UNIVERSITI TEKNOLOGI MARA

ANALYSIS OF PRESCRIBING ANTIBIOTICS KNOWLEDGE AMONG DENTAL PRACTITIONERS IN KLANG VALLEY REGION

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ABSTRACT

There is a major concern with ongoing exaggerated use of antibiotics in dental practice and the emergence of resistant bacterial strains, in recent years, dentists have reported a shift from narrow-spectrum to broad-spectrum antibiotic prescriptions due to increasing antibiotic resistance. In addition, the empiric use of antibiotic prophylaxis for dental procedures, especially those that cause bleeding in the mouth has become a reasonably well established practice among dental professionals. This misuse of antibiotics is no longer acceptable and the dentists must prescribe antibiotics in a judicious and prudent manner to avoid the adverse effects of antibiotics.

The main aims of this study arc to assess the knowledge among dental practitioners in the use of antibiotics for patients with acute dental infection and to compare their prescription with the Malaysia National Clinical Guidelines (MNCG) 2003, investigates the prescribing habits of dental practitioners for some clinical dental situations, determine their antibiotic prescribing knowledge for prophylactic purpose and compare their prescription with American Heart Association (AHA) guidelines 2008, assess their knowledge regarding the need of cardiac diseases to antibiotic cover and also to determine their knowledge regarding antibiotic cover for dental procedures in patients at risk of infective endocarditis.

This study utilized a questionnaire which was designed to investigate the antibiotic prescribing patterns by dental practitioners in the Klang valley region in Malaysia. To evaluate its validity and reliability, the questionnaire was pretested by a pilot study before the actual data collection.

The questionnaire was distributed to 706 dental practitioners who are working in the Klang valley region; this includes clinicians, academicians, researchers and others. The returned questionnaires were analysed using SPSS to determine the antibiotic prescribing, to identify compliance to antibiotic guidelines (American Heart Association (AHA) guidelines 2008 and National Clinical Guidelines 2003 guidelines) and to evaluate the statistical significance of various demographic parameters.

217 dentists responded to the questionnaire and the responses show that there is a wide variety of antibiotic prescriptions among dentists; there is also antibiotics misuse in some clinical dental conditions.

The majority of dental practitioners surveyed (25.8%, n=56) prescribed amoxicillin 500 mg 3 times daily for 5 days (7.7 DDDs for each prescription) to treat acute dentoalveolar infection for patients not allergic to Penicillin, although the National Clinical Guidelines

(2003) recommended phenoxymethyl penicillin 250-500 mg as a first choice for the treatment of acute dentoalveolar infection and only 2% (n=4) of surveyed dentists prescribed phenoxymethyl penicillin 250-500 mg 3-4 times daily for 5 days.

The majority of dental practitioners surveyed prescribe antibiotics for acute periapical infection before and after drainage, pericoronitis, dry socket and periodontal abscess in which local measure can be effective for their treatment.

The results show that there is a large variation in the antibiotic prescriptions patterns for prophylaxis against infective endocarditis. This study found about 30% of dental practitioners surveyed did not follow the AHA guidelines 2008 in their prophylaxis prescription for patients at risk of infective endocarditis and not allergic to Penicillin.

Furthermore, there is uncertainty as to which cardiac conditions require prophylaxis and for which particular dental procedures, as 12.0% (n=26) of dental practitioners surveyed prescribed antibiotics when performing invasive dental procedure for patients with old myocardial infarction in which antibiotics are not recommended and more than 50% (n=151) of dental practitioners surveyed prescribed antibiotics for bleeding from trauma to the lip or oral mucosa in patients at risk of infective endocarditis in which antibiotics are not recommended (AHA guidelines 2008).

The results also demonstrate that there is a lack of knowledge in the incidence of adverse reactions of some antibiotics and development of multiresistant strains; more than 50% of dental practitioners surveyed did not know the meaning of MRSA. This reveals that there is lack of knowledge with regards to the development of antibiotic resistance and its risk.

There is a clear need for the development of prescribing guidelines, regular monitoring of antibiotic prescriptions by dental practitioners and educational initiatives to encourage the rational and appropriate use of the antibiotics.

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LIST OF ABBREVIATIONS

S.	Streptococcal.
I.E.	Infective Endocarditis.
HACEK	Haemophilus influenza, Actinobacillus actinomycetemcomitans, Cardiobacterium hominis, Eikenella corrodens, Kingella kingae.
AAC	Antibiotic-Associated Colitis.
API	Acute Periapical Infection.
AHA	American Heart Association.
DDD	Defined Daily Dose.
ANUG	Acute Necrotizing Ulcerative Gingivitis.
M.I.	Myocardial Infarction.
MRSA	Methicillin Resistance Staphylococcus Aureous.
MNCG	Malaysia National Clinical Guidelines.

CHAPTER 1

INTRODUCTION

1.1 Background

We live in the "antibiotic era", beginning with the early work of Sir Alexander Fleming in 1929. He found penicillin and it is the first "miracle drug" which saved innumerable lives from scourges such as pneumonia, wound sepsis and bacteremias. Dentists benefited greatly from the discovery of penicillin because most infections are caused by penicillin-sensitive microorganisms (Peterson, 2002; Samaranayake & Johnson, 1999).

Antimicrobial prescriptions in dentistry are justified when they are used as:

- therapeutic aids for surgical treatment of an acute or chronic infection;
- therapy to treat an infective infectious disease, such as acute ulcerative gingivitis; and
- prophylactic to prevent metastatic infection such as infective endocarditis (Al-Haroni, 2008).

Accordingly, antibiotics are invaluable adjuncts in the management of orofacial infection but they are not a substitute for a definitive treatment. Their judicious use can shorten infection periods and minimize associated risks such as the spread of infection to adjacent anatomical spaces or systemic involvement.

There is a widespread concern about the exaggerated use of antibiotics in dental practice and the emergence of resistant bacterial strains (Palmer, et al., 2000a). In recent years, a

shift from narrow-spectrum antibiotic prescriptions to broad-spectrum ones by dentist was reported due to increasing antibiotic resistance (Al-Haroni, 2008). In addition, the empiric use of antibiotic prophylaxis for dental procedures, especially those that cause bleeding in the mouth has become a reasonably well established practice among dental professionals (Thompson, et a!,, 2007).

This misuse of antibiotics is no longer acceptable and dentists must prescribe antibiotics in a judicious and prudent manner to avoid the adverse effects of antibiotics. Furthermore, health authorities are encouraged to monitor the trends in antibiotic prescriptions in order to control antibiotic misuse (Sweeney, et al., 2004).

1.2 A Review of Antibiotic Use in Dental Practice

1.2.1 Antibiotics Use for Odontogenic Infections Treatment

Odontogenic infections are the most common infections of the human body; their complications arc rare but life-threatening demand careful evaluation and opportune treatment aimed for appropriate drainage as well as administration of suitable antibiotic therapy (Perdikaris, et al., 2007).

1.2.2 Management of Odontogenic Infection

According to Peterson (2001) and Flynn (2004); there are certain fundamental steps for the treatment of odontogenic infection to help the dental practitioners to make a decision when treating patients with antibiotics and selecting the most appropriate antibiotics as an adjunct to treat infections. These steps are as follows:

First step - Presence of infection

In most clinical situations, signs are determined for a patient having an infection pain, swelling, surface erythema, pus formation and limitation of motion. Systemically, the patient will also have fever, lymphoadenopathy, malaise, a toxic appearance and an elevated white blood cell account.

Some patients report these symptoms or some, but not all of the signs of infection. In such a situation, the patient has a painful tooth but has no swelling, trismus, elevated temperature, or other sign of infection. In such a situation, an inflammatory process such as pulpitis may occur rather than infection in which the antibiotic therapy is inappropriate. So the clinical judgment is important in making the diagnosis and the clinician should weigh all the information available before making the diagnosis of infection.

Second step - Evaluation of host defense

Host defense mechanisms are the most important factors in the final outcome of a bacterial insult. If the patient presents with any factors that may decrease host defense, the infection may spread rapidly and has an increased chance of becoming severe. In this situation, bactericidal antibiotics will be necessary and removal of the offending tooth is more likely to be indicated than conservative endodontic therapy. Moreover, in severe cases, early referral to a specialist and early hospitalization may be indicated.

Third step - Surgical drainage and incision

The three primary goals of surgical drainage are to remove the cause, drain the pus that has accumulated in abscess space and relieve pressure. Furthermore the surgical drainage may also reduce the use of antibiotic or may increase the effectiveness of antibiotic as the vascular flow is restored.

Fourth step - Antibiotic choice

Once the decision has been made to use antibiotic as an adjunct to treat an infection, the antibiotic should be properly selected. Factors such as host defenses, patient's allergic status and patient drug history are important in antibiotic choice.

In general, a narrow-spectrum antibiotic is preferred over a broad-spectrum antibiotic so that the alteration of the normal host microflora will be kept to a minimum and the drug of the lowest toxicity should be most preferred.

Fifth step - Antibiotic administration

Once the antibiotic is selected, it must be administered properly. This means that the drug should be given by the proper route, in a proper dose and at the proper dosage interval. The use of combination antibiotic therapy should be avoided unless specifically indicated, to reduce the emergence of resistant bacteria.

Sixth step - Patient's monitoring

This is to ensure patient's response to the treatment and to prevent the development of adverse reactions (e.g. allergic reaction and toxicity reaction).

1.2.3 Microbiology of Odontogenic Infection

In recent years the microbiology of odontogenic infections has been clearly defined. The use of improved aseptic and anaerobic techniques for obtaining culture specimens, as well as the use of standard anaerobic culture and identification techniques has resulted in a clear, consistent picture of the usual causative bacteria (Peterson, 2002; Mahmood & Almahmood, 2005). Table 1.1 shows bacteria responsible for odontogenic infection.

Tabic 1.1: Bacteria responsible for odontogenic infections

Aerobic bacteria	Frequency	Anaerobic bacteria	Frequency
Gram-positive cocci			
Streptococcus			
Viridans	Very common	Gram-positive cocci	
P-Hemolytic	Unusual	*Streptococcus*	Common
Group D	Rare		
Staphylococcus	Rare		
Gram-negative bacilli		Gram-negative bacilli	
Haemophilus influenza	Rare	*Porphyromonas (Bacteroides)*	Rare
Escherichia coli	Rare	*Prevotella (Bacteroides)*	Very common
Klebsiella	Rare	*Fusobacterium*	Common
Eikenella corrodens	Unusual	*Acteroides fragilis*	Rare

(Adapted from Peterson, 2002)

According to Peterson (2002) the typical odontogenic infection is caused by a mixture of aerobic and anaerobic bacteria and approximately 70% of these infections are caused by this mixed flora. Infections caused by aerobic bacteria only are less common, account for approximately 5%. Similarly, pure anaerobic infections are seen in only approximately 25% of odontogenic infections.

The aerobic bacteria found in the odontogenic infections are primarily gram-positive cocci, most of which are of the viridance type of streptococci. These streptococcal species include *Streptococcal milleri, S. sanguis, S. salivarius and S. mutans.* **These oral** streptococci, also known as *a-hemolytic cocci,* account for approximately 85% of the aerobic bacteria found in odontogenic infections.

Peterson (2002) also reported that there is other species such as *S. pyogenes*, a few *Staphylococci* and a variety of other bacteria that appear to play non pathogenic role may be isolated occasionally from odontogenic infection.

The aerobic component of the mixed aerobic-anaerobic bacteria causing odontogenic infections consists mainly of *a-hemolytic streptococci* and all are susceptible to penicillin and other antibiotics with similar antimicrobial spectrum to that of penicillin.

The number of anaerobic bacteria found in the typical odontogenic infection is greater than of aerobic bacteria. There are two major groups of anaerobic bacteria: anaerobic gram-positive cocci and anaerobic gram-negative rods.

Anaerobic gram-positive cocci are found in approximately one third of odontogenic infections and account for approximately 30% of the anaerobic bacteria isolated from these infections. Their antibiotic susceptibility is similar to that of aerobic *streptococci;* i.e. sensitive to penicillin and to other antibiotics with antimicrobial spectrum similar to penicillin.

Anaerobic gram-negative rods account for approximately 50% of the anaerobic bacteria isolated from odontogenic infections. The two important genera of anaerobic gram-negative rods are *Bacteroides* and *Fusobacterium.*

There are two main groups *of Bacteroides:* the first is the oropharyngeal group, which is found in the mouth and contributes to odontogenic infection. The other group, the enteric *Bacteroides*, is found in the gut. *Oropharyngeal Bacteroides* has been reclassified into two separate genera: *Porphyromonas* and *Prevotella.*

Prevotella is the gram-negative anaerobic rod isolated from odontogenic infections and it has a natural resistance to penicillin; between 40% and 80% are resistant (Handal, et al., 2003).

The other important group of anaerobic gram-negative rods is the genus *Fusobacterium. Fusobacteriiim* organisms are quite pathogenic and can destroy tissues through production of proteolytic enzymes and endotoxins. *Fusobacterium* organisms are usually sensitive to Penicillin and Penicillin-like drug, but they are frequently resistant to erythromycin. In fact, approximately 50% of *Fusobacterium* organisms isolated from odontogenic infections are resistant to erythromycin (Peterson, 2002).

The mixed odontogenic infection occurs primarily through the entrance of aerobic bacteria to the underlying tissue; during this time the infection is established and cellulitis develops. The cellulitis process, if left untreated, produces a hypoxic acidotic condition in the tissue that allows the proliferation and in-growth of anaerobic bacteria. The anaerobic bacteria then produce a variety of proteolytic enzymes, endotoxin and exotoxins which can cause tissue destruction, combined with the ingress of large numbers of white blood cells that result in the formation of an abscess cavity and pus. If the infection becomes defined and marginated by the body's host defenses, the aerobic bacteria are eradicated from the infection and it is populated by only anaerobic bacteria. Early cellulitis is the result primarily of *streptococcus,* the typical moderate to severe infection caused by a combination of aerobic and anaerobic bacteria and a well-circumscribed chronic abscess is caused by anaerobic bacteria alone (Zalelnik & Kasper, 1982).

1.3 **Prophylactic Antibiotic** Use

Antibiotic prophylaxis is the administration of antibiotics for the purpose of preventing microbial colonization and reducing the potential of postoperative complications (Corgel & Sonis, 2001). In dental practice the antibiotic prophylaxis is used either for preventing complications after dental surgery or in patients at risk of infective endocarditis.

1.3.1 Infective Endocarditis (I.E.)

I.E. is an infection of the lining of the heart chambers (endocardium) or the heart valves. It is caused by microorganisms, usually bacteria, but sometimes fungi or other types of microorganisms that enter the bloodstream and lodge in the heart. These microorganisms occur naturally and harmlessly in other parts of body, such as the mouth or the urinary tract, and may enter the bloodstream from any tiny cut or breakdown of tissue.

The presence of bacteria in the bloodstream (which is called bacteremia) does not necessarily lead to infection, and not all bacteria are even capable of causing endocarditis; it is a relatively uncommon disease (Lipsky, et al., 2008).

Though it is an uncommon disease, it is a serious infection with a high mortality rate; this is why prophylactic administration of antibiotic is recommended for patients who are at risk of endocarditis and on whom dental procedure or oral manipulation is most likely to cause bacteremia performed.

It is not possible to make recommendations regarding antibiotic prophylaxis for all clinical situations; however, there are general principles guiding the selection of a regimen of antibiotic prophylaxis (Corgel & Sonis, 2001):

- Benefits from prophylaxis outweigh the risk of antibiotic-related allergy, toxicity, superinfection and the development of drug-resistance microbial strains.
- An antibiotic loading dose should be used.
- The antibiotic should be selected based on the organism most likely to cause an infection.
- Before the spread of microorganisms, the antibiotic should be present in blood and target tissues.
- Antibiotic prophylaxis should be continued as long as contamination from the operative site persists.

Recently the American Heart Association (AHA) revised their guidelines for the use of antibiotic in the prevention of I.E. and the use of prophylaxis antibiotic for patients susceptible to I.E. (AHA guidelines 2008).

1.3.2 The Etiology of I.E.

Streptococcus sanguis is generally regarded as the most common causative microorganism of I.E. Some studies, however, have detected a decline in *S.* I.E. and an increase in I.E. caused by *Staphylococcus aureus, staphylococcus epidermidis,* and HACEK *(Haemophilus influenza, Actinobacillus actinomycetemcomitans, Cardiobacterium hominis, Eikenella corrodens, Kingella kingae)* (Corgel & Sonis, 2001; Krcmery, et al., 2003).

1.4 The Most Used Antibiotics in Dental Practice

Antibiotics are chemical substances that are able to kill or inhibit the growth of bacteria. Approximately 20 distinct antimicrobial drugs are present, and about half of these are used in the treatment of orofacial infection. Antibiotics can be classified according to their mechanism of action (Sanz & Herrera, 2001). Table 1.2 demonstrates the pharmacology of commonly used antibiotics in dental practice.

