Australian Dental Journal
The official journal of the Australian Dental Association
AUSTRALIAN DENTAL ASSOCIATION INC.
Australian Dental Journal 2017; 62: 464–470
doi: 10.1111/adj.12538

Clinical guideline for the management of odontogenic infections in the tertiary setting

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ABSTRACT

Background: Odontogenic infections are a common presentation to emergency departments of Australian hospitals. Due to the limited training in diagnosis and treatment of dental conditions, these patients can present a challenge for the medical practitioner. The objective of this study was to provide an evidence-based approach to the management of odontogenic infections in adults presenting to Royal Perth Hospital.
Methods: A literature search was conducted to identify evidence-based guidelines for the management of odontogenic infections in the tertiary hospital setting. Keywords 'dental', 'infections' and 'management' were used to search PubMed, DynaMed and Embase databases.
Results: Recommendations were drawn from existing literature including coroner reports with respect to clinical assessment, investigations, medical and surgical management, and postoperative care. A flow chart, incorporating these recommendations, was created to allow for appropriate disposition of patients presenting with odontogenic infections to Royal Perth Hospital.
Conclusions: A clinical guideline is needed to appropriately manage patients presenting with odontogenic infections. We recommend the guideline be submitted to intradepartmental committees for assessment.

Keywords: Australia, dental, hospitals, infections, management.

Abbreviations and acronyms: AFOI = awake fibre optic intubation; CT = computed tomography; OPG = orthopantogram; RPH = Royal Perth Hospital; VTE = venous thromboembolism.

(Accepted for publication 8 June 2017.)

INTRODUCTION

Dental problems are a common presentation to emergency departments across Australia. An audit at Royal Hobart Hospital found that dental abscesses were the most common dental problem presenting to the emergency department, accounting for 35.7% of all dental-related visits.[1]

Patients may present to a general hospital rather than a dental practice for several reasons including anxiety, financial difficulties, lack of access to dental practices, limited knowledge, perception that antibiotics can alleviate the problem, transport issues as well as the lack of a regular dental practitioner. As a consequence, medical practitioners are often faced with managing odontogenic infections in the hospital setting.[1]

A study at the Royal Melbourne Hospital found that 47 out of 107 patients had received initial treatment from general dental or medical practitioners prior to being referred to the hospital. Common features of their pre-referral management included delays in diagnosis, the failure to establish and maintain adequate drainage of these infections, relying on antimicrobials as the primary management as well as poor antibiotic treatment with respect to drug choice and duration of therapy.[2]

Delayed presentation of patients with odontogenic infections to hospital was found to be associated with a higher airway risk. Patients who delayed presentation for more than 1 week were found to be significantly more likely to have a spreading deep neck infection. Furthermore, those patients who did have a spreading deep neck infection were significantly more likely to require intensive care admission. This delay in presentation is partly attributed to inappropriate referral patterns in the community setting.[3]

Complications of severe odontogenic infections can include mediastinitis, pulmonary complications, sepsis, hypoxia, cardiac arrest and death. In a retrospective study conducted by Opitz *et al.*, which analyzed the incidence and management of a total of 814 patients with severe odontogenic infections, five patients had pulmonary complications such as pleural effusion and empyema, one patient developed mediastinitis requiring a sternotomy, three developed acute renal failure, and one required cardiopulmonary resuscitation due to neck soft tissue swelling resulting in hypoxia and cardiac arrest. Another patient, with underlying cardiac disease, sustained a cardiac arrest.[4]

There have been three reported deaths in recent years from odontogenic infections in Australia. The first occurred in Perth in 2001 from hypoxic brain injury due to respiratory obstruction following surgery for a dental abscess with cellulitis.[5] The subsequent death was in 2002 in Brisbane from upper airway obstruction due to a pharyngeal abscess caused by a treated dental abscess.[6] The last death occurred in Adelaide in 2002 as a result of airway obstruction due to Ludwig's angina following lower molar tooth extraction.[7] The Royal Adelaide Hospital has implemented a protocol in 2004, which outlines procedure for patients with odontogenic infections and a threatened upper airway.[8] There has been no protocol implemented in Western Australia to date.

