# GENDER PROFILE OF HEALTHCARE-ASSOCIATED INFECTIONS IN ORAL AND MAXILLOFACIAL SURGERY CLINIC IAȘI (2011-2018)

**Magda Călina Bârlean[1], Monica Mihaela Scutariu[2], Cosmin Ionuț Crețu[3] , Livia Bobu[4] Alexandra-Lorina Platon[5], Andra Tărăboanță-Gamen[6] , Georgiana Macovei[7]**

[1]„Grigore T. Popa" University of Medicine and Pharmacy Iași, Faculty of Dental Medicine, Department of Oro-Dental Diagnosis and Geriatric Dentistry
[2] „Grigore T. Popa" University of Medicine and Pharmacy Iași, Faculty of Dental Medicine, Department of Oro-Dental Diagnosis and Geriatric Dentistry
[3] „Grigore T. Popa" University of Medicine and Pharmacy Iași, Faculty of Dental Medicine, Department of Partially Removable Denture
[4]„Grigore T. Popa" University of Medicine and Pharmacy Iași, Faculty of Dental Medicine, Department of Preventive Dentistry
[5] „Grigore T. Popa" University of Medicine and Pharmacy Iași, Faculty of Dental Medicine, Department of Orthodontics and Dentofacial Orthopaedics
[6] „Grigore T. Popa" University of Medicine and Pharmacy Iași, Faculty of Dental Medicine, Department of Pedodontics
[7] „Grigore T. Popa" University of Medicine and Pharmacy Iasi, Faculty of Dental Medicine, Department of Oro-Dental Diagnosis and Geriatric Dentistry
*Corresponding Authors***:** Monica Mihaela Scutariu – e mail : monascutaru@yahoo.com
Andra Tărăboanță-Gamen - e-mail: andra.gamen@gmail.com

**Abstract**

The **aim** of this study was to evaluate the Healthcare Associated Infections (HAI) profile according to the patient's gender in Oral and Maxillo-Facial Surgery Clinic Iași between 2011 and 2018. **Material and methods**. A retrospective study on HAI between 2011 and 2018 was initiated at the OMF Clinic Iași . SPSS 24 system was used for the statistical analysis of the data.. **Results**. 231 cases of HAI were diagnosed in a total of 154 patients.. The HAI recorded incidence was twice higher in men compared to women (0,99% and 0,49%, respectively). 72,2% of female patients were hospitalised for tumour pathology. Women were mainly exposed to urinary and digestive infections, while in men the most frequent HAI were the surgical site infections, respiratory infections and infections associated with therapeutic manoeuvres. The discharge status was 63,0% healed, 2,3% stationary, 22,5% improved for male patients and 44,8% healed, 34,5% improved for females. 3,5% men and 10,3% women died. Male patients attended Intensive Care Unit in a significantly higher proportion compared to female patients (66,1%, respectively, 41,7%)**.** **Conclusions**. The assessment of the patients' gender as a risk factor for HAI is necessary for this pathology surveillance, control and prevention.

**Key words***:* Healthcare associated infections, gender profile, oral surgery.

## INTRODUCTION

Healthcare Associated Infections (HAI) are a major problem for healthcare systems worldwide. These adverse events, as defined by the Centres for Disease Control and Prevention, include infections that occur 48-72 hours after a patient's admission, within 10 days of discharge, or up to 30 days after surgery.(1)

HAI surveillance is essential in order to evaluate their burden and the needed specific interventions which lead to decrease their incidence.(2,3) The risk factors for HAI, especially based on clinical elements, should be identified in order to establish their predictive values for infection. (4) Among those, patient gender, in a complex interaction with age, type of procedure and medication, is demonstrated to have a major significance for HAI incidence and evolution and for targeting appropriate preventive measures. (5)

## MATERIAL AND METHODS

A retrospective study on Healthcare Associated Infections between 2011 and 2018 was conducted in Oral and Maxillo-Facial Surgery Clinic (OMF) Iași. For all the patients included in the study information was collected regarding age, gender, diagnosis at the time of admission, preclinical examinations and hospitalisation length. HAI were diagnosed according to the criteria of Centres for Disease Control and Prevention in patients who were being monitored by active surveillance methods. The data were obtained by accessing the database of the Surveillance and Prevention of Healthcare-Associated Infections Department Iași (reporting sheets, statistical reports, epidemiological and bacteriological investigations).

