Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2023; Vol 12
Open Access

Prevalence of Oral Opportunistic Pathogens (OPPs) among Hospitalized Patients

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Cite this paper as:: Mohammad Sayeem Rahman Bhuiyan, Erfanul Huq Siddiqui, Afroza Akter Juhi, KM Rafiqul Islam, Abu Hena Helal Uddin Ahmed, Anjumun Ara, Sheikh Forhad (2023) Prevalence of Oral Opportunistic Pathogens (OPPs) among Hospitalized Patients. Frontiers in Health Informa

ABSTRACT

Background: The oral cavity hosts a diverse microbiome, but prolonged hospitalization can disrupt this balance, promoting colonization by opportunistic pathogens (OPPs) like *Candida albicans*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. Critically ill patients, especially those in ICUs or on mechanical ventilation, are at heightened risk due to factors like poor oral hygiene, reduced saliva, and antibiotic use. Oral OPPs can migrate to the respiratory tract, contributing to infections such as ventilator-associated pneumonia.

Aim of the study: This study aims to assess the prevalence of oral opportunistic pathogens (OPPs) among hospitalized patients.

Methods: This cross-sectional descriptive study was conducted at the Department of Oral and Maxillofacial Surgery, BSMMU, Dhaka, Bangladesh, over 1.6 years. Seventy hospitalized patients (≥18 years, admitted for >7 days) were enrolled after obtaining ethical approval and informed consent. Clinical data, including demographics, comorbidities, and oral care practices, were collected through structured interviews and a review of records. Using standard culture techniques and Gram staining, oral, buccal mucosa and tongue swabs were cultured at the microbiology lab to identify opportunistic pathogens. Data analysis was performed using SPSS version 22.0, and results were presented through tables and graphs for interpretation.

Result: This study examined the prevalence of oral opportunistic pathogens (OPPs) among 70 long-term hospitalized patients in Bangladesh. Most were over 50 years old, male, and underweight, with poor nutritional status (mean BMI 18.69±2.34 kg/m²). Hypertension (54.29%) and diabetes (44.29%) were the most common comorbidities. Oral care was inadequate, with 44.29% receiving no oral hygiene. Pseudomonas aeruginosa was the most frequent OPP (42.86%), followed by Candida albicans (17.14%). No Klebsiella pneumoniae, Staphylococcus aureus, Acinetobacter spp., or Enterococcus spp. were detected. Mortality was high at 22.86%, reflecting severe illness and prolonged hospitalization.
Conclusion: This study reveals a high prevalence of oral opportunistic pathogens in hospitalized patients in Bangladesh, primarily Pseudomonas aeruginosa and Candida albicans. Contributing factors include poor oral hygiene, malnutrition, comorbidities, and prolonged hospital stays. Enhanced oral care, nutritional support, and infection control are crucial to improving patient outcomes.
Keywords: Prevalence, Oral Opportunistic Pathogens, Colonization and Hospitalized Patients

INTRODUCTION

The oral cavity hosts a diverse microbiome composed of commensal bacteria, fungi, and viruses, which normally maintain a balanced microbial ecosystem under healthy conditions [1]. However, prolonged hospitalization, particularly in patients with compromised immunity, critical illness, or those undergoing invasive procedures, can disrupt this balance, promoting the colonization and overgrowth of opportunistic pathogens (OPPs) [2,3]. These pathogens include *Candida albicans*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, which are frequently implicated in local and systemic infections in hospitalized patients [4,5]. Long-term hospitalized patients, especially those in intensive care units (ICUs) or receiving mechanical ventilation, are at heightened risk of oral colonization by OPPs [6]. Poor oral hygiene, reduced salivary flow, polypharmacy, malnutrition, and broad-spectrum antibiotics create a favorable environment for opportunistic colonization [7,8]. Moreover, the oral cavity can serve as a reservoir for these pathogens, which can migrate to the lower respiratory tract and contribute to nosocomial infections, including ventilator-associated pneumonia (VAP) [6,9]. Numerous studies have highlighted the relationship between oral health and systemic health outcomes in hospitalized patients. Poor oral health is directly linked to an increased risk of aspiration pneumonia, bacteremia, and sepsis, particularly in older adults and immunocompromised populations [10,11]. For example, *Candida* species, which normally exist in low numbers in the healthy oral cavity, can proliferate extensively in critically ill patients, leading to oropharyngeal candidiasis and systemic candidemia [12]. Similarly, multidrug-resistant *Acinetobacter* and *Enterobacter* species have been isolated from the oral cavities of hospitalized patients, raising concerns about cross-transmission and hospital outbreaks [13]. Despite the recognized importance of oral colonization in hospitalized patients, surveillance of oral OPPs remains limited in many healthcare settings, particularly in low-and middle-income countries (LMICs), where infection control practices may be less stringent [14]. Understanding the prevalence and types of OPPs colonizing the oral cavity of long-term hospitalized patients is crucial for guiding infection control measures, antimicrobial stewardship, and targeted oral care interventions [15]. This study aims to assess the prevalence of oral opportunistic pathogens (OPPs) among long-term hospitalized patients and to explore the factors associated with their colonization, providing valuable insights into the oral-systemic health link in hospitalized populations.