While there are only three reported coroner cases surrounding deaths from odontogenic infections, there is literature to suggest a larger number of deaths which might not have resulted in coronial inquests.[9] This highlights the importance of early recognition of severity with timely intervention, and the need for hospital-based protocols for management of these cases. The aim of this guideline is to provide a simplified evidence-based pathway for the management of odontogenic infections in hospitals, as demonstrated in Fig. 1.

METHODS

Due to the review nature of the study, institutional ethical approval was not required. No animal or human subjects were directly involved in the study and there are no conflicts of interest to be declared. Current literature was searched for evidence-based recommendations for management of odontogenic infections in adult patients with respect to clinical assessment, airway management, surgical and pharmacological therapy. A flow chart, incorporating these recommendations, was designed to be implemented at the Royal Perth Hospital (RPH) to assist in management of patients with odontogenic infections.

RESULTS

Clinical assessment

History

A focused history of the presenting complaint should be carried out on all patients to determine the severity of their presentation and to determine the setting for their care, whether as inpatient or outpatient. Other components of a comprehensive history include past medical and surgical history, medications, allergies and social history. It is also prudent to take a dental history, in particular enquiring about any recent dental work, dental symptoms, substance abuse, trauma and previous antibiotic exposure.

Another major factor contributing to the spread of these infections is compromised host defences. These include diabetes, corticosteroids, chemotherapy, organ transplants, HIV, alcoholism, malignancy, malnutrition and renal disease.

Clinical symptoms of an acute dental infection may include pain, tooth mobility, tenderness to palpation over the tooth apices, as well as intraoral swelling and/or extraoral swelling. With progression, fever and malaise can also occur. Other concerning symptoms suggesting possible airway compromise include trismus, dysphagia, odynophagia, dyspnoea and inability lying supine. These must always be enquired as they will determine the severity of the patient's presentation and guide their management.

Examination

Initial examination of all patients should always begin with an assessment of the patients' airway, breathing and circulation. Once these are deemed satisfactory, this should be followed by vital signs. Raised temperature, increased or decreased respiratory rate, stridor, tachycardia, saturations less than 94% in an otherwise well patient and altered level of consciousness are all concerning signs.[10]

An extraoral examination should be carried out first to assess extent and location of any facial swelling. An intraoral examination can then be carried out to assess any focal swelling, halitosis, gross dental caries, broken dentition and drainage of pus. Trismus is defined as mouth opening of less than 20 mm, with a 'hard end feel' and suggests involvement of the muscles of mastication.[10]

Superficial infections, such as those that involve the buccal and canine space, are considered to be less of an airway threat. Deep infections, such as those involving the lateral pharyngeal space, are a threat to the airway.