Table 1.2: Pharmacology of commonly used antibiotics in dental practice

Drug type	Mechanism of action*	Route of administration*	Excretion*	Major adverse effects**	Spectrum**
Penicillin G	Inhibition of cell wall synthesis	IM, IV	Renal	Allergy	Streptococcus, Staphylococcus, Neisseria, Treponema, Actinomyces, anerobes
,.„„„V	Inhibition of cell wall synthesis	Oral	Renal	Allergy	Same Penicillin G
Amoxicillin	Inhibition of cell wall	Oral	Renal	Allergy	Gram - negative cocci and gram-negative bacilli
Amoxicillin /clavulanic	Inhibition of cell wall	Oral	Renal	GI upset & allergy	As amoxicillin and inhibiting p-lactamase activity
Cephalosporins	Inhibition of cell wall	Oral	Renal	Allergy	Gram-positive &
Vancomycin	Inhibition of Cell wall	IV, Oral	Renal	Phlebitis	Gram- positive
Tetracyclines	Inhibition of protein	Oral	Renal	—	gram- negative, treponemas, mycoplasmas, Chlamydia, rickettsiae and
Erythromycin	Inhibition of protein	Oral	Hepatic	Gl upset	Gram - positive facultative anaerobic & strict anaerobic
Azithromycin	Inhibition of protein	Oral	" -	Gl upset	Gram - positive aerobes, gram - negative aerobes, stict anaerobes, Actinobacillus actinomycetemc Porphyromonas gingivalis
Clindamycin	Inhibition of protein	Oral	Hep*,	0 , u p »	Like erythromycin
Metronidazole	Interference with nuclic synthesis	Oral	Renal	Nausea	Only anaerobic bacteria

(Adapted from Sanz & Herrera, 2001 *; 1 lupp, 2002**)

1.4.1 Inhibition of Cell Wall Synthesis

P - Lactam antibiotics

Antibiotics of the P-lactam class remain the mainstay for prevention and treatment of most bacterial infections of the head and neck because of their effectiveness and relative safety. These antibiotics inhibit replication of susceptible bacteria by interfering with cell wall cross-linking and killing them by activation of murein hydrolases that break down cell walls.

Resistance to the p-lactam antibiotics occurs when bacteria can synthesize P-lactamase which breaks the P-lactam ring and neutralizes the antibiotic or there are some bacteria that alter the permeability of penicillin into the cell wall by changes in penicillin-binding proteins (Hupp, 2002).

P-lactam antibiotics include Penicillins and Cephalosporins which have similar chemical structures.

A. **Penicillins**

Penicillins can be sub-classified on the basis of their antibacterial activity:

- Natural penicillin (penicillin G); this is the only natural penicillin still in use.
- Pencillinase-resistant Penicillins, including isoxazolylpenicillins (oxacillin sodium, cloxacillin sodium, dicloxacillin sodium).
- Aminopenicillins, including ampicillin—like agents and amoxicillin.
- Expanded-spectrum Penicillins, including ureidopencillins (ticarcillin, azlocillin, mezlocillin sodium, piperacillin).
- Carbapenems (imipenem, meropenem).
- Monobactamse (aztreonam).
- P-lactamase inhibitors which have a weak antibacterial activity and are used in combination with other Penicillins and Cephalosporins. This group includes clavulanic acid, sulbactum and tazobactam (Sanz & Herrera, 2001).

The main contraindication to using Penicillins for the treatment of susceptible bacteria is hypersensitivity. The incidence of allergy to Penicillins ranges from 1% to 10 % among various populations. Most hypersensitivity cases are limited to dermatological reaction (2% to 3%), but anaphylactic responses to Penicillins are not unusual, occurring in 0.004 to 0.015 of patients. This incidence represents 75% of fatal anaphylactic reactions in the United States each year (Hupp, 2002).

Penicillin G

Mode of action: Inhibits cell wall synthesis, leading to loss of cell wall integrity.

Spectrum: Penicillin G is mainly active against gram positive bacteria including *streptococci, staphylococci* (excluding most *Staphylococcus Aureus, Clostridia,* and *Coryne* bacteria and some gram negative cocci, including *Neisseria Meningitides).* Among gram negative anaerobes, it is active against the *Fusobacterium* and *Porphyromonas* species.

Absorption: Because of its erratic oral absorption, penicillin G is usually given parenterally to obtain complete absorption, though the chance of allergy developing is increased by injection. The typical adult dose is 2 to 5 million units administered intramuscularly. Procaine penicillin G is a longer acting formulation used to achieve adequate serum levels for 8 to 12 hours. Levels remain effective for 1 to 2 days when the drug is administered intramuscularly.

Distribution: Widely distributed throughout the body, it crosses the placenta but not the blood-brain barrier in healthy individuals, and it is excreted in breast milk in low concentration.

Metabolism: Metabolism of parenterally administered penicillin is minor; the chief metabolites are the corresponding penicilloic acids (Pratt & Fekety, 1986).

Excretion: This antibiotic is cleared by the renal system. Dosage in patient with impaired renal function should be decreased.

Adverse effects: It includes hypersensitivity (0.6% to 10%), fatal anaphylaxis, diarrhoea and other gastrointestinal disturbances. At a high dose, toxic effects such as haemolytic anaemia, encephalitis and nephritis may occur.

Penicillin V

Identical to penicillin G except that penicillin V is acid stable and administered orally.

Amoxicillin

Mode of action: Amoxicillin has a quicker bactericidal action than ampicillin.

Spectrum: It is a broad spectrum antibiotic. It is less effective than penicillin G against gram positive *cocci* but more active against gram negative *cocci* and gram negative *bacilli.*

Absorption: It is very well absorbed by enteral route; it has a bioavailability of 70% to 80%.

Distribution: It has good diffusion to organic fluids and infected tissues. It does not pass the blood-brain barrier in healthy patients, but an adequate level has been detected in surgical patients. Very low levels are secreted in breast milk.

Metabolism: Amoxicillin is primarily excreted unchanged by tubular secretion; 10-15% is converted to penicilloic acid (Finch, et al., 2003).

Excretion: 60% is eliminated by urine during the first 4 hours.

Adverse effects: Amoxicillin's adverse effects are similar to those of penicillin G.

Amoxicillin/clavulanic acid

Spectrum: This antibiotic is resistant to penicillinase (p- lactamases) and is indicated for infection which is caused by penicillinase-secreting staphylococcus and shown by antibiotic susceptibility testing to be susceptible to semi-synthetic Penicillins.

Although clavulanic acid has a low antibacterial activity, it extends the spectrum of amoxicillin by inhibiting |J-Iactamase activity; thus improving their ability to eradicate bacteria such as *Staphylococcus Aureus* and *Haemophilus Influenzae.*

Absorption: Clavulanic acid is well absorbed orally; allowing maximum serum levels to be reached in less than I hour, and has a bioavailability of 75%.

Distribution: The combination has a good diffusion to organic fluid and infected tissues.

Metabolism: It appears to be metabolized extensively with metabolites eliminated via the urine, bile, faeces and lungs. Variation in the bioavailability may be related to difference in first-pass effects through these organs (Finch, et al., 2003).

Excretion: It is excreted mainly al glomerular level. 40% of the clavulanic acid is eliminated by urine during the first 3 hours; it is also eliminated via faeces, and it is metabolized in the liver.

Adverse effects: Gastrointestinal problems including nausea, vomiting, diarrhoea and pain affect 8% of those who take it and allergic reaction and *Candida* superinfection may also occur.

B. Cephalosporins

Cephalosporins are another important group of p-lactam antibiotics. Fortunately, they are less susceptible to P-lactamases compared with natural penicillin. They have been classified according to their generation into:

- First generation: Cephalothin, cephalexin, cephatrizine.
- Second generation: Cefuroxime, cefamandole, cefaclor.
- Third generation: Cefoperazone sodium, cefotaxime, moxalactam.
- Fourth generation: Cefepime, cefpirome.

Mode of **action:** Like Penicillins, Cephalosporins are bactericidal and inhibit cell wall synthesis.

Spectrum: The first generation agents have the greatest gram-positive activity, but as the generation numbers increase, the gram-positive coverage decreases somewhat while the effectiveness for gram-negative bacteria increases.

Absorption: Most Cephalosporins are not absorbed well after oral administration and thus some generations are only available for intramuscular or intravenous administration.

Distribution: Cephalosporins are widely distributed throughout the body. Most of the dose is excreted via urine within 4 to 6 hours. They cross the placenta but not the blood -brain barrier (not useful in meningitis) and are excreted in breast milk in low concentration.

Metabolism: Cephalosporins are deacetylated by liver esterases to form derivatives that are less active than the parent compounds. Both the unaltered drug and the deacetylated metabolites are eliminated in the urine (Pratt & Fekety, 1986).

Excretion: Cephalosporins are cleared by renal glomerular filtration.

Adverse effects: Allergic reaction, including possible cross-reactivity with Penicillins, is seen in approximately 10% of patients. Other possible effects are haemolysis, renal damage, oral moniliasis, local pain tissue sloughing at the injection site, rash, urticaria, fever, gastrointestinal disorders, glossitis, neutropenia and superinfection with *Pseudomonas* and *Enterbacter* species.

Glycopeptides (Vancomycin Hydrochloride)

Vancomycin is mainly used in gram-positive infections unresponsive to P-lactam antibiotics or in patients who are sensitive to P-lactam antibiotics.

Mode of action: Vancomycin Hydrochloride, a bactericidal agent, inhibits peptidoglycan synthesis by interfering with chain lengthening.

Spectrum: Vancomycin hydrochloride is effective against all gram-positive bacteria. Bacterial resistance to the agent is extremely uncommon but has been reported in strains of *enterococci.*

Distribution: Vancomycin enters many tissues and fluid compartments but does not enter cerebrospinal fluid in amount adequate for therapeutic need.

Metabolism: Vancomycin is poorly metabolized and it is excreted unchanged in urine (Vacher, et al., 2002).

Adverse effects: Vancomycin is administered intravenously but requires very SIQW infusion. Otherwise, patients may experience unpleasant symptoms, including flushing, muscles spasm, chest pain and a decrease in blood pressure. This reaction to infusion of vancomycin is called "red man syndrome".

1.4.2 Inhibition of Protein Synthesis

A. Tetracyclines

Tetracyclines are classified according to their pharmacological action:

- Short action: Chlortetracycline, oxytetracycline and tetracycline.
- Intermediate action: Demeclocycline.
- Long action: Doxycycline and minocycline.

Mode of action: This group of drugs, which are bacteriostatic at a common concentration, bind to the 30S ribosomal subunit, leading to inhibition of protein synthesis. Besides their antibacterial properties, several non antimicrobial benefits have been reported, including inhibition of host collagenase and enhancement of periodontal reattachment and bone formation.

Spectrum: Tetracyclines provide adequate antibacterial action but the rapid appearance of resistance limits their utility; they are broad-spectrum antibiotics effective against gram-positive and gram-negative bacteria: *Treponemas, Mycoplasmas, Chlamydiae, Rickettsiae and Protozoa.* Minocycline may be active against *Staphylococci.*

Absorption: As Tetracyclines bind to calcium, antacid and dairy products may inhibit absorption and approximately 70% is absorbed orally. Doxycycline and minocycline are absorbed approximately 100% and 95% respectively; doxycycline may be taken with food or milk.

Distribution: Tetracyclines are widely distributed throughout the body. They concentrate in gingival crevicular fluid at a higher level than in plasma. They cross the placenta and are present in breast milk in low concentrations.

Metabolism: The metabolism of Tetracyclines has not been well defined. 30% of a dose of minocycline is accounted for by bioassay in urine and faeces, suggesting that the

remaining drug may be indicated by metabolism or chelation. Some metabolism of doxycycline occurs, because the half-life is reduced to approximately 7 hours in patients who are receiving drugs like Barbiturates or Phenytoin, which induce the hepatic drug metabolizing system (Pratt & Fekety, 1986).

Excretion: Tetracyclines are excreted via the renal system by glomerular filtration.

Adverse effects: Gastrointestinal disturbance, discoloration of bone and teeth and growth disturbance of teeth are the most adverse effects of Tetracyclines. The effect on teeth contraindicated their use in pregnant patients and children. Photosensitivity reactions are also common; hepatotoxicity and nephrotoxicity may occur at a high dose. The incidence of allergic reactions is uncommon.

Drug variations: There are different formulations of Tetracyclines as locally delivered agents for the adjunctive treatment of periodontitis. These formulations include ointments, irrigation solutions, acrylic strips, dialysis tubing, gels for root conditioning, and different types of fibers.

B. Macrolides

Macrolides are frequently useful for maxillofacial infections. These antimicrobials are bacteriostatic which interfere with protein synthesis. Although its dose does not kill the organism, this interference with protein manufacture neutralizes the bacteria.

Resistance to macrolide antibiotics may occur by receptor site alteration or bacterial modification of the antibiotic. Gram-negative bacteria can resist macrolides inherently; methicillin-resistant *Staphylococcus Aureus* infections are macrolide resistant.

Erythromycin

Mode of action: Erythromycin inhibits protein synthesis via an unknown action against ribosomal function.

Spectrum: Erythromycin is active against gram-positive facultative anaerobic and strict anaerobic bacteria.

Absorption: Erythromycin base has a low solubility and is destroyed by gastric acid. To protect the drug, enteric-coated capsules may be used, but this may be counter-productive, resulting in incomplete absorption. Esters of erythromycin with stearate, estolate and succinate improve absorption.

Distribution: Erythromycin is distributed to most body tissues, with peak blood levels occurring 1 to 4 hours after oral administration. The stearate and succinate esters reach similar serum levels while the estolate compound reaches 3 to 4 times higher concentrations. Low levels are reached in the gingival crevicular fluid. It is secreted in breast milk, passes the placenta barrier and reaches the cerebrospinal fluid in meningitis.

Metabolism: It is not clear how extensively the drug is metabolized by human. Studies in animals show that erythromycin is inactivated by N-demethylation in the liver (Pratt &Fekety, 1986).

Excretion: Via urine and bile.

Adverse effects: It is well tolerated by most patients, although gastrointestinal symptoms such as vomiting, nausea and diarrhoea have been reported.

Azithromycin (Zithromax)

It is used in some cases of oral infection such as periodontitis, periodontal abscess and other acute oral infection.

Mode of action: It has been shown that an active intake by phagocytes can transport the drug to the infected site.

Spectrum: It is a broad-spectrum antibiotic; it's effective against gram-positive and gram-negative aerobes and strict anaerobes. Azithromycin has also shown activity against *Actinobacillus Actinomycetemcomitans* and *Porphyromonas gingivalis.*

Absorption: Azithromycin has better oral absorption than erythromycin because it has a higher resistance to gastric acid. Its bioavailability is approximately 37%.

Distribution: This drug is characterized by unique pharmacokinetic profile. Its blood levels are high with a high level in saliva, bone and gingival tissues. Azithromycin also reaches very high intracellular concentrations. It is secreted in breast milk.

Metabolism: Most of azithromycin in the body remain unmetabolized and any metabolites occur are not active (Scholar & Pratt, 2000).

Excretion: Its excretion is very slow; levels of the unmodified drug have been detected in the urine 14 days after administration. The principle route of the excretion is hepatic bile.

Adverse effects: Azithromycin is associated with low incidence of side effects. The drug is well tolerated in most individuals, including the elderly and children.

C. **Clindamycin**

Mode of action: This bacteriostatic antibiotic binds to the 50S ribosomal subunit and interferes with protein synthesis.

Spectrum: Its spectrum includes aerobic gram-positive bacteria and facultative and strict anaerobic bacteria.

Absorption: The absorption of clindamycin is almost total after oral administration.

Distribution: It passes readily into most tissues, with special relevance for its active transport to the interior of macrophages and leukocytes (high concentration in abscesses) and into bone tissues. It crosses the placenta barrier but does not pass through inflamed meninges.

Metabolism: Two metabolites of clindamycin, the N-demethyl form and the sulfoxide, have been identified in human bile and urine. Both of the metabolites are bioactive (Pratt &Fekety, 1986).

Excretion: Clindamycin is metabolized in the liver and excreted mainly in bile, but also through urine and feces.

Adverse effects: Diarrhoea is reported to occur in 10% to 20% of patients using clindamycin, and morbiliform eruption appears in 3% to 5% of individuals. An uncommon but potentially serious side effect of clindamycin is the development of pseudomembranous colitis, an intestinal disease caused by overgrowth of *Clostridium difficile*.

Drug variation: A formulation of clindamycin hydrochloride in a gel has been evaluated for local use in the adjunctive treatment of periodontitis.

1.4.3 Interference with Nuclic Acid Synthesis

A. Nitromidazoles

The most important member of this group is metronidazole. Nitromidazoles are bactericidal drugs; they stimulate the production of toxic metabolites able to kill susceptible bacteria.

Metronidazole

Mode of action: Metronidazole is a bacteriocidal drug; it can diffuse into both aerobic and anaerobic bacteria through its metabolites which react with DNA and other macromolecules, resulting in cell death.

Spectrum: Metronidazole is effective only against anaerobic bacteria including those in the oral cavity. This drug can be a useful adjunct to antibiotics with an aerobic spectrum in the treatment of mixed aerobic and anaerobic infection.

Absorption: Metronidazole is well absorbed orally.

Distribution: It passes readily into most tissues and saliva. Metronidazole also crosses the placenta barrier; it is secreted in breast milk and may cause mutagenic effect; therefore, it should not be prescribed to pregnant or nursing women.

Metabolism: Metronidazole is extensively metabolized in the liver by side chain oxidation and conjugation. The two major oxidative metabolites are hydroxy metabolite and an acid metabolite. The hydroxy metabolite appears in substantial concentrations in the plasma and has about 30% of the bioactivity of the unchanged drug. The acid metabolite does not appear in the serum and it is only 2-5% as bioactive as the unchanged drug (Pratt & Fekety, 1986).

Excretion: Metronidazole is excreted by the renal system.

Adverse effects: A disulfiram reaction, caused by the accumulation of acetaldehyde in the blood, can develop in patients who drink alcohol while taking metronidazole. It also potentiates the effect of anticoagulant and may leave a metallic taste in the mouth. Nausea occurs in 12% of patients. Headaches, anorexia and vomiting may sometimes occur. This drug should not be used in pregnant patients.

Drug variation: This drug has a different formulation as an agent for subgingival topical application in irrigation solution, gels, dialysis tubing, acrylic strips and surgical cement.

1.5 Problem Associated with Inappropriate Use of Antibiotic

1.5.1 Toxicity

A toxic reaction is seen rather often with antibiotic use, as penicillin is considered as a drug with an extremely low toxicity potential. However, surgeons who use a wide range of antibiotics encounter various manifestation of toxicity.

The main cause of toxicity is dose related and many are reversible if the diagnosis is made early and the therapy discontinued. The other cause of toxicity is the alteration in the antibiotic metabolism, as most of the antibiotics are metabolised or excreted by the liver or kidney so the functions of these two organs must be noted by dentists before prescribing antibiotics (Peterson, 2001).

