067)	.041 (0.107)
65+ years N=111	Multiple spaces	.151 (0.057)			
	Systemic diseases	.168 (0.039)	.002 (0.490)		
	Antibiotics#	.109 (0.128)	.020 (0.841)	.170 (0.037)	
	Change in treatment*	.026 (0.393)	.122 (0.101)	.099 (0.150)	.089 (0.370)
	Bacteria growth	.078 (0.207)	.073 (0.225)	.235 (0.007)	.036 (0.353)

* Spearman's correlation coefficient (Significance). # Prescription of penicillin group versus the prescription of non-penicillin group antibiotics or antibiotic combinations. *Empirical antibiotic treatment changed after the microbiological assessment

In the group of adult patients, four significant associations were identified: 1) between multiple space involvement and the prescription of non-penicillin group antibiotics or antibiotic combinations (P=0.001), 2) between systemic diseases and multiple infected spaces (P=0.001), 3) between the prescription of non-penicillin group antibiotics or antibiotic combinations and multiple infected spaces, and 4) between a change in treatment and the prescription of non-penicillin group antibiotics or antibiotic combinations.

In order to examine which of the variables best explain/predict the longer length of hospitalization, binary logistic regression analyses were performed (Table 6), where the binary outcome was seven or less days of hospitalization versus more than a week of hospitalization. The overall logistic regression model was significant (P<0.001) and the following significant predictors/ determinants for the longer hospitalization were identified: more severe infections as indicated by multiple teeth involvement and multiple infected spaces, prescription of non-penicillin group antibiotics or antibiotic combinations, and change in treatment (antibacterial treatment was changed based upon microbiological assessment).

Table 6. Predictors of Hospitalization in Patients with Acute Odontogenic Infections

Binary Logistic Regression: Outcome: ≤ 7 days vs. > 7 days of hospitalization **Predictor selection** in all models: enter			
Model: (N=1077): ≤ 7days (N=604) & >7 days (N=473). Model summary**:** -2 log likelihood=1319, P<0.001, Nagelkerke R Square=0.183. Hosmer and Lemeshow Test (Chi-square=13.37, df=7, P=0.064), c-statistics (AUC)=0.716			
Predictors	**P value**	**Odds Ratio**	**95 %CI**
Multiple teeth involvement	0.001	1.6	1.2;2.2
Multiple spaces infected	<0.001	1.4	1.2;1.7
Systemic diseases	0.078	1.4	1.0;2.2
Antibiotics#	<0.001	2.3	1.7;3.0
Change in treatment*	<0.001	4.1	2.9;5.9
Bacteria growth	0.124	1.3	0.9;1.7

Prescription of penicillin group versus the prescription of non-penicillin group antibiotics or antibiotic combinations. *Empirical antibiotic treatment changed after the microbiological assessment

Bacteriological testing results

Overall, types of microorganisms cultured from inflammations were similar during the 10-year follow-up period where a total of 62 different microorganisms were found. In 795 cases (73.8%) microorganisms were cultured and in 282 cases (26.2%) no bacteria growth was observed. In 569 cases (52.8%) only one microorganism was cultured, while in 202 cases

(18.8%) there were two microorganisms and in 24 cases (2.2%) three or more microorganisms were cultured.

The most common microorganisms were: *Streptococcus α haemoliticus* found in 341 samples (42.9%), *Streptococcus spp anaerobic (γ non haemolitic)* found in 224 samples (30.0%) and *Staphylococcus coagulase negative (epidermidis, capitis, hominis)* in 162 samples (20.4%). Anaerobic strains such as *Bacteroides* and *Prevotella* were found in 104 samples and *Streptococci pyogenes* were found in 101 (12.8%) samples.

Antibiotic treatments according to the spaces involved are shown in Figure 4.

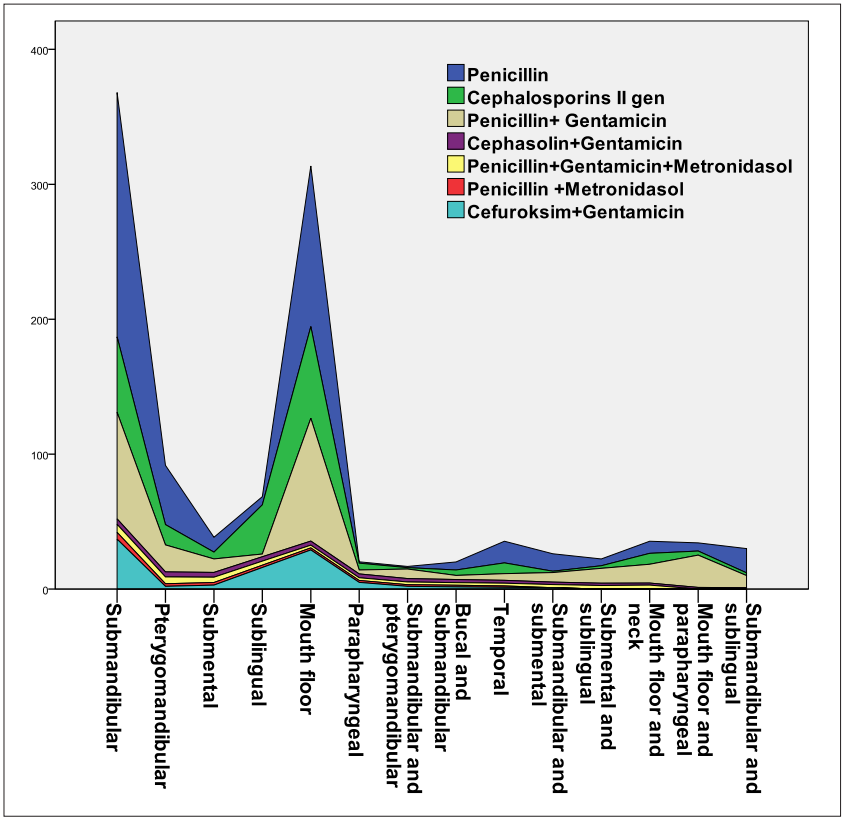

Figure 4. Antibiotic treatment according to the spaces involved

Time trends of antibiotic treatments are presented in Figure 5. Intravenous penicillin alone or in a combination with gentamycin or metronidasol was prescribed in 69.1% of cases, and II generation cephalosporins alone or in combination with gentamycin were prescribed in 24.7% of cases.

