Pediatric dentists, general dental practitioners, &Intern dental students compliance with antibiotic prescribing guidelines for dental infections in children

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الإهداء

إلى قدوتي الأولى ، و نبراسي الذي ينير دربي ، إلى من أعطاني و لم يزل يعطيني بلا حدود ، إلىمن رفعت رأسي عالياً إفتخاراً به .....أبي العزيز

إلى التي رآني قلبها قبل عينيها ، و حضنتني أحشاؤها قبل يديها ، إلى شجرتي التي لا تذبل ، إلى الظل الذي أوي إليه في كل حين .....أمي الحبيبة

حفظهما الله

لهم أهدي ثمرة جهدي

الباحثة فاطمة محمد الصادق

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LIST OF CONTENTS

Contents Page No .

List of Tables

List of Figures

List of abbreviation :

Abbreviation	Description
AAPD	American Academy of Pediatric Dentistry
ADA	American Dental Association
tRNA	Transfer ribonucleic acid
DNA	Deoxyribonucleic acid
RNA	Ribonucleic acid
mRNA	Messenger ribonucleic acid
AIDS	Acquired ImmunoDeficiencySyndrome
DT	Dispersible tablet
AHA	American Heart Association
BNF	British National Formulary
PI	Principle Investigator
SPSS	Statistical package for Social Sciences
SD	Standard Deviation
GDP	General Dental practitioner

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Abstract

Purpose :

To investigate the antibiotic prescribing training received in the past by dentists, clinical experience in treating child patients, awareness of antibiotic prescribing guidelines, and compliance with the antibiotic prescribing guidelines for the management ofdental infectionsinchildren.

Method :

Across sectional survey was conducted to pediatric dentists, general dental practitioners & intern dental student at faculty of dentistry in Benghazi using a self administrated questionnaire, the survey was approved by institutional review board at university of Benghazi .

A self-administered questionnaire consisting of five clinical case scenarioswas answered by pediatric dentists, general dental practitioners and intern dental students in Benghazi responses were compared for each

clinical case scenario with the prescribing guidelines of the American Academy of Pediatric Dentistry and the American Dental Association.

Results :

Totally, three hundred ninety five (395) participants had filled the questionnaire in about (15_20 minutes) for each one , only 43.98% of all participants reported that they had training in antibiotic prescribing in the past .

pediatric dentists (92.85%) were more likely to report awareness compared with general dental practitioners (71.79%), and only (30.8%) of the intern students show awareness of antibiotic prescribing guidelines .

Generally the adherence ranged between 11% and 19%. Highest adherence rate among the pediatric dentists was in case 3 (57%), among GDPs was in case 4 (16.6%), and dental trainees was in case 5 (38%). On the other hand, the lowest adherence for pediatric dentists was in case 5 (14%), among GDPs and dental trainees in case 2 (8%& 19.7%, respectively).

Conclusion :

The results of this study show low awareness and adherence specially among the general dental practitioners and intern dental students , the pediatric dentists show better adherence to professional guide lines for prescribing antibiotics for dental infections in children.

Chapter One

Introduction

1.1 Introduction:

Dentistry is a comprehensive field dedicated to resolving oral infections or restoring and rehabilitating tooth structure lost to the bacterial process[1]. The use of antibiotics is an important part of dental practice as they are commonly prescribed medication for the treatment as well as prevention of bacterial infection in oral-facial region. The oral cavity is a complex biological ecosystem with very large number of organisms living in a biofilm [2] Although bacteria is a part of the normal flora in the oral cavity, some harmful bacteria can cause disease and hence antibiotics are used to cure the disease by killing, injuring, or inhibiting the growth of these bacteria at very low concentrations[3].

The word antibiotic came from the word "antibiosis" a term coined in 1889 by Pasteur which suggested a process by which life might be utilized to destroy life. Term antibiotic was initially used by Selman Waksman in 1942 and his collaborators in journal articles to describe any substance produced by a microorganism that is opponent to the growth of other microorganisms in high dilution[4].

Oral infections are classified as odontogenic and nonodontogenic. Odontogenic infections are the farmost frequent and start affecting periodontal and dental structures. Non-odontogenic infections start in extra dental structures like mucosa, glands, tongue, etc. These infections are usually localized and respond well to treatment. However, favored by children's special features, they can spread to remote regions and cause serious problems compromising even the patient's life[5]. Only a few of the microorganisms cause odontogenic infections, in disease state, other nonpathogenic bacterial species contribute by making an ecosystem

beneficial for growth and survival of the pathogenic species. The onset of disease is due to a shift in microbial flora. Understanding this ecological principle is important while treating oral and dental infections. Micro-organisms in a biofilm are consistently more resistant to usual dosage of antibiotics by 1000-1500 fold[6]. Young children tend to lack medical antecedents suggesting the likelihood of drug allergies or adverse reactions.

The greater proportion of water in the tissues of children, and their increased bone sponginess facilitate faster diffusion of infection. Hence, they require adequate dose adjustment of the prescribed medication. The deficient oral hygiene found in most children and the consumption of sugarrich foods contribute to increase the presence of microorganisms in the mouth and thereby increasing the risk of bacteraemia following oral treatments. As dental practitioners the knowledge on antibiotics and its prescription is important because it plays a crucial role in our day to day clinical practice for the treatment of oral and dental infections[7].

Antibiotics should not be used in the normally healthy patient for minor infections that are likely to respond to the treatment by other means ,or self-limiting[8], in dentistry the reasons (indications) to prescribe a systemic antibiotics are limited, a considerable percentage of dental pain originates from acute and chronic infections of pulpal origin, which necessitates operative intervention rather than antibiotics. Non-indicated clinical cases for antibiotic use include acute periapical infection , dry socket, and pulpitis, chronic inflammatory periodontal conditions are also not indicated for antibiotics. Systemic antimicrobials should only be used in acute periodontal conditions where drainage or debridement is impossible, where there is local spread of the infection or where systemic

upset has occurred, as a supplement to the local treatment is the most appropriate method of managing oral infections[9].

However, the increasing and inappropriate use of antibiotic by dental professionals remain an international finding, combined with the increased risk of causing side effects ranging from gastrointestinal disturbances to fatal anaphylactic shock and emergence of resistant bacteria[10]. In addition, theover-use of antibiotics in healthcare settings has been identified as one of the key factors contributing to the antibiotic resistance phenomenon resulting in potential infection with resistant bacteria and complicated treatment[11,12].American Dental Association Council on Scientific Affairs stated that in children increasing microbial resistance to antibiotics is well documented and is a serious global health concern [11] .Thus , dentistry-based antibiotic prescribing for prophylactic and therapeutic conditions is dictated by defined criteria, and dentists are urged to judiciously prescribe antibiotic [12].

It is well documented that dentists are prone to prescribe on patient's demand , or to prevent post-operative infections as a consequence of the lack of aseptic clinical techniques.[10]for example, researches have shown that general practitioners prescribe therapeutic and prophylactic antibiotics, inappropriately in Iran [13] ,Lebanon [12], Australia [14] , and UK[15]Data reported from different countries indicate differences in dentists' knowledge of clinical situations indicated for antibiotics, almost half or more of the dentists investigated in England[15] , Kuwait[7], and Turkey[16] would prescribe for dry socket , another non-indicated condition is localized swelling , which was also among the conditions for which antibiotics were prescribed in Norway [17], South Australia [18],Kuwait [7] ,and England.[15].