One toxic reaction that should be discussed is antibiotic-associated colitis (AAC). The three most common antibiotics that lead to AAC are clindamycin, ampicillin/amoxicillin and Cephalosporins. Each of these antibiotic groups causes about one third of the reported cases of ACC as these antibiotics may alter the colonic flora (overgrowth of Clostridium difficile) which leads to AAC.

The treatment of this condition involves discontinuation of the causative antibiotic, restoration of fluid and electrolytes balance and administration of anti-clostridia antibiotics. The usual antibiotic used is oral vancomycin but metronidazole also may be used.

1.5.2 Allergic Reaction

Allergic reaction is the frequent adverse effect of antibiotics and occurs with all antibiotics; Penicillins and Cephalosporins have the highest incidence of reactions. These reactions may include accelerated anaphylactic (typel) reaction or less severe reactions associated with oedema, urticaria and itching, or they may be delayed reactions presenting only as a low-grade temperature elevation (Peterson, 2002).

1.5.3 Adverse Microbiological Effects

Antibiotics affect not only target bacteria but also the human body microflora; this can lead to overgrowth of opportunistic pathogens (superinfection) or emergence of resistant strains of bacteria.

A. Superinfection

The normal microbial flora of the skin, mouth, outer opening of the urogenital tract and large intestine contains a wide variety of bacteria that colonize the healthy human body. These resident bacteria are normally harmless and maintain an ecological balance. Any antibiotic taken especially the broad spectrum antibiotic, alters the balance of this natural bacterial microflora causing outgrowth of specific species, which may in turn lead to superinfection or secondary infection.

A common super infection or (secondary infection) is the overgrowth of *Candida* in the oral cavity or vagina candidiasis. Candidiasis (thrush) is primarily the result of Penicillin use, which eliminates the gram-positive cocci, and it occurs most commonly after a relatively high-dose, long-term Penicillin therapy. Patients treated for osteomylitis or actinomycosis with Penicillin are susceptible to thrush. When thrush occurs, it should be treated with an antifungal agent such as Clotrimazole.

B. Antibiotic Resistance

Bacterial resistance to antibiotics can be defined either genotypically, where the bacteria carries certain genetic resistance elements or phenotypically and where the bacteria can survive and grow above a certain level of antibiotics in the laboratory. Clinically, the bacteria are able to multiply in humans in the presence of drug concentration during therapy (AI-Haroni, 2008).

It can be either intrinsic or acquired, as its name suggests the intrinsic resistance occurs naturally and is inherent to some bacterial species, whereas for acquired resistance, the bacterial strain can acquire resistance to an antimicrobial drug through different mechanisms (AI-Haroni, 2008).

Over the years, antibiotic use has led to the emergence of infectious bacteria that are resistant to one or more antibiotics; actually there are strains of bacteria today for which only one effective drug treatment is available.

Penicillinase-producing staphylococci are described early and has become a major problem as the widespread use of penicillin has resulted in recognition of "new diseases" caused by antibiotic-resistance species.

Bacterial antibiotic resistance is a global problem and efforts should be directed to prevent the development of antibiotic resistance and this is done by preventing infections from taking place which will eliminate the need for antibiotic use. Optimal use of antibiotics must be ensured when these drugs are necessary and optimal infection control measures should be used to prevent the spread of resistant bacteria (AI-Haroni, 2008).

Table 1.3 summarizes the mechanism of actions, antibiotics spectra, and the main antimicrobial resistance mechanisms of antibiotics mostly used in dental practice.

Tablel .3: Main antibiotics used in dentistry, mechanisms of action, spectrum of activity and main bacterial resistance mechanisms

Drug	Mechanism of	Spectrum	mechanism(s)
Phenoxymethyl penicilllin	Inhibition of cell wall synthesis	Aerobic G+, anaerobic G+, anaerobic G-(narrow-spectrum)	Enzymatic (0-lactamases), alteration of the target site
Amoxicillin, Ampicilin	Inhibition of cell wall synthesis	As above plus haemoghilus spp.(broad-spectrum)	As above
Metronidazole	Inhibition of RNA synthesis	Strict anaerobic bacteria, some facultative anaerobes	Enzymatic (5-nitoimidazole reductase)
Erythromycin	Inhibition of protein synthesis	Mainly G+	modification, enzymatic inactivation and
Clindamycin	Inhibition of protein synthesis	As above plus additional activity on anaerobes	As above
Tetracycline	Inhibition of protein synthesis	Mainly G+ and G-	Active efflux, enzymatic ribosomal protection proteins

(Adapted from Al-Haroni, 2008)

1.6 Problem Statement

Antibiotics are one of the most important groups of drugs used in dental practices. The wise use of antibiotics can reduce any undesirable side effects. Dentists should not assume that antibiotics must be given in all instances of infection; this can lead to unnecessary cost and expose patient to undesirable side effects, such as allergic reaction,

toxicity and adverse microbiological effects (Brown, et al., 1989; Peterson, 2002; Crumpton & McClanahan, 2003, Chan et al., 2006). It is estimated that approximately 5% of the individuals taking antibiotic drug develops some form of these adverse reactions (Van Winkelhoff, Vanden Broucke-Grauls, 2001, Lawler et al., 2005).
Adverse drug interaction during dental therapy are not easily known due to the fact that dentistry practice is often limited to certain class within a community, and any unusual drug response happened in a dental clinic might not be well documented.

The certainty of a true drug interaction depends mainly on the quality and quantity of documentations. Some reactions have been reported for years and are well-documented, where others have been established through extrapolation from limited clinical information. Some suggested interactions are based on the understanding of drug mechanism but were never reported in a clinical situation (Moor, et al., 1999).

Table 1.4: Significance **rating** lor dental drug

Severity rating	
-	Potentially life threatening or capable of causing permanent damage.
Moderate	Could cause deterioration of patient's clinical status: additional treatment or hospitalization might be necessary.
Minor	Mild effects that arc bothersome or unnoticed; should not significantly affect therapeutic

Documentation rating	
Established	Proved to occur in well-controlled clinical studies.
Probable	Very likely, but not proved clinically.
Suspected	Could occur; some good data exist, but more study is needed.
Possible	Could occur; dalu are very limited.
Unlikely	Doubtful; there is no consistent and reliable evidence of an altered clinical effect.

Cumulative rating	
Rating	Definition
-	Major reactions (hut arc established, probable or suspected.
2	Moderate reactions that are established, probable or suspected.
3	Minor reactions that are established, probable or suspected.
4	Major or moderate reactions that are possible
5	Minor reactions that arc possible; all reactions that are unlikely.

(Adapted from Moore, el al., 199'))

Moor, et al. (1999) have attempted to rate significant scale to each drug interaction based on the reaction's severity and the strength of documentation (Table 1.4).

Table 1.5 summarizes the specific interactions associated with antibiotic therapy in dentistry and provides rating significance for each.

Table 1.5: Adverse interactions of antibiotics in dentistry

Possible drug interaction	Significance rating	Mechanism and clinical presentation
Bactericidal antibiotics with bacteriostatic antibiotics	2	Theoretically, bactericidal drugs work best when microbes are actively growing. By inhibiting cell growth, bacteriostatic agents may antagonize the bactericidal agent. This interaction is not demonstrated clinically.
Metronidazole with alcohol	2	Metronidazole produces a disulfiram effect by inhibiting the enzyme acetaldehyde dehydrogenase. Acetaldehyde accumulation can lead to facial flushing, headache, palpitation and nausea.
Metronidazole with lithium	1	Metronidazole inhibits the renal excretion of lithium, leading to elevated lithium blood concentrations. Lithium toxicity—as manifested by confusion, ataxia and kidney damage—can result.
Tetracyclines or other broad-spectrum antibiotics with warfarin or anisindione	4	Broad-spectrum antibiotics are hypothesized to reduce the gut flora that normally synthesize vitamin K, a necessary cofactor for clotting. Since warfarin's and anisindione's anticoagulant mechanism involves an antagonism of vitamin K-dependent clotting factors, an increased risk of bleeding may occur. Interaction appears significant only in patients with poor \ itamin K intake.
Erythromycin, clarithromycin or metronidazole with warfarin or anisindione	1	These antibiotics decrease the metabolism of warfarin and anisindione and can significantly increase prothrombin times and increase the risk of serious bleeding in anticoagulated patients.
Penicillins, Cephalosporins, erythromycin, clarithromycin, Tetracyclines, metronidazole with combined estrogen and progestin oral contraceptives	4	Sporadic case reports have implicated the concomitant ingestion of antibiotics and oral contraceptives with unwanted pregnancies. It is theorized that antibiotics, by decimating the normal gut flora, can interfere with the enterohepatic recycling of the estrogen component of oral contraceptives, thereby leading to subtherapeutic blood levels and ovulation.

(Adapted from Hersh, 1999)

As problems related to inappropriate antibiotics use became apparent and their seriousness became obvious, the need to take steps to control the inappropriate use of antibiotics have been evident through periodic and regular review of antibiotic prescriptions by dental practitioners and development of clear guidelines that help the dentists making the right decision when the need for antibiotics arise.

1.7 Objectives of the Study

The main aim of this study is : to assess the knowledge among dental practitioners in the use of antibiotics for patients with acute dental infection, to compare their prescription with the Malaysia National Clinical Guidelines (MNCG) 2003, and to investigate the prescribing habits of dental practitioners for some clinical dental situations (acute pulpitis, acute periapical infection before drainage, acute periapical infection after drainage, chronic apical infection, pericoronitis, acute necrotizing ulcerative gingivitis, chronic marginal gingivitis, chronic periodontitis, dry socket, cellulitis, dental implant, acute periodontal abscess). The other is to determine their antibiotic prescribing knowledge for prophylactic purpose and compare their prescription with American Heart Association (AHA) guidelines 2008, assess their knowledge regarding the need of cardiac diseases to antibiotic cover and also to determine their knowledge regarding antibiotic cover for denial procedures in patients at risk of I.E.

Specifically, the study will be conducted to fulfil the following objectives:

- To investigate the antimicrobial treatment of acute dental infection (type of antibiotic, dose, frequency and number of days) for patients not allergic/allergic to Penicillin.
- To investigate the use for antibiotics for clinical dental conditions; if there is a positive response, they need to slate what antibiotic will be prescribed.
- To determine the antibiotic regime for patients predispose to I.E.

- To assess dental practitioners' knowledge on which cardiac condition required antibiotic prophylaxis.
- To identify their knowledge on which dental procedures required antibiotic prophylaxis in patients at risk of I.E.
- To assess their knowledge on the use of antibiotics in dental practice.

1.8 Significance of the Study

By assessing how appropriate antibiotic prescriptions in dental practice in both therapeutic and prophylactic purposes, the study essentially highlights the following:

1. To recommend appropriate treatment guidelines in dental practice.
2. To provide useful data for the dental practitioners to upgrade their knowledge regarding antibiotic prescribing.
3. To enhance the awareness from the adverse reactions of antibiotics and the emergence of resistant bacteria and their relation with the inappropriate use of antibiotics.
4. To encourage the dentists' compliance with prophylaxis guidelines.
5. To provide data to improve or update the current antibiotic guidelines.
6. To encourage research on the application of antibiotics in dental practice.
7. To encourage the implementation of the antibiotic guidelines in dental practice.
8. To further highlight the antibiotic prescriptions in dentistry which has not been given priority in the past.

CHAPTER 2

LITERATURE REVIEW

Many antibiotics usage studies have been performed all over the world. The majority of these studies indicate that antibiotics are used when there is no evidence for its use (Roy & Bagg, 2000). Even when there is evidence, the wrong antibiotic may be chosen. Frequently, when the correct antibiotic is chosen it may be given either in the wrong dose, incorrect route of administration or for the wrong duration.

2.1 The Use of Antibiotics in Dental Practice

In dental practice, antibiotics along with analgesics are the most prescribed drugs. Epstein, et al. (2000) showed that the dental practitioners in British Columbia, Canada, write 4.45 prescriptions per week for therapeutic purposes and the antibiotics that they predominately prescribe were amoxicillin (64%), penicillin V (49.9%), erythromycin (9.1%), clindamycin (8.5%), metronidazole (5.0%), tetracycline (3.0%), ampicillin (1.4%) and cloxacillin (1.4%). The authors also noticed that the respondents write 1.15 prescriptions per week for I.E. prophylaxis and amoxicillin is the antibiotic of choice among the respondents. It is prescribed by 89.3% of the respondents (Epstein, et al., 2000).

In Spain, it has been estimated that odontogenic infections are the cause of 10% of all antibiotic prescriptions (Roda, et al., 2007).

Accordingly the high antibiotic usage by dentists and the American Dental Association suggested that dentists are responsible prescribers of antibiotics and play a major role in the global problem of antibiotic resistance (Sweeney, et al., 2004).

2.1.1 Therapeutic Antibiotic Prescribing in Dental Practice

There is evidence that suggests that antibiotic prescriptions by dental practitioners for therapeutic purpose differ significantly. Palmer, et al. (2000) stated that the antibiotic prescriptions among general dental practitioners working in the National Health Services in England varied widely (Palmer, et al., 2000a).

In Kuwait, there is a great diversity in the antibiotic prescriptions among dental practitioners and there is an urgent need for the formulation of evidence-based guidelines (Salako, et al., 2004).

In another study performed on 10% of South Australia dental practitioners, the authors noticed that the dental practitioners have an appropriate knowledge of antibiotic prescriptions but there is also a tendency to over-prescribe. The results showed amoxicillin is the predominant antibiotic prescribed by dental practitioners and there is a tendency towards lower dosages over a long period of time. However the basic principle of antibiotic usage recommended a higher dose over a short period of time (Jaunay, et al., 2000).

The same antibiotic is prescribed by the majority of general dental practitioners in the National Health Service in England and 5.6% of the practitioners prescribed a combination of antibiotics (amoxicillin and metronidazole). Although the recommended antibiotic for acute dentoalveoler infection by the Dental Practitioner Formulary is phenoxymethyl penicillin at a dose of 500 mg, only 8.2% of the respondents prescribed phenoxymethyl penicillin. The authors also noticed that there is a wide range of doses and duration of antibiotics prescribed for dentoalveoler infection. The tendency to

prolong the course of antibiotics by some of the practitioners for a period up to 10 days has been noticed. This kind of prescription could be harmful by selecting resistant bacteria (Palmer, et al., 2000a).

Yingling, et al. (2002) suggested that there is a need for improvement in the prescribing habits of endodontists as there is no change over the 25 years in the prescriptions for irreversible pulpitis, necrotic pulps with no systemic involvement and sinus tracts among members of the American Association of Endodontists. This study however shows that 61.48% of the practitioners' choice is appropriate (phenoxymethyl penicilin 500 mg 4 times daily). The remaining 35.52% of the respondents prescribed antibiotics inappropriately, as they recommended clindamycin 150-450 mg 4 times daily for the treatment of orofacial infection as a first choice for patients allergic to Penicillin; although the top choice for Penicillin-allergic patients is erythromycin. In this study, only 26.65%) prescribed erythromycin (Yingling, et al., 2002).

There are also some studies conducted in other parts of the world (Yemen, Scotland and Jordan) which found that there is a discrepancy in prescribing patterns among dental practitioners and there is a need to educate the dental practitioners about the appropriate use of antimicrobial agents in clinical practice (Roy & Bagg, 2000; Al-Haroni & Skaug, 2006; Sawair, 2006).

2.1.2 The Use of Antibiotics in Specific Dental Conditions

A. Periodontal Diseases

The most common forms of periodontal diseases are gingivitis and periodontitis which are caused by bacteria adjacent to or associated with periodontal structures. These bacteria along with calculus and other local factors are the principle components that perpetuate the disease process, so the therapy of gingivitis and periodontitis requires control of these local factors (Peterson, 2002).

Scaling, root planning and periodontal surgery are the most effective treatment for gingivitis and periodontitis and the antibiotics are seldom necessary for the treatment of these conditions.

In the case of gingivitis, suppression of bacterial plaque adjacent to the gingiva by the physical or chemical means to resolve inflammation and the tissue returns to its previously intact state. Chlorohexidine oral rinse when applied twice daily strongly inhibits supragingival plaque formation and significantly retards gingivitis by 50% to 80%. As chlorohexidine rinse has a little effect on subgingival plaque it cannot be used alone in the treatment of periodontitis. Antimicrobial agents are required in the treatment of periodontitis as the debridement of the subgingival root surface and pocket is almost impossible by mechanical means only (Peterson, 2002).

Therefore, efforts focussed on reducing the subgingival plaque and several systems have been developed for intrapocket delivery (fibre, gel and microsphere). These systems, when combined with mechanical debridement of the pocket, show a significant reduction of probing pocket depth and bleeding (Peterson, 2002). Systemic antimicrobial therapy has been studied extensively in adult periodontitits. Although some studies suggest that a particular antimicrobial may improve the outcome of mechanical therapy, the available evidence does not support adjunctive systemic antimicrobial use in adult periodontitis (Peterson, 2002). Despite the presence of these evidences, Palmer, et al. (2000a) noticed that more than 3% of surveyed general dental practitioners working in England prescribed systemic antibiotics for chronic marginal gingivitis and 14% prescribed systemic antibiotics for chronic periodontitis. In Kuwait 17% of the surveyed dental practitioners prescribed antibiotics for chronic marginal gingivitis and 37% still prescribed antibiotics for chronic periodontitis (Salako, et al., 2004).

B. Acute Periapical Infection

Acute periapical infection (API) is a highly symptomatic inflammatory response of the periapical connective tissue. It originates when the pulpal tissues initiate an inflammatory response to trauma or caries and eventually leads to pulpal necrosis (Matthews et al, 2003).

Because API is due to pulpal necrosis and localized infection, the recommended treatment is the removal of the necrotic tissue. This is generally accomplished by the drainage of infection through the tooth and extirpation of necrotic pulp, incision of the soft tissue and drainage or extraction of the offending tooth. The use of antibiotics as a sole or concomitant therapy in the treatment of API has no additional benefits (Foud, et al., 1996).