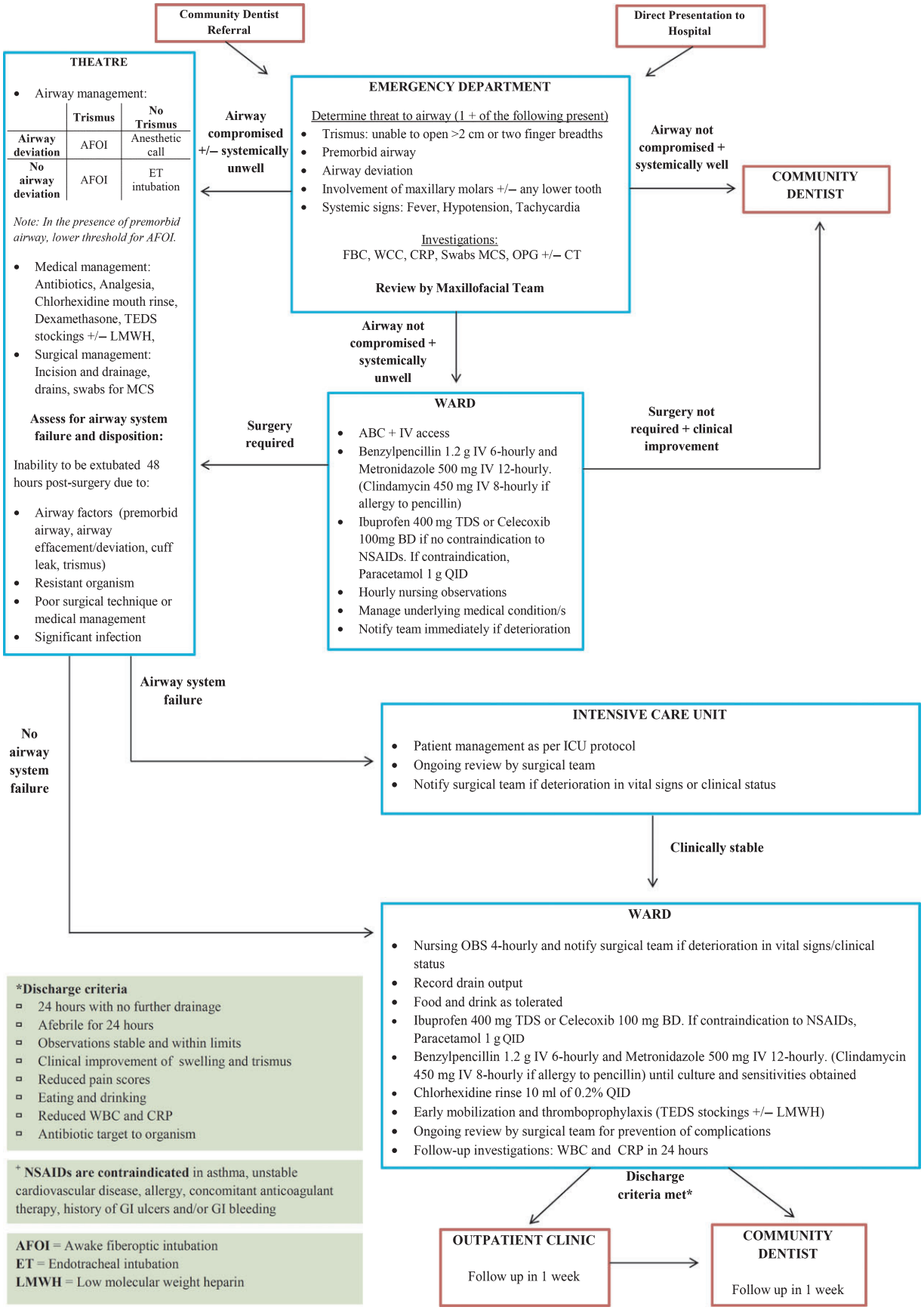

Fig. 1 Flow chart for management of odontogenic infections.

The majority of infections of the maxillofacial region are odontogenic in origin. Non-odontogenic infections follow a different diagnostic and management pathway and are beyond the scope of this guideline. The Royal Melbourne Hospital study which evaluated 107 patients with acute maxillofacial infections found that 75% of them were odontogenic in origin. In terms of facial space involvement, they found that 53% of patients presented with single space infections while 47% of the patients studied presented with involvement of two or more spaces. For both groups, it was found that the submandibular and buccal spaces were most commonly involved.[2]

A study in Adelaide found that the submandibular region was the most commonly involved (78.6%) of cases, with decayed mandibular molars being the primary cause.[3] Submandibular space was also found to be the most common single space involved (28.6%), followed by buccal (21.4%) in another prospective study.[11] The frequency of deep neck space infection was significantly higher in patients with mandibular odontogenic infection (29% of patients) than those with maxillary odontogenic infections (7%). Subsequently, the length of hospital stay was found to be significantly longer in patients presenting with mandibular dental infections (5.6 days), compared with maxillary infections (3.2 days). Again, this highlights the importance of assessing the anatomical spaces involved as part of the initial risk management.[12] Figs. 2 and 3 demonstrate some of the common anatomical spaces involved in odontogenic infections.