For these reasons providing a guidance in the proper and judicious use of antibiotic therapy in the treatment of oral conditions is needed, so, many medical and dental practitioners and professional associations have recognized the growing problem of antibiotic resistance , two dental organizations have promulgated guidelines in an attempt to cope with this growing problem, the American Academy of Pediatric Dentistry (AAPD) , Chicago, is concerned with the upward trend in antibiotic resistance and has developed specific clinical indications for antibiotic use , the AAPD guidelines rely on clinical presentation to underscore conservative antibiotic use, and the American Dental Association (ADA).

Conflicting data from the region show that in some countries in spite of good knowledge of local and international guidelines, and awareness of the importance of the judicious use of antimicrobials, dentists tend to use antibacterial for inappropriate indications [(12).] However, to our best knowledge, data of prescribing habits of dental practitioners in Libya is scarce. Therefore, this study was carried out to determine dentists' current knowledge and behavior regarding antibiotic prescription and compliance to antibiotic prescribing guidelines for dental infections in children in Benghazi – Libya .

Chapter Two

Research Aims

Research Aims :

1-To examine the antibiotic prescribing practices of dentists and their adherence to professional guidelines.

2-To assess the dentists knowledge of and attitude toward antibiotic resistance .

Chapter Three

Literature Review

Literature Review

Dental infections are multimicrobial in origin with their etiological factors involving a combination of Gram-positive, Gram-negative, facultative anaerobes, and obligate anaerobic bacteria. Thus, antibiotics and analgesics account for a great majority of medicines prescribed by the dental surgeons. Inappropriate prescription of antibiotics by health care professionals has become a worldwide issue nowadays.

Prescribing antibiotics by dental practitioners has become an important aspect of day-today dental practice. This is the reason why antibiotics account for a huge majority of medicines being prescribed by dentists. It has been observed that contribution toward the problem of antibiotic resistance by dentists can be substantial as dentists prescribe 10% of all common antibiotics.[19]It was concluded from findings of a study among members of the American Association of Endodontists (AAE) that they were prescribing antibiotics inappropriately[20]. On the contrary, the National Center for Disease Control and Prevention found that almost one-third of all outpatient antibiotic prescriptions are unnecessary. [21]We have now entered an era where some bacterial species are resistant to the full range of antibiotics presently available, with the methicillin-resistant *Staphylococcusaureus* and vancomycin-resistant *Staphylococcus aureus* being the most widely known example of extensive resistance[22].

3.1 History of Antibiotics

Infections were the major cause of death during the nineteenth century. The introduction of antibiotics not only helped in the treatment of infections but also have a major role in decreasing mortality and morbidity. In 1910 Paul Ehrlich developed the first antimicrobial

salvarsan for the treatment of syphilis, a disease that was almost incurable back then[16]. In 1932 prontosil, a sulfonamide antibiotic was discovered and since it was cheap, many companies were encouraged to mass produce many derivatives of prontosil[17].

During the second half of the nineteenth century and before the important discovery of Fleming many researchers recorded observations regarding the antibacterial properties of penicillium fungi. Fleming introduced "penicillin" in 1929 as a compound with germicidal properties, when he noticed that a bacterial growth was terminated by a mold, however, because prontosil was available there was not much interest in penicillin. Till 1941, the purity of extracted penicillin was only 0.3 to 7%, which was not sufficient to be clinically used. Dorothy (Crowfoot), Hodgkin and Barbara Low in 1945 used x-ray crystallography to discover the chemical structure of penicillin and in 1950 penicillin was chemically synthesized. The isolation of 6-aminopenicillanic acid in 1958 led to the semisynthesis of new penicillins such as ampicillin, methicillin and carbenicillin[18]. Few years later, ticarcillin (1971) and piperacillin (1977) were synthesized and in 1989 the combination of piperacillin- tazobactam was introduced and was widely used because of its high activity against gram positive bacteria[23]. Choice of an Antibiotic Many therapeutically effective antimicrobials are now available and more are being added, it is necessary to lay down certain guiding principles for tailoring a rational therapeutic regimen for an individual patient.

3.2 Mode of Action of Antibiotics

1. Inhibit synthesis of peptidoglycan. These antibiotics work by causing hindrance in the synthesis of bacterial cell walls by either: blocking the transport of peptidoglycan monomers synthesized in the cytosol across

the cytoplasmic membrane, hampering a transpeptidase and hence the formation of the peptide cross-links, or blocking both the transglycosidase and transpeptidase enzymes. The transglycosidases are necessary for the formation of glycosidic bonds between transpeptidases and sugars are essential for the formation of peptide cross-links[24].

2. Alter the microbial cytoplasmic membrane. Polymixins are cationic peptides which consist a cyclic peptide with a fatty acid chain. The interaction between the cationic peptide and the membrane causes disruption of the bacterial cell membrane and increases the permeability of cell components[25].

3. Alter translation. Many antibiotics work by binding to bacterial ribosomes. Examples of antibiotics that work by binding to the 30S ribosomal subunit are aminoglycosides and tetracyclines, which prevent the binding of tRNA[26, 27]. Other macrolide antibiotics, such as erythromycin, bind to the 50S ribosomal subunit and block the exit tunnel of the bacterial ribosome[28].

4. Antibiotics inhibit nucleic acid replication by blocking enzymes i.e. topoisomerases which are essential for supercoiling, bacterial DNA replication and separation of circular bacterial DNA. The fluoroquinolone antibiotic class contains potent inhibitors for topoisomerases or DNA gyrase[29].

5. Inhibit transcription. Some antibiotics, such as rifampin or rifampicin, work by binding to RNA polymerase and inhibiting the transcription of DNA to mRNA[30].

3.3 General principles of antibiotic usage[31, 32]

In recent times, antibacterial administration has been given lots of importance both at the patient as well as at the community level. Antimicrobial stewardship (administration) is defined as "the optimal selection, dosage, and duration of antimicrobial treatment which results in the best clinical outcome for the prevention or treatment of infection, with less toxicity to the patient and minimal impact on subsequent resistance." 4 D's of antimicrobial therapy were summarized by Joseph and Rodvoldas following:

- Right Dose
- RightDrug
- RightDurationoftherapy
- De-escalationtopathogen-directedtherapy,

An important consideration in starting antibiotic therapy is to check if the infection is localized and if the patient has an adequate immune response to control the bacteria if supported surgically. These considerations are summarized in following indications and contraindications of Antibiotic use.

3.3.1 Indicated clinical conditions for antimicrobial therapy

1. Pyrexia which has lasted for 24 hours – indicates a systemic response to the infection
2. Systemic symptoms like malaise, fatigue, weakness, dizziness, rapid respiration and local tender lymphadenopathy – indicate an impending sepsis

3. Trismus– here antibiotics are indicated because infection can spread to perimandibular spaces and can extend to secondary spaces that can be potentially dangerous.
4. As a prophylaxis in patients with systemic conditions like rheumatic heart disease, endocarditis, heart / orthopaedic prosthesis.
5. In immunocompromise patients – AIDS, cancer, corticosteroid therapy, autoimmune diseases, cyclic neutropenia, pancytopenia, uncontrolled diabetes etc.
6. After solid Organ transplant/grafts (cardiac/renal/bone marrow/liver/osseous implants)

3.3.2 Non-indicated clinical conditions forantimicrobialtherapy

1. Pain–(Analgesics/Anti-inflammatorydrugsareindicated)
2. Oedema–(Anti-inflammatorydrugsindicated)
3. Redness/heat(Anti-inflammatorydrugsindicated)
4. Purulence – (Resolved by drainage of pus /debridement)andthusantibioticsarenotrequired.
5. Abscess – localized (e.g., alveolar abscesses,periodontal abscesses) – (Resolves by incision anddrainage)
6. Draining sinus tract in which there is removal ofinfection andsinustractmayhealonitsownormayhavetobesurgicallyexcised.)