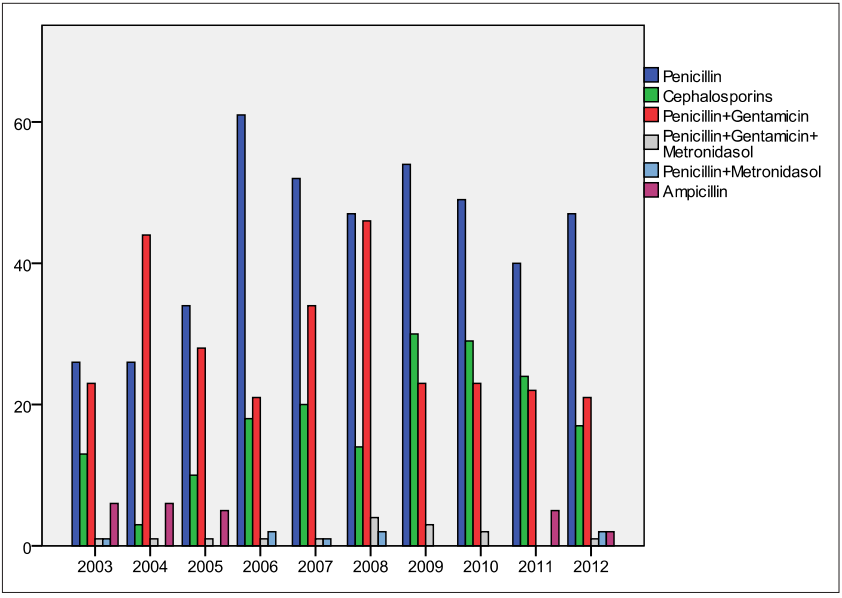

Figure 5. Time trends of antibiotic treatments during a 2003-2012 period

Figure 6 presents the length of hospital stay and antibiotic treatment change, where treatment was changed due to microbiological test results in 153 cases (14.2%) and this change was also associated with a longer hospital stay.

The results of sensivity analyses and resistance to penicillin, cephasolin, gentamycin and metronidasol are shown in Table 7. The tests showed that *Streptococcus α haemoliticus* was resistant to penicillin in 56 cases (16.4%), *γ non haemolitic Streptococcus spp*. were resistant to penicillin

in 46 cases (20.1%), and *Staphylococcus epidermidis* in 72 (44.0%) cases, *γ non haemolitic Streptococcus* was resistant to metronidasol in 130 cases (58%) and *Streptococcus α haemoliticus* was resistant to metronidasol in 86 (25.2%) cases.

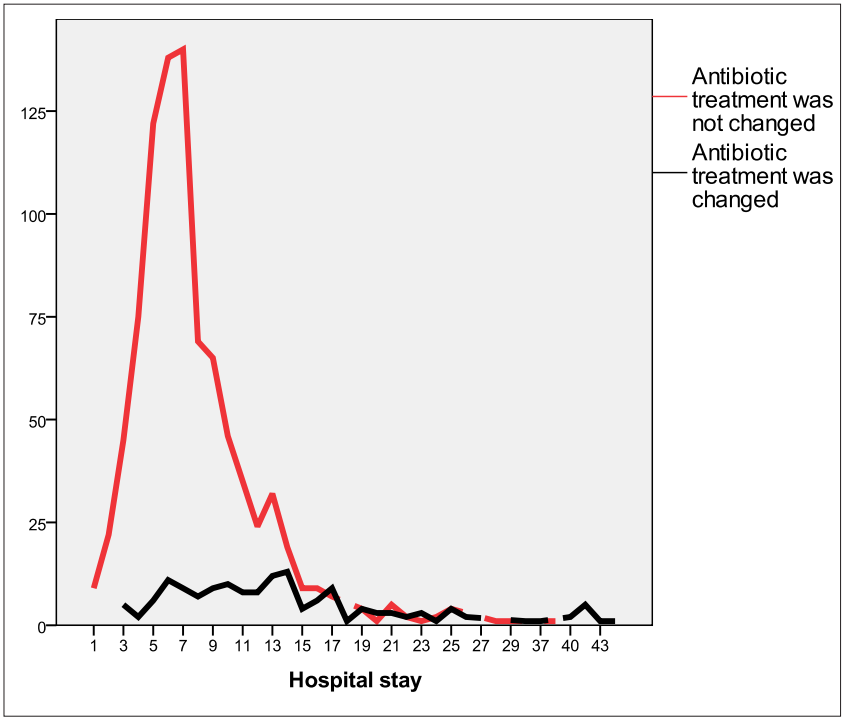

Figure 6. The length of hospital stay and antibiotic treatment change

Table 8 presents results related to the evaluation of oral health and different dental treatment needs of patients with acute odontogenic maxillofacial infections (AOMIs). The overall dental treatment need in patients with AOMIs was high with the mean (sd) being 46.0% (29.7%) indicating that on average almost half of the remaining dentitions in these patients needed dental treatments. The highest level of treatment need related to restorative treatments, while the lowest treatment needs were for extractions.

Table 7. Microorganism resistance (R) and sensivity (S) to different antibiotics

Microorganisms (N)	*Penicillin*		*Cephasolin*		*Metronidasol*		*Gentamycin*	
	R	*S*	*R*	*S*	*R*	*S*	*R*	*S*
Str. α haemoliticus (341)	56 16.4%	246 72.1%	44 12.9%	266 78%	86 25.2%	38 11.1%	43 12.6%	61 17.9%
Str. spp anaerobius (γ non haemoliticus) (224)	46 20.5%	178 79.5%	29 12.9%	182 81.2%	130 58.0%	35 15.6%	31 13.8%	69 30.8%
Bacteroides (104)	39 3.8%	57 54.8%	18 17.3%	58 55.7%	40 38.5%	37 35.6%	21 21.0%	20 19.0%
Staph. epidermidis (162)	72 44.4%	53 32.7%	15 9.2%	112 69.1%	25 15.0%	14 8.6%	11 6.7%	19 11.7%

Table 8. Dental treatment needs and functional dentitions in patients with acute odontogenic infections

Dental Treatment Needs (N=160)	*Mean±SD (%)*	*Minimum/ Maximum %*	*In relationship with Ratio Function ϒ (Significance)*
Ratio of total treatment needs	46.0±29.7	0.0; 100.0	-0.635 (<0.001)
Ratio of functional dentition	32.4±17.1	0.0; 89.3	
Specific dental treatment needs (Ratios)			
Restorative dental treatment needs	20.3±17.1	0.0; 84.0	-0.573 (<0.001)
Endodontic treatment needs	9.7±13.5	0.0; 100.0	-0.163 (<0.040)
Extraction needs	7.7±14.5	0.0; 100.0	-0.486 (<0.001)
Periodontal treatment needs	8.3±13.9	0.0; 64.3	0.010 (0.904)
Significance #	P<0.001		

Kruskal Wallis test; ϒ Spearman's correlation

The mean (sd) of the ratio of functional dentition was 32.4% (17.1%) indicating that this cohort of patients on average had approximately only 1/3 of their functional dentitions left. Further comparisons in Table 8 present correlations between the ratio of the functional dentition (% of the remaining dentition that has either sound or filled teeth) and specific ratios of dental treatment needs (for restorations, endodontics, extractions and periodontal treatments). All correlations of dental treatment needs with the Ratio Function were statistically significant, except for the correlation

between the ratio of functional dentition and the ratio of periodontal treatment needs.