Statistical analysis was performed using the SPSS 24 system (SPSS Inc., Chicago, IL, USA). The Chi-square and Fisher tests were used to compare the variables. Statistical significance was set at $p < 0.05$.

## RESULTS

The study database included a number of 21,277 patients hospitalised in the OMF Iași Clinic between 2011-2018. During this period, 231 cases of HAI were diagnosed in a total of 154 patients. Those cases included respiratory tract infections, urinary tract infections, infections associated with therapeutic manoeuvres, surgical site infections, digestive tract and skin infections. (tab.I)

Table I
Types of Healthcare Associated Infections

| HAI type | Absolute frequency | Percentage frequency % |
|---|---|---|
| Septicemia | 5 | 2,2% |
| Digestive tract infections | 13 | 5,6% |
| Respiratory tract infections | 36 | 15,6% |
| Urinary tract infections | 13 | 5,6% |
| Infections associated with therapeutic maneuvers | 33 | 14,3% |
| Skin infections | 4 | 1,7% |
| Surgical site infections | 125 | 54,1% |
| Other | 2 | 0,9% |
| Total | 231 | 100%,0 |

**General incidence and annual distribution of HAI according to patient gender**

Of the 154 total number of patients diagnosed with HAI, 118 (76,6%) were men and 36 (23,4%) were women. The HAI recorded incidence was twice higher in men compared to women (0,99% and 0,49%, respectively). (tab. II)

Table II
HAI incidence by patient gender

| Gender | Absolute frequency | Percentage frequency % | Total number | Incidence |
|---|---|---|---|---|
| Women | 36 | 23,4% | 7290 | 0,49% |
| Men | 118 | 76,6% | 11959 | 0,99% |
| Total | 154 | 100,0% | 19249 | 0,80% |

From the 231 HAI cases 173 (74,9%) were diagnosed in men and 58 (25,1%) in women. The annual frequency of HAI cases by gender ranged from 55,0% in 2017 to 91,7% in 2012 for men and 8,3% in 2012 and 45,0% in 2017 for women. (tab. III)

Table III
The annual frequency of HAI cases according to patients' gender

| Pearson Chi-square = 20.425 | | GENDER | | | | Total | |
|---|---|---|---|---|---|---|---|
| | | men | | women | | | |
| **p = .005, SS** | | n | % | n | % | n | % |
| Year | 2011 | 18 | 78.3% | 5 | 21.7% | 23 | 100.0% |
| | 2012 | 22 | 91.7% | 2 | 8.3% | 24 | 100.0% |
| | 2013 | 23 | 88.5% | 3 | 11.5% | 26 | 100.0% |
| | 2014 | 19 | 79.2% | 5 | 20.8% | 24 | 100.0% |
| | 2015 | 26 | 74.3% | 9 | 25.7% | 35 | 100.0% |
| | 2016 | 30 | 83.3% | 6 | 16.7% | 36 | 100.0% |
| | 2017 | 22 | 55.0% | 18 | 45.0% | 40 | 100.0% |
| | 2018 | 13 | 56.5% | 10 | 43.5% | 23 | 100.0% |
| Total | | 173 | 74.9% | 58 | 25.1% | 231 | 100.0% |

**Frequency of HAI according to patient age and hospital admission diagnosis**

The average age in the total of 231 HAI cases was 59,2 years for men and 55,6 years for women. Data processing according to patients' age and gender revealed that the highest frequency was recorded in the age group of 36 - 65 years both in men (67,1 %) and women (44,8 %). (tab. IV

Table IV
The frequency of HAI according patients age and gender

| Pearson Chi-square = 15.621 | | Age group | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | 18 - 35 years | | 36 - 65 years | | over 65 years | | | |
| **p = .000, SS** | | n | % | n | % | n | % | n | % |
| Gender | Men | 9 | 5.2% | 116 | 67.1% | 48 | 27.7% | 173 | 100.0% |
| | Women | 12 | 20.7% | 26 | 44.8% | 20 | 34.5% | 58 | 100.0% |
| Total | | 21 | 9.1% | 142 | 61.5% | 68 | 29.4% | 231 | 100.0% |