If adequate drainage cannot be established through pulpectomy incision and drainage or extraction, antibiotics are commonly prescribed to prevent systemic complications. The incidence of such complications is very rare (Matthews, et al., 2003).

However, there is some confusion in prescribing antibiotics in API condition; up to 75% of patients with painful abscesses and no systemic symptoms may be treated with antibiotic therapy in emergency dental clinics in North and South Cheshire (Dailey & Martin, 2001). And 45% of the members of the American Association of Endodontists in the year 2000 routinely prescribed antibiotics for this condition (Yingling, et al., 2002).

In England, 69% of surveyed general dental practitioners working in National Health Service prescribed antibiotics before drainage and 45% when it is established (Palmer, et al., 2000a).

Salako, et al. (2004) also noticed that more than 46% of general dental practitioners working in Kuwait prescribed antibiotics for patients with API before drainage and 29% prescribed antibiotics after drainage.

C. **Acute Pulpitis**

Acute pulpitis treatment includes opening the tooth, removing the inflamed pulp and cleaning the root canal. Yet there are a significant number of dentists that continue prescribing antibiotics to stop the pain. Palmer, et al. (2000a) showed that 13% of the surveyed general dental practitioners in England used antibiotics for this condition, and this percentage increased in Kuwait where 33% of the surveyed dentists prescribed antibiotics for this condition (Salako, et al., 2004).

D. Dry Socket, Pericoronitis and Acute Periodontal Abscess

Generally, the dental practitioners routinely prescribed antibiotics for these conditions (Palmer, et al., 2000a) although all these three conditions can be effectively treated by local measures. In a Kuwait study, around 72% of surveyed dentists prescribed antibiotics for periodontal abscess and periodontitis and 46% still prescribed antibiotics for dry socket (Salako, et al., 2004).

2.1.3 Prophylactic Antibiotic Prescribing in Dental Practice

In dentistry prophylactic, antibiotics are prescribed either to prevent serious life-threatening complication (I.E.), or to prevent infection following surgical treatment (Jason, et al., 2009).

A. The Use of Antibiotics to Prevent I.E.

I.E. occurs in up to 50 people per million per year and 40% exhibits no known risk factors. It has also been noted that cases of endocarditis involving oral microorganism are related infrequently to dental treatment (Sweeney, et al., 2004). There is also evidence which suggests that a significant minority of I.E. cases may develop following invasive procedures and surgical interventions (Durack, 1995; Scheld & Sande, 2007).

Lonks, et al. (1999) reported a case of endocarditis caused by an isolate *S. mitis* resistant to penicillin and cefotaxime and the patient in this case had recently undergone several dental procedures and was given amoxicillin for prophylaxis (Lonks, et al., 1999).

A study conducted on general dental practitioners working in ten English Health Authorities suggested that a significant number of surveyed practitioners prescribed antibiotics inappropriately, both for surgical procedures and for patients at risk from endocarditis. This study also showed that the practitioners prescribed antibiotic prophylaxis for clinical procedures and medical conditions when there is little evidence to prescribe it (Palmer, et al., 2000b).

Jaunay, et al. (2000) study showed that 90% of respondents to their survey closely follow the American Heart Association guidelines (AHA) for antibiotic prophylaxis for patients with valvular heart disease who undergo invasive dental procedure. They also found that there is a lack of knowledge regards the use of antibiotic prophylaxis for patients at risk of I.E. (Jaunay, et al., 2000).

Epstein, et al. (2000) study concluded that there are discrepancies in the prophylactic use of antibiotics for I.E. and for patients with large joint prostheses. Solomon, et al. (2000) found that there is a need for improved education of hospital based clinicians regarding endocarditis prophylaxis recommendations.

B. The Use of Antibiotics in Surgical Procedures

Dentists commonly prescribe antibiotics after surgical procedures in the belief to reduce the postoperative infection although the incidence of postoperative infection after simple or surgical extractions or soft tissue surgery is very low. Therefore in healthy patients prophylactic administration of antibiotics is not necessary after most dental procedures (Lawler, et al., 2005).

Palmer, et al. (2000b) stated that close to 40% of the practitioners in England prescribed prophylactic antibiotics for surgical extraction and 43.5% prescribed antibiotics for apicectomies. Furthermore, 30% of surveyed dentists in South Australia prescribed antibiotics for surgical procedures where there is no evidence of infection (Jaunay, et al., 2000).

In general, there is a wide variety of the prescription patterns for the prophylactic purpose among dental practitioners both for surgical procedures and for patients at risk of1.E.

2.2 The Use of Antibiotics in Dental Practice in Malaysia

Generally, there is a lack in studies in this field of practice. A study conducted among the Ministry of Health Oral Surgery units in this country showed that there is **a** wide variation in the choice of antibiotics used for surgical prophylaxis and there is widespread use of metronidazole and other broad spectrum antibiotics (ampicillin, amoxicillin, 2nd and 3rd generation Cephalosporins) (Royan, 1999). Another study showed that there are a significant number of dental officers who do not understand the meaning of antibiotic prophylaxis and which drug and regime to use (Kanagaratnam & Kanagalingam, 1998).

There are studies focused on the appropriateness of antibiotics prescriptions by medical practitioners in Malaysia. Lim, et al. (1993) found that there is a great diversity in antibiotics and antibiotic regimes employed in six governmental general hospitals in Malaysia and the study indicated a lack of compliance with guidelines on antibiotic use issued by the Ministry of Health. The authors found that only 20% of the therapeutic prescriptions are based on microbiological test results (Lim, et al., 1993).

Another study performed in six Malaysian general hospitals showed that nearly 80% of antibiotics are prescribed without microbiological test to determine the most causative bacteria. Ampicillin is prescribed at least once by nearly 90% of doctors during the month prior to the survey. The authors also found that doctors' knowledge of local antibiotic resistance is rather poor (Lim, et al., 1995).

The results of these studies showed the diversity in antibiotics use and antibiotics regimens employed. It was evident that there was a lack of compliance to guidelines on antibiotic use issued by the Ministry of Health (Lim, ct al., 1993; Lim, et al., 1995).

2.3 The Effects of Educational Intervention on Rational Use of Antibiotics

The inappropriate use of antibiotics expose patients to the risk of adverse effects such as drug toxicity, long hospitalization period, resistance microorganisms and associated infections. Therefore, it is necessary that strategies are developed to improve antibiotic prescribing (Peterson, 2002; Apisarnthanarak, etal., 2006).

Several programs on the control of antibiotic use such as medical management baseline protocols and guidelines related to antibiotic prescription, continuous education courses in the application of antibiotics in dental practice and clinical audit, have showed their effectiveness on the rational use of antibiotics (Nalhwani & Davcy, 1999). Frccmantlc, et al, (2005) found that the effectiveness of the printed guidelines alone with no active

intervention is small and apparently of uncertain clinical significance. These guidelines become more effective when linked with added educational intervention. Clinical audit with the issuing of guidelines and an educational component can change prescribing practice and leads to more rational and appropriate use of antibiotics in general dental practice (Steed & Gibson, 1997). Palmer, et al. (2001) showed that there is a reduction in the number of prescription for periodontal and periapical abscess, pulpitis, infected sockets, sinusitis and following minor oral surgery.

OCek, et al., (2008) concluded that the course also has the effect of covering the gaps in the knowledge of the dentists in the short term. The study suggested that the long term program plan is needed to rationalize antibiotic prescription. Several studies demonstrated that educational outreach visits can significantly affect prescribing including antibiotic prescribing in medical practitioners (Bernal, et al., 2002; Freemantle, et al., 2002; O'Brien, et al., 2007).

In addition, Seager, et al. (2006) concluded that the strategies based upon educational outreach visits may be successfully employed to rationalize antibiotic prescribing by dental practitioners. They found that antibiotic prescribing by general dental practitioners for acute dental pain can be reduced using academic detailing combined with guidelines while guidelines alone do not affect antibiotic prescribing.

2.3.1 Antibiotic Guidelines for Dental Practitioners in Malaysia

The prescription habits among dental practitioners vary widely between countries and within the country itself. In view of that, the need for the development of antibiotic guidelines for practitioners is important to rationalize the antibiotic prescription of dental practitioners. The available antibiotic guidelines for dental practitioners in Malaysia are described in the following subsequent sections. Section 4 outlined the AHA guidelines for the prevention of I.E.

2.3.1.1 Clinical Management Guidelines of Chronic Periodontitis

The aim of this guideline is to provide information on the management of chronic periodontitis. According to this guideline, antibiotic therapy should not be considered as routine for the treatment of chronic periodontitis, and if antibiotic is needed, it should be given as an adjunct to periodontal therapy.

According to this guideline, adjunctive antibiotic therapy is required for patients:

- who do not respond to conventional mechanical therapy.
- who have Acute periodontal infection associated with systemic manifestations
- who are medically compromised.
- as a supplement in selected patients undergoing non-surgical and surgical periodontal therapy.

Table 2.1 shows the recommended antibiotic dosages which are used as an adjunct in periodontal therapy (adult dosage with normal renal function).

Table 2.1: Recommended adjunct antibiotic of periodontal therapy

Antibiotic	Dosage	Duration
Metronidazole	500 mg tds	8 days
Clindamycin	300 mg tds	8 days
Ciprofloxacin	500 mg bd	8 days
Azithromycin	500 mg daily	4-7 days
Metronidazole+ Amoxicillin	250 mg each tds	8 days
Metronidazole + Ciprofloxacin	500 mg each bd	8 days

(Adapted from Clinical Practice Guidelines Management of Chronic **Periodontitis)**

2.3.1.2 Antibiotic Prophylaxis against Surgical Wound Infection for Oral Surgical Procedures

These guidelines are intended to provide evidence in:

- identifying which oral surgical procedures require prophylactic antibiotic cover against wound infection;
- assisting the surgeons to decide which antibiotics to use and what regime to follow.

According to this guideline, multiple risk factors must be considered before the administration of antibiotics and they are:

- ASA score.
- Length of preoperative stay in hospital.
- Compromised host defenses.
- Insertion of implants and grafts.
- Surgical wound class and duration of surgery.

The recommended doses for adults and for patients with normal hepatic and renal functions are shown in Table 2.2.

Antibiotic	Therapeutic dose	Prophylactic dose
Oral Penicillin (Phenoxymethyl penicillin) (Pen V)	500 mg	lg
IV Penicillin (Benzyl penicillin) (Pen G)	1 mega unit	2 mega units
Oral clindamycin*	300 mg	600 mg
IV clindamycin*	300 mg	600 mg
Oral cloxacillin*	500 mg	lg
IV cloxacillin*	500 mg	lg
Oral Erythromycin (E. Ethyl Succinate) *	400 mg	800 mg
IV vancomycin*	500 mg	lg

*The first dose of prophylactic antibiotic should be given at twice the usual therapeutic dose. Subsequent doses should be given at the therapeutic dose.

(Adapted from Antibiotic Prophylaxis against Surgical Wound Infection)

2.3.1.3 Guidelines for Treatment of Acute Periodontal Abscess

According to the Malaysia National Clinical Guidelines 2003 (MNCG, 2003), the **treatment** of **periodontal** abscess does not differ substantially from other odontogenic infections.

The principles of management of simple dental infections are as follows:

1. Local measure:
   - Drainage.
   - Maintain drainage.
   - Eliminate cause.
2. Systemic antibiotic measures in conjunction with local measures.

The systemic antibiotic regimens which are recommended for empirical use are shown in Table 2.3.

Table 2.3: The systemic antibiotic regimens which are recommended for empirical use according to MNCG

Antibiotic type	0»8c	Daily frequency	Number of days
Phenoxymethyle penicillin	250-500 mg	*	5-7
Amoxcillin	250-500 mg	tds	5-7
Metronidazole	200-400 mg	tds	5-7
If allergic to Penicillin:			
Erythromycin	250-500 mg	qid	5-7
Doxycycline	100 mg	bd	7-14
Clindamycin	150-300 mg	qid	5-7

(Adapted from Guidelines for Treatment of Aeute Periodontal Abscess)

2.3.1.4 Prevention of I.E. Guidelines from the AHA

AHA has made recommendations for the prevention of I.E. for more than 50 years. The 1997 AHA document on the prevention of I.E. stratified cardiac conditions into high, moderate and low-risk (negligible risk) categories, with prophylaxis not recommended for the low-risk group (AHA guidelines 2007).

In 2007 the AHA revised the 1997 document and the same guidelines were republished in 2008. These guidelines have been adopted as references to assess the appropriateness of antibiotic prescriptions for prophylactic purposes among dentists (Wilson, et al., 2008).

A. General Principles

According to Wilson, et al. (2008) the general principles for giving antibiotic prophylaxis are:

1. An antibiotic for prophylaxis should be administered in a single dose before the procedure. If the dosage of antibiotic is inadvertently not administered before the procedure, the dosage may be administered up to 2 hours after the procedure.
2. Some patients who are scheduled for an invasive procedure may have a coincidental endocarditis. The presence of fever or other manifestations of systemic infection should alert the provider to the possibility of I.E. In these circumstances, it is important to obtain blood cultures and other relevant tests before the administration of antibiotics intended to prevent I.E.

B. Regimens for Dental Procedures

Previous AHA guidelines on prophylaxis listed a substantial number of dental procedures and events for which antibiotic prophylaxis is recommended and those procedures for which prophylaxis is not recommended.

In recent revision of the previous guidelines, the committee recommends antibiotic prophylaxis for only patients listed in Table 2.4 who undergo any dental procedures that perforate the oral mucosa Table 2.5.

Table 2.4: Cardiac conditions associated with the highest risk of adverse outeome from endocarditis for which prophylaxis with dental procedures is reasonable

- I i osthetic cardiac valve or prosthetic material used for cardiac valve repair
- Previous infective endocarditis
- Congenital heart disease (CUD)*
- Unrepaired cyanotic CI ID. including palliative shunts and conduits
- Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first six months after the proceduref
- Repaired CI ID with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization)
- Cardiac transplantation recipients who develop cardiac valvulopathy

I * Kxcept for the c id t 1 I tc J above, antibiotic prophylaxis is no longer recommended for I any other form of CUD.

t Prophylaxis is reasonable because endotheliah/alion ol'prosihctic matenal occurs within six months alter the procedure.

Table 2.5: Dental procedures for which endocarditis prophylaxis is reasonable for patients in table 2.4
All dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa.*

* The following procedures and events do not need prophylaxis: routine anesthetic injections through noninfected tissue, taking dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of primary teeth, and bleeding from trauma to the lips or oral mucosa.

In the antibiotics prophylaxis regimens for dental procedure which are shown in table 2.6, amoxicillin is the preferred choice for oral therapy because it is well absorbed in the gastrointestinal tract and provides high and sustained serum concentrations.

For individuals who are allergic to Penicillin, the use of clindamycin, azithromycin or clarithromycin is recommended (Wilson, et al., 2008).

Tabic 2.6: Regimens for a dental procedure

Situation	* -	Regimen: Single dose 30-60 minutes before procedure for adult
Oral	Amoxicillin	2g
Allergic to Penicillins or Ampicillin Oral	Cephalexin^ OR Clindamycin OR Azithromycin or Clarithromycin	2g 600 mg 500 mg

{ Or other first- or second-generation oral Cephalosporins in equivalent adult or pediatric dosage.
§ Cephalosporins should not be used in a person with a liislory ol anaphylaxis, angioedema or urticaria with penicillins or ampicillin.

CHAPTER 3

METHODOLOGY

This study is a questionnaire based survey and is designed to investigate the antibiotic prescribing patterns by dental practitioners in the Klang valley region in Malaysia.

3.1 Questionnaire Design

The questionnaire aims to:

- assess the knowledge of dental practitioners regard the antibiotic prescribing (drug type, dosage, daily frequency, number of days) to treat acute dentoalveolar infection for patients not allergic and for patients allergic to Penicillin.
- investigate their use of antibiotics on some clinical dental conditions.
- determine their antibiotic prophylactic regime for patients at risk of I.E.
- determine their knowledge as to which cardiac conditions required antibiotic prophylaxis in adult patients.
- determine their knowledge as to which dental procedures required antibiotic prophylaxis in patients at risk of I.E.

For the preparation of questionnaire, questions made by past researchers such as Jaunay, et al., 2000; Ocek, et al., 2008; Palmer, et al., 2000a; and others have been carefully studied and some are selected. The questionnaire, has then been validated, tested and modified (pilot study) before the actual data collection.

3.2 Pilot Study

A pilot study was conducted from August to November 2008. The validity of the preliminary questionnaire was checked by 5 experts: 3 clinicians and 2 academicians.

The dentists were asked to check the questionnaire's validity, i.e., to check whether the questionnaire content accurately assesses all fundamental aspects of the topic (Burns, et al., 2008; Singh, et al., 2008). For quantitative research, the validity refers to whether the research truly measures what it was intended to measure. In other words, do the research instruments lead to the main objectives of the research (Golafshani, 2003).

After readjusting the questionnaire according to the experts' comments, the questionnaire was handed over to 50 dental practitioners who are working in the Petaling Jaya and Bangsar districts to analyse its reliability by calculating Cronbach's alpha; Cronbach's alpha: a coefficient whose value is between 0 and 1. If the value exceeds 0.6, then the scale is said to have internal consistency - hence reliable (Singh, et al., 2008).

After readjusting according to pilot study results, the questionnaire was finalized for actual data collection as in APPENDIX A.

3.3 Actual Data Collection

This stage was conducted over the period of January-July 2009. The target population for this study are the dental practitioners in Klang valley region. This includes clinicians, academicians, researchers and others. A list of dentists' names, addresses and contact numbers were obtained from the secretary of the Malaysian Dental Council; there are around 1300 dentists registered in the Klang valley region.

The sample size was determined according to the following equation:

$$s = \frac{Z^2 xp(1-p)}{C,^2}$$

Z= Z value (e.g. 1.96 for 95% confidence level).