METHODOLOGY & MATERIALS

This cross-sectional descriptive study aimed to assess the prevalence of oral opportunistic pathogens (OPPs) among hospitalized patients in a clinical setting. The study was conducted in the Department of Oral and Maxillofacial Surgery at Bangabandhu Sheikh Mujib Medical

University (BSMMU), Dhaka, Bangladesh. Seventy patients were enrolled over 1.6 years, from March 2016 to September 2017. Ethical approval was obtained from the hospital's Institutional Review Board (IRB), and informed consent was secured from all participants or their legal guardians before participation.

Inclusion Criteria

- Patients aged 18 years or older.
- Patients who have been hospitalized for more than 7 days.
- Conscious Patients can consent to participate in the study.
- Patients with varied medical conditions, including those with comorbidities (e.g., diabetes, hypertension, respiratory disease, etc.).
- Written informed consent from the patient or their legal guardian.

Exclusion Criteria

- Patients with severe cognitive impairment or unconscious patients who cannot provide consent.
- Patients who have undergone recent oral surgery or other major interventions.
- Pregnant women due to potential complications.
- Patients who have been in the hospital for less than 7 days.

Clinical data, including demographic information (age, gender) and relevant medical history, such as comorbidities and current medications, were collected from structured interviews and a review of hospital records. Key clinical parameters, such as the length of hospital stay and type of treatment received, were also documented. To evaluate oral care practices, patients completed a questionnaire capturing the frequency and consistency of oral hygiene routines during hospitalization. For microbial sampling, sterile oral swabs were used to collect specimens from the buccal mucosa, tongue, and other areas of the oral cavity. The collected swabs were immediately transported to the microbiology laboratory for analysis.

All samples were processed at the Biomedical Laboratory of the Department of Microbiology and Immunology at BSMMU, where they were cultured to identify opportunistic pathogens. Samples were inoculated onto appropriate culture media, including chocolate agar, blood agar, and other relevant media, and incubated at 37°C in a 5% CO2 environment for 48 hours. Representative colonies were examined to identify the presence of opportunistic pathogens. Standard culture techniques and Gram staining were used to identify bacterial and fungal pathogens, including Candida albicans, Pseudomonas aeruginosa, Klebsiella pneumoniae, and Staphylococcus aureus.

The data were thoroughly reviewed to identify any missing values or inconsistencies. Statistical analysis was performed using suitable methods and software tools. Data processing and analysis were conducted using SPSS version 22.0 for Windows. The summarized findings were interpreted appropriately and presented through tables, graphs, and bar charts.