Figure 7 illustrates the distribution of patients with AOMIs regarding their specific dental treatment needs. There was a considerable variation among patients regarding different treatment needs with only a few patients not needing dental treatments. There were some patients whose treatment needs were very high with some in need of treatment for all their remaining teeth.

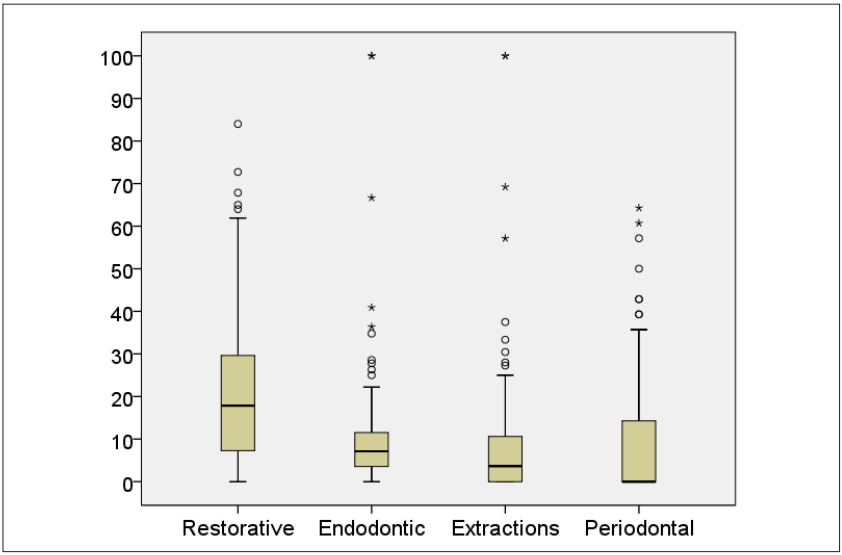

Figure 7. Specific Dental Treatment Needs (% of dentition) in patients with acute odontogenic infections

Table 9 presents the relationships between socio-demographic characteristics and specific dental treatment needs of patients with acute odontogenic infections. Older patients needed significantly more endodontic treatments, extractions and periodontal treatments as compared to their younger counterparts. As it relates to residency, patients living farther from a capital city had higher specific dental treatment needs,

except for endodontic treatments. Females needed less treatments than males. Patients living with partners tended to have higher treatment needs, although statistically significant differences were observed only regarding the need for periodontal treatments. A consistent trend of higher treatment needs was observed in less educated patients as compared to more educated ones. There was a significant difference between the patients who were working and those who did not (jobless, retired or disabled). Patients from households with the lowest income tended to have higher specific dental treatment needs as compared to their better-off counterparts, but none of these differences were statistically significant.

Table 9. Socio-demographic characteristics and specific dental treatment needs of patients with acute odontogenic infections

Variables (N)	*Ratio Restorative*	*Ratio Endodontics*	*Ratio Extractions*	*Ratio Periodontics*
	Mean±SD	*Mean±SD*	*Mean±SD*	*Mean±SD*
Age groups				
18-29 years (49)	19.4 ±15.4	6.5±5.0	4.8±11.3	4.5±10.2
30-49 years (64)	23.2 ±18.1	8.8±9.1	7.7±13.9	9.8±15.2
≥50 years (47)	17.4 ±17.1	14.3±21.3	10.7±17.7	10.3±14.7
Significance ^	P=0.148	P=0.029	P=0.019	P=0.020
Distance from a capital city (for referrals, consultations, outpatient and hospital care)				
Same city (81)	18.3 ±15.1	8.7±8.1	4.6± 6.9	8.3±12.2
< 50 km (31)	18.1± 15.4	11.4±18.4	7.5±12.9	10.8±18.1
> 50 km (48)	25.1±20.3	10.3±16.8	13.1±21.8	6.7±13.5
Significance #	P=0.068	P=0.605	P=0.005	P=0.437
Gender #				
Males (88)	25.3±16.6	9.3± 9.9	8.6±14.0	10.6±16.5
Females (72)	14.3±15.7	10.2±16.9	6.6±15.1	5.5± 9.2
Significance ^	P<0.001	P= 0.381	P=0.009	P=0.014
Marital Status				
Single (77)	20.2±17.3	8.5±12.4	6.3 ±14.0	5.2±11.2
Married (81)	20.0±16.9	11.1±14.5	8.2 ±13.5	11.5±15.6
Significance #	P=0.935	P=0.077	P=0.067	P=0.004

Table 9 (continuation). Socio-demographic characteristics and specific dental treatment needs of patients with acute odontogenic infections

Variables (N)	*Ratio Restorative*	*Ratio Endodontics*	*Ratio Extractions*	*Ratio Periodontics*
	Mean±SD	*Mean±SD*	*Mean±SD*	*Mean±SD*
Education				
Secondary or less (43)	26.4±20.2	8.5± 9.3	13.5±22.3	4.9±9.4
Trades education (46)	22.0±16.9	11.1±15.0	11.1±15.0	13.4±17.3
University/college (48)	14.1±11.2	9.7±14.9	9.7±14.9	7.5±13.2
Significance ^	P< 0.001	P=0.114	P=0.002	P=0.037
Occupation				
Not working (46)	24.8±19.5	13.9±21.7	11.7±19.5	7.8±14.9
In school (16)	15.4±12.1	3.9±3.2	0.7±1.4	2.5±6.7
Working (98)	19.0±16.2	8.7±8.0	6.9±12.3	9.5±14.1
Significance ^	P= 0.077	P=0.004	P=0.001	P=0.034
Household income				
Lowest (48)	28.3±20.2	13.4±21.4	12.1±21.5	4.9±10.3
Medium (44)	20.3±15.4	8.6±6.3	7.6±12.2	8.8±14.6
Highest (66)	14.7±13.2	8.1±8.4	4.5±7.5	8.3±15.5
Significance #	P<0.001	P=0.088	P=0.023	P=0.051

Independent sample t test/Mann Whitney test; ^ ANOVA & Post Hoc Bonferroni adjustment/Kruskal Wallis test

Table 10 presents results of associations between different aspects of dental care seeking behaviours and specific dental treatment needs. Patients with irregular dental visits and those who sought professional dental care mainly due to pain had significantly higher levels of need for restorations, extractions and periodontal treatments as compared to patients who visited their dentists on a regular basis. Similarly, patients who chose to use services of emergency departments for their dental problems needed more restorations and periodontal treatments as compared to patients who accessed public or private clinics. There was no consistent pattern related to the costs of primary dental care.