P = percentage picking a choice, expressed as decimal (0.5 used for sample size needed).

C|= confidence interval, expressed as decimal (e.g. 0.04=- 4) (Singh, et al., 2008; Bartlett, etal., 2001).

Therefore, for a population of 1300, the sample size is 20%, assuming a response rate of 70% or more (Singh, et al., 2008). Due to the low response rate, typical for this kind of study (Gubins & Scott, 2008), over sampling should be considered to bring the number of answers to the desired value (Fink, 1995; Salkind, 1997).

In the attempt to collect sufficient data, 656 questionnaires were distributed to dental practitioners in the Klang valley. The distribution was carried out as follows:

- Dental faculties: 168 questionnaires were distributed to the dental faculties (University Malaya (UM), University Kebangsan Malaysia (UKM) and University Teknologi MARA (UiTM). The copies of questionnaires were handed to the administrators in the faculties to make sure that the questionnaire reached all dentists working in these faculties. Follow ups were carried out through e-mail and telephone to encourage the staff members to reply.
- Conferences: 268 questionnaires were distributed during 2 conferences.
- By post: 160 questionnaires were sent by post. The questionnaires were accompanied by self-addressed envelops with return postage. After I week, the dentists were reminded through telephone to encourage them to reply.
- Self administration: The questionnaire was handed over to 60 clinicians working in Kajang, Cheras and Subang Jaya. The questionnaire was collected after 1 week. Self-addressed envelops with return postage were sent to those who did not prepare the reply. Follow-up by telephone was carried out to encourage them to reply.

3.4 Data Analysis

By analysing the collected data we aim to:

- determine the antibiotic use, over or under dosage prescribing.
- identify the compliance to antibiotic guidelines (AHA guidelines 2008 and MNCG 2003 guidelines).
- evaluate the statistical significance of various demographic parameters.

After consulting with experts in statistics, it was decided that the following parameters were monitored:

1) Percentage: The overall response rate and percentage of responses for each question are calculated.

2) *P* value: Chi-square and one way ANOVA are utilized to check if there is significant difference in the prescribing habits among dentists according to their qualification, years of experience, their designated position or post. The effect of attending courses on application of antibiotics in dental practice was also evaluated. Chi-square is used to determine whether the prescribing habits differ between two categorical variables (qualification, attending courses on application of antibiotics in dental practice); and one way ANOVA is used to test the differences among three or more means at one time (years of experience, designated position or post) (Chu, et al., 2009).

In order to perform this analysis, the Statistical Package for Social Science (SPSS) version 12.0 was used.

3) Calculation of Defined **Daily** Dose (DDD): The Defined Daily Dose (DDD) can be defined as the assumed average maintenance dose per day for a drug used for its main indication in adults (WHO Collaborating Centre to Drug Statistics Methodology, 2009).

The calculation of DDD facilitate the ability to compare consumption information across time and geography. Different DDDs may be assigned for different drug formulation (parenteral versus oral). DDD for antibiotics used in this study are represented in Table 3.1 (WHO Collaborating Centre to Drug Statistics Methodology, 2009).

I able !.I Delined Daily I)ose of antibiotics

Drugs' name	Defined Daily Dose(Oral)
Amoxicillin	Igm
Amoxicillin Clavulanate	1 gm
Penicillin	2gm
Cephalaxin	2gm
Erythromycin	1 gm
Erythromycin-Ethyle -Succinate) EES)	2gm
Metronidazole	1.5 gm
Tetracycline	1 gm
Azithromycin	0.3 gm
Clarithromycin	0.5 gm
Clindamycin	1.2 gm

(Adapted from Wl lO Collaborating Centre to Drug Statistics Methodology 2009)

The number of DDD is calculated by multiplying the quantity field by the DDD conversion factor. For explanation, consider the following hypothetical example of the application of Anatomical Therapeutic Chemical (ATC)/DDD to single prescription claim which dispensed 14 Ciprofloxacin 500 mg tablets from a pharmacy; in this example, the strength of one tablet is 500 mg and ATC/DDD is 1 gram for Ciprofloxacillin. Each 500 mg tablet is equivalent to 0.5 DDD. Multiplication of the quantity dispensed by a conversion factor of 0.5 equals a total of 7 DDDs dispensed for this prescription (Hutchinson, et al., 2004).

CHAPTER 4

RESULTS

4.1 Pilot Study

The questionnaire clarity, order and familiarity have been verified through the validity study. In addition the confusing, redundant, irrelevant and poorly worded questions have been rectified or removed.

The reliability test has then been performed by calculating Cronbach's Alpha. Twenty five respondents participated at this stage and a Cronbach's Alpha of the questionnaire was found to be 0.651. As Alpha value is higher than 0.60, the results are consistent and thus reliable to analyse the dental practitioners' knowledge with regards to antibiotic prescription (Aripin, 2008).

4.2 Demographics

Table 4.1 shows the details of response obtained during the data collection stage. The table shows that 217 dentists participated in this survey and this represented about 70% of the sample size.

Table 4.1: Response rate

Location	Copies given	Returned answers	Response rate (%)
Pilot study	50	25	50
University Malaya	100	18	18
University Teknologi MARA	38	19	50
University Kebangsaan Malaysia	30	2	6.6
Malayian Dental Association conference	225	69	30.6
UiTM conference	43	21	48.83
By post	160	37	23.12
Selfadministration	60	26	43.33
Total	706	217	30.7

The demographic of the practitioners are represented in Figures (4.1-4.6). Only 16.6% (n=36) of the practitioners had attended a course on the application of antibiotics in dental practice (Figure 4.5) and only 22.1% (n=48) had taken samples from dental infection for culture and sensitivity test (Figure 4.6).

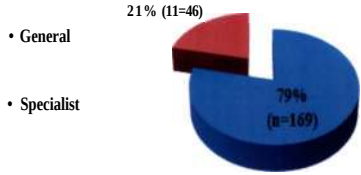


Figure 4.1: Qualificatio

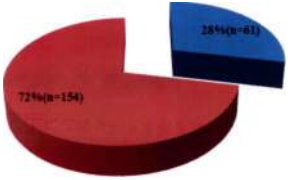


Figure 4.2: Gender

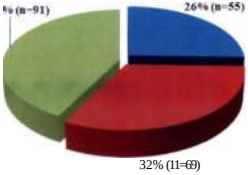


Figure 4.3: Years of experience

- **Lecturers**
- **Clinical dentists**

Researchers *I*

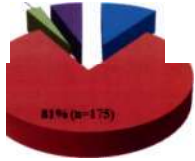


Figure 4.4 : Designated position or post

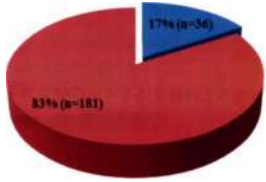


Figure 4.5 : Course attendance

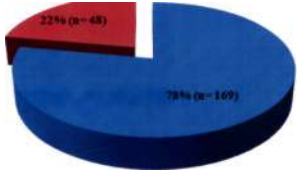


Figure 4.6 : Culture & sensitivity test

4.3 Antibiotic Choice for the Treatment of Acute Dentoalveolar Infection

Figure 4.7 shows the types of antibiotics prescribed by practitioners for adults with an acute dentoalveolar infection for patients not allergic to Penicillin. Table 4.2 shows the daily frequency of dosage and the length of the course for antibiotic choice for patients not allergic to Penicillin. Amoxicillin is the principle antibiotic prescribed as 25.8% (n=56) of practitioners choose this antibiotic as their first choice. The principle dosage of amoxicillin is 500 mg 3 times daily for 5 days; 7.5 DDDs for each prescription (Table 4.3). Metronidazole is also used in combination with amoxicillin for a period of 3-5 days; 7.5 DDDs for each prescription (fable 4.3).

Other antibiotics which are used by 1.8% (n=4) of the practitioners are:

a) Bacampicillin 400 mg 2 times daily for 5 days.
b) Bacampicillin HC1 (Penglobe) 400 mg 2 times daily for 5 days.

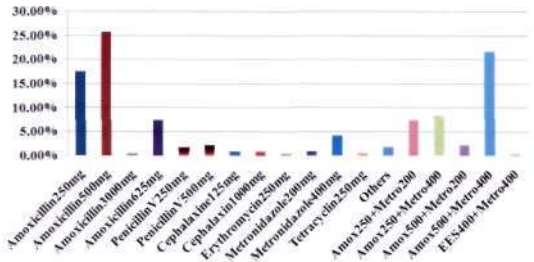


Figure 4.7: Antibiotics prescribed by dentists for treatment of acute dentoalveolar infection for patients not allergic to Penicillin

Table 4.2: Antibiotic prescription by dentists for acute dentoalveolar infection showing frequency of dosage and number of days for patients not allergic to Penicillin

Drug type	Antibiotic dosage(mg)	Daily frequency				Number of days					Total
		1	2	3	4	3	4	5	6	7	
Amoxicillin	250	1	1	50	15	6	7	53	0	1	67
	500	1	8	93	5	9	5	84	0	9	107
	3000	0	1	0	0	0	0	1	0	0	1
Amoxicillin clavulinate	625	0	9	6	0	1	1	11	0	2	15
Penicillin*	**250**	0	0	1	2	0	0	2	0	1	3
	500	0		1	3	0	0	5	0	0	5
Cephalaxin	125	0	0	2	0	0	0	2	0	0	2
	1000		0	1	0	2	0	0	0	0	2
Erythromycin	250	0	0	0	1	0	0	1	0	0	1
Metronidazole	200	1	1	13	6	4	3	13	1	0	21
	400	1	15	45	5	5	4	47	4	6	66
Tetracycline	250	0	0	0	'	0	0	1	0	0	'
Others		0	3	1	0	0	0	3	0	1	4
Total		5	39	213	38	27	20	221	5	20	295

\Tahi\si;] National (linical Guidelines 2003 recommended dose.

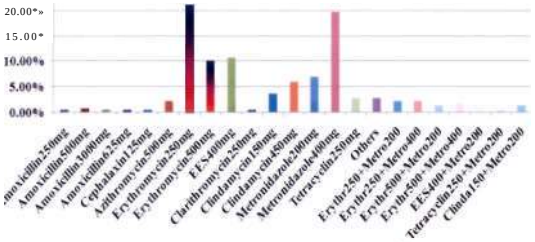
"['able4.3: **1)1)1)** ni'**prescribed** anLi Holies io [real acale denloalveolar irifeeiion tor palii'Ms nol allemk- io **Penicillin**

Drug type	Antibiotic dosage(mg)	DDD
Amoxicillin	250 500	3.75 7.5
Amoxicillin clavulnate	625	6.25
Penicillin	250 500	2.5 5
Cephalaxin	125 1000	0.93 4.5
Erythromycin	250	5
Metronidazole	200 400	1.99 3.99
Tetracycline	250	5

The choices of therapeutic antibiotic to treat acute dentoalveolar infection for patients allergic to Penicillin are shown in Figure 4.8. Table 4.4 shows the daily frequency and number of days for antibiotic choice for patients allergic to Penicillin. Erythromycin (250 mg) is used by 21.2% of practitioners (n=46), 3 times daily for 5 days; 5 DDDs (Table 4.5) followed by metronidazole (400 mg) as 19.8% (n=43) used it for 4 times daily for 5 days; 5 DDDs (Table 4.5).

In addition, there are other types of antibiotic prescribed by dentists (2.8%, n=6) for patients allergic to Penicillin such as;

a) Doxacillin 250 mg4 times daily for 5 days
b) Rodogyl (combination of metronidazole & spiramycin) 250 mg 2-3 times daily for 5-7 days.
c) Doxycycline 100 mg 2 times daily for 8 days.
d) Rodogyl (combination of metronidazole & spiramycin) 125 mg 2 times daily for 4 days.



liyure -LN: Amihhities prescribed b> dentists liir irentment ofaeuie denumluvular in;eetion Inr patients allergic to Penicillin

Table 4.4: Antibiotic prescription by dentists for acute dentoaiveolar infection showing frequency of dosage and number of days for patients allergic to Penicillin

Drug type	Antibiotic dosage(mg)	Daily frequency				Number of days					Total
		1	2	3	4	3	4	5	6	7	
Amoxicillin	250	1	0	1	0	1	0	1	0	0	2
	500	0	0	1	0	0	0	1	0	0	1
Amoxicillin clavulinate	625	0	1	0	0	0	0	1	0	0	1
Cephalaxin	125	0	0	0	1	0	0	0	0	1	1
Azithromycin	500	0	2	2	0	0	2	2	0	0	4
Erythromycin*	**250**	0	2	24	27	4	4	40	1	4	53
	500	0	8	14	6	0	4	24	0	0	28
EES	400	0	16	13	2	4	2	22	0	3	31
Clarithromycin	250	0	0	1	0	0	0	1	0	0	1
Clindamycin	150	0	1	7	2	0	3	7	0	0	10
	450	0	2	11	1	0	2	10	0	2	14
Metronidazole	200	1	2	18	3	2	4	18	0	0	24
	400	0	11	48	0	7	1	45	4	2	59
Tetracycline	250	0	0	1	7	4	0	4	0	0	8
Others		0	4	1	1	0	1	3	1	1	6
Total		2	49	142	50	22	23	179	6	131	243

Malaysia National Clinic 003 recommended dose.

Table 4.5: DDD of prescribed antibiotics to treat acute dentoalveolar infection for patients allergic to Penicillin

Drug type	Antibiotic dosage(mg)	DDD
Amoxicillin	250	3.75
	500	7.5
Amoxicillin clavulnate	625	6.25
Cephalaxin	125	1.75
Erythromycin	250	5
	500	5
EES	400	2
Clarithromycin	250	7.5
Clindamycin	150	1.8
	450	5.6
Metronidazole	200	1.95
	400	4.95
Tetracycline	250	5

There is a significant trend to prescribe antibiotics for treatment of acute dentoalveolar infection for long periods among researchers when compared with other groups. The average prescription period is 6 days; this is significantly higher than other categories. Table 4.6 & 4.7 demonstrate the average prescription period among dental practitioners for acute dentoalveoler infection in patients not allergic and allergic to Penicillin according to their designated position or post.

Table 4.6: The average prescription period among dental practitioners for acute dentoalveoler infection in patients not allergic to Penicillin according to their designated position or post

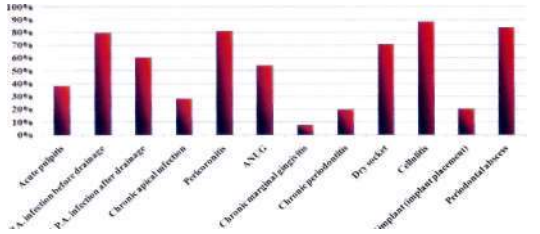
Demographic of the participants according to their designated position or post	Designated position or post
•Lttiras ^N k M f i ^) IOH=23)	Clinical dentists

Table 4.7: The average prescription period among dental practitioners for acute dentoalveolar infection ii patients allergic to Penicillin according to their designated position or post

Demographic of the participants according to their designated position or post	Designated position or post	Number of days	*P* value
iLtdiitn [R]*(~*k 6%(f=13) 104(f=23)	Clinical dentists	4.7	0.021
• fiikidchifors *JM*	Lecturers	4.9	
Resnitikn ^H	Researchers	5.8	
1MEI H . *A*	Others	5.1	

4.4 Prescribing Antibiotics for Specific Clinical Conditions

The percentages of dentists prescribing antibiotics for specific dental conditions are shown in Figure 4.9, with the majority prescribing antibiotics for acute periodontal abscess, pericoronitis, dry socket and API before and after drainage. Although the antibiotics are recommended for the treatment of ANUG, only 54.0% of practitioners (n=1 18) prescribed antibiotics for this condition.



rii'.iirL' 4.[1]J: IV^L'tiUigu ol ik'iilisl[1]. nivstrihiny antibiotics for sped lie dental conditions

4.4.1 Antibiotics Choice

The dentists' choices of antibiotics for the previous dental conditions for medically well patients and not allergic to Penicillin are shown in Figure 4.10. Amoxicillin or metronidazole or a combination of these two antibiotics are the most common antibiotics used for the conditions. This figure highlight the three highest percentages of antibiotics used.

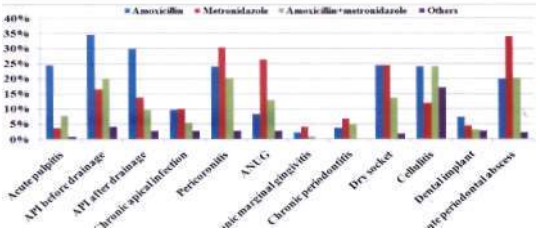


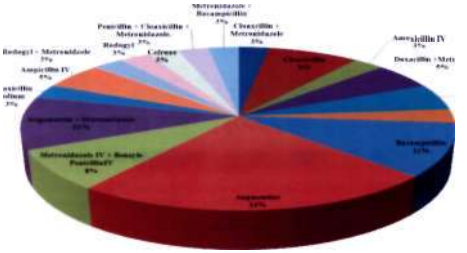
Figure 4.10: Dentists' choices of antibiotics lor the specific denial conditions tor patients medically well and not allergic lo Penicillin

In addition, there are other types of antibiotics which have been prescribed by some dental practitioners for previous clinical situations (Table 4.8).

Table 4.8: Other antibiotic choices by dentists for specific clinical conditions

Antibiotic types	Clinical conditions								
	pSs	API drainage	API after drainage	(limine infection	Pericoronitis	ANUG	so^et	Denial	periodontal abscess
Bacampicillin	'	v	*j*	*			'	Λ	
Doxacillin Metronidazole		V	V	'	V	<	Λ		"
Bacampicillin Penicillin syrup		V	V						
Rodgyl		V			V		V		
Augementine		V	'					'	
Cloaxicillin Metronidazole		V							V
Cloaxicillin			V						
Penicillin					V			'	
Tetracycline Chlorohexidine mouth rinse						V			
Doxycycline						V	V		
Rodogyle Metronidazole									V
Bacampicillin HCL Metronidazole									V

For cellulitis, this study shows that there is a wide variation of antibiotic prescriptions for this condition (Figure 4.11).