A prospective study in 2006 found that 70% of patients admitted to hospital with odontogenic infections had trismus and dysphagia with masticator, perimandibular (submandibular, submental and sublingual) and peripharyngeal spaces being involved in 78% of patients.[13] Both trismus and dysphagia are concerning signs on examination and should be documented and conveyed to the on-call maxillofacial registrar if present.

Table 1 summarizes the airway risk associated with the various dentition based on the facial spaces the infection is likely to spread.[10]

Investigations

It is important to note that investigations should not delay securing an unstable airway and if a patient has a clinically compromised airway, this should be attended to promptly. Imaging and laboratory investigations should be carried out only once the patient is deemed stable.

Blood tests that should be carried out include a full blood count, with a differential white cell count and inflammatory markers such as C-reactive protein. Blood cultures are not routine, unless the patient is febrile and sepsis is of concern. These tests help categorize patients into either 'systemically well' or 'systemically unwell'. The admission criteria highlighted in the study are similar to our guideline and includes fever, swelling, trismus, odynophagia and raised inflammatory markers.[12]

An orthopantogram (OPG) can help to determine which teeth are involved. Once the OPG confirms the swelling is odontogenic in origin and involving dentition that pose a risk to the airway, computed tomography (CT) should be carried out for evidence of obstruction, anatomical spaces involved and as part of presurgical planning. Patients exhibiting signs of airway compromise and trismus on examination should have their airway stabilized prior to undergoing any CT imaging. These patients should be transferred to theatre. Patients with infections involving teeth that do not compromise the airway do not need urgent transfer to theatre for surgery, but need appropriate care in a timely manner.

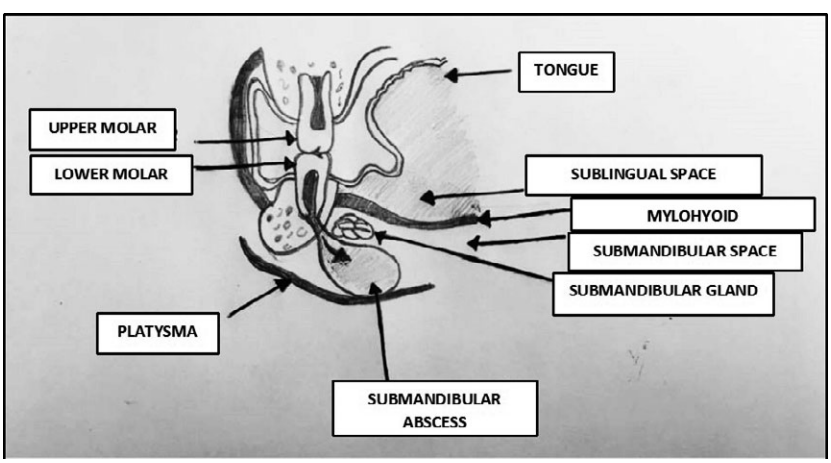

Fig. 2 Anatomical spaces I.