RESULTS

The study investigated the prevalence of oral opportunistic pathogens (OPPs) and related clinical factors among 70 long-term hospitalized patients in Bangladesh. The mean age of patients was 59.11±8.86 years, with the majority (74.3%) over 50 years, reflecting the higher hospitalization rates in older populations (Table 1). Figure 1 shows the gender distribution of the study population, where most patients were male (60.00%). Over half (51.43%) of the patients were underweight, with a mean BMI of 18.69±2.34 kg/m², indicating poor nutritional status (Table 2). Nearly half (47.14%) stayed in the hospital for more than 14 days, highlighting their prolonged critical condition (Table 3). Comorbidities are shown in Table 4, where hypertension (54.29%) and diabetes (44.29%) were the most common comorbidities, followed

by respiratory diseases (31.43%) and cancer (14.29%). Oral care was notably poor, with 44.29% receiving no oral care during hospitalization, while only 25.71% received daily oral hygiene care, which may have contributed to oral colonization by opportunistic pathogens (Table 5). Pseudomonas aeruginosa was the most frequently detected pathogen in 42.86% of patients, followed by Candida albicans in 17.14% of cases (Table 5). Alarmingly, no Klebsiella pneumoniae, Staphylococcus aureus, Acinetobacter spp., or Enterococcus spp. were detected, but 40% of patients showed no detectable pathogens, possibly due to antimicrobial therapy or sampling limitations (Table 6). Regarding patient outcomes, 60% were discharged, 17.14% were transferred to other facilities, and 22.86% died, indicating a high mortality rate consistent with severe underlying conditions and prolonged hospitalization (Table 7).

Table 1: Age distribution of the study population (n=70)

Age (in years)	Frequency (n)	Percentage (%)
31-40	2	2.86
41-50	12	17.14
51-60	28	40.00
61-70	24	34.29
71-80	4	5.71
Mean±SD	59.11±8.86	

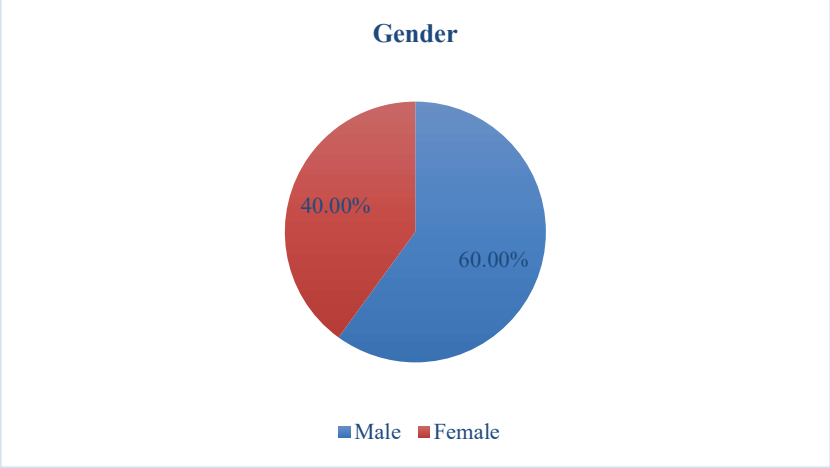

Figure 1: Gender distribution of the study patients (n=70)

Table 2: Body Mass Index (BMI) Distribution of the study population (n=70)

BMI (kg/m^2)	Frequency (n)	Percentage (%)
Underweight (≤18.5)	36	51.43
Normal (19-25)	30	42.86
Over weight (>25)	4	5.71
Mean±SD	18.69±2.34	

Table 3: Length of Hospital Stay of the study population (n=70)

Length of Hospital Stay	Frequency (n)	Percentage (%)
≤7 days	15	21.43
8-14 days	22	31.43
>14 days	33	47.14

Table 4: Distribution of patients comorbidities (n=70)

Comorbidities	Frequency (n)	Percentage (%)
Diabetes	31	44.29
Hypertension	38	54.29
Cancer	10	14.29
Respiratory Disease	22	31.43
None	12	17.14

Table 5: Oral Care Frequency among the study patients (n=70)

Oral Care Frequency	Frequency (n)	Percentage (%)
Daily	18	25.71
Every 2 days	12	17.14
Irregular	9	12.86
None	31	44.29

Table 6: Prevalence of Oral Opportunistic Pathogens (OPPs) among the study population (n=70)

OPPs	Frequency (n)	Percentage (%)
Candida albicans	12	17.14
Klebsiella pneumoniae	0	0.00
Pseudomonas aeruginosa	30	42.86
Staphylococcus aureus	0	0.00
Acinetobacter spp.	0	0.00
Enterococcus spp.	0	0.00
None Detected	28	40.00