From the total of 154 patients diagnosed with HAI, 123 (79,9%) were hospitalized for tumour pathology, 12 (7,8%) for trauma with different locations, 12 (7,8%) for suppurations and 7 (4,5%) for other conditions. Among the female patients with HAI, 26 (72,2%) were hospitalized for tumour pathology, 5 (13,9%) for suppurations, 2 (5,6%) for trauma, and 3 (8,3%) for other types of pathology. In men, the frequency was 82,2%, 5,9%, 8,5% and 3,4%, respectively.

The frequency of HAI for the patient hospitalized for suppurations was twice higher for women (13,9%) than for men (5,9%). No major differences were recorded regarding tumour and traumatic pathology. (fig.1)


Figure 1. HAI cases according the hospital admission diagnosis

**HAI type according to patient gender**

The most common types of HAI were surgical wound infections (54,11%) and respiratory infections (tracheobronchitis and bronchopneumonia) (15,58%). Other reported HAI were: infections associated with therapeutic manoeuvres (central venous catheter) (14,29%), digestive tract infections (5,63%), urinary tract infections (5,63%), septicaemia (2,16%) and skin infections (1,73%).

Regarding HAI type, women were mainly exposed to urinary and digestive infections, while in men the most frequent HAI were the surgical site infections, respiratory infections and infections associated with therapeutic manoeuvres (central venous catheter). (tab. V)

Table V
HAI type according to patients gender

| HAI Type | Female | | Male | | Total | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Surgical site infection | 22 | 20,7 | 84 | 79,3 | 106 | 100 |
| Respiratory tract infection | 8 | 22,3 | 28 | 77,7 | 36 | 100 |
| Urinary tract infections | 7 | 53,9 | 6 | 46,1 | 13 | 100 |
| Digestive tract infections | 7 | 53,9 | 6 | 46,1 | 13 | 100 |
| Device associated infections (intravenous catheter) | 4 | 12,2 | 29 | 87,8 | 33 | 100 |
| Septicaemia | 2 | 40,0 | 3 | 60,0 | 5 | 100 |
| Cutaneous infections | 0 | 0 | 2 | 100 | 2 | 100 |

Surgical site infections (SSI) were reported in 106 patients representing 66,6% of all patients with HAI. Of those 20,7% were women and 79,3% were men. Among the 106 patients with surgical site infection, 16 women (17,9%) and 73 men (82,1%) were diagnosed with a single infection and 6 women (35,2%) and 11 men (64,7%), had two or more infections. (tab.VI )

Table VI
Number of surgical site infections by gender

| SSI NUMBER | PATIENT GENDER | | TOTAL |
|---|---|---|---|
| | Women | Men | |
| 1 SSI | 16 (17,9%) | 73 (82,1%) | 89 (84,0%) |
| >2 SSI | 6 (35,2%) | 11 (64,7%) | 17 (16,0%) |
| TOTAL | 22 | 84 | 106 |

77,7% of the respiratory tract infections were reported in male and 22,3% in female patients. From the patients diagnosed with urinary tract infections 53,9% were women and 46,1% were men. The same gender distribution was reported for digestive tract infections.

Infections associated with therapeutic manoeuvres (central venous catheter) were registered between 2011 - 2016. Their proportion in the total HAI ranged from 8,3% in 2016 to 30,4% in 2011. From 33 such infections, 29 (87,8%) were reported in males and 4 (12,2%) in females. Severe healthcare-associated infections (septicemia) were reported within three years of the investigated period (2014-2016), with a proportion between 2,8% in 2016 and 8,3% in 2014. 40,0% of such infections were reported in women and 60,0% in men. Skin infections were diagnosed in 2011, 2017 and 2018, with a proportion between 2,5% in 2017 and 8,7% in 2011. All these infections were recorded in male patients.

**Discharge status of the patients diagnosed with HAI according to gender**

From the 154 patients with HAI 58,4% were discharged as healed, 25,5% as improved, 1,7% as stationary. 5,2% HAI patients died and 9,1% were transferred to other clinics.