Table 10. Dental care seeking behaviours and specific dental treatment needs of patients with acute odontogenic infections

Dental Care (N)	*Ratio Restorative*	*Ratio Endodontics*	*Ratio Extractions*	*Ratio Periodontics*
	Mean±SD	*Mean±SD*	*Mean±SD*	*Mean±SD*
Regularity of dental visits				
Every year (44)	12.7±12.9	8.2±11.7	2.4±4.5	6.7±13.4
Not every year (48)	17.2±15.4	12.2±19.8	7.8±20.1	4.3±9.3
Pain/problem (68)	27.5±17.9	8.9±7.9	11.0±13.1	12.2±16.0
Significance ^	P< 0.001	P=0.158	P=0.009	P=0.014
Accessing dental care				
Public clinic (98)	23.1±16.9	10.1±15.7	9.3±17.1	6.5±11.4
Private clinic (24)	10.2± 9.3	8.9±12.2	4.6±8.9	9.7±11.8
Emergency clinics (38)	19.7±19.0	9.2±6.4	5.5±8.1	12.3±19.3
Significance ^	P=0.001	P=0.124	P=0.146	P=0.043
Costs of primary urgent care				
None (105)	20.6±17.1	9.5±11.9	8.7±16.7	11.3±15.9
Minimal (28)	16.2±13.1	12.7±21.6	5.8±8.9	3.7±6.9
Moderate (27)	23.0±20.3	7.7±7.2	5.5±8.6	1.7±4.1
Significance ^	P=0.003	P=0.603	P=0.205	P=0.010
Waiting with symptoms until seeking care for acute odontogenic infections				
1-3 days (78)	18.3±15.7	11.2±16.8	7.8±14.7	9.4±13.8
> 3 days (82)	22.3±18.1	8.3±9.1	7.5±14.4	7.3±13.9
Significance #	P=0.124	P=0.181	P=0.894	P=0.235
Reasons for delayed care of acute odontogenic infections				
Accessed care (62)	16.7 ±14.2	9.3±10.0	6.5±13.9	5.8±10.4
Waited for symptoms to disappear (98)	22.6±18.4	10.0±14.9	8.5±14.9	9.9±15.6
Significance #	P=0.024	P=0.758	P=0.394	P=0.048
Self-treatments of oral pain				
No (94)	21.3±18.7	8.2±11.6	8.2±16.7	6.4±13.0
Rinses/compresses (66)	19.0±14.4	11.9±15.7	6.9±10.6	11.1±14.8
Significance #	P=0.383	P=0.074	P=0.563	P=0.010
Self-medication for acute odontogenic infections				
None (42)	22.3±19.7	10.5±15.7	5.2±7.4	11.0±16.1
Analgesics (66)	18.6±16.5	9.4±13.2	6.3±10.8	8.1±14.5
Analgesics & antibiotics (52)	21.0±15.6	9.5±12.0	11.5±21.0	6.5±10.7
Significance ^	P=0.528	P=0.907	P=0.063	P=0.292

Independent sample t test/Mann Whitney test; ^ ANOVA & Post Hoc Bonferroni adjustment/Kruskal Wallis test

Table 11 presents associations between systemic conditions, lifestyle and dental treatment needs of patients with acute odontogenic infections More than half of this cohort of patients tended to wait more than three days before they sought professional help but there were no statistically significant differences in specific dental treatment needs between patients who waited longer than three days and those who waited three days or less. Of all patients with AOMIs, 61.3% expected symptoms to disappear and a substantial proportion of them (41.3%) decided to self-treat their acute odontogenic infections with rinses or cold/heat compresses (26.6%), analgesics or antibiotics (73.8%). Specific dental treatment needs did not differ significantly between the patients who self-treated or self-medicated themselves for their acute odontogenic infections as compared to those who did not.

Table 11. Presence of systemic conditions, lifestyle & dental treatment needs of patients with acute odontogenic infections

Variables (N)	*Ratio Restorative*	*Ratio Endodontics*	*Ratio Extractions*	*Ratio Periodontics*	*Ratio Function*
	Mean±SD	*Mean±SD*	*Mean±SD*	*Mean±SD*	*Mean±SD*
Systemic diseases					
No (129)	21.2±17.6	8.1±7.6	6.1±9.7	8.6±7.1	34.0±17.3
Yes (31)	16.5±14.5	16.3±25.7	14.3±25.7	7.1±13.3	25.8±14.4
Significance ^	P=0.125	P=0.002	P=0.005	P=0.588	P=0.017
Severity of acute odontogenic infection					
Not extended (124)	19.3±16.1	9.9±14.0	7.7±15.4	10.3±15.0	33.8±17.7
Advanced (36)	23.8±20.0	9.2±11.7	7.7±11.2	1.7±5.6	27.6±13.9
Significance #	P=0.162	P=0.758	P=0.997	P=0.001	P=0.030
Smoking					
No (86)	17.2±16.7	10.8±16.9	6.5±13.6	6.7±11.9	35.6±18.2
Yes (74)	24.0±16.8	8.5±7.9	9.1±15.4	10.3±15.7	28.6±14.8
Significance #	P=0.012	P=0.277	P=0.043	P=0.099	P=0.008
Oral self-care					
Not daily (88)	29.0±21.2	11.0±14.7	15.4±22.0	8.4±16.4	21.5±14.1
Daily (121)	16.2±13.3	8.4±12.3	3.8±6.5	8.1±12.9	37.5±16.1
Significance #	P<0.001	P=0.073	P=0.001	P=0.437	P<0.001

Independent sample t test; ^ ANOVA with Post Hoc Bonferroni adjustment

There were some significant differences between patients with systemic co-morbidities and those without regarding the need for endodontic treatments and the need for extractions. Patients with systemic diseases retained less of their functional dentitions as compared to patients without systemic diseases.

No consistent pattern or significant associations were found regarding relationships between the severity of the current odontogenic infection and specific dental treatment needs. Smokers needed significantly more restorations, more extractions and non-significantly more periodontal treatments as compared to non-smokers. Those with a daily oral self-care routine needed significantly less restorations, endodontic treatments and extractions, but there was no significant difference in regards to need of periodontal treatments.

Table 12 presents results of multivariate testing where the two outcomes were the ratio of total dental treatment needs and the ratio of remaining functional dentition. In linear multiple regression models, a stepwise selection was used to enter explanatory variables from the following domains: 1) socio-demographic characteristics, 2) health care seeking behaviours, 3) systemic conditions and 4) lifestyle.