J-'iiiuiv 1.1 1 ; (>-JKT unlihiiuk choices In dentists for cellulitis

4.5 Antibiotics Prophylaxis for Patients at Risk of I.E.

The prophylactic antibiotic regimes used by dentists for patients not allergic to Penicillin are shown in Figure 4.12. A 2gm of amoxicillin 1 hour before procedure is provided by 66.4% (n=!44) of the practitioners. Amoxicillin 3 gm 1 hour before procedure and 1.5 gm 6 hours after procedure is used by practitioners (29.5%, n=64).

1

Figure 4.12: Antibiotic propjt_\ la vis regimes use J b> dentists lor patients predisposed **to** L!-!, **not** allergic to **Penicillin**

The antibiotic regimes used by dentists for patients allergic to Penicillin are shown in Figure 4.13. Clindamycin 600 mg 1 hour before procedure is used by the majority of the practitioners, followed by cephalaxin 2gm 1 h. before procedure.

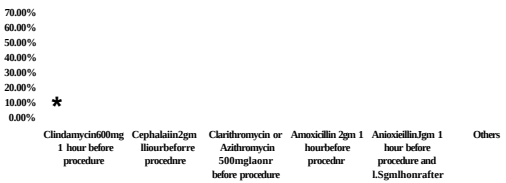


Figure 4.13: Antibiotic prophylaxis regimes used by dentists for patients predisposed to I.E. allergic Penicillin

4.6 Cardiac Conditions Requiring Antibiotic Prophylaxis

Table 4.9 shows that the majority of dentists prescribed antibiotics for patients with previous I.E., prosthetic heart valve, unrepaired cyanotic heart disease and mitral valve incompetence.

Table 4.9: Dentists' responses to which cardiac conditions require antibiotic prophylaxis in adult patients lor inuisixc denial procedure

Patients' conditions	*Yes* response (Percentage)	Didn't know (Percentage)
Unrepaired cyanotic congenital heart disease	70.0 (n=152)	8.3 (n=18)
Previous I.E.	94.9 (n=206)	0.9 (n=2)
Prosthetic heart valve	86.6 (n=188)	1.8 (n=4)
Mitral valve incompetence	70.0 (n=152)	5.1 (n=11)
Innocent heart murmur	13.0 (n=28)	4.2 (n-9)
Recent MI	27.2 (n=59)	6.9 (n=15)
Rheumatic fever	51.2 (n=111)	3.2 (n=7)
Old MI	12.0 (n=26)	3.2 (n=7)
Pacemaker or an implantable cardiac defibrillator	41.7 (n=90)	7.4 (n=16)

4.7 Dental Procedure Requiring Antibiotic Prophylaxis in Patients at Risk from I.E.

Table 4.10 represents the dentists' responses regarding which dental procedure required antibiotic prophylaxis in patients at risk from I.E. 98.1% (n=213) of practitioners prescribed antibiotics for routine dental extraction for patients at risk of I.E.; more than 50%o (n=151) of practitioners prescribed antibiotics in bleeding situation from lips or oral mucosa.

Table 4.10: Dentists' responses to which dental procedure require antibiotic prophylaxis for patients at risk of I.E.

Procedures	*Yes* response (Percentage)	Do not do it (Percentage)	Do not know (Percentage)
Placement of rubber dam	20.3 (n=44)	16.1 (n=35)	0 (n=0)
Tooth extraction	98.2 (n=2!3)	0 (n=0)	0 (n=0)
Placement of orthodontic band	27.2 (n=59)	9.7 (n=21)	0.5 (n=1)
Placement of orthodontic bracket	9.2 (n=20)	10.1 (n=22)	0.5 (n=1)
Endodontic debridement where instruments are not passed through the root apex	29.6 (n=64)	4.1 (n=9)	0.5 (n=1)
Endodontic obturation (post placement and build up)	14.3 (n-31)	3.7 (n=8)	0.9 (n=2)
Taking of oral radiograph	8.3 (n=18)	0 (n=0)	0.5 (n=1)
Bleeding from trauma to the lips or oral mucosa	69.9 (n=151)	0.9 (n=2)	0.5 (n=1)

4.8 Knowledge on Some Antibiotics Used in Dentistry

The responses to the general questions on antibiotics are presented in Table 4.11. Generally there are low correct response to abbreviation such as MRSA (Methicillin Resistance Staphylococcus Aureous) is 48.8% (n=104), and for the question on the use of P-lactam antibiotics with bleeding and coagulation disorders is 35.5% (n=77).

Tabic 4.11: (iencral know ledge questions on antibiotics

Questions	Correct answer	Correct response (Percentage)
The advantage of the rational drug use is to increase the quality and decrease the costs of the health care services, f	**True**	**71.9 (n=156)**
Alveolar pent Hal ion **of** [he antibiotics that are **used in dentistry is low. t**	**M s e**	**47.0** (n-102)
fi-lactam antibiotics should be avoided in patients with bleeding and ambulation **disorders, t**	**T„**	**35.5 (n=77)**
Erythromycin is the safest antibiotic **lor asthma patients using theophylline, f**	**False**	**41.0 (n=89)**
In which cardiac conditions the risk of **occurrence of I.E. is lower than the other? %**	**Mitral stenosis**	**57.6 (n=125)**
The most common causative pathogen **in "right - heart "I.E.}**	*S'7JZT*	**40.6 (n=88)**
What is MRSA stand for? **§**	**Methicillin resistance staphylococcus aureous**	**48.4 (n=104)**

f Ocek, Sahin, Bats & Apaydin (2008).

tZarei, Navahie & Chamani (2008).

§ Jaunay, Sambrook & Goss (2000)

4.9 The Prescribing Knowledge and Behavior among Different Dentists Groups

This section demonstrates the statistical significant difference in the antibiotics prescribing knowledge and behavior among the surveyed dentists according to their designated position or post, qualification, years of experience and the effect of attending course on the application of antibiotics in dental practice.

4.9.1 The Therapeutic Prescribing Knowledge and Behavior for the Surveyed Dental Conditions

A. Acute Pulpitis

Figure 4.4 demonstrates the demographic of the dental practitioners according to their designated position or post (clinical dentists, lecturers, researchers and others). A statistically significant difference was noticed between clinicians and other categories when comparing this group with regards to their prescribing habits for acute pulpitis where the clinicians tend to prescribe antibiotics more frequently for acute pulpitis. The average clinicians' prescription is 43.7% (n=76), lecturers 13.0% (n=3), researchers 0.0% (n=0) and others 30.8% (n=4); *P* value < 0.05 (Table 4.12).

Table 4.12: Antibiotic prescribing patterns for acute pulpitis among dentists according to their designated position or post

Demographic of the participants according to their designated position or post	Designated position or post	Percentage of dentists prescribing antibiotics for acute pulpitis according to their designated position or post	*P* value
• Lettnrtn 3H(i=6K 6*,(B=13) 10% (n=23) • Clinical demists Rsnrdns H ^ H ^ ^ H ^ B	Clinical dentists	43.7% (n=76)	0.006
	Lecturers	13.0% (n=3)	
	Researchers	0.0% (n=0)	
	Others	30.8% (n=4)	

B. Acute Periapical Infection before Drainage

Table 4.13 shows that there is a statistically significant difference between general practitioners and specialists where the general dentists tend to prescribe more frequent

antibiotics for API before drainage. The average antibiotic prescription for general practitioners is 84.1% (n=143) and specialists 63.0% (n=29), with *P* value < 0.05.

Table 4.13: Antibiotic prescribing patterns for acute periapical infection before according to their qualifu

Demographic of the participants according to their qualification	Percentage of dentists prescribing antibiotics for API before drainage according to their qualification

A significant difference was also noticed between clinicians and other categories where the clinicians tend to prescribe more frequent antibiotics for this condition. The average antibiotic prescription for clinicians are 86.8% (n=151), lecturers 43.5% (n=10), researchers 16.7% (n=l) and others 76.9% (n=10); *P* value < 0.05 (Table 4.14).

Table 4.14: Antibiotic prescribing patterns for acute periapical i nfection before drainage among dentists according to theii

Percentage of the participants according to **their** designated position or post	Designated position or post	Percentage of dentists prescribing antibiotics for API before drainage according to their designated position or post	*P* value
• L e d u m 3H(i=6)^ s u(n-13) my.(i=23) • Clinical d HI this Researchers ^ H ^ B • Others 81S(i=175| -*	Clinical dentists	86.8% (n= 151)	0.000
	Lecturers	43.5% (n= 10)	
	Researchers	16.7% (n=l)	
	Others	76.9% (n= 10)	

C. Chronic Apical Infection

According to figure 4.1, 79% (n=169) of the dental practitioners are general dentists and 21% (n=46) are specialists. The general practitioners tend to prescribe significantly more antibiotics for chronic apical infection than specialists. The average antibiotic prescriptions for general dentists is 32.2% (n=55) and specialists 15.2% (n=7), the correspondent, *P* value < 0.05 (Table 4.15).

Table 4.15: Antibiotic prescribing patterns for chronic apical infection among dentists according to their qualification

Demographic of the participants according their qualification	Qualification	Percentage of dentists prescribing antibiotics for chronic apical infection according to their qualification	*P* value
• Specialist	General	32.2% (n=55)	0.02
	Specialists	15.2% (n=7)	

D. Acute Necrotizing Ulcerative Gingivitis (ANUG)

A significant trend towards less frequent prescribing of antibiotics is seen among researchers compared with the other groups (clinicians, lecturers, others) for ANUG. The average antibiotic prescriptions for researchers is 0.0% (n=0), clinicians 57.1% (n=100), lecturers 34.8% (n=8) and others 76.9% (n=10), *P* value < 0.05 (Table 4.16).

Table 4.16: Antibiot c prescribing patterns for ANUG among dentists according to their designated position or post

Percentage of the participants according to their designated position or post	Designated position or post	Percentage of dentists prescribing antibiotics for ANUG according to their designated position or post	*P* value
• Lecturers 3**(*=6)_ o».(B=i3) io*(,-23) • Clinicil dentists ^ ^ k Researchm ^ H ^ H • Ohras ^ ^ ^ ^ H . ^A	Clinical dentists	57.1% (n= 100)	0.003
	Lecturers	34.8% (n=8)	
	Researchers	0.0% (n=0)	
	Others	76.9% (n= 10)	

E. Chronic Periodontitis

Table 4.17 demonstrates that the general practitioners are significantly more likely to prescribe antibiotics than specialists for chronic periodontitis. The average antibiotic prescription for general dentists is 24.1% (n=41) and for specialists 4.3% (n=2); *P* value <0.05.

Table 4.17: Antibiotic prescribing patterns for chronic periodontitis among dentists according to their qualification

Demographic of the participants according their qualification	Qualification	Percentage of dentists prescribing antibiotics for chronic periodontitis according to their qualification	*P* value
• Specialist	General	24.1% (n=41)	0.003
	Specialists	4.3% (n=2)	

A significant difference was also noticed between researchers and other categories (clinicians, lecturers and others) where the researchers tend towards more frequent prescribing of antibiotics for this condition. The average antibiotic prescriptions for researchers is 50.0% (n=3), clinicians 20.7% (n=36), lecturers 0.0% (n=0) and others 30.8% (n=4); *P* value < 0.05 (Table 4.18).

I able 4.1 K: Aril i hi oik- prescribing **patterns tor chronic periodontitis** aiiioni: dentists **according to their designated position or post**

Percentage ofthe participants according lo their designated position **or post**	**Designated position or post**	**Percentage of dentists prescribing antibiotics for chronic pcriodotitis according** to their designated **position or post**	*P* **value**
•LWuffl w(,=f)A(H{F|3) *mtfty*	**Clinical dentists**	**20.7% (n=36)**	
• CHolUM	**Lecturers**	**0.0% (n=0)**	
	Researchers	**50.0% (n=3)**	**0.003**
	Others	**30.8% (n=4)**	

F. Cellulitis

A significantly less number of antibiotic prescriptions are issued by dentists who have 5-10 years experience compared with other categories. The average antibiotic prescription by dentists who have 5-10 years is 80.3% (n=57), < 5 years is 96.4% (n=53) and I0< years is 90.1% (n=82); *P* value < 0.05 (Table 4.19).

Table 4.19: Antibiotic prescribing patterns for cellulitis among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for cellulitis according to their years of experience	*P* value
	< 5 years	96.4% (n=53)	0.016
	5-10 years	80.3% (n=57)	
	10< years	90.1% (n=82)	

G. Dental Implant

Table 4.20 shows that there is a significant trend to prescribe more frequent antibiotics for dental implants among dentists who have < 5 years experience compared with the other groups. The average antibiotic prescriptions by dentists who have < 5 years is 32.7% (n=18), 5-10 years 15.5% (n=l 1) and 10< years 17.8% (n=16); $P < 0.05$.

Table 4.20: Antibiotic prescribing patterns for dental implant among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for dental implant according to their years of experience	*P* value
~If	< 5 years	32.7% (n= 18)	0.04
	5-10 years	15.5% (n=l1)	
	10< years	17.8% (n= 16)	

"

H. Acute Periodontal Abscess

The average antibiotic prescription for general practitioners differs significantly compared to specialists, where the general dentists tend to prescribe antibiotics more frequently than specialists for acute periodontal abscess. The average antibiotic prescriptions by general dentists is 86.5% (n=148) and specialists 73.9% (n=34); *P* value < 0.05 (Table 4.21).

Table 4.21: Antibiotic prescribing patterns for acute periodontal abscess among dentists according to their qualification

Demographic of the participants according to their qualification	Qualification	Percentage of dentists prescribing antibiotics for acute periodontal abscess according to their qualification	*P* value
21.,(n=4* • **General** | ^ ^ _	General	86.5% (n= 148)	0.039
• **Specialist**	Specialists	73.9% (n=34)	

Table 4.22 demonstrates a significant difference between clinicians and other categories where the clinicians are more inclined to prescribe antibiotics for this condition. The average antibiotic prescription for clinicians is 88.0% (n=154), lecturers 60.9% (n=14), researchers 66.7% (n=4) and others 76.9% (n=10); *P* value < 0.05.

Table 4.22: Antibiotic prescribing patterns for acute periodontal abscess among dentists according to their designated position or post

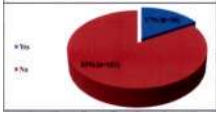
Demographic of the participants according to their designated position or post	Designated position or post	Percentage of dentists prescribing antibiotics for acute periodontal abscess according to their designated position or post	*P* value
• Lwflirm 3^(»‾*)N6W(ii=13) 10H(n=23) **AS** Researchers ^H ^^^^H ^B | lOthen *A*	Clinical dentists	88.0%(n=154)	0.005
	Lecturers	60.9% (n= 14)	
	Researchers	66.7% (n=4)	
	Others	76.9% (n= 10)	

4.9.2 The Prophylactic Prescribing Knowledge and Behavior for the Surveyed Cardiac Conditions

A. Previous I.E.

According to figure 4.5, 17 % (n=36) of the dental practitioners have attended courses on the application of antibiotics in dental practice. When comparing this group with those who did not attend any courses, it was found that there is a significant difference between the groups of dentists. The dentists who did not attend courses tend to prescribe antibiotics more frequently when performing invasive dental procedures for patients with previous I.E. The average antibiotic prescriptions for dentists who did not attend any course was 96.7% (n=175) and 86.1% (n=31) for dentists who attended course on application of antibiotics in dental practice; *P* value is 0.005 (Table 4.23).

Table 4.23: Antibiotic prescribing for previous I.E. among dentists who have and have not attended courses

Demographic of the participants according to course attendance	Course attendance	Percentage of dentists prescribing antibiotics for previous I.E. according to whether they have or have not attended courses	*P* value
	Yes	86.1% (n=31)	0.005
	No	96.7% (n=175)	

B. Prosthetic Heart Valve

The results show that dentists who have less than 5 years experience prescribed antibiotics significantly higher than other categories. The average antibiotic prescription by dentists who have < 5 years is 94.5% (n=52), 5-10 years 78.9% (n=56) and 10< years 87.9% (n=80); *P* value < 0.05 (Table 4.24).

Table 4.24: Antibiotic prescribing for prosthetic heart valve among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for prosthetic heart valve according to their years of experience	*P*
. KKynn	< 5 years	94.5% (n=52)	0.018
	5-10 years	78.9% (n=56)	
	10< years	87.9% (n=80)	

C. Innocent Heart Murmur

This study found that dentists who did not attend any course on the application of antibiotics in dental practice tend to prescribe antibiotics less frequently than other groups when performing invasive dental procedures for patients with innocent heart murmur. The average antibiotic prescriptions by dentists who did not attend any course was 8.9% (n=16) and for dentists who attended courses was 33.3% (n=12); *P* value < 0.05 (Table 4.25).

Table 4.25: Antibiotic prescribing for innocent heart murmur among dentists who have and have not attended courses

Demographic of the participants according to course attendance	Course attendance	Percentage of dentists prescribing antibiotics for previous I.E. according to whether they have or have not attended courses	*P* value
: ^	Yes	33.3% (n=12)	0.000
	No	8.9%(n=16)	

D. Recent Myocardial Infarction (M.I.)

In this study the antibiotics prescriptions issued by dentists who have less than 5 years experience were significantly less than other categories when performing invasive dental procedures for patients with recent M.I. The average antibiotic prescription by dentists who have < 5 years was 12.7% (n=7), 5-10 years was 31.0% (n=22) and 10< years was 33.0% (n=30); *P* value < 0.05 (Table 4.26).