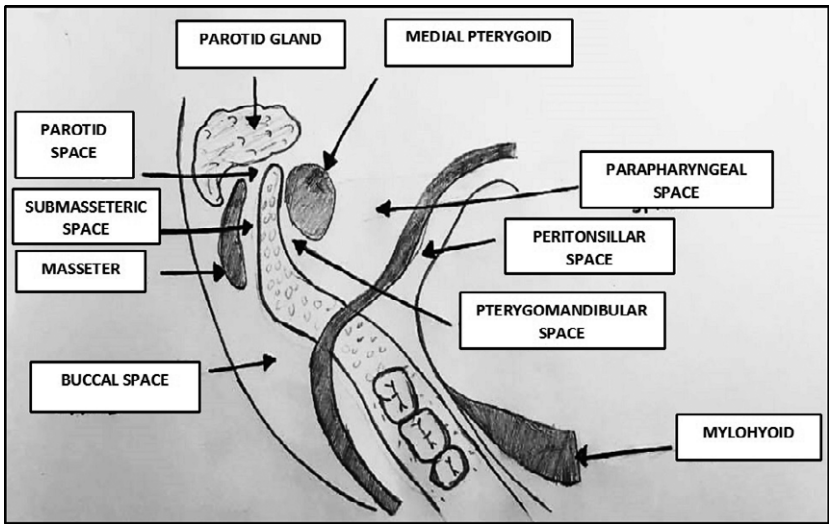

Fig. 3 Anatomical spaces II.

Table 1. Risk of airway threat

Airway threat	Teeth involved	Anatomical space involved
Possible	Mandibular molars	Submental
	Mandibular premolars	Sublingual
	Mandibular canines	Submandibular
	Mandibular incisors	Pharyngeal
	Maxillary molars	Temporal
		Submasseteric
Less likely	Maxillary incisors	Vestibular
	Maxillary canines	Infraorbital
	Maxillary premolars	Canine
		Buccal
		Space of body of mandible

Management

Airway management

There are multiple techniques that can be used for securing the airway. These include awake or asleep fibre optic intubation, nasotracheal and orotracheal intubation under direct laryngoscopy, or nasotracheal and endotracheal intubation under indirect laryngoscopy with or without video assistance.[14] A surgical airway is a last resort where the above have failed.

Patients who have either airway compromise or trismus require urgent anaesthetic assessment. Patients presenting with trismus, defined as mouth opening of less than 2 cm, and airway deviation/obstruction should receive awake fibre optic intubation (AFOI). Those presenting with trismus but no airway deviation/obstruction should also receive AFOI. Patients who do not present with trismus but have airway obstruction, intubation technique decision-making is to be deferred to the anaesthetist. Lastly, patients who have neither trismus nor airway obstruction should be managed according to their premorbid airway. There should be a lower threshold for the initiation of an anaesthetic consult and routine intubation in patients who are judged on clinical examination to have a premorbid airway. Fig. 1 outlines the proposed airway choices according to the clinical situation.

Postoperative airway failure is defined as the inability to extubate a patient 48 h post-surgery or need for reintubation and mechanical ventilation after initial postoperative extubation.[15] This can be due to airway-related factors such as premorbid airway, airway effacement or deviation, trismus, positive cuff leak test or other factors such as a resistant microorganism, poor surgical technique or intraoperative complications, inadequate medical management or significant preoperative infection.

Antimicrobial therapy

Antibiotics are not indicated in the absence of facial swelling or systemic signs of illness. The therapeutic guidelines recommend the use of benzylpenicillin 1.2 g i.v. every 6 h and metronidazole 500 mg i.v. every 12 h for deep infections.[16] Patients with a penicillin allergy can alternatively be treated with clindamycin 450 mg i.v. every 8 h and metronidazole 500 mg i.v. every 12 h.[16] Chlorhexidine gluconate is an antiseptic used in mouthwashes with bactericidal and antifungal activity. Patients should rinse with 10 mL of 0.2% chlorhexidine mouthrinse every 6 h preoperatively and postoperatively.[16]

The empirical antibiotics of choice are penicillins in combination with metronidazole. We propose that antibiotic susceptibility tests should be performed to further guide drug choice. The rates of penicillin-resistant organisms vary depending on the population group, with one prospective study noting that penicillin-resistant organisms were identified in 19% of strains isolated with treatment failure in 21% of

cases.[13] Another prospective study found that resistance to penicillin by gram-positive aerobes to be higher than 38%.[11]

Following clinical improvement, it is recommended to step down to oral antibiotic therapy with amoxicillin 500 mg every 8 h and metronidazole 400 mg every 12 h. If allergic to penicillin, step down to clindamycin 350 mg every 8 h.