Both linear multiple regression models were highly statistically significant ($P<0.001$). In the LMR model for the ratio of total dental treatment needs, 66.9% of variance (R square) in the total treatment needs was explained and e significant determinants of higher total treatment needs were: a lower household income (0.332, $P<0.001$), male gender (0.262, $P<0.001$), dental visit due to a dental pain or problem (0.237, $P=0.001$), presence of systemic conditions (0.217, $P=0.001$) and lower education (0.146, $P=0.033$) (table 12).

In the LMR model for the ratio of the remaining functional dentition, the most significant explanatory variables were: daily oral self-care (0.328, $P<0.001$), regular dental visits (0.269, $P<0.001$), seeking dental care while the odontogenic infection was less advanced (0.178, $P=0.010$), not having co-existing systemic conditions (0.251, $P<0.001$), being female and not self-treating for acute odontogenic infections (0.191, $P=0.006$).

Table 12. Multivariate analysis of explanatory factors related to total treatment needs and functional dentitions in patients with acute odontogenic infections [#]

Model Summary: Outcome: Ratio of total dental treatment needs. Selection: Stepwise. P<0.001, R Square=0.669			
Explanatory factors	***β coefficient***	***P values***	***Tolerance***
Household income	0.332	<0.001	0.721
Gender	0.262	<0.001	0.875
Dental visit frequency	-0.237	0.001	0.798
Systemic conditions	-0.217	0.001	0.920
Education	0.146	0.033	0.825
Model Summary: Outcome: Ratio of functional dentition. Selection: Stepwise. P<0.001, Adjusted R Square=0.624.			
Explanatory factors	***β coefficient***	***P values***	***Tolerance***
Oral self-care	-0.328	<0.001	0.750
Dental visit frequency	0.269	<0.001	0.833
Severity of odontogenic infection	-0.178	0.010	0.922
Systemic conditions	0.251	<0.001	0.947
Gender	-0.219	0.002	0.873
Self-treatment	0.191	0.006	0.891

[#] Linear Multiple Regression

4. DISCUSSION

The present research included three studies. Two national retrospective studies examined the country's distribution of treatment facilities and urgent care provision for patients with acute odontogenic maxillofacial infections (AOMIs), explored time trends of incidence of these infections within the period 2009-2013 and related such infections with several potential group-based risk determinants. The third clinical prospective study examined different individual AOMI-related determinants (social, clinical and access to primary dental care) and associated them with a varying length of hospitalization.

In Lithuania, the most severe acute odontogenic infections are determined as acute life-threatening conditions requiring urgent medical care (Health Ministry of Lithuania 2004). Despite relatively easy access

to primary medical care for patients with acute odontogenic maxillofacial infections, the prevalence of these infections remained almost unchanged during the 10-year follow-up period. The present research found that a substantial proportion of Lithuanians tended to delay regular appointments and prophylactic visits, as well as ignored dental pain by not seeking timely professional medical help even when serious complications occurred. An important consideration is that due to delayed appointments, specialised dental care for patiens with acute odontogenic maxillofacial infections was provided too late and consequently led to serious health complications and longer hospitalization, which added to overall treatment costs.

Many dental clinics provide primary care for such patients and the number of such treatment facilities has grown in the last five years. A limitation of the National Health Insurance Fund (NHCIF) data is that it does not contain individual data about the type of treatments provided for patients with AOMI's who were treated in small treatment facilities. Consequently, we did not know what type of treatment modality was used, i..e whether a surgical intervention was done or only drug prescription or a referral to a bigger treatment facility was offered to patients. One may question if the NHCIF resourses are used efficiently when resources are distributed accross multiple treatment sites. To answer this question, new research is needed focusing on the cost-effectiveness of the two-tier model for treatment of acute odontogenic maxilofacial infections.

Another important finding of the present study was that seemingly there is no standardized protocol for treating acute odontogenic maxillofacial infections in Lithuanian facilities. This may lead to varying treatment modalities accross the country that may contribute to additional risks inherent in delayed treatments of potentially life treatening oral infections.

The present study evaluated the Primary Care Model, where urgent care for patients with acute maxillofacial infections was delivered both locally and centrally possible due to contracting with dentists or dental specialists practicing in multiple country's locations. Due to these contracts between the Lithuanian National Health Care Insurance Fund (NHIF –a

governmental institution) and practicing dentists, Lithuanian patients with acute conditions were able to receive treatments for their urgent dental conditions in the treatment facility of their choice and in the vicinity of their homes. The Lithuanian care model, comprising both free and partially subsidized medical urgent care, warrants that all patients including the uninsured (not working) have access to timely medical care for their urgent dental conditions. Considering this infrastructure of the primary care model for the provision of urgent care, we did not expect to find substantial regional differences in the incidence of acute odontogenic infections.

During the observation period, four types of treatment facilities, namely private dental clinics located throughout the country, central polyclinics established in the big cities, regional hospitals operating in the big cities and local public clinics located in both urban and rural areas treated patients with acute odontogenic infections (AOMIs).

From the population health perspective, an incidence of acute odontogenic infections amounting to around 1% of the total population needs attention. Unfortunately, due to the limited evidence available from heterogeneous studies, direct comparisons of the incidence rates or time trends of Lithuania to those of other countries was not feasible. The recent review (22) reported that it is difficult to predict the spread of an odontogenic infection. Consequently, timely professional care of patient with odontogenic infections is of importance. Access to professional urgent care should not be difficult for Lithuanians with acute maxillofacial infections as multiple treatment facilities in multiple locations throughout the county provide urgent care. Thus, professional dental care can be accessed in a timely manner as there is a wide distribution of dental treatment facilities providing such care.

Timely management of acute odontogenic infections is necessary not only to avoid complications but also to minimize potential for co-morbidities (23). The Lithuanian Health Care System infrastructure allows patients with acute odontogenic infections to seek timely professional help; this has several benefits: a reduction in the overall costs related to

treatment of acute infections or their complications (economical benefit), a decrease in overall morbidity (population gains) and an improvement in each patient's well-being and quality of life (individual gains).

Severe odontogenic infections constituted a substantial proportion of maxillofacial surgeons' everyday work and it is important to consider that these infections can be lifethreatening if not treated timely and adequately (5,8,22,24).