Table 4.26: Antibiot c prescribing for recent M.I. among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for recent M.I. according to their years of experience	*P* value
	< 5 years	12.7% (n=7)	0.001
	5-10 years	31.0% (n=22)	
	10< years	33.0% (n=30)	

E. Old M.I.

Table 4.27 shows that dentists who attended courses on application of antibiotics in dental practice tend to prescribe antibiotics more frequently when performing invasive dental procedure for patients with old M.I. The average antibiotic prescription for dentists who did not attend any course was 8.3% (n=15) and for dentists who attended courses was 30.6% (n=l 1); *P* value < 0.05.

Table 4.27: Antibiotic prescribing for old M.I. among dentists according to their course attendance

Demographic of the participants according to course attendance	attendance	Percentage of dentists prescribing antibiotics for previous I.E. according to their course attendance	*P* value
: ^	Yes	30.6% (n=ll)	0.001
	No	8.3%(n=15)	

F. Pacemaker or an Implantable Cardiac Defibrillator

The use of antibiotics by dentists who have 5-10 years experience when performing invasive dental procedures for patients with pacemakers was significantly lower than other groups. The average antibiotic prescriptions by dentists who have < 5 years experience was 32.7% (n=18), 5-10 years was 23.9% (n=23) and 10< years was 53.8% (n=49); *P* value < 0.05 (Table 4.28).

Table 4.28: Antibiotic prescribing for patient with pacemaker among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for patients with pacemaker according to their years of experience	*P* value
	< 5 years	32.7% (n= 18)	
	5-10 years	23.9% (n=23)	0.004
. . . . . ^	10< years	53.8% (n=49)	

4.9.3 The Prophylactic Prescribing Knowledge and Behavior for the Surveyed Dental Procedures

A. Tooth Extraction

This study found that researchers tend to prescribe significantly less antibiotics than other categories (clinicians, lecturers and others) when performing tooth extraction for patients at risk of I.E. The average antibiotic prescriptions for clinicians was 98.3% (n=172), lecturers was 100.0% (n=23), researchers was 83.3% (n=5) and others was 100.0% (n=13); *P* value < 0.05 (Table 4.29).

Table 4.29: Antibiotic prescribing for tooth extraction in patients at risk of I.E. among dentists according to their designated position or post

Demograph c of the participants according to their designated position or post	Designated position or post	Percentage of dentists prescribing antibiotics for tooth extraction according to their designated position or post	*P* value
• Lecturers M" (»=*>), 6^ (n=13) 10»*(n=23)	Clinical dentists	98.3% (n= 172)	0.046
• Clinical dentists ^ 3 B	Lecturers	100.0% (n=23)	
Researchers ^ H ^ B	Researchers	83.3% (n=5)	
•Others ^^»H(l=17S) -*M*	Others	100.0% (n=l3)	

B. Placement of Orthodontic Band

Table 4.30 shows that antibiotic prophylaxis is prescribed appropriately by dentists who have < 5 years experience when performing orthodontic band placement for patients at risk of I.E. compared with other groups. The average antibiotic prescriptions by dentists who have an experience of < 5 years was 43.6% (n=24), 5-10 years was 28.2% (n=20) and 10< years was 16.5% (n=15); *P* value < 0.05.

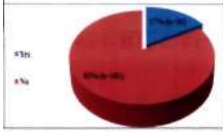
Table 4.30: Antibiotic prescribing for placement of orthodontic band in patients at risk of I.E. among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for placement of orthodontic band according to their years of experience	*P* value
	< 5 years	43.6% (n=24)	0.002
	5-10 years	28.2% (n=20)	
	10< years	16.5% (n= 15)	

C. Endodontic Obturation (Post Placement and Build up)

There is a significant difference *(P* value < 0.05) between dentists who did not attend any course on application of antibiotics in dental practice and other categories, where they tend to prescribe antibiotics less frequently than other groups when performing endodontic obturation for patients at risk of I.E (Table 4.31). The average antibiotic prescriptions by dentists who have attended courses was 27.8% (n=10) and dentists who did not attend any courses was 11.6% (n=21).

Table 4.31: Aniibiolic prescribing for endodontic obturation in patients Lt risk ot'I.R. among dentists

Demographic of the participants according to course attendance	Course attendance	Percentage of dentists prescribing antibiotics for endodontic obturation according to their course attendance	*P* value
	Yes	27.8% (n=10)	0.048
	No	11.6% (n=21)	

D. Taking of Oral Radiograph

A significant difference was found between dentists who have more than 10 years experience and other categories (Table 4.32), where they tend to prescribe antibiotics more frequently when taking oral radiograph for patients at risk of I.E. The average antibiotic prescription by dentists who have an experience of < 5 years was 1.8% (n=l), 5-10 years was 5.6% (n=4) and 10< years was 14.3% (n=13); *P* value was <0.05.

Table 4.32: Antibiotic prescribing for taking oral radiograph in patients at risk of I.E. among dentists according to their years of experience

Demographic of the participants according to their years of experience	Years of experience	Percentage of dentists prescribing antibiotics for oral radiograph according to their years of experience	*P* value
	< 5 years	1.8% (n=1)	0.04
	5-10 years	5.6% (n=4)	
	10< years	14.3% (n= 13)	

This difference was also found between dentists who did not attend any courses on the application of antibiotics in dental practice and other categories (Table 4.33), where they prescribed antibiotics less frequently when taking oral radiograph for patients at risk of I.E. The average antibiotic prescriptions by dentists who have attended courses was 19.4% (n=7) and dentists who did not attend was 6.1% (n=l 1); *P* value < 0.05.

Table 4.33: Antibiotic prescribing for taking oral radiograph in patients at risk of I.E. among dentists according to their course attendance

Demographic of the participants according to course attendance	Course attendance	Percentage of dentists prescribing antibiotics for oral radiograph according to their course attendance	*P* value
W	Yes	19.4% (n=7)	0.027
	No	6.1% (n=l 1)	

CHAPTER 5

DISCUSSION

5.1 Response Rate

5.1.1 The Effect of Low Response Rate

A total of 217 dentists participated in this survey and this represented around 70% from the sample size (300).

As was mentioned in chapter 4, the response rate is 30.7%, and is considered low, but it should not influence the validity of the data (Templelon, et al., 1997).

Similarly, Cockburn found that there are no systematic differences on the general characteristics or attitude related to patients' care on general practitioners. Their results are based on findings between the general practitioners who participate in an observational study of general practice (n=56) and doctors who declined to participate in this research (n=52) (Cockburn, 1988).

Bostick, et al. (1992), stated that, despite the response rale improvement with follow up (66% to 94%), there are no significant differences in demographic characteristics between the early and late responders; in addition, the answers of late responders have limited impact on a survey findings.

Furthermore Sobal, et al. (1989) suggested that a high response rate need not necessarily be prerequisite of a valid survey. Bostick, et al. (1992) and Leslie (1972) suggested that effort made to increase the response rate may not always result in data that are any more reprehensive of the sampled population.

A national postal survey of all general practitioners in England and Wales was conducted towards identifying and dealing with alcohol-misusing patients, and to assess the validity of low response rate. The study method was modified after the second mailing because of the low response rate and, after four mailings 44% response rate was obtained from this survey. This study concluded that a low response rate did not affect the validity of the data collected (Deehan, etal., 1998).

5.1.2 Dealing with Low Response Rate

Gubins, et al. (2008) found that the role of surveys in gathering information from physicians and physicians-in training remains problematic. In the National Physician Survey (NPS) which is organized every 3 years by the college of Family Physicians of Canada, the Canadian Medical Association and the royal college of physicians and surgeons of Canada collaboratively to collect information from physicians across Canada regarding the health care system. In 2004, the response rate to this survey was only 35.9%. In 2007 more effort was made to increase the overall response rate of the (NPS) from the 2004 survey with the implementation of various methodological strategics.

Despite shortening the questionnaires, contacting more physicians by e-mail and enhancing marketing and follow-up, the 2007 NPS response rate for practicing physicians did not surpass the 2004 NPS response rate of 31.64% (compared with 35.85% in 2004). No difference in response rate was found between the longer and shorter versions of the survey. If contacted by regular mail, the response rate was 34.1%; the e-mail group had a response rate of 29.9%. Medical student and resident response

rates were 30.8% and 27.9%, respectively (compared with 31.2% and 35.6% in 2004) (Gubins & Scott, 2008).

in the current study oversampling is used to overcome this problem and to obtain adequate sample size. Fink stated that "oversampling can add costs to the survey but is often necessary" (Fink, 1995). Salkind (1997) recommended oversampling when he stated that "if you are mailing out a survey or a questionnaire count on increasing your sample size to account for lost mail and uncooperative subjects".

5.2 Antibiotics Choice by Dentists for Treatment of Acute Dentoalveolar Infection

This section presents the discussion and analysis of the antibiotics choice of the surveyed dentists for treatment of acute dentoalveolar infection for patients not allergic and allergic to Penicillin which represents the first objective of this study.

Amoxicillin is the most frequently prescribed antibiotics for acute dentoalveolar infection for patients not allergic to Penicillin although MNCG 2003 recommended phenoxymethyl penicillin 250-500 mg as a first choice for the treatment of acute dentoalveolar infection.

Some practitioners use amoxicillin in combination with metronidazole; the use of combination antibiotics therapy which resulted to a broad-spectrum exposure that led to depression of the normal host flora and increased opportunity for resistant bacteria to emerge. Thus, when broad-spectrum antibiotics arc used, many different bacteria present in the body are also exposed to the antibiotic.

The use of metronidazole especially in combination with amoxicillin increases the emergence of resistance to this drug more than if it's used alone. Some studies found

that *Actinobacilhis actinomycelemcomiians*, which is isolated from periodontal and odontogenic abscesses, is resistant to metronidazole and this bacteria is an important factor in intractable periodontal disease and leading to early loss of permanent teeth (Eick,etal., 1999; Mandinies, et al., 1999).

Accordingly, the disadvantages of combination therapy outweigh the advantages in the treatment of routine infection. The recent guidelines published by the Commission of the Federation Dentaire International recommend that the combination therapy should be avoided whenever possible in dentistry (Samaranayake & Johnson, 1999).

In the current study, about 2% of the surveyed dentists prescribed phenoxymethyl penicillin 250-500 mg 3-4 times daily for 5 days. According to Malaysian statistics on medicine 2005, Tan, et al. (2005) also found that amoxicillin was the most frequent prescribed antibiotic and this is perhaps because of its cost. It was suggested that the reason for the wide use of amoxicillin is that amoxicillin can be given 3 times per day instead of four to ensure sufficient blood saturation level (Campbell, et al., 2004). Compared with other studies (Palmer, et al., 2000a), amoxicillin have been prescribed by 70.5% of the dental practitioners in England, and 20.5% prescribed penicillin V which is recommended by the Dental Practitioners Formulary. Jaunav, ct al. (2000) found that amoxicillin was the predominant antibiotic prescribed by South Ausiralian dental practitioners and there was a tendency towards a lower dosage over a long period of time.

However in Norway, dentists prefer to prescribe antibiotics conservatively. The use penicillin and narrow spectrum antibiotics lead to a low prevalence of antibiotic resistance among oral bacteria in Norway (AM laroni & Skaug, 2007).

The dentists' antibiotic choices for treatment of acute dentoalveolar infection for patients' allergy to Penicillin comply with the MNCG 2003 guidelines. Erythromycin 250 mg is used by 21.2% (n=46) for 3-4 times daily for 5 days.

This drug is also widely used in the medical field in Malaysia. Kakoei, et al. (2007) suggested that the wide use of erythromycin in different parts of the world may be referred to its recommendation in previous literatures and its low price while clarithromycin is the most common macrolide prescribed in the British Columbia (Patrick, et al., 2004).

Although metronidazole is only effective against anaerobic bacteria, it was prescribed by 20.0% (n=43) of dentists surveyed. We noticed in this survey that 2.5% (n=5) of dentists used amoxicillin for patients allergic to Penicillin and this is not recommended for allergic patients because of the hypersensitivity reaction.

Some dental practitioners surveyed prescribed cephalaxin in the treatment of acute dentoalveolar infection for patients allergic to Penicillin. Clinical prudence dictates avoidance of all (^-lactam antibiotics in any patients with a history of anaphylaxis or other serious reaction to (3-lactam antibiotics because cross reactivity occurs in approximately 10% of the patients.

Although DDDs of the prescribed antibiotic complies with the MNCG 2003, there is still a wide variation in the antibiotic prescribing patterns among surveyed dental practitioners. The reason for this diverse in antibiotic prescriptions is unclear. Previous studies suggested that the prescription is influenced by undergraduate and postgraduate education and the pharmaceutical industry (Jaunay, et al., 2000).

Other factors which may influence the dental practitioners' prescriptions include: patient's expectation, the inability to make a definitive diagnosis or the treatment has to be delayed. However, the decision to prescribe antibiotics must be based on a thorough medical history, clinical examination and accurate diagnosis (Palmer, et al., 2000; Hoffman & Botha, 2003; Salako, et al., 2004).

5.3 The Prescribing Antibiotics for Specific Dental Conditions

The results discussion presented in this section verify that there is an overprescribing of antibiotics in dental practice. This might be referred to the fact that there are only general guidelines on prescribing rather than a definitive regimen. The dental practitioners need clear and practical guidelines on when to prescribe, what to prescribe, the duration and in what dose (Palmer, 2000a). The following subsections discuss this result in details:

5.3.1 Acute Pulpitis

According to Cochrane systematic reviews, there was no evidence which supported the use of antibiotics for pain relief in pulpitis (Keenan, et al., 2006) and the Malaysian guidelines did not mention antibiotics for acute pulpitis whereas in this study, about 40% (n=83) of dental practitioners surveyed prescribed antibiotics for this condition.
The treatment of acute pulpitis includes extraction, endodontic treatment or pulp capping. Douglas, et al. (2000) and Sutherland (2005) found that there is no significant difference in pain relief between patients taking penicillin and those who do not. The majority of patients with untreated pulpitis and taking penicillin had a significant pain and required analgesic to manage the pain.

5.3.2 Acute Periapical Infection (API)

In API, about 80% (n=172) used antibiotics for **API** before drainage and 60.5% (n=130) prescribed antibiotics after drainage was established. Systematic literature on the effectiveness of antibiotics intervention in the management of API indicated that the use of antibiotics has no additional benefit, unless there are systemic complications (e. g. fever, lymphadenopathy or cellulitis). Drainage of an infection is only necessary in the majority of uncomplicated swellings (Longman, et al., 2000; Matthews, et al., 2003). Foud, et al. (1996) & Kurimaya, et al. (2000) concluded that there is no demonstratable benefit from penicillin supplementation to patients with periapical pain or swelling.

5.3.3 Chronic Apical Infection

Chronic apical infections do not require antibiotics; extraction or root canal therapies are the definitive treatment options (Palmer, 2003). In this study, however, more than 25% (n=62) of dentists prescribed antibiotics for this condition.

5.3.4 Dry Socket, Periodontal Abscess and Pericoronitis

The majority of dental practitioners surveyed in the study routinely prescribed antibiotics for these conditions although these three conditions can be effectively treated by local measures and antibiotics are only indicated for large spreading infections or systemic involvement.

In dry socket treatment, irrigation of the socket to remove debris (Trieger & Schlagel, 1991; Cawson & Odell, 2002) and placement of a sedative dressing are all that is required for its management (Bloomer, 2000; Cawson & Odell, 2002). The use of antibiotics has not been recommended for the treatment of dry socket and the prevention methods remain the key to avoid this complication. Prophylactic placement of topical antibiotics can be considered, whereas systemic antibiotics should be reserved for patients who are immunocompromised (Fazakerley & Field, 1991; Noroozi & Philbert, 2009).

In most cases of pericoronitis, debridement and drainage can lead to resolution of the initial signs and symptoms within a few days and according to Peterson (2002) and Palmer (2003), the use of systemic antimicrobial therapy or topical antimicrobial in such cases is not prudent and cost effective.

In periodontal abscesses, the majority of cases resolve promptly and without complication after drainage of the exudates and debridement of the pocket. Systemic antimicrobial therapy is reserved for specific situations; these include patients with

multiple abscesses occurring simultaneously and patients with spread diffuse acute periodontal infections (Trammel & Behnia, 2002; Sutherland & Matthews, 2003).

5.3.5 **Chronic Periodontal** Diseases

Chronic periodontal diseases include chronic gingivitis and chronic periodontitis. Controlling of the microbial flora adjacent to the dentogingival area is sufficient to resolve chronic marginal gingivitis (Trammel & Behnia, 2002).

In case of chronic periodontitis the use of topical antibiotics as an adjunct to scaling and root planning is sufficient to resolve this condition (Trammel & Behnia, 2002; Clinical Practice Guidelines 2005). In this study however, about 10% (n=17) was found to prescribe antibiotics for chronic marginal gingivitis and 20% (n=43) prescribed antibiotics for chronic periodontitis.

5.3.6 **Dental Implant (Implant Placement)**

The use of antibiotics in implant dentistry is controversial; the scientific evidence is not sufficient to either recommend or discourage the use of preoperative systemic antibiotics to prevent dental implant complications or failure (Esposito, et al., 2004; Reed, 2004). This finding is supported by Gynther, et al. (1998); Powell, et al. (2005) and Mazzoccbi, et al. (2007); they found that there is no additional benefit on the use of antibiotic prophylaxis for dental implant.

Roda, et al. (2007) suggested that prophylaxis antibiotics are recommended in subjects with risk factors including immune suppressed patients with metabolic disorders such as diabetes or splenectomised patients; however, in this current study, only 20% (n=45) of practitioners prescribed antibiotics for this condition.

5.3.7 ANUG **and Cellulitis**

In this study, up to 50% (n=l 18) of the surveyed dentists did not prescribe antibiotics for ANUG, but according to Cawson, et al. (2002) metronidazole (200 mg 3 times a day for 3 days) was recommended, which greatly accelerates resolution.

While the majority of dental practitioners surveyed prescribed antibiotics for cellulitis, there are some dentists surveyed who did not use antibiotics for this condition. In addition there is a wide variety of antibiotics used for this condition (Figure 4.11); however, Zinman, 2001 & Fung, et al. 2003 recommended penicillin (250-500 mg) 4 times a day to treat this condition.