According to gender, the discharge status was 63,0% healed, 2,3% stationary, 22,5% improved for male patients and 44,8% healed, 34,5% improved for females. 3,5% men and 10,3% women died. (tab. VII)

Table VII
The discharge status of the patients diagnosed with HAI according to gender

| Pearson Chi-pătrat = 10.309, **p = .036, SS** | | Discharge status | | | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved | | Deceased | | Stationary | | Transferred | | Healed | | | |
| | | n | % | n | % | n | % | n | % | n | % | n | % |
| Gender | men | 39 | 22,5% | 6 | 3,5% | 4 | 2,3% | 15 | 8,7% | 109 | 63,0% | 173 | 100,0% |
| | women | 20 | 34,5% | 6 | 10,3% | | | 6 | 10,3% | 26 | 44,8% | 58 | 100,0% |
| Total | | 59 | 25,5% | 12 | 5,2% | 4 | 1,7% | 21 | 9,1% | 135 | 58,4% | 231 | 100,0% |

Male patients attended Intensive Care Units in a significantly higher proportion compared to female patients (66,1%, 41,7%, respectively ) (tab.VIII)

Table VIII
Admission to ICU of the patients with HAI according to gender

| Pearson Chi-pătrat = 6,885 **p = ,009 SS** | Gender | | | | Total | |
|---|---|---|---|---|---|---|
| | Men | | Women | | | |
| | n | % | n | % | n | % |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ICU | No | 40 | 33,9% | 21 | 58,3% | 61 | 39,6% |
| | Yes | 78 | 66,1% | 15 | 41,7% | 93 | 60,4% |
| Total | | 118 | 100,0% | 36 | 100,0% | 154 | 100,0% |

The average period of hospitalization for the patients diagnosed with HAI was of 26,4 days, with no differences according to their gender. (tab. IX**)**

Table IX

Length of hospitalisation for the patients diagnosed with HAI by gender

Mann-Whitney U = 1990,000; p = ,567 NS

| Gender | N | Media | Standard deviation | Standard error | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Women | 36 | 26,08 | 12,616 | 2,103 | 8 | 60 |
| Men | 118 | 26,59 | 9,417 | ,867 | 3 | 59 |
| Total | 154 | 26,47 | 10,211 | ,823 | 3 | 60 |

## DISCUSSIONS

The concern regarding the control of HAI led to the initiation of numerous epidemiological studies at national, European and global level, which provide data on the impact of this pathology. The complex operatory interventions performed in the Oral and Maxillo-Facial Clinic for various pathological conditions, the use of advanced surgical techniques and equipment require sustained efforts to control the transmission of infection for the safety of the medical procedures.

This study aimed to evaluate gender specific differences in the incidence and clinical evolution of HAI contributing to Romania integration into the surveillance and control systems. The analysis of gender differences also allows the evaluation of targeted preventive strategies.

Very few data exist on the impact of gender regarding HAI in oral and maxillofacial surgery. The scientific research worldwide reveals that men are more exposed to infection due to an increased prevalence of a factor such as immune deficiency. (6)

The gender of the patients is considered as a significant risk factor for surgical site infections (SSI) . In our study, of 106 patients diagnosed with SSI a high proportion of 79,3% were men and only 20,7% were women. This finding is consistent with the results reported by Park et al (2016), Al-Qurayshi et al.(2019), Haque et al.(2019) and Shi et al.(2020) (7,8,9,10)

For other surgical specialities the active surveillance revealed an increased rate of surgical site infection for men. Langelotz et al.(2014) (11) concluded that women had a lower rate of SSI in abdominal surgery than men but no gender-specific differences were found in orthopaedic and vascular surgery. Women had a higher risk for SSI in cardiac surgery. Cohen et al. (2013) (12) reported similar trends regarding gender differences for SSI and bloodstream infections.