Analgesia

Simple analgesics, such as paracetamol and non-steroidal anti-inflammatory drugs, should be used initially provided there are no contraindications for their use. Ibuprofen also has anti-inflammatory effects and starting dose is 400 mg every 8 h.[16,17] The COX-II inhibitors such as celecoxib may be used as an alternative to ibuprofen at a starting dose of 100 mg every 12 h. Patients who are older, with previous history of peptic ulcers and/or upper gastrointestinal bleeding, concomitant anticoagulant therapy, asthma or unstable cardiovascular disease should be given paracetamol instead. The dose for paracetamol is 1 g every 4 h.[16] Opiates may be indicated for severe pain, but should be used cautiously, particularly where respiratory depression is suspected.

Corticosteroids

Corticosteroids such as methylprednisolone and dexamethasone have been proven to reduce postoperative oedema following surgical extractions as well as reduction of pain post-administration.[18–23] A range of doses were used in previous studies investigating the effect of corticosteroids in oral surgery. A systematic review in 2010 concluded that a minimum dose of i.v. dexamethasone of 4 mg administrated preoperatively can reduce oedema. We recommend a dose of 8 mg i.v. dexamethasone or equivalent to be administrated preoperatively to decrease pain and airway swelling.[23]

Thromboprophylaxis

Deep vein thrombosis is a complication in patients undergoing surgery. All patients should be mobilized where appropriate and adequately hydrated as these are primary measures for prevention of venous thromboembolism (VTE). Mechanical prophylaxis with graduated compression stockings should be considered for all patients. Patients with additional VTE risk factors such as immobility, thrombophilia, oestrogen therapy, pregnancy, active inflammation, obesity and strong family history of VTE should also receive anticoagulant therapy with low molecular weight heparin such as enoxaparin at 40 mg daily. In high-risk patients where anticoagulant therapy is contraindicated, intermittent pneumatic compression should be used.[24]

Surgical management

Incision, drainage and extraction of the affected teeth removes the offending source and allows for decompression of the infected spaces. Microbiological swabs can be collected during the drainage procedure and sent for microscopy, culture and sensitivities. Consideration should also be given to the potential for fungal involvement such as *Candida* and *Actinomyces* organisms in these infections. This will guide targeted antibiotic and/or antifungal therapy.[10,25]

Fluid and nutrition

A proportion of these patients may have reduced oral intake over days as a consequence of pain, swelling and trismus. The presence of fever further increases fluid and caloric requirements. These patients are therefore vulnerable to malnourishment and dehydration.[26] When undergoing surgery, patients should be fasted and maintenance fluids should be administrated i.v. Postoperatively, patients should be encouraged to eat and drink as tolerated.

Postoperative management

Appropriate disposition of patients, whether to intensive care unit or the surgical ward, should be carefully assessed postoperatively. As would be expected, the postoperative disposition of patients has a significant effect on their length of stay. One study in Adelaide, which evaluated a total of 48 patients presenting to the Royal Adelaide Hospital, found that patients who were extubated postoperatively and transferred back to the ward had an average length of hospital stay of 1–2 days. Those patients who required intensive care (31% of patients admitted) were discharged after 6 days.[3]

The patients should have their vitals checked hourly with their temperature recorded every 4 h. There should be improvement in swelling, drainage, malaise and pain 48 h postoperatively. Patients should also be monitored for possible complications of surgery.[10] If no clinical improvement is seen at 48 h post-surgery, reasons for treatment failure should be explored. The likely causes are inadequate surgical treatment, foreign body, impaired host defences, poor choice of antibiotics and poor compliance.[1,10]

CONCLUSIONS

A significant proportion of patients presenting to hospitals with dental infections outlines the need for a

clinical guideline to be implemented. An evidence-based clinical guideline ensures timely flow of patients through the hospital and allows standardized practises within RPH.

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