5.4 Antibiotics Prophylaxis for Patients at Risk of I.E.

This study found that 66.4% (n=144) of dental practitioners follow the AHA guidelines (2008) in their prophylaxis prescription for patients not allergic to Penicillin who were at risk of I.E. 30% (n=64) did not follow AHA guidelines, as most of them used amoxicillin 3 gm 1 hour before procedure and 1.5 gm 6 hours after procedure.

For patients allergic to Penicillin, a majority of dentists surveyed follow the AHA guidelines. On the other hand, there were 3% (n=6) of surveyed dentists who used amoxicillin for patients allergic to Penicillin, and this is contraindicated for patients allergic to Penicillin because of anaphylaxis and hypersensitivity reactions.

In general, compliance with antibiotic prophylaxis regimens does seem to be a problem world wide. According to Seymour, et al. (2000), compliance to recommended antibiotic dose, identifying "at risk patient" and providing cover for the appropriate dental procedure range from 15-35%.

5.5 Cardiac Conditions Requiring Antibiotic Prophylaxis

The aim of this section is to determine the knowledge of the surveyed dentists regarding prescribing prophylactic antibiotic for some cardiac conditions.

The results demonstrate that there is a tendency to use antibiotics unnecessarily in some cardiac conditions. More than 10% (n=26) of dentists in this study prescribed antibiotics for patients who have old myocardial infarction where antibiotic prophylaxis is not recommended and there is a tendency to prescribe antibiotics for patients with pacemakers where antibiotic prophylaxis is not recommended (AHA guidelines 2008).

The majority of dentists prescribed prophylactic antibiotic for patients with previous I.E., prosthetic heart valve and unrepaired cyanotic congenital heart diseases; however, there are still some dental practitioners who did not consider these conditions as high risk conditions. In summary, there is a considerable noncompliance to AHA guidelines among dental practitioners in the conditions surveyed.

The study of Thompson, et al. (2007) concluded that there is under and over-prescription of antibiotic prophylaxis in some specific cardiac conditions and the knowledge of Welsh dentists regarding cardiac conditions vary widely. But Jaunay, et al. (2000) showed that patients with a history of rheumatic fever but no murmur was given antibiotics by 36% of dentists surveyed in Australia.

5.6 Dental Procedures Requiring Antibiotic Prophylaxis in Patients at Risk of I.E.

This section reflects the surveyed dentists' knowledge regarding prescribing prophylactic antibiotic for some dental procedures in patients at risk of I.E.

According to AHA Guidelines 2008, the antibiotic prophylaxis for patients at risk of endocarditis are required if the dental procedures involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa and the following procedures and events do not need prophylaxis:

- routine anaesthetic injections through non infected tissue,
- taking dental radiographs,
- placement of removable prosthodontic or orthodontic appliances,
- adjustment of orthodontic appliances,
- placement of orthodontic brackets,
- shedding of deciduous teeth and
- bleeding from trauma to the lips or oral mucosa.

There is an extreme variation in the antibiotic prescription by the surveyed dental practitioners. Close to 70% (n=151) of dental practitioners surveyed prescribed antibiotics for bleeding from trauma to the lip or oral mucosa in which antibiotic prophylaxis is not indicated. On the other hand, only 27.2% (n=59) prescribed antibiotics for orthodontic band placement for patients at risk of I.E.

Compared with other studies, Thompson, et al. (2007) showed that there is confusion among Welsh dentists as to which cardiac conditions required prophylaxis and for which particular dental procedures.

Jaunay, et al. (2000) showed that only 53% identified rubber dam placement as a high risk procedure. The authors claimed that the placement of the rubber dam, particularly with the rubber dam clamps, results in a substantial bacteraemia. The authors are aware of at least two Australian cases of bacterial endocarditis where the rubber dam clamps were placed during endodontic therapy, so antibiotic prophylaxis for endodontics with rubber dam is mandatory for at risk patients.

Sections 5.5 and 5.6 demonstrate that there is confusion as to which cardiac conditions required prophylaxis and for which particular dental procedures. There is a need to update dentists' knowledge with the recent antibiotic guidelines and make these guidelines readily accessible by dentists and physicians as many dentists consult physicians regarding the need for prophylaxis and the application of current regimen before performing a dental procedure (Lauber et al, 2007).

5.7 General Knowledge on Some Antibiotics Used in Dentistry

The second section of the questionnaire aims to assess the general knowledge on some antibiotics used in dental practice and demonstrate that there is a lack of knowledge in some specific areas related to the development of antibiotic resistance and how to recognize the characteristics for each antibiotic and its compatibility with the medical condition of the patients.

In this study, 41% (n=89) of dental practitioners realize that the use of erythromycin with asthmatic patients who used theophylline should be avoided because theophylline toxicity could develop with the use of macrolide (Redd & Hienz, 2002; Nahata, 1996; Hersh & Moore, 2008). 35.5% (n=77) of the dentists are aware of the use of P-Lactam antibiotics with bleeding and coagulation disorder as the use of p-Lactam creates a decrease in platelet function (Redd & Hienz, 2002; Hassan & Kroll, 2005).

Thus, there is a clear need to improve the dentists' knowledge on the application of antibiotics in specific medical conditions. There is also a need to explain the meaning of MRSA as around 50% (n=!08) of the dental practitioners surveyed did not know its meaning. This reveals that there is insufficient understanding to the meaning of antibiotic resistance and its risks. Similarly, Jaunay, et al. (2000) found that only 20% of the surveyed dentists know the meaning of MRSA.

5.8 Demographics

From the demographic section, only 22.3% (n=48) of the dentists surveyed have taken samples from dental infections for culture and sensitivity test.

There are evidences which manifested the benefit of using the culture and sensitivity test before antibiotic prescription for treatment of odontogenic infection. As these infections are polymicrobial infection, the microbiological data regarding exudates must be obtained in order to reduce the potential harmful effects in inappropriate antibiotic prescribing (Kuriyama, et al., 2000; Harris & Crawford, 2007).

5.8.1 The Prescribing Patterns and Behavior among Different Groups

A. According to Years of Experience

This study shows that dentists who have more than 10 years of experience tend to prescribe more prophylactic antibiotics for patients with recent M.I. and pacemakers where antibiotics are not required. At the same time they tend to decrease antibiotic prescriptions when performing orthodontic band placement for patients at risk of I.E. in which prophylaxis antibiotics is required. They tend to prescribe more frequent antibiotics when taking oral radiograph for patients at risk of I.E. where antibiotics are not required.

It was noticed that dentists who have less than 5 years experience are more aware of prosthetic heart valve patients as those dentists are more aware than other groups the requirement of antibiotic prophylaxis when performing invasive dental procedure for those patients. Accordingly, there is a need for knowledge update that may inform the earlier dentists with the current antibiotics prescription.

On the other hand, we noticed that dentists who have worked less than 5 years tend to prescribe antibiotics more frequently for dental implants.

B. Qualification

The number of specialist dentists who responded to this survey is approximately 20% (n=46). It was also noted that general dentists prescribed antibiotics significantly more than specialists for some clinical dental conditions (API and acute periodontal abscesses) in which local measures are sufficient to resolve these two conditions.

In addition, they also tend to prescribe more antibiotic for chronic periodontitis. Many studies recommend that scaling and root planning under local antibiotics are all that are required in the treatment of this condition.

General practitioners also prescribed antibiotics more frequently for chronic apical infection in which extraction or root canal therapy is the only treatment required for this condition.

The general practitioners should modify their prescription habit to minimize the impact of unnecessary antibiotic use.

C. Designated Position or Post (Main Job)

This study shows that researchers prescribe antibiotics for a longer period in the treatment of acute dentoalveolar infection when compared with other groups (clinicians, academicians and others). It was also noticed that they did not recognize that ANUG need antibiotics and they prescribed antibiotics more frequently for chronic periodontitis, where systemic antibiotics are not recommended for this condition as most cases of uncomplicated chronic periodontitis respond readily to mechanical therapy and the benefit of antimicrobial use in treatment of this condition does not seem to justify the risk.

This study shows that clinicians prescribed antibiotics significantly more than other groups for acute pulpitis and API and acute periodontal abscesses where antibiotics are not required.

Accordingly there is a need for continuing education for undergraduate students to improve their knowledge with regards to antibiotic prescription and there is a need to continuously monitor antibiotic prescriptions of the clinicians to reduce the unnecessary use of antibiotics which can lead to the emergence of antibiotic resistance.

D. Attending Courses on the Application of Antibiotics in Dental Practice

The results demonstrate that there is a need to more effective intervention to help dentists to rationalize antibiotic prescription. There is uncertainty in prescribing antibiotic prophylaxis for patients with innocent heart murmur and old M.I. among dental practitioners who attended courses on the application of antibiotics in dental practice and also there is unnecessary use of prophylactic antibiotics among them when performing endodontic obturation or taking oral radiograph for patients at risk of I.E.

Compared with other studies, Frecmantle, et al. (2005) found that the audit and conferences/ workshops did not produce substantial changes in practice. Accordingly there is a need to more effective intervention and some studies suggested that educational outreach visit may be successfully employed to rationalize antibiotic prescribing by dentists (Delgado, et al., 2002; Midlov, et al., 2006).

CHAPTER 6

LIMITATIONS AND FUTURE WORK

6.1 Limitations of the Study

There are some limitations that need to be acknowledged and properly addressed. Low response rate posed the main limitation in this research since only one response was obtained for every five questionnaires given. Although this figure is close to some similar studies carried out worldwide, it certainly imposes important challenges. Some dentists refused to take part in this survey as they explained that the survey resembles an exam and many of them gave the excuse that they were too busy.

This reluctance to take part in the survey forced the researcher to do an oversampling to reach the target sample size and overcome the low response rate.

After the pilot study stage, some of the questions were eliminated because they were not answered by the participants. In a few cases, the participants, at the pilot study stage, responded by protesting about the questions or by inconclusive answers. The elimination of some questions restricted the parameters covered by this study.

Being the first study of this topic in Malaysia made it impossible to compare the results of this study with previous data. Comparing the outcome of such studies with previous data could furnish important feedback to the health and academic institutes which is impossible to provide here due to this limitation.

Finally, this study did not cover the factors influencing the prescribing patterns of the dental practitioners; for example, professional factors (imperfect knowledge, diagnostic uncertainty, fear of complication and perceived patient expectations), patients' factors, socio-cultural and socio-economic environments and the cause of this wide variation in their prescribing due to the time limitation and consideration of the length of the questionnaire.

6.2 Suggestions of Further Studies

According to our literature survey there is a need for further future studies in different aspects:

- Studies associated with antibiotic prescription patterns of different type of specialist dentists (oral surgery, endodontic, pediatric, etc..) to determine the use of antibiotics in different dental procedures.
- There is a clear need for research in the efficacy and indications for antibiotic use to provide evidence based regime for dentists.
- Studies to determine knowledge and educational needs of dental practitioners regarding cardiac diseases and provision of antibiotic prophylaxis for common cardiac conditions in Malaysia.
- Studies on the appropriateness of antibiotic prescription by dentists for specific medical conditions, and investigate the compatibility extent of antibiotics with patient's medical condition.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This is the first study to investigate the antibiotic prescribing patterns by dental practitioners in Klang valley. Findings of this survey showed that the proportion of those who attend courses on application of antibiotics in dental practice is very small. This has probably influenced the knowledge of the surveyed dentists with regards to antibiotics prescription in dental practice.

This study shows that there is a wide spectrum of prescription patterns for the treatment of acute dentoalveolar infection; only a minority of the dentists surveyed followed the MNCG 2003 for the treatment of dentoalveolar infection for patients not allergic to Penicillin.

In addition, a combination of antibiotics (amoxicillin and metronidazole) are used by more than 20% (n=47) of surveyed dentists. The use of combination antibiotics therapy result in a depression of the normal host flora and increased opportunity for resistant bacteria to emerge may result in failure to control infection. In addition, the use of combination antibiotics therapy resulted in a broad-spectrum exposure that leads to expose many different bacteria present in the body to the antibiotic.

Although the majority follows the MNCG 2003 in the treatment of acute dentoalveolar infection for patients allergic to Penicillin, there is a wide variety of the antibiotic prescription among dentists. In addition there are some dentists who did not consider

that the use of amoxicillin is contraindicated in patients allergic to Penicillin because of the hypersensitivity reaction.

The results of this study conclude that there is a tendency to unnecessary use of antibiotics in some clinical dental conditions (acute periodontal abscess, API, pericoronitis and dry socket). On the other hand, the results demonstrate that up to 50% (n=99) of dentists surveyed did not consider that ANUG required antibiotics. As a result there is a misunderstanding on the application of antibiotics for routine clinical dental condition.

This survey shows that there is a misunderstanding on the application of prescribing antibiotic prophylaxis for patients at risk of I.E. and there is a confusion among dentists as to which patient groups and cardiac conditions required prophylaxis and for which particular dental procedures.

The data show that there is a need to update the knowledge for the senior dentists with the recent antibiotic guidelines for prophylaxis against I.E. as there was confusion among this group to which cardiac conditions required prophylaxis and for which particular dental procedures.

The study showed that there is a need for valuable intervention to help the dentists to rationalize their antibiotic prescriptions. Finally, monitoring of antibiotic prescription by clinicians is the most important thing to reduce the unnecessary use of antibiotics which leads to the emergence of antibiotic resistance.

7.2 Recommendations

7.2.1 Suggestion of Educational Intervention

The proper awareness about the issue of antibiotics and the improvement of antibiotic prescription can enhanced by considering various aspects in education, training and administration such as:

A. **Educational/Training Interventions**

The health authorities should institute an active, continuing educational program to inform the dentists on the use of antibiotics, new antibacterial agents and update them in the recent antibiotic guidelines. The educational intervention may take various modalities such as lectures and practical skill orientation.

B. Reprinted and Distributed the Local Antibiotic Guidelines

Although this strategy has failed to cause measurable improvement, there is a need to review the local antibiotic guidelines and distribute them to all dentists who are working in specialist clinics and dental schools to improve their knowledge with regards to the prescription of antibiotics. The printed guidelines are distributed in the form of hand book, letter or poster.

These guidelines should include more details regarding:

- antibiotic dose, daily frequency and number of days;
- antibiotic prescription guidelines for routine dental conditions; and
- must include special attention to the prescription of antibiotic prophylaxis according to AHA guidelines.

C. The Individual Outreach Visits

This method has great potential effect for improving prescribing practices among health workers. This is conducted by providing the dentists with educational antibiotic guidelines. Then they are visited by health care providers to discuss the content of the guidelines and encourage the rational use of antibiotics when managing their patients.

D. Antibiotic Audits

In order to know if the policy implemented has been adhered to, the health authorities must conduct regular audit of the use of antibiotics and notice to which degree the prescriptions of dentists' compliance with implemented policy is. If there is poor compliance, the reasons for this must be established and steps should be taken to overcome it.

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APPENDIX

Appendix A

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KELULUSAN JAYVATANKUASA ETIKA PENYEUDIKAN UiTM

TajiliN Projek: A Suivey on Ant'bk-kc Prescribing **Pattern by De*ai**

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I -.-ssukH **hVc** io **invite you** !n participate in itiis suiicy which is concerned about the oniibiutics **prescribing patterns by denial practitioners for both** therapeutic MKl prophy lactic, **purposes.**

The antibiotics am invaluable adjunct in the mn:niL>.cn>iio! «f Orinoco! infection.; thoir judicious **use can shorten infection periods and minimize associated risks. Over years, antibiotics misuse !ed to the** emergence u!" iaiectbns 'aL'Scria I hah arc rssi-anrM io -onie a!i*ihitH;t:-i A^tirrnk-rssbl^l **resistance is now a major threat Io public health. Controlling the antimicrobial resistance is an international** concern and i1 *;s* ihc t:;--cntial motivation **ofthis Study.**

Antibiotic prescription;: |»; ii i s: ? rs =* studies have been conducted in differ;™ parts of the work! MKIII **as U.K., Canada, Australia and the** Middle fast i'he-sc ^rsidii-s aic crucial io rc-twani.'s the **antibiotics** prescription guidelines provided by trie health service organizations and proves **important database** for **both** researches **and authorities.**

the research we **are** in the coarse of conduciinp. aims NsproviJes **.cry** important teciflwei: aMhc **dentists as** we!! as dentistry faculties **its** academic institute:; to **lurmsh** statistical mslkator; and **recommend a I** ions for medical and **denial professional bodies** M **i i t!ic counsel.**

I look forward tor your kind cooperation by providing your **invaluable answers to (his tju.es!iotinaire.** Your helpful response io all **die questions has** a **vital importance** *\bi* the **success** of **this** study which will **contribute in enhancing the quality of the medic;'!** service **in general and dental service** in particular 1> the stead if. pro _ res **sing Malaysia.**

Dr. Huda K& Abdul Kader

(M.Sc Candidate)

B-maii: huda_kh_h@yHhoo.com

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Section I

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2) Do you usually prescribe antibiotic for the Eolk'wiiiri clinical L-outlitLims? Please indicate (YES OR NO) for each condition. I f i w please indicate your dunce ol'mililiuilic for patients {nol attrny, ••• ..i, •;•:•- ••;,••» ,,i;,.' au-iliealtv it ell).

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Section H
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6) The advantage of the rational drug use is to increase the quality and decrease the costs of the health care services		
7) Alveolar penetration of the antibiotics that are used in dentistry is low.		
S) |1 lactam antibiotics should be avoided in patients with bleeding and coagulation disorders.		
0) Erythromycin iv [he •-.*dv-.x* :iniilnoti<- for asthma patients using theophylline		

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c> Mitral stenosis.

11) I he most common causative pathogen in "right -heart "iniicrn i i nduiiinliii. i-
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12) Wliat is MRSA stand for?

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18)	Have yon ever taken a sample from a dental infection for culture and sensitivity to see the most effective		«,•	M.D