

# Oral Flora of Elderly Patients following Acute Medical Admission

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## Key Words

Oral flora · Gram-negative bacilli · Geriatric medicine · Acute medical care

## Abstract

The human oral microflora is diverse and is usually predominately composed of Gram-positive bacteria. It is uncommon to find Gram-negative bacilli (GNB) in healthy mouths. The incidence of infection with GNB rises in institutionalised, frail elderly subjects. There is also evidence of an association between intra-oral GNB presence and denture wearing. There have been few studies which have investigated intra-oral GNB carriage in acutely ill elderly patients. The aim of this study was to evaluate the oral flora of a group of elderly patients during an acute medical admission and to investigate any associations between the oral microflora and existing medical or oral factors. A total of 28 patients (17 females and 11 males; age: 74-93 years) on a care for the elderly ward were studied. Epidemiological data, detailed medical histories and oral examinations were undertaken. In addition, oral swabs of the palate area were taken to determine their oral flora. Twelve (43%) of the patients had GNB in their oral cavities. These patients were suffering from a variety of medical conditions and were on various drug regimes. There was a correlation between oral GNB presence and denture use. There was no asso-

ciation between GNB presence and denture hygiene. As oropharyngeal GNB colonisation can be associated with infections such as aspiration pneumonia, it is important in patients at risk that intra-oral organisms are identified and managed.

## Introduction

Enteric Gram-negative bacilli (GNB) are uncommon in healthy mouths [1]. GNB, such as *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Enterobacter* spp. are putative pathogens and can cause infections such as pneumonia [2]. It has been shown that the incidence of infection with GNB rises in institutionalised patients and frail elderly subjects [3]. Mylotte et al. [4] have demonstrated that elderly patients have a high rate of GNB oropharyngeal carriage when debilitated, hospitalised or resident in nursing homes. Johanson et al. [5] reported a prevalence of oropharyngeal GNBs in 'moderately ill' hospitalised adults of 16%. It has also been reported that intra-oral levels of GNBs rise in patients suffering from advanced malignant disease [6]. The use of chemotherapy and radiotherapy along with increased GNB proliferation may be associated with intra-oral problems such as irradiation mucositis [7].

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**Table 1.** Intra-oral GNB isolated from the patients and their medical conditions

Gram-negative species isolated	Relevant medical/pharmacological factors
<i>Pseudomonas aeruginosa</i> and <i>Serratia marcescens</i>	chronic pulmonary disease corticosteroid inhaler
<i>Aeromonas</i> spp.	left ventricular failure pneumonia antibiotics
<i>Klebsiella pneumoniae</i>	H <sub>2</sub> -antagonist (ranitidine) aspirin
<i>Klebsiella pneumoniae</i>	stroke Bell's palsy
<i>Escherichia coli</i>	reflux oesophagitis aspirin antibiotics
<i>Escherichia coli</i>	chronic bronchitis diabetes mellitus corticosteroid inhalers, systemic
<i>Escherichia coli</i>	left ventricular failure
<i>Hafnei</i> spp.	chronic bronchitis Parkinson's disease antibiotics corticosteroid inhaler
<i>Citrobacter freundii</i>	chronic bronchitis sodium bicarbonate
<i>Enterobacter agglomerans</i> and <i>Serratia liquefaciens</i>	chronic pulmonary disease left ventricular failure antibiotics aspirin
<i>Enterobacter sakazakii</i>	chronic pulmonary disease corticosteroid inhaler
<i>Acinetobacter</i> spp.	left ventricular failure antibiotics aspirin

An increase in GNB in the oral cavity may also be associated with such factors as diminished salivary flow [8], stroke [9], or aspiration pneumonia [10]. In addition, there is evidence of an association between intra-oral GNB carriage and denture wearing [11]. The aim of this study was to investigate the oral flora of elderly patients under acute medical care. The association between any oral, medical or pharmaceutical factors and the presence of bacterial species was also determined.

## Method

### Subjects

One ward of 28 elderly patients was studied. Seventeen were female and 11 were male; the age range was 74–93 years. All the subjects had been admitted due to cardiac or respiratory illness or for the investigation of suspected gastrointestinal problems. The mean duration of stay was 6.40 ( $\pm$  5.0) days. The patients gave informed consent prior to taking part in the study, and full ethical approval for the study had been obtained.

### Epidemiological and Medical Data

Epidemiological data (name, sex and date of birth) were obtained from the patients' case notes. A medical and drug history was taken: the main current medical conditions and current drug regimes were also recorded. Additionally, the recent administration of antibiotic agents or any corticosteroid therapy was ascertained.

### Oral Examination

A brief oral examination was performed on each patient on the same day and within 2 h of a hospital-provided meal. Any soft tissue lesions were noted and denture examination was carried out where applicable. A note was made of the type of dentures and the presence of debris on the dentures. The patients and ward staff were interviewed to ascertain which methods (if any) were used to maintain denture hygiene.