For urinary tract infections (UTI), gender is generally considered an individual risk factor among hospitalised patients. The urinary tract infections occur in both genders and across all age groups but women, particularly those aged 16–64 years, are significantly more likely to experience such infections than men. (13) Therefore female gender is generally considered an important risk factor along with prolonged catheterization, inadequate catheter insertion and drainage, old age, diabetes mellitus, and the inappropriate systemic antibiotics administration. (Mitchell et al.(2016), Labi et al.(2019), Magliano et al.(2012)). (14,15,16)

Our study results confirm this trend since female patients were mainly exposed to urinary tract infections compared to male patients (53,9% , respectively, 46,1%). Likewise, in his study aimed to examine gender specific differences in the incidence and clinical course of nosocomial infections Griemsmann et al. (2022)(17) reported that cumulative incidence of nosocomial UTI was significantly higher in females than in male patients.

Significant differences were reported in the present study regarding the device associated infections (intravenous catheter) with an incidence of 87,8% in men compared to 12,2% in women. Similar results are reported by Cohen et al (2013) (12) from his investigation on healthcare-associated bloodstream and surgical site infections variations by patient gender. Several studies in the literature identify as a possible reason for gender dissimilarities the biological differences between men's and women's skin regarding the bacterial colonization of the skin surrounding a central venous catheter at the insertion site.

The outcome of HAI management is affected by many factors from which gender is one of the most important. In our study the serious evolution of the HAI cases

In OMF Clinic Iași the respiratory tract infections were reported in a much higher proportion in men (77,7%) compared to 22,3% for women. Those results support the data from the study developed by Rosenthal et al. (2020) (18) which identified an association between male gender and nosocomial pneumonia (VAP). Same data were reported by Walter et al. (2018)(19 ) in an analysis of data from a point prevalence survey hospitals in European Union.

required patients' attendance in the Intensive Care Unit (ICU) for a much higher proportion of men compared to women (66,1% and 33,9%, respectively).

However, female gender proved to be an independent predictor of increased mortality in surgical patients as the rate of mortality was three times higher for female patients. (10,3%) compared to 3,5% for male patients. Our results confirm the conclusions of an extended prospective study carried out by Rosenthal et al.(2022)(20) in Asia, Eastern Europe, Latin America, and the Middle East, according to which the ICU mortality rates is higher for female patients. These results will prove to be of the utmost significance also in the approach of complex maxillary and mandibular restaurations. (21)

## CONCLUSIONS

Evaluating the individual characteristics as risks for healthcare-associated infections lead to a decrease of the infection rates.Women were mainly exposed to urinary and digestive infections, while in men the most frequent HAI were the surgical site infections, respiratory infections and infections associated with therapeutic manoeuvres (central venous catheter) Gender significance was demonstrated in a complex relation with the immunologic response and should target to specific prevention measures for each gender.

## REFERENCES

1. Horan T.C., Andrus M. Dudeck M.A., CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting Atlanta, Georgia 2012. http://apicintermountain.webs.com/CDC-HAIDefinitions.pdf
2. European Union (2018), "Healthcare-associated infections", in Health at a Glance: Europe 2018: State of Health in the EU Cycle, OECD Publishing, Paris/European Union, Brussels. https://doi.org/10.1787/health_glance_eur-2018-45-en