Table 7: Patient Outcomes among Long-term Hospitalized Patients (n=70)

Patient Outcome	Frequency (n)	Percentage (%)
Discharged	42	60.00
Transferred	12	17.14
Deceased	16	22.86

DISCUSSION

The findings of this study highlight the significant prevalence of oral opportunistic pathogens (OPPs) among hospitalized patients in Bangladesh. The study sample, consisting of 70 patients with a mean age of 59.11±8.86 years, is consistent with existing literature, which suggests that older individuals are more vulnerable to prolonged hospital stays and associated complications [16]. The fact that 74.3% of the patients were over 50 years of age supports the higher hospitalization rates observed in older populations due to the presence of chronic diseases and comorbidities [17]. In this cohort, hypertension (54.29%) and diabetes (44.29%) were the most common comorbidities, similar to findings in other hospitalized patient populations [18]. Chronic diseases like hypertension and diabetes impair immune function, increasing the likelihood of infections, including opportunistic oral pathogens [19]. The significant prevalence of respiratory diseases (31.43%) in our study aligns with studies showing that prolonged hospitalizations, particularly in intensive care units (ICUs), often lead to respiratory complications, further compounding the risk of pathogen colonization [8]. The observed poor

nutritional status, with 51.43% of patients being underweight, is concerning and could contribute to increased infection vulnerability. Malnutrition has been shown to negatively affect the immune response, leading to a higher susceptibility to oral and systemic infections [20]. Our study's mean BMI of 18.69±2.34 kg/m² reflects malnutrition in hospitalized patients, especially in critical care settings, which could also facilitate the colonization of opportunistic pathogens in the oral cavity [21]. Oral care is another critical factor influencing pathogen colonization. The poor oral care practices observed in this study, with 44.29% of patients receiving no oral care, are consistent with previous research indicating that inadequate oral hygiene in hospitalized patients significantly increases the risk of colonization by oral pathogens [22]. This finding is particularly relevant as the oral cavity is a major reservoir for opportunistic pathogens, which can lead to systemic infections, particularly in immunocompromised or critically ill patients [23]. Regarding the oral pathogens, the study found that Pseudomonas aeruginosa was the most prevalent pathogen, detected in 42.86% of patients. This pathogen is often associated with hospital-acquired infections, particularly in patients with prolonged stays or ventilatory support [24]. The detection of Candida albicans in 17.14% of patients is also significant, as oral Candida infections are common in hospitalized patients, especially those receiving antibiotics or immunosuppressive therapy [25]. However, the absence of pathogens like Klebsiella pneumoniae, Staphylococcus aureus, and Acinetobacter spp. in the oral cavity of these patients is surprising, especially considering the high rates of antibiotic use in hospitalized individuals, which can influence the presence of certain pathogens [26]. The mortality rate of 22.86% is consistent with the severe clinical conditions of the study population, where prolonged hospitalization and multiple comorbidities often result in poorer outcomes [27]. The high mortality rate underscores the critical need for improving clinical management and patient care, particularly for those with underlying conditions, to reduce the risk of infections and enhance survival rates.

Limitations of the study: This study had several limitations, including a small sample size from a single hospital, limiting generalizability. Microbial detection relied on conventional culture methods, which may have missed some pathogens. Additionally, patient oral care practices were self-reported, introducing potential bias.

CONCLUSION AND RECOMMENDATIONS

This study highlights the high prevalence of oral opportunistic pathogens (OPPs) among hospitalized patients in Bangladesh, with Pseudomonas aeruginosa and Candida albicans being the most frequently detected. Poor oral hygiene, malnutrition, comorbidities such as hypertension and diabetes, and prolonged hospital stays were key contributing factors to pathogen colonization. The high mortality rate further reflects the severity of these patients' conditions. Improved oral care practices, nutritional support, and infection control measures are essential to reduce the risk of opportunistic infections and improve patient outcomes. These findings emphasize the need for comprehensive oral health protocols in hospitalized patient management strategies.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee.

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