### Microbiological Analysis

An oral swab of each patient's palate was taken (Trans-swab, Medical Wire & Equipment Company, Corsham, UK). The swabs were immediately plated out onto 5% (v/v) blood agar (LAB M, Bury, UK), MacConkey agar (LAB M), kanamycin-aesculin agar (LAB M) and yeast morphology agar (Merck, Darmstadt, Germany). The media were inoculated and scored using the four quadrant method [12]. After streaking onto the solid media, the swab was broken off into 5 ml of brain heart infusion broth. All the cultures were incubated aerobically in 4% (v/v) CO<sub>2</sub> at 37 °C overnight. Quantitative bacterial counts (colony-forming units ml<sup>-1</sup>) were made using a grading system estimated from growth density on the solid media and in the enrichment broth [12]. The aerobic GNB were identified using the API 20E system (Biomérieux, Basingstoke, UK).

## Results

Forty-three percent [12] of the subjects had intra-oral GNB and 43% [12] of the subjects had *Candida*. Of the 24 subjects who had GNB or *Candida*, 5 had both. The presence of GNB was associated with a variety of medical and pharmaceutical factors (table 1). Twenty-three subjects (82%) wore some form of denture. The remainder (18%) were either edentulous or partially dentate and did not have any dentures. All patients who wore dentures (n = 23) used some form of denture maintenance measure such as soaking alone (22%), brushing alone (48%) or both (30%). Sixty-one per cent of the denture wearers had

debris covering part of their denture. Of the 12 patients who had GNB oral colonisation, 10 wore some form of denture – and in 6 cases, these were covered with debris.

## Discussion

Forty-three percent of a sample of 28 elderly patients under acute medical care had GNB in their mouths. Although oropharyngeal colonisation with GNBs is uncommon in healthy subjects [7], there was a prevalence of 16% of oropharyngeal GNBs in ‘moderately ill’ adult patients in one previously reported study [5]. Our results, therefore, showed that GNB carriage increased in ‘acutely ill’ elderly patients.

It is noteworthy that 2 of the subjects had *K. pneumoniae* present intra-orally. This organism is often causative of pneumonia – a leading cause of death in the frail elderly [13]. A further subject had *P. aeruginosa* present and suffered a *Pseudomonas* septicaemia shortly after intra-oral investigation. Subsequent bacterial gene-probing has shown that the strain of *Pseudomonas* present in the blood was the same as that in the oral cavity [unpubl. data]. Hence, it is possible that the origin of the *Pseudomonas* infection was the mouth. This is one of the first reports of such an occurrence.

Ten of the 12 subjects who were positive for intra-oral GNBs wore dentures. This high correlation between intra-oral GNB presence and denture-use is in keeping with a previously reported correlation between the presence of enteric rods in the mouth and denture wearing [11]. Half of the GNB-positive subjects had debris present on their dentures.

It would have been useful to elicit information regarding the duration of denture wearing in the subjects. This is relevant as conditions such as chronic candidiasis may be related to the duration of denture wearing. It proved, however, impossible to gain reliable information from the subjects in this regard.

Several factors have been implicated in intra-oral GNB carriage. These include the length of stay in hospital [14], whether the GNB infection is nosocomial or exogenous and associated medical conditions or pharmaceutical factors.

Elderly patients suffering from acute conditions are debilitated and may be medically compromised. Medically compromised patients have an increased incidence of oral disease [15], and aspiration pneumonia has been positively correlated with a history of periodontal disease [16]. Indeed, the source of GNB in aspiration pneumonia

is unknown, but may originate from the oral cavity. Additionally, there has been speculation that *Helicobacter pylori* in the stomach may originate from the mouth. Malignancy [17] and stroke [9] have both been associated with intra-oral GNB colonisation. Debate continues as to the role of antibiotics in intra-oral GNB carriage. This latter point is, however, equivocal [18, 19].

The present study was only a ‘snapshot’ of the oral microbiological profile of a relatively small sample. The intra-oral flora of subjects needs to be investigated over a period of time to gain a sequential microbiological profile but this would not determine whether the oral flora resulted in medical problems. More discriminatory methods of denture hygiene assessment (such as those described by Blair et al. [20]) could be implemented in follow-up studies, as the method of assessment described here was necessarily crude in order to ensure that all the patients could be studied at the same time. The lack, however, of correlation between denture hygiene and intra-oral GNB presence is important since it suggests that adequate denture hygiene may not be a factor in GNB oral colonisation. Other medical and pharmaceutical factors which may alter the oral pH could be more important and this warrants further investigation. Denture hygiene is important in the prevention of infections such as oral candidiasis and so should not be neglected as a result of this study. Indeed, the presence of well-cleaned dentures may not reflect the GNB presence of the mouth. A further study looking at the oral care in such patients is at present underway.

## Conclusions

Intra-oral GNB were detected in 43% of a sample of elderly patients under acute medical care. The majority of GNBs were present in denture wearers, but there was no association between denture hygiene and GNB presence. Intra-oral colonisation by GNB may be associated with medical and pharmaceutical factors hitherto not identified as being associated with this colonisation and its role in the development of medical problems such as septicaemia or aspiration pneumonia is, as yet, unclear.

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