3. Suetens Carl, Latour Katrien, Kärki Tommi et al. The Healthcare-Associated Infections Prevalence Study Group. Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: results from two European point prevalence surveys, 2016 to 2017. Euro Surveill. 2018; 23(46). https://doi.org/10.2807/15607917.ES.2018.23.46.1800516
4. Mehta Y, Gupta A, Todi S, et al. Guidelines for prevention of hospital acquired infections. Indian J Crit Care Med. 2014;18(3):149–163.
5. WHO Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level.2016 ISBN 978-92-4-154992-9. https://www.who.int/gpsc/ipc-components-guidelines/en/
6. McClelland EE, Smith JM. Gender specific differences in the immune response to infection. Arch Immunol Ther Exp. 2011;59:203–213.
7. Park SY, Kim MS, Eom JS, Lee JS, Rho YS. Risk factors and aetiology of surgical site infection after radical neck dissection in patients with head and neck cancer. Korean J Intern Med. 2016;31(1):162–169.
8. Al-Qurayshi Z, Walsh J, Owen S, Kandil E. Surgical Site Infection in Head and Neck Surgery: A National Perspective. Otolaryngology–Head and Neck Surgery. 2019;161(1):52-62. doi:.
9. Haque M, McKimm J, Godman B, et al. Initiatives to reduce postoperative surgical site infections of the head and neck cancer surgery with a special emphasis on developing countries. Expert Rev Anticancer Ther 2019; 19: 81–92.
10. Shi M, Han Z, Qin L, Su M, Liu Y, Li M, Cheng L, Huang X, Sun Z. Risk factors for surgical site infection after major oral oncological surgery: the experience of a tertiary referral hospital in China. J Int Med Res. 2020;48(8): https://doi.org/10.1177/0300060520944072
11. Langelotz C, Mueller-Rau C, Terziyski S, Rau B, Krannich A, Gastmeier P, Geffers C. Gender-Specific Differences in Surgical Site Infections: An Analysis of 438,050 Surgical Procedures from the German National Nosocomial Infections Surveillance System. Viszeralmedizin. 2014 ;30(2):114-7. doi: 10.1159/000362100.
12. Cohen B, Choi YJ, Hyman S, Furuya EY, Neidell M, Larson E. Gender differences in risk of bloodstream and surgical site infections. J Gen Intern Med. 2013;28(10):1318-25. doi: 10.1007/s11606-013-2421-5.
13. Tedja R., Wentink J. , O'Horo J., Thompson R., Sampathkumar P. Catheter-Associated Urinary Tract Infections in Intensive Care Unit Patients. Infection Control & Hospital Epidemiology 2015; 36(11):1330–1334.
14. Mitchell BG, Ferguson JK, Anderson M, Sear J, Barnett A. Length of stay and mortality associated with healthcare-associated urinary tract infections: a multi-state model. J Hosp Infect. 2016;93(1):92–99.
15. Labi AK, Obeng-Nkrumah N, Owusu E, Bjerrum S, Bediako-Bowan A, Sunkwa-Mills G, Akufo C, Fenny AP, Opintan JA, Enweronu-Laryea C, Debrah S, Damale N, Bannerman C, Newman MJ. Multi-centre point-prevalence survey of hospital-acquired infections in Ghana. J Hosp Infect. 2019;101(1):60-68. doi: 10.1016/j.jhin.2018.04.019.
16. Magliano E, Grazioli V, Deflorio L, Leuci AI, Mattina R, Romano P, Cocuzza CE. Gender and age-dependent aetiology of community-acquired urinary tract infections. ScientificWorldJournal. 2012;2012:349597. doi: 10.1100/2012/349597.
17. Griemsmann M, Tergast TL, Simon N, Kabbani AR, Manns MP, Wedemeyer H, Cornberg M, Maasoumy B. Nosocomial infections in female compared with male patients with decompensated liver cirrhosis. Sci Rep. 2022;12(1):3285. doi: 10.1038/s41598-022-07084-9.
18. Rosenthal, VD, Bat-Erdene, I, Gupta, D, et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 45 countries for 2012–2017: device-associated module. Am J Infect Control 2020;48:423–432.

19. Walter J. , Haller S. , Quinten C. , Kärki T. , Zacher B. , Eckmanns T. , Abu S. M. , Plachouras D. , Kinross P. , Suetens C. , ECDC PPS study group . Healthcare-associated pneumonia in acute care hospitals in European Union/European Economic Area countries: an analysis of data from a point prevalence survey, 2011 to 2012. Euro Surveill. 2018; 23(32): pii=1700843. https://doi.org/10.2807/1560-7917.ES.2018.23.32.1700843
20. Rosenthal VD, Yin R, Lu Y, Rodrigues C, Myatra SN et al. The impact of healthcare-associated infections on mortality in ICU: A prospective study in Asia, Africa, Eastern Europe, Latin America, and the Middle East. Am J Infect Control. 2022 Sep 6:S0196-6553(22)00658-7. doi: 10.1016/j.ajic.2022.08.024.
21. Forna DA, Constantin BC, Mihali M, Tiutiucă C, Earar K. Complex maxillary and mandibular oral rehabilitation using the all-on-6 concept, case report. Romanian Journal of Oral Rehabilitation. 2023 Apr;15(2).