After treatments are completed, all related documentation is archived centrally. This centrally accumulated information allows for the study of time trends in disease incidence as well as examination of risk factors and different aspects of disease management. Our retrospective audit analysis showed similar incidences of odontogenic infections throughout a 10-year follow-up period. In the present study, the main complications of maxillofacial infections were: mediastinitis, airway obstruction, necrotizing fasciitis and bleeding with an overall complication ratio relatively low (1.8%). It is important to consider that odontogenic infection-related complications vary among countries and range from 1.4% to 46.3% (25–28). It has been emphasized that early surgical drainage and adequate antimicrobial treatment remain the most effective treatment for acute maxillofacial infections (29). The relatively low complication rate in Lithuania may be explained by timely professional care, where surgical procedures were performed within the first six hours after hospital admittance. Early diagnosis and timely referral to maxillofacial surgeons can save patients' lives but only 15.0% of patient's first appointment was during first 48 hours after start of the symptoms. The substantial proportion of patients with AOMIs delayed medical visits and the mean waiting time prior to seeking professional help was 5.5 days. About 40.0% of our patients self-treated with mouth rinses and painkillers instead of seeking timely professional help. Delayed appointments, neglected dental pain in patients with maxillofacial infections and their self-treatments such as mouth rinses, heated compresses, non-prescription drugs such as herbal medicaments and painkillers are well-known concerns (22,27,30,31).

According to the findings of the present study, delayed appointments were associated with more serious infections, longer hospital stays and a need to change antibacterial treatment, all associated with higher treatment costs.

Prior to the interpretation of microbiological results we need to consider that microbiological tests identify only the most aggressive and abundant microorganisms. Our microbiological results identified a total of 62 different microorganism species with *Streptococci* α *haemolitic* and *Streptococci γ non haemolitic* being the most predominant bacteria and *Bacteroides* and *Prevottela* being rather common microorganisms responsible for odontogenic infections. The *Streptococci* and obligate anaerobes were predominant microorganisms in the present study while a previous report listed *Enterococcus faecalis* as a dominant microorganism in similar infections (32).

The microbiological findings of the present study are in accordance to previous reports stating that there is no consensus or standardization about antibacterial treatments of odontogenic infections as evidenced by variations in antibiotic prescription reported elsewhere (23,26,33–35). The present study found that penicillin alone or in combination with gentamycin were chosen for treating severe odontogenic single-space infections, while second generation antibiotics such as cephalosporins or penicillin in combination with gentamicin were used for treating multi-space infections. Though other studies recommended metronidasol as an additional antibiotic for treatment of anaerobic odontogenic infections (4,22), the present study's microbial susceptibility analysis showed the high levels of resistance of *Streptococci* α *haemolitic* (26.9%) and *Bacteroides* (35.6%) to metronidasol.

The trend of increasing microorganism resistance to simple antibiotics e.g. penicillin has been reported in other studies (7,22,36). Nevertheless, we recommend choosing penicillin for treating maxillofacial infections given that resistance to penicillin does not seem to be a current problem in Lithuania.

The third part of the study focused on several oral health or disease related outcomes in a cohort of adult patients with acute odontogenic infections. An important consideration is that such Lithuanian patients

retained only around one third of their functional dentitions. The extent of total dental treatment needs in this cohort of patients was substantial with almost half of their remaining dentitions in need of dental treatments, with the highest need being for restorative dental treatments (~20%) and substantially lower treatment needs for extractions, endodontic or periodontal treatments (~7-10%). These findings lead one to question why these patients did not seek regular dental care but allowed their oral health to deteriorate to the level of advanced dental disease.

Lithuania has a mixed dental care model. Some dental care is provided in private practices based on a business model (fee-for-service) and some is provided in public clinics (partly subsidized treatments) or in hospitals (free treatments); both of the latter are governed by the principles of public health care. The cost differential between dental treatments provided in private clinics as compared to similar treatments provided in public clinics is substantial, e.g. a simple extraction in public clinics costs around 1/10 of the price paid in private clinics and the cost of restorative treatments in public clinics costs around 1/2 of the price paid in private clinics.

One of the possible explanations for the high overall treatment needs in Lithuanian patients with acute odontogenic infections may be that these patients can`t afford regular dental care in private dental clinics and their access to public clinics is limited as there are fewer public clinics than private ones. In addition, public clinics are mainly located in regional centers, while private practices can be found in multiple urban and rural locations. Consequently, for patients with limited resources, public clinics are more affordable but they also may be more distant and thus require additional time and financial resources. Our findings at least partly support this explanation as we observed that patients living in more distant areas had higher levels of dental treatment needs.

Some level of social deprivation was evidenced by both the extent of dental treatment needs and less retention of functional dentition. Patients with acute odontogenic infections residing in more distant locations, from households with lower incomes, less educated and not currently working or being unable to work (jobless, disabled) had higher levels of treatment

needs as compared to patients with a higher socio-economic status and living closer to a capital city. Concomitantly, we could also see that inadequate health care seeking behaviors contributed to a patient's worse oral health status, and consequently a higher need for dental treatments. Seemingly, both individual behaviors and limited access to affordable dental care for this vulnerable segment of population play a role in the development of substantial dental treatment needs and loss of functional dentitions. It is important to consider that only a small proportion of the Lithuanian population has dental insurance. Most importantly, those few with dental insurance have relatively well-paid jobs as compared to the rest of Lithuanians. Therefore, patients with high levels of unmet dental treatment needs and without dental insurance should be considered a vulnerable population group. Therefore, these patients need special attention from both health professionals and policy makers.

We can expect that higher level of dental treatment needs is a complex phenomenon where social factors (social deprivation) and individual factors (individual deprivation) may interact. Health policies focusing on lowering dental care costs will make regular health care more accessible for all population groups (37). Oral health promotion particularly in more remote areas focusing on vulnerable population groups will help to increase awareness of the importance of oral health and facilitate behavior changes.

After the evaluation of different treatment modalities of acute odontogenic maxillofacial infections, the standardized guidelines for the rational antibiotic terapy were proposed and the manual for for dentists regarding the treatment of odontogenic infections was developed. In addition, the recommendation to optimize specialised care of acute odontogenic maxillofacial infections was submitted to the Lithuanian Health Care Ministry. The study findings could also be useful for the reorganisation of odontogenic maxillofacial infection treatment strategies in Lithuania, that could rationalise the utilisation of NHCI fund resourses potentially in a more effecient way. The study could also be useful when drafting normative documentation, planing prophylactic dental

programms focusing on vulnerable population groups, particularly in more remote areas. These approaches may help to increase awareness of the importance of oral health and subsequently may facilitate behavioral changes, consequently may help to reduce the overall incidence of acute odontogenic maxillofacial infections in Lithuania.