3.3.3 Choice of an antibiotic is made on the following factors:

1. Host related factors :Age, renal and hepatic function.
2. Local factors Pathogen related factors .
3. Drug factors: Spectrum of activity, Cost consideration, Compliance by the patient[33].
4.

3.4 The drug dosage of mainly used antibiotics

Amoxicillin

Amoxicillin is a broad spectrum Penicillin group of antibiotics. It became first available in 1972 and one of the most commonly prescribed antibiotics in children. It is present on the World Health Organization‟s list of essential medicines, the most important medication needed in a basic health system [(34)]. It is active against many gram positive and gram negative bacteria e.g. *Streptococcus, Bacillus subtilis, Enterococcus,Haemophilus, Helicobacter*, and Morexellaetc, whereas *Citrobacter,*Klebsiella, and Pseudomonas aeruginosa are resistant to it. Some E.coli and most clinical isolates of *Staphylococcus aureus* have developed resistance to it. Amoxycillin is indicated in Dental prophylaxis in patients at risk of endocarditis, upper respiratory tract infection, treatment of pulpal, periapical and periodontal infection, infection of skin and soft tissues due to *streptococci* and susceptible *staphylococci*. It is contraindicated in Penicillin allergy, hypersensitivity reaction (anaphylaxis or Steven Johnson syndrome), kidney disease, phenylketonuria.

Dosage:Child dose: 25-50mg/kg/day q 8- 12 hr oral and

Adult dose: 250-500 mg q 6-8 hr.

Maximum dosage for Children: 2 g/day Available as: Caps 250 and 500 mg, DT 125 mg, 250 mg, syrup 125 mg/ 5 ml and 250 mg/5ml; drops 100 mg per ml (Amoxil, Amoclox, Novamox, Amoxybid, Comoxyl, Cidomix)

Cephalosporins

Cephalosporin**s** were discovered in 1945 and indicated for the prophylaxis and treatment of infections for children who are allergic to penicillin group of drugs. First generation cephalosporins are active predominantly against gram positive bacteria, and further generations have increased activity against gram negative bacteria.

Cephalexin

Dosage(35): 25-100 mg/kg/ day q 6-8 hrs oral; Adult dose: 250-500 mg every 6 hours (maximum 4g/day). Available forms: Tablet 500mg, 1g (Cedadrox, Odoxil), Capsule 500 mg (Iydroxil), Oral suspension 125mg/5ml, 250 mg/5 ml and 500 mg/5 ml (Droxil, Iydroxil).

Cefixime

Dosag[(35)]: 8 mg/kg/day oral once or twice a day; Adult dose: 200-400 mg daily q 12-24 hr Available forms: Tablet 50 mg, 100mg, 200mg, 400 mg, and syrup 100 mg/5 ml, 200 mg/5 ml and 500 mg/5 ml.

Doxycycline Hyclate

Dosage [(35)]:2-5 mg/kg/day q 12 hr oral; Adult dose: 200 mg on day 1, then 100 mg daily (Avoid in children below 8 years of age due to risk of staining of teeth and growth retardation, pregnancy and lactation) Available forms: 50 mg, 100 mg, 200 mg tabs and syrup 25mg/5ml, 50 mg/5ml (Cedox DT, Revidox, Vivocycline, Dox-T, Minicycline, Tetradox, Vibazine DT,Solomycine;Minocyclinesyrup) Available forms: Tablet 125mg, 250 mg and 500mg (Sporidex DT, CEFF kidtab), Capsule 250 mg, 500 mg (Cephaxin, Sepexin, Ceff, Sporidex, Monacef, Solexin), Oral Suspension

Metronidazole

Metronidazole was introduced in 1959 and is one of the mainstay drugs for the treatment of anaerobic and certain parasitic infection. It is a potent inhibitor of obligate anaerobic bacteria and protozoa. It is indicated in acute necrotizing ulcerative gingivitis, Pericoronitis and pericoronal abscess, chronic aggressive periodontitis, Periapical and periodontal abscess, dentalalveolar abscess, Cellulitis and Space infections, Osteomyelitis, Infected sockets, Surgical prophylaxis and contraindicated in hypersensitivity to metronidazole and alcohol consumption.[36]

Dosage: 30 mg/kg/day in 3 divided doses; Age 1 – 3 years: 150 mg in three divided doses, Age 3 – 7 years: 200 mg in three divided doses, Age 7 - 10 years: 300 mg in three divided doses; Maximum dosage for Children: 2 g/day ; Adult dose: 200-400 mg q 8 hr. Available forms: Tablet 200 mg, 400 mg, Infusion solution 500 mg/100ml, Oral suspension 200 mg/5 ml (Flagyl, Aristogyl, Metrogyl, Rogyl).

Antibiotic combinations

Antibiotic combinations are used to enhance antibacterial activity against manifold potential pathogens for initial empirical treatment, as it may enhance or impair the overall antimicrobial activity. drug combinations may have additive/super additive toxicities and the selection of an appropriate combination requires an understanding of the potential for interaction between the antimicrobial agents.

Amoxicillin with clavulanic acid

Amoxicillin/Clavulanic acid combination was introduced in United States in 1984 as an antimicrobial agent that would increase the activity of Amoxicillin by the addition of the beta-lactamase inhibitor Clavulanic acid. It covers the wide spectrum activity with coverage of betalactamase

producing strains of*streptococcus.pneumonia*, *staphylococcus.aureus*,*haemophilus*.*influenza* but is contraindicated in jaundice, penicillin allergy, hepatic dysfunction

Dosage [37]: For Severe infections 45mg/kg/day every 12 hours Or 40 mg/kg/day every 8 hours, For less severe infections 25 mg/kg/day every 12 hours Or 20 mg/kg/day every 8 hours, 50-100 mg/kg/day (amoxicillin base) q 6-8 hr IV; Adult dose: 250-500 mg of amoxicillin orally 3 times a day, 1.2 g q 6-8 hr IV infusion; Maximum dosage: For children < 40 kg, (1000 – 2800) mg Amoxicillin/ 143 - 400 mg. Available forms: Augmentin, Advent, Moxclav, Moxkind-CV, Megaclav, Clavamtablets 375 mg (Amoxycillin 250 mg+ 125 mg clavulanate), 625mg (Amoxycillin 500mg+ 125 mg clavulanate) and 1000mg(Amoxycillin 875 mg+clavulanate), syrup 156mg/5ml (125 mg amoxicillin +31.5 mg clavulanate); augemntin duo, moxclavb.d. andaugpen HS syrup (200mg amoxicillin +28.5 mg clav/5ml); Augpen, Augmintin DDS, Moxclav DS.

3.5 The use antibiotics in dental practiceaccording to the professional guidelines of AAPD[38]:

Dental practitioners should be practicing the following general guidelines while prescribing antibiotics for the child patient

•**Pulpitis, acute and chronic apical periodontitis, draining sinus tract, localized intra-oral swelling:** Antibiotic therapy usually is not indicated and nor effective if the dental infection is confined within the pulpal tissue or the immediate surrounding tissue. Therefore, the use of antibiotics should be considered in cases of advanced nonodontogenic bacterial infections such as staphylococcal mucositis, tuberculosis, gonococcal stomatitis, and oral syphilis and in the presence of systemic signs of an infection i.e., fever and facial swelling.

•**Acute facial swelling of dental origin**: Any facial swelling or facial cellulitis secondary to an odontogenic infection with the signs of systemic involvement and septicemia (e.g., fever, malaise, asymmetry, facial swelling, trismus, tachycardia, dysphagia, respiratory distress) warrant emergency treatment. Intravenous antibiotic therapy management is indicated. Derivatives of Penicillin remain the best choice for odontogenic infections. However, additional adjunctive antimicrobial therapy (i.e., metronidazole) can be given where there is anaerobic bacterial involvement. However Cephalosporins can also be considered as another choice against odontogenic infections.

•**Dental trauma**: Systemic antibiotics should be recommended as adjunctive therapy for avulsed immature and mature permanent incisors. Tetracycline (doxycycline twice daily for seven days) is the drug of choice, but child's age must be taken into consideration before the systemic use of tetracycline owed to the risk of discoloration in the developing permanent dentition. Penicillin V or amoxicillin can be given as an alternative in patients under 12 years of age. The use of topical antibiotics (minocycline or doxycycline) to heighten pulpal revascularization and periodontal healing in immature non-vital traumatized teeth has exhibited some potential. Antibiotics are not indicated for the luxation injuries of primary dentition. Antibiotics can be used in cases of concomitant soft tissue injuries and when imposed by the patient's medical status.

•**Pediatric periodontal diseases**: Patients with aggressive periodontitis require adjunctive antimicrobial therapy in conjunction with treatment. In pediatric periodontal diseases associated with systemic disease (e.g., severe congenital neutropenia, Papillon-Lefèvre syndrome, leukocyte

adhesion deficiency), the immune system is unable to control the growth of periodontal pathogens and treatment may involve antibiotic therapy.

•**Endodontic Flare-ups**: Adverse reactions (flareups) during the endodontic treatment occur infrequently. Antibiotics are frequently administered to avert the adverse post treatment sequelae of root canal treatment and oral surgery.

- **Antibiotics commonly used in application to odontogenic infections[39]:**

Table-[1]:Antibioticscommonlyusedinapplicationto odontogenicinfections

DRUGS SUBTANCE	ROUTE	DOSAGE	SIDEEFFECTS
Amoxicillin	Oral	500mg/8hours 1000mg/12hours	Diarrhea,nausea,hypersensitivityreactions
Amoxicillinclavulanic Acid	OralorIV	500-875mg/8hours*2000mg/12hours*1000-2000mg/8hours**	Diarrhea,nausea,candidiasis, Hypersensitivityreactions
Clindamycin	OralorIV	300mg/8hours* 600mg/8hours**	Pseudomembranouscolitis
Azithromycin	Oral	500mg/24hours3consecutivedays	Gastrointestinaldisorders
Ciprofloxacin	Oral	500mg/12hours	Gastrointestinaldisorders
Metronidazole	Oral	500-750mg/8hours	anesthesia/paresthesiaofthelimbs,Seizure, incompatiblewithalcoholingestion
Gentamycin	IMorIV	240mg/24hours	OtotoxicityNephrotoxicity
Penicillin	IMorIV	1.2-2.4millionIU/24h*** Upto24millionIU/24hours**	Hypersensitivity reactions, gastric alterations

*=Oral route, **=Intravenous routeand ***=IntramascularRoute of drug adminstration

3.6 Antibiotic Resistance

Antibiotic resistance is considered as one of the biggest threats to global health, food security, and development today. A growing number of infections such as pneumonia and tuberculosis are becoming harder to treat as the antibiotics used to treat them become less competent. Some of the complications associated with the use of antibiotics are drug toxicity, hypersensitivity reactions, antimicrobial drug resistance, superinfection, nutritional deficiencies, masking of an infection. Antibiotic resistance is increased by the overuse and misuse of antibiotics, as well as poor infection prevention and control. According to Dr. Thomas J. Pallasch, antibiotic misuse in dentistry mainly involves prescribing them in ‚inappropriate situations‘ or for too long, which includes[40, 41]:

- Giving of an antibiotic after any dental procedure in an otherwise healthy patient to stop spread of infection which in all likelihood will not occur.
- Using antimicrobials as analgesics, mostly in endodontics - employing antibiotics for prophylaxis in patients not at risk for metastatic bacteremia
- Using of an antibiotics for the treatment of chronic adult periodontitis, which is almost totally responsive to mechanical treatment .
- Using antibiotics instead of surgical incision and drainage of infections
- Using antibiotics to prevent claims of negligence.

A global action plan on antimicrobial resistance, was countersigned at the World Health Assembly in May 2015 with an aim to ensure prevention and treatment of infectious diseases with safe and effective medicines. Global action plan on antimicrobial resistance has 5 strategic objectives i.e. To improve awareness and understanding of antimicrobial

resistance, to strengthen surveillance and research, to reduce the incidence of infection, to optimize the use of antimicrobial medicines and to ensure sustainable investment in countering antimicrobial resistance[42].

3.7 Prophylactic Antibiotics

The use of antibiotics as prophylaxis for focal infection is common practice, and has been widely accepted in the dental profession. Prophylactic antibiotics, taken prior to a number of dental procedures, have been advocated to reduce the likelihood of postoperative local complications, like infection, dry socket, or serious systemic complications like infective endocarditis.

The paradigm of this model of treatment is the prevention of bacterial endocarditis, indicated in risk patients in the context of any invasive procedure within the oral cavity – and following the guidelines of the American Hearth Association (AHA) [43]Table [2]. Nevertheless, there are doubts in relation to this practice. Firstly, transient bacteremia occurs not only after dental treatments such as extractions (35-80%) or periodontal surgery (30-88%). It also occurs in the context of tooth brushing (40%) or while chewing gum (20%), and is proportional to the trauma caused and to the number of germs colonizing the affected zone. Secondly, not only bacteria cause endocarditis, and of those that do cause the disease, many are resistant to the antibiotics administered as prophylaxis (fundamentally amoxicillin). Lastly, it is known that most cases of bacterial endocarditis are not related with invasive procedures, and that dental care is only responsible for a minimum percentage of cases of the disease. Despite the mentioned inconveniences, antibiotic prophylaxis is still recommended in patients at risk [44].

However, the results of a survey conducted by Tomas-Carmona et al. [45] on the knowledge and approach to the prevention of bacterial endocarditis among Spanish dentists showed that fewer than 30% of the professionals were aware of correct antibiotic indications and posology. There is no scientific basis for recommending systematic antibiotic prophylaxis prior to invasive dental treatment in patients with total joint prostheses[46]. Jacobson published a study on 2693 patients with total joint replacement (hip or knee). In 30 of the patients he detected infection of the prosthesis, and in only one case was a time relationship with prior dental treatment established. Furthermore, 54% of the germs isolated were Staphylococcus aureus and epidermidis[47].

According to the American Dental Association and the American Academy of Orthopedic Surgeons, evaluation is required of antibiotic prophylaxis in patients with total joint prostheses in the presence of immune deficiency, when contemplating high risk dental procedures in patients with prostheses in place for less than two years, and in patients who have already suffered past joint prosthesis infections[48].

TableReg[2]:imenrevisedbytheAmericanHeartAssociationin 2014 [18,49]

Regimen:SingleDose30 to60 minbeforeprocedure			
Specific	Agent	Adults	Children
Oral	Amoxicillin	2 g	50mg/kg
Unableto takeoralmedication	Ampicillinor	2 gIMorIV	50mg/kgIMorIV
	Cefazolin/Cephtrioxone	1 gIMorIV	50mg/kgIMorIV
AllergictoPenicillinsorAmpicillin-oral	CephalexinOr	2g	50mg/kg
	ClindamycinOr	600mg	20mg/kg
	Azithromycin/ Clarithromycin	500mg	15mg/kg
AllergictopenicillinorAmpicillinand Unabletotakeoralmedication	Cefazolin/CeftrioxoneOr	1 gIMorIV	50mg/kgIMorIV
	Clindamycin	600mgIMorIV	20mg/kgIMorIV

3.8 Therapeutic antibiotic prescribing by dentists

Most oral diseases presented to the dentist are primarily inflammatory conditions that are associated with pain. Data reported from different countries indicate differences in dentists' knowledge of clinical situations indicated for antibiotics. Almost half or more of the dentists investigated in England,[50] Kuwait,[51] and Turkey[52] would prescribe for dry socket. Another non-indicated condition is localized swelling, which was also among the conditions for which antibiotics were prescribed in Norway,[53] South Australia,[54] Kuwait,[51] and England.[55] On the other hand, the figures for England show that admissions for 'drainage of an abscess related to tooth has doubled from just under 800 in 1998 to almost 1600 in 2006.3 More common dental infections present in the form of pulpitis

and periapical periodontitis, which require only operative measures like fillings, root canal therapy, or extraction if the tooth is not restorable. Unfortunately, dentists still prescribe antibiotics for this condition.[50,56 ,51 ,57 , 52,20 ,58 ,59] A distressing finding was that a number of dentists prescribe antibiotics for viral infections like herpes simplex virus-1 infections.[56] Clinical situations that require antibiotic therapy on empirical basis are limited, and they include oral infection accompanied by elevated body temperature and evidence of systemic spread like lymphadenopathy and trismus.6 Facial cellulitis that may or may not be associated with dysphagia,[51] is a serious disease that should be treated by antibiotics promptly because of the possibility of infection spread via lymph and blood circulation, with development of septicemia. There are also a limited number of localized oral lesions that are indicated for antibiotic use and these include periodontal abscess, acute necrotizing ulcerative gingivitis, and pericoronitis.[51]

Another aspect of antibiotic over-prescribing is prescribing based on non-clinical factors. Patient's expectation ofan antibiotic prescription, convenience, and demand necessitated by the social background of the patients are considered unscientific reasons for antibiotic prescription. Whereas English and Scottish dentists would not prescribe for nonclinical factors,[55] dentists in the Eastern Mediterranean region have shown a tendency to prescribe on a patient's demand or socially, especially when short of time [51,57].

The most commonly used antibiotic in dental practice, penicillins in general, were found to be the most commonly prescribed antibiotics by dentists,[60 ,57 ,61] the most popular one being amoxicillin[50,60, 62,63 ,64 ,65] followed by penicillin V,[56,66,20] metronidazole,[50,62] and amoxicillin and clavulanate.[49]

Penicillin is still the gold standard in treating dental infections.[67] Among the group of penicillins, penicillin V, amoxicillin,[68] and amoxicillin and clavulanate[69] have been advocated for the treatment of odontogenic infections. Kuriyama et al found no difference in clinical outcome between penicillin V, amoxicillin, or amoxicillin and clavulanate.[70] Frequency of prescribing is usually mentioned in the known resources for antibiotic prescribing,[71] whereas duration of treatment recommended in therapeutic guidelines is most commonly based on expert opinion.[72]A survey in Canada found that the average duration of antibiotic use prescribed by dentists is 6.92 days.[73] Another survey in the USA found that endodontists prescribe antibiotic use for an average of 7.58 days.[20] Recent studies on the attitudes of dentists in the Eastern Mediterranean region showed that dentists preferred to prescribe a lower dosage of an antibiotic over a longer period.[51,63]

In recent years, more attention has been given to short courses. Rubenstein explains that short-course antibiotic therapy requires that antibiotics have certain characteristics, such as: rapid onset of action, bactericidal activity, lack of propensity to induce resistant mutants, easy penetrability into tissues, activity against non-dividing bacteria, not being affected by adverse infection conditions (low pH, anaerobiasis, presence of pus, etc.), administration at an optimal dose, and optimal dosing regimen.[72] A two-dose, 3-gm regimen of amoxicillin has been shown to be effective in certain situations.[23] On the other hand, oral antibiotic use for 2 or 3 days has been advocated for the treatment of acute dentoalveolar infections, and in doses recommended by the British National Formulary (BNF).[74] Indeed, in some studies, patients improved after 2 or 3 days of antibiotic therapy.[70,75, 76]

In general, reducing the frequency of antibiotic intake (without compromising the dose) has yielded improved results: a twice-daily dosage of amoxicillin/clavulanate had several advantages over the three times-daily dosage, including increased convenience, improved compliance, and improved tolerability.[77,78] Short courses are preferred to long courses particularly when treating children, since children's compliance with conventional courses is poor.[79] A false conception about the use of antibiotics is that antibiotics should be used for a certain number of days to 'kill the resistant strains' as the vast majority of strains acquire resistance via transposable elements that are preferentially transferred when antibiotics are used in sub-therapeutic doses or for long durations.[80]

In summary, antibiotics should be prescribed at the correct frequency, dose, and duration so that the minimal inhibitory concentration is exceeded, and so that side effects and the selection of resistant bacteria are prevented. Prolonged courses of antibiotics destroy the commensal flora.[42] In addition, longer durations of up to 21 days may result in the selection of resistant strains and a reduction in the ability of the oral flora to resist the colonization by harmful micro-organisms that are not normal residents,[81] leading to superimposed infections by multi-resistant bacteria and yeasts.[51]

3.9 Recommendations

Recommended treatment modalities for common inflammatory oral conditions are drainage is the recommended treatment for periapical periodontitis and for localized dentoalveolar abscess, with incisional drainage rather than via the root canal preferred.[70] Empirical antibiotic therapy and drainage are recommended for more severe infections such as

facial cellulitis, pericoronitis, lateral periodontal abscess, and necrotizing ulcerative gingivitis.

The type of antibiotic chosen and its dosing regimen are dependent upon the severity of infection and the predominant type of causative bacteria. According to the BNF, amoxicillin is recommended for dental infections in doses ranging from 250 mg to 500 mg, every 8 hours.[82] The use of 3 g amoxicillin repeated after 8 hours is also mentioned, as a short course of oral therapy.[83] Another antibiotic that is also recommended by the BNF is co-amoxiclav, which can be used in doses ranging from 375 mg to 625 mg every 8 hours.[84] In patients allergic to penicillin, clindamycin can be used in doses ranging from 150 mg to 450 mg every 6 hours[85] Another option for penicillin-allergic patients (as recommended by the BNF) is metronidazole, which can be used in a dose of 200 mg every 8 hours for 3–7 days.[86]

For severe odontogenic infections, higher doses of a broad-spectrum antibiotic may be required. Lewis et al have shown that only 5% of the main isolates from dental abscesses are resistant to amoxicillin/clavulinic acid.[87] A more recent study found that bacteria associated with endodontic infections are completely susceptible to amoxicillin/ clavulinic acid.[88] Furthermore, some researchers observed that amoxicillin/clavulinic acid and clindamycin are the only orally administratedantimicrobial drugs with adequate pharmacokinetic/pharmacodynamic properties to be effective against the most commonly isolated oral pathogens for the treatment of orofacial infections. When amoxicillin/clavulinic acid is used, a dosing regimen of 1 g twice daily provides a successful clinical outcome, better patient convenience and compliance, and less gastrointestinal upset owing to the minimizing of the clavulinic acid dose.[78]

As mentioned previously, patients can be seen after 2 or 3 days to determine whether treatment should be stopped or continued. Patients who are allergic to penicillin should benefit from clindamycin; it is active against some oral anaerobes and facultative bacteria, and has the advantage of good bone penetration. However, increasing the dose may increase the possibility of serious side effects such as pseudomembranous colitis[89,90] Sweet's syndrome,[91] and neutropenia.[92] Infections in which anaerobic bacteria are implicated (such as pericoronitis, periodontal abscess and necrotizing ulcerative gingivitis) are better treated with metronidazole; the best dosage regimen in terms of pharmacodynamic/ pharmacokinetic aspect is 250 mg every 8 hours.[78]

Other inflammatory/painful oral conditions such as cracked tooth, dentine hypersensitivity, and bacterial sialadentitis are outside the scope of this review and their management is thoroughly explained in specialized references. In addition to the proper dosing regimens and professionally responsible prescribing practices, the general public needs to be educated about the importance of restricting the use of antibiotics to only cases of severe infection.

Patients have become accustomed to being given an antibiotic for a range of medical complaints. Unfortunately, patients presenting at dental surgeries also routinely expect an antibiotic for the treatment of 'toothache'.[93] Dental patients not only pressure their dentist to get an antibiotic prescription, they also self-medicate.

Self medication with antibiotics was found to be alarmingly high in some developing countries.[94][95] Also in Europe, self-prescription of antibiotics was reported, particularly in eastern and southern parts.[96], In conclusion, prescribing practices of dentists can be improved by increasing awareness among dental practitioners of the recommended guidelines. Furthermore,

the importance of initiating awareness programs among the general public should not be overlooked.

Chapter Four

Materials & Method

This chapter provides an overview of the study methods and materials used in the current research.

4.1 Study design, setting&sampling:

A cross-sectional survey was conducted among pediatric dentists and general dental practitioners in the city of Benghazi, as well as intern dental trainees at the faculty of dentistry, University of Benghazi, Benghazi, Libya. The study was carried out during the period between. November 2018 to February 2020

Convenience samplingtechnique was used to recruit study participants. The pediatric dentists and general dental practitioners who work in the public poly-clinics, University clinics, and private dental clinics in Benghazi, were invited to take part in the study. Most of the pediatric dentists who participate in this study also work as teaching staff at the faculty of dentistry University of Benghazi. The intern dental trainers class (2019 – 2020) were recruited from the faculty of Dentistry, University of Benghazi.The list of dentists was obtained from the Benghazi dental syndicate. A total of 1283 dentists were registered in the syndicate,onFebruary 2019. Likewise, 241 intern dental students were registered in dental faculty of Benghazi University (2019 -2020) class. A minimum sample size of 386 participants was found to be sufficient to identify 50% compliance rate with antibiotics guideline, at 95% confidence level and 0.05 error margin. This was increased to 500 participants to compensate for potential 10% drop off rate or incomplete questionnaires.

4.2 Data collection

The data for this study was collected using a self-administered questionnaire which was developed to assess antibiotic prescribing practices for dental infections in children.

4.2.1 The questionnaire

An anonymous questionnaire using a face-to-face interview has been adopted in this study. The questionnaire was divided into three principal sections; the first section included the following variables; (1) demographic data, (2) confidence in prescribing antibiotics for dental infectionsand (3) clinical case scenarios involving antibiotics prescribing decisions. The case scenarios were taken from previous study conducted in North Carolina where an expert panel composed of two pediatric dentists, a general dentist, and an oral surgeon developed the open-ended interview questions based on the AAPD and ADA guidelines and on structured interviews with practicing dentists. The expert panel members reviewed the AAPD and ADA clinical guidelines to determine the recommended professional practices for prescribing antibiotics[43]. The five clinical cases focused on antibiotics prescribing for dental infections in children. Four management scenarios are offered for cases 1_4 ,and three management scenarios were offered for case 5. Dentists were asked to indicate for each scenario whether they would prescribe antibiotic or not , each case varied with regard to the clinical signs and symptoms. clinical signs and symptoms included pain, fever, localized swelling, skin warmness and facial swelling.

Dentists were considered compliant with guidelines if they answered all scenarios correctly for each case, they were noncompliant if they

answered wrongly in any one scenario, The proportion of participants who complied with the guidelines in each scenario was calculated, dentists were also asked for the number of child patients they treated in a week , whether they had antibiotic prescribing training in the past , their awareness of any antibiotic prescribing guidelines and how well prepared they felt in prescribing antibiotics for dental infections in children .

4.2.2. Administration of the questionnaire

The questionnaire was written in English language and takes about15 to 20 minutes to be completed. Five hundred questionnaires were handed by the principal investigator (PI) to pediatric dentists, general dental practitioners and intern dental trainees, in many polyclinics, private dental clinics, and at the faculty of dentistry of Benghazi university. The PI was present at the time of filling in the questionnaire to clarify any questions.

4.3 Data analysis:

The data collected were analyzed using statistical package for the social sciences (SPSS) statistics version 25. Descriptive analysis of dentist's and practices' characteristics was conducted. The proportions of participants who complied with antibiotic prescribing guidelines in each case were calculated. Compliance in each scenario was tested for association with their preparedness in antibiotic prescribing, previous training on antibiotic prescribing, and awareness of antibiotic prescribing guidelines using the Chi-square test.

4.4. Ethical considerations:

The survey was approved by institutional review board of postgraduate studies at the faculty of dentistry, University of Benghazi. The participation in the study was optional. All data were handled with high confidentiality and no personal information that can identify participants were used.

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Chapter Five

Results

5.1. Sample profile

Out of 500 questionnaires distributed, three hundred ninety-five (395) participants have filled the questionnaires, giving a response rate of 79% . The mean age of participants was 28 years (SD). Figures 1-4 depicts the distribution of study sample by sex, specialty,number of children treated per week and previous training experience. While 91.1% of the respondents were females (fig.1), most of them were general dental practitioners (75.9%), andonly 14 participants were pediatric dentists (fig.2). Only 44% of all participants reported that they had training in antibiotic prescribing in the past, and treated more than one child per week, (fig. 3,4).

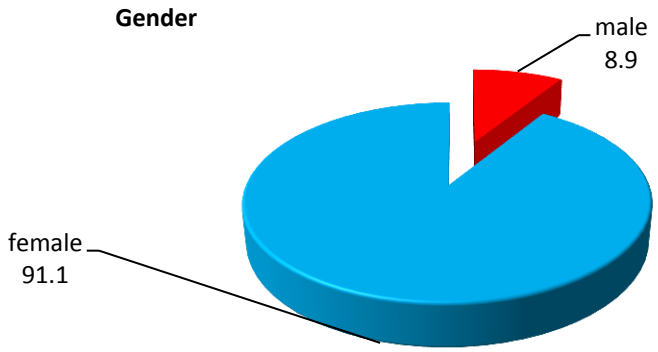

Figure 1: Gender distribution of study sample

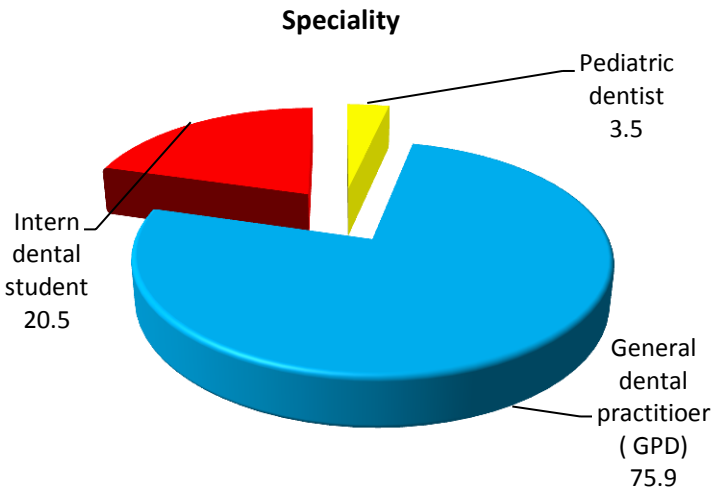

Figure 2: specialty distribution of study sample.

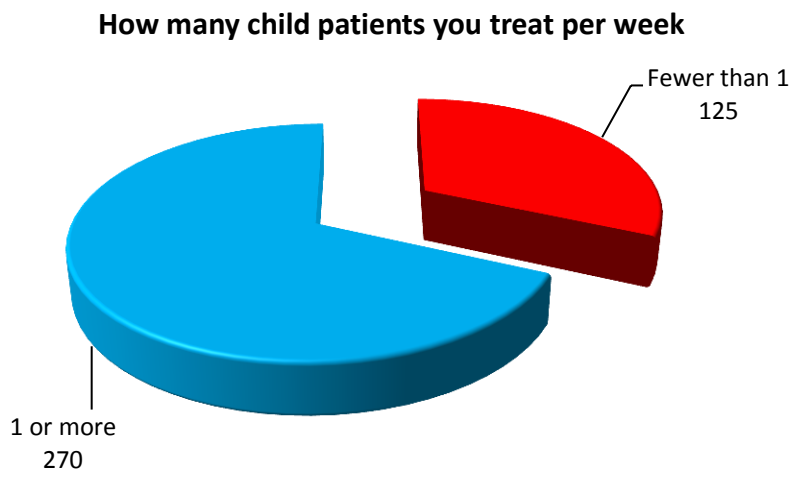

Figure 3:Number of children treated per week

Figure 4:Antibiotics prescribing training in the past

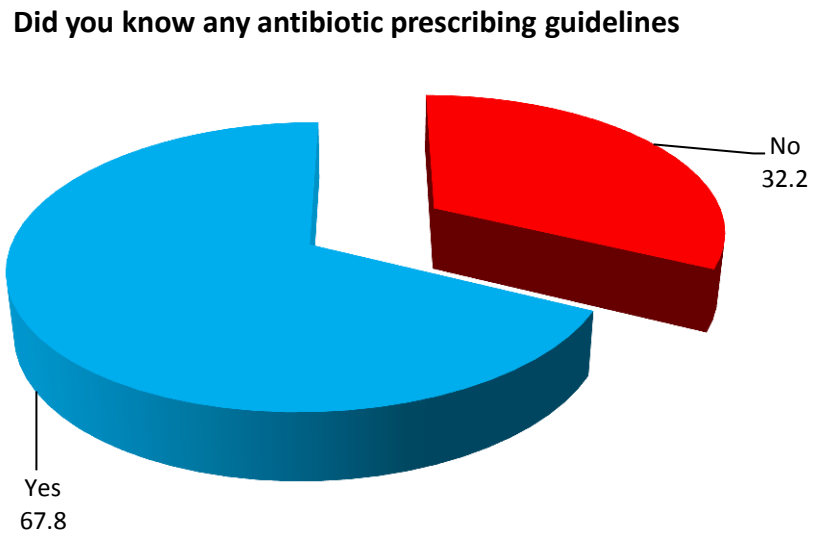

Figure 5 : Awareness of antibiotics prescribing guidelines

Table 3 shows comparison between intern dentists and GDPs according to their previous antibiotic prescribing training, awareness of guidelines and perceived preparedness to prescribe antibiotics. Significant differences were observed in all competencies. GDP and Pediatric dentists were more competent in prescribing antibiotic than new graduates ($p \leq 0.05$)

Table [3]: comparison between intern dentists and GDPs according to their competency to prescribe antibiotics

Competence	Internship students	GPs and Specialist	P value
Previous antibiotic prescribing	22 (18)	154 (49.7)	≤0.001***
Awareness of antibiotic prescribing guidelines	46 (56.2)	220(70.1)	0.019*
Preparedness of antibiotic prescribing	25 (30.9)	153 (49.5)	0.003**

Chi square test was used. *$p \leq 0.05$, **$p \leq 0.01$, ***≤ 0.001

Table 4 shows comparison between males and females in terms of their previous antibiotic prescribing training, awareness of guidelines and perceived preparedness to prescribe antibiotics. No Significant differences were observed in all competencies. Although higher proportion of males were more competent in prescribing antibiotic than female dental practitioners, this was not statistically significant ($p \geq 0.05$)

Table [4]: comparison of competency to prescribe antibiotics according to gender

Competence	Male	Female	P value
Previous antibiotic prescribing training	20 (57.1)	152 (42.7)	1.00
Awareness of antibiotic prescribing guidelines	26 (70.4)	240(67.1)	0.382
Preparedness of antibiotic prescribing	21 (60.0)	157 (44.2)	0.074

Chi square test was used. *p≤0.05, **p≤0.01, ***≤0.001

Table 5 shows comparison of participants' previous antibiotic prescribing training, awareness of guidelines and perceived preparedness to prescribe antibiotics according to the average number of pediatric patients. Significant differences were observed in previous training on antibiotic prescribing (p=0.023) and preparedness of antibiotic prescribing (p≤0.001). The higher the average number of children observed per week, the higher the competency of dental practitioners to prescribe antibiotics. The difference in awareness of antibiotic guidelines by the number of child patients was not statistically significant (p≥0.05)

Table [5]: comparison of competency to prescribe antibiotics according to number of child patients treated per week

	Average number of patients per week		
Competence	No Mean (SD)	Yes Mean (SD)	P value
antibiotic prescribing training	3.84 (4.82)	5.63 (7.44)	0.023*
Awareness of antibiotic prescribing	4.24 (4.84)	4.62(4.64)	0.693
Preparedness of antibiotic prescribing	3.62 (4.66)	5.50 (7.41)	0.001***

Man-Whitney U test was used. *p≤0.05, **p≤0.01, ***≤0.001

Table 6 shows overall adherence to antibiotic prescription guidelines. The adherence ranged between 11% and 19%. Highest adherence rate among the pediatric dentists was in case 3 (57%), among GDPs was in case 4 (16.6%), and dental trainees was in case 5 (38%). On the other hand, the lowest adherence for pediatric dentists was in case 5 (14%), among GDPs and dental trainees in case 2 (8%& 19.7%, respectively).

Table [6]: response to the clinical case scenarios (adherence rate %)

Clinical case scenarios	Overall adherence to guidelines No .(%) N =395	No (%) of Pediatric dentists adhering N =14	No(%) of general dentists adhering N =300	No(%) of intern dental students adhering N = 81
Case 1: prescribe antibiotic only for pain,Facial swelling and radiographic evidence of pathology .	75 (19)	6 (42.8)	48 (16)	21 (26)
Case 2: prescribe antibiotic only for pain, fever , facial swelling ,and radiographic evidence of pathology .	46 (11.6)	6 (42.8)	24 (8)	16 (19.7)
Case 3: prescribe antibiotic only for pain , facial swelling , draining fistula, and radiographic evidence of pathology .	73 (18.4)	8 (57)	47 (15.6)	18 (22)
Case 4: would see the patient before prescribing , and prescribe only for pain and facial swelling .	78 (19.7)	(50) 7	50 (16.6)	21 (26)
Case 5: would see the patient before prescribing , and prescribe only for pain ,warmness of skin and facial swelling .	74 (18.7)	2 (14)	41 (13.6)	31(38)

Table [7] shows the adherence to the guidelines in case 1.

The case show all symptoms of pain , radiographic evidence of pathology with facial swelling. Most of the participants prescribed antibiotics correctly to option 4 with no statistically significant difference observed between dental trainees and dental practitioners. However, varied numbers of dentists and trainees incorrectly prescribed antibiotic to patients with pain only, local swelling or no radiographic evidence of pathology, which was significantly different across study subgroups. Higher rates of dentists unnecessarily prescribed antibiotics for pain only ($p=0.001$). On the other hand, higher rates of dental trainees prescribed antibiotics for local swelling and where there is no radiographic evidence of pathology.

Table [7] compliance rate of case 1

Case 1 prescribe antibiotic only for pain,Facial swelling and radiographic evidence of pathology .			Total	General dental practitioner (GDP)&specialist	Intern dental student	p.value
			N(%)	N(%)	N(%)	
1	Pain Only	No	377(95.4)	306(97.4)	71(18)	0.001
		yes	18(4.6)	8 (2.5)	10(12.5)	
2	Pain and local swelling with no radiographic evidence	No	223(56.5)	166(52.8)	57(14.4)	0.006
		yes	172(43.5)	148(47.%)	24(29.1)	
3	Pain and local swelling withradiographic evidence	No	28(7.1)	66(21)	28(7.1)	0.004
		yes	301(76.2)	248(79)	54(65.9)	
4	Pain and facial swelling with radiographic evidence	No	28(7.1%)	21(0.06%)	7(1.8%)	0.437
		yes	367(92.9)	293(93.3)	75(91.5)	

Table [8] shows comparisons of participants responses to case 2. Most participants correctly indicated that they would prescribe antibiotics to patients with facial swelling and fever and radiographic evidence of pathology. No statistically significant differences were observed between subgroups in this option (p=0.845). However,significant differences were observed in the responses to other options that included local swelling ($p \leq 0.05$), but not the situation of pain and fever only (p=0.992).

Table [8]compliance rate of case 2

Case 2			Total	(GPD)&specialist	Intern dental student	p.value
			N(%)	N(%)	N(%)	
1	Pain and fever	No	232(58.7)	280(89)	48(12.2)	0.995
		yes	163(41.)	34(41.5)	130 (41.4)	
2	Pain , fever , and local swelling without radiographic evidence	No	148(37.5)	277(88)	45(11.4)	0.000
		yes	247(62.5)	37(45.5)	211 (67.2)	
3	Pain , fever , local swelling with radiographic evidence	No	63(15.9)	44(14)	19(4.8)	0.043
		yes	332(84.4)	270(86.6)	63(76.7)	
4	Pain , fever , facial swellingwith radiographic evidence	yes	369(93.4)	293(93.4)	77(93.9)	0.843
		No	26(6.6)	21(0.06)	5(1.3)	

Table [9]summarizes participants responses to case 3. No statistically significant differences were observed among subgroups. However, most participants reported that they would prescribe antibiotics to patients who experienced pain, fistula, and radiographic evidence of pathology.

Table [9] compliance rate of case 3

Case 3			(GPD)&specialist	Intern dental student	Total (%)	p.value
			N(%)	N(%)		
1	Pain with draining fistula only	No	214(68)	62(15.7)	276(69.9)	0.01
		yes	100(25.3)	19(4.8)	119(30.1)	
2	Pain with draining fistula and local swelling with no radiographic evidence	No	153(48.7)	43(10.9)	183(46.3)	0.003
		yes	161(43.5)	38(9.6)	212(53.7)	
3	Pain with draining fistula , local swelling and radiographic evidence	No	82(26.1)	26(6.6)	104(26.3)	0.00
		yes	232(58.7)	55(13.9)	291(73.7)	
4	Pain , draining fistula , facial swelling andradiographic evidence	No	43(13.6)	7(1.8)	39(9.9)	0.324
		yes	271(68.6)	74(18.7)	356(90.1)	

In cases 4 and 5, the adherence rate to the professional guidelines was higher among GDPs and specialist , according to ADA professional guide lines state that to prescribe antibiotic to patient you should make an

. compliance rate of case 4:			General dental practitioner (GDP)& specialists	Intern dental student	Total (%)	p.value
			n(%)	n(%)		
1	Pain only	No	299(95.2)	74(18.7)	373(94.4)	0.161
		yes	15(4.8)	7(8.5)	22(5.6)	
2	Pain and local swelling	No	205(65.2)	56(14.2)	261(66.1)	0.454
		yes	109(30.5)	25(34.7)	134(33.9)	
3	Painand facial swelling	No	143(45.5)	36(9.1)	179(45.3)	0.946
		yes	171(54.5)	45(54.9)	216(54.7)	
4	I would see the child before prescribing antibiotics	No	59(18.7)	10(2.5)	69(17.5)	0.382
		yes	255(87.8)	72(81.2)	327(82.5)	

accurate diagnosis, that means you should see the patient before prescribe any antimicrobial , table [10] , table [11].

Table [10] compliance rate of case 4

-Table [11] compliance rate of case 5:

Case 5			(GPD)&specialist	Intern dental student	Total (%)	p.value
			N(%)	N(%)		
1	Pain , warmness of the skin and localized swelling	No	199(63.3)	53(13.4)	252(63.8)	0.667
		yes	115 (36.6)	28 (34.1)	143(36.2)	
2	Pain , warmness of the skin and facial swelling	No	147(46.8)	24(6.1)	171(43.3)	0.008
		yes	167(53.2)	57(69.5)	224(56.7)	
3	I would see the child before prescribing antibiotics	No	65(20.7%)	4(1)	69(17.5)	0.002
		yes	249(79.3)	78(95.1)	326(82.5)	

Chapter Six

Discussion

6.1 Over view

Antibiotics are helpful to patient care when given and administered appropriately for bacterial infections. However, the widespread use of antibiotics has allowed common bacteria to develop resistance to drugs that once controlled them. [97,98]Drug resistance is prevalent throughout the world. [97,98]In the United States, for example, at least two million people are infected by antibiotic-resistant bacteria each year.[6] To diminish the rate at which resistance is increasing, health care providers must be careful in the use of antibiotics.[97,99]. Conservative use of antibiotics is designated to minimize the risk of developing resistance to current antibiotic regimens [97,98].

Adverse events such as allergic reactions, development of C. difficile, or drug interactions and side effects can occur.[97,100]. The Centers for Disease Control and Prevention reports that every year there are 140,000 emergency department visits for reactions to antibiotics, and that antibiotics are the most common cause of emergencydepartment visits for adverse drug events in children under the age of 18 years.[97] The American Academy of Pediatric Dentistry (AAPD) recognizes the increasing prevalence of antibiotic-resistant microorganisms and potential for adverse drug reactions and interactions. Therefore, the AAPD published recommendations for antibiotic use among pediatric dental patients. The present study was set out to investigate how Libyan dentists and newly graduated dental practitioners (Dental interns) would deal with five different case scenarios of child patients in terms of antibiotic prescribing. To the author best of knowledge, this is the first study, to our knowledge, that has investigated the prescription of antibiotics among Libyan pediatric dentists, general dental practitioners, and intern dental students in Benghazi – Libya

6.2 Main findings

The study explored previous training in antibiotic prescribing, clinical experience in