5. CONCLUSIONS:

1. Annual incidences ~1% of acute odontogenic maxillofacial infections in Lithuania were found but no consistent time trend of an increase or decrease of these infections could be observed.
2. There was a trend of higher statistically significant incidence rates of acute odontogenic maxillofacial infections in areas where there were lowest numbers of practicing specialists (dentists and oral and maxillofacial surgeons).
3. Older age, systemic diseases, neglect of oral health, presence of dental pain and self-treatment were the main determinants significantly associated with a longer hospital stay.
4. In adult Lithuanian patients with acute odontogenic infections, only around one third of these patients' remaining dentitions were functional. The total dental treatment needs in these patients was also high with around half of their dentitions being in need of dental treatments with the highest need being for restorative treatments. Differences in socio-demographic characteristics, irregular or delayed dental care seeking behaviors, the presence of systemic diseases and an unhealthy lifestyle associated significantly with higher levels of specific and total dental treatment needs.
5. The most frequent microorganisms in acute odontogenic maxillofacial infections were: *Streptococci α Hemolytic* which were sensitive to penicillin, cephalosporin and clindamycin. Penicillin was a drug of first choice for treatment of odontogenic maxillofacial infections.

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8. POSTER PRESENTATIONS

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6. Rastenienė R, Pūrienė A. Self-reported behavior in patients with acute dental pain. 19th congress of European Association of dental public health, 2014, Goteborg, Sweden.

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CURRICULUM VITAE

Rūta Rastenienė was born on 18th of April 1981 in Vilnius.

Educational background:

- Užupis gymnasium (1987-1999).
- Institute of Odontology, Faculty of medicine, University of Vilnius, Lithuania (1999-2004); Diploma – Medical doctor in dentistry.
- Institute of Odontology, Faculty of medicine, University of Vilnius Lithuania postgraduate study (2004-2005); Certificate – Dentist general practioner.
- Institute of Odontology, Faculty of medicine, University of Vilnius, Lithuania secondary postgraduate study (2005-2008); Certificate-specialist in Oral Surgery.

Current position:

- Since 2006 works as assistant in Institute of Odontology, Faculty of Medicine, University of Vilnius, (field Oral Surgery).
- Since 2008 works as oral surgeon in Hospital of Vilnius University Žalgirio Clinic.

SANTRAUKA

Ūminės odontogeninės pūlingos veido ir žandikaulių sričių infekcijos – tai ligos, atsirandančios kaip negydyto dantų ėduonies, endodontinės patologijos, dantų traumų, periodonto patologijos, nepavykusio endodontonio ar chirurginio gydymo komplikacijos (6). Ankstyvuoju ligos vystymosi laikotarpiu, kai uždegimo procesas yra po antkauliu ar danties šaknies viršūnės projekcijoje, jei į gydytojus kreipiamasi laiku, komplikacijų tikimybė nedidelė, tačiau, laiku nesuteikus reikiamos pagalbos, uždegimas greitai progresuoja, plinta į gretimas anatomines struktūras: iltinę duobę, smilkininį, žando, pasmakrinį, pažandinį ar paliežuvinį tarpus, o vėliau ir į giliuosius anatominius tarpus (7–9) – vystosi minkštųjų audinių pūlynai, kurie vėliau gali komplikuotis sepsiu, akytojo ančio tromboze, smegenų pūliniu, nekroziniu fascitu, mediastinitu, Liudviko angina ar net tapti paciento mirties priežastimi (10–12).

Sėkmingą veido ir kaklo sričių pūlynų gydymą lemia: laiku nustatyta tiksli diagnozė, suteikta skubi medicinos pagalba – visavertis pūlyno drenažas, tinkamas empirinio antibakterinio gydymo parinkimas. Gerą gydymo rezultatą užtikrina laiko veiksnys – kaip greitai nuo susirgimo pradžios pradedamas profesionalus chirurginis gydymas (17,18). Svarbi ir iš karto tinkamai parinkta antibiotikų terapija, nes mikroorganizmų virulentiškumas, patogeniškumas bei atsparumas antibakteriniams vaistams daro įtaką ligos eigai ir lemia gydymo prognozę (19,20). Lietuvos ir daugelio kitų pasaulio šalių gydytojai odontologai antibakterinius preparatus dažniausiai skiria empiriškai, atsižvelgdami į labiausiai tikėtinus sukėlėjus bei remdamiesi klinikine patirtimi, tačiau ne visuomet šis pasirinkimas būna teisingas (21–23).

Pradinėse odontogeninių ligų stadijose, kol infekcija neišplitusi iš žandikaulių, dažniausiai pirminė odontologinė pagalba suteikiama pirminės sveikatos priežiūros įstaigoje, kurioje pacientas yra prisiregistravęs. Kai ji suteikiama laiku ir kokybiškai, užkertamas kelias infekcijai plisti ir galimoms komplikacijoms išsivystyti (24). Išplitusios pūlingos infekcijos – pū-

lyno – gydymui reikalinga specializuota burnos ir (ar) veido, žandikaulių chirurgų pagalba stacionare (25). Po stacionarinio gydymo pacientų priežiūra vėl turėtų rūpintis pirminės sveikatos priežiūros įstaigose dirbantys odontologai. Nuo to, kaip darniai dirba visos pagalbos grandys – ar tinkama visų lygių skubi medicinos pagalba – priklauso pūlynų gydymo trukmė ir baigtys, todėl paslaugų prieinamumo klausimai tampa ypač svarbūs gydant šią greitai plintančią, dažnai grėsmingą paciento gyvybei patologiją.

Darbo tikslas ir uždaviniai

Darbo tikslas – išanalizuoti ūminius odontogeninius veido, žandikaulių ir kaklo pūlynus įtakojančius veiksnius ir šių susirgimų gydymą Lietuvoje.

Darbo uždaviniai

1. Įvertinti ūminių odontogeninių veido, žandikaulių ir kaklo sričių ligų gydymo mastus Lietuvoje, pasitelkiant Valstybinės ligonių kasos informacinę sistemą.
2. Įvertinti Lietuvos apskričių odontologinės sveikatos priežiūros paslaugų prieinamumo, socialinio ekonominio indekso ir gyventojų sergamumo bendromis ligomis sąsajas su ikistacionarinės ir stacionarinės medicinos pagalbos apimtimis.
3. Išanalizuoti socialinius demografinius, ekonominius, elgesio bei klinikinius pacientų, gydytų nuo ūminių odontogeninių veido ir kaklo srities pūlynų, duomenis ir jų įtaką stacionarinio gydymo laikui.
4. Įvertinti pacientų, sergančių ūminiais odontogeniniais veido ir kaklo sričių pūlynais, burnos sveikatą.
5. Nustatyti ūminių odontogeninių veido ir kaklo sričių pūlynų sukėlėjus ir jų jautrumą antibakteriniams preparatams.

Šiame darbe išanalizuoti ir susisteminti duomenys apie ūminius pūlingus odontogeninius veido ir kaklo sričių uždegimus. Ūminės veido ir kaklo sričių uždegiminės ligos išanalizuotos ir įvertintos trimis lygmenimis:

I. Nacionalinis lygmuo – ūminių veido ir kaklo uždegiminių ligų penkerių metų gydymo apimčių analizė remiantis VLK duomenimis. Nustatyti veiksniai, galėję turėti įtakos suteiktų medicinos paslaugų kiekiui

skirtingose Lietuvos apskrityse. Duomenų analizei atlikti sukurti specialūs niekur anksčiau nenaudoti indeksai. Įvertintas ūminių uždegiminių odontogeninių veido ir žandikaulių ligų dažnumas Lietuvoje.

II. Odontologinės sveikatos priežiūros įstaigos lygmuo – atlikta Vilniaus universiteto ligoninės Žalgirio klinikoje gydytų pacientų ligos istorijų retrospektyvioji 10 metų analizė. Išnagrinėti odontogeniniai veido ir žandikaulių bei kaklo pūlynai, ligos sunkumas, stacionare taikytas gydymas, retrospektyviai įvertintas mikroorganizmų jautrumas dažniausiai VUL Žalgirio klinikoje skiriamiems antibakteriniams preparatams. Įvertinti paciento socialiniai demografiniai bei klinikiniai duomenys, galėję įtakoti šių susirgimų gydymo trukmę bei komplikacijas.

III. Individualus lygmuo – perspektyvusis anketinis ir klinikinis pacientų, sergančių ūminiais odontogeniniais veido ir kaklo sričių pūlynais, ištyrimas. Nustatytos ūminės odontogeninės infekcijos sunkumo, pirminės sveikatos priežiūros prieinamumo, paciento socialinių ekonominių, demografinių veiksnių, asmeninių įpročių bei požiūrio į burnos sveikatos priežiūrą sąsajos su stacionarinio gydymo trukme; įvertinta pacientų burnos sveikata ir odontologinio gydymo poreikis; kliniškai nustatytas dažniausi ūminių odontogeninių veido ir kaklo sričių pūlynų sukėlėjų jautrumas empiriškai skiriamiems antibakteriniams vaistams.

Mūsų tyrimas parodė, kad nors pastarąjį dešimtmetį sveikatos priežiūros prieinamumas gydant ūmines odontogenines veido ir kaklo sričių ligas gerėjo, paslaugas per nagrinėtą laikotarpį teikė 482 gydymo įstaigos sudariusios sutartis su valstibine ligonių kasa, tačiau suteiktų odontologinių paslaugų kiekis bei gydymo stacionare laikas išliko beveik nepakitęs, nes iki šiol didelė Lietuvos gyventojų dalis nesirūpina burnos sveikata, ne tik vengia profilaktiškai lankytis pas gydytojus odontologus, bet laiku neatvyksta gydytis, nekreipia dėmesio į besivystančius uždegimo simptomus net esant sunkiems negalavimams ar sutrikus organų funkcijai. Kiekvienais metais dėl odontogeninės kilmės pūlynų stacionare gydoma virš 1200 darbingo amžiaus pacientų (metų vidurkis 37,0±16,9), kurie vidutiniškai ligoninėje praleidžia 8,7±5,5 dienos. Dažniausia pūlynų priežastis buvo

krūminiai apatinio žandikaulio dantys – 851 pacientams (79,0 proc. atvejų), iš jų 189 pacientams (17,5 proc. atvejų) – antrasis apatinio žandikaulio krūminis dantis. Vienas dantis kaip infekcijos priežastis identifikuotas 797 pacientams (74,0 proc. atvejų). Nustatyta, kad statistiškai patikimai ilgesnį stacionarinio gydymo laiką (>nei 7 dienas) įtakojo: infekcijos sunkumo kriterijai (keli priežastiniai dantys ir uždegimas išplitęs į dvi ar daugiau anatomines sritis), empiriniam gydymui paskirtas ne penicilino grupės antibiotikas ar antibiotikų deriniai, empirinio gydymo pakeitimas po mikrobiologinio tyrimo atsakymo. Didelė dalis susirgusiųjų ūminiais odontogeniniais veido ir kaklo sričių pūlynais (52,3 proc.) nurodė, kad į dantų gydytoją kreipiasi tik atsiradus skausmui, ir tik 6,2 proc. pažymėjo, kad į dantų gydytoją kreipiasi reguliariai du kartus per metus. Dėl uždelsto pacientų kreipimosi neretai specializuota medicinos pagalba suteikiama pavėluotai. Paaiškėjo, kad ūminiais odontogeniniais veido ir kaklo sričių pūlynais sergančių tyrimo dalyvių burnose yra likę vidutiniškai tik ~1/3 funkcionuojančių dantų. Bendra tokių pacientų burnos sveikata yra nepatenkinama, o dantų gydymo poreikiai dideli.

Išvados

1. Lietuvoje ūminių, skubios pagalbos reikalaujančių odontogeninių veido ir kaklo sričių ligų gydymo paslaugos kasmet suteikiamos apie 1 proc. gyventojų.
2. Apskrityse, turinčiose mažiau gydytojų odontologų ir gydytojų odontologų specialistų, yra daugiau pacientų, sergančių ūminiais veido ir kaklo sričių pūlynais ($P<0,001$). Daugiau medicinos paslaugų ($P<0,001$) suteikiama apskrityse, kurių socialinis ekonominis indeksas (A-SEI) yra aukštas, o apskrityse, kuriose sergamumas bendromis ligomis yra vidutinis, suteikiama statistiškai patikimai mažiau paslaugų dėl ūminių odontogeninių infekcijų, palyginti su apskritimis, kur sergančiųjų bendromis ligomis yra daugiau.
3. Statistiškai patikimai vyresnis amžius, sisteminės ligos, abejingumas savo sveikatai, ligos neigimas bei neefektyvi savigyda buvo pagrindiniai

veiksniai, lėmę ilgesnį pacientų, sergančių odontogeniniais veido ir kaklo sričių pūlynais, gydymo stacionare laiką ($p<0,001$) ir komplikacijų vystymąsi.

4. Lietuvos gyventojų, sergančių ūminiais odontogeniniais veido ir kaklo sričių pūlynais, burnos sveikata yra nepatenkinama, dantų gydymo poreikiai dideli, o asmeninės higienos įpročiai ir profilaktinių apsilankymų pas gydytoją dažnis nepakankami. Vyresnis amžius, vyriškoji lytis, mažesnės gaunamos pajamos ir žemesnio lygio išsilavinimas buvo statistiškai reikšmingai susiję su didesniu prarastų ir gydytinų dantų skaičiumi.
5. Dažniausi odontogeninių veido ir žandikaulių sričių pūlynų sukėlėjai Lietuvoje yra α hemoliziniai streptokokai, jautrūs penicilino, cefalosporinų ir klindamicino grupės antibiotikams. Penicilino grupės preparatai išlieka pirmo pasirinkimo vaistais empiriniam šių infekcijų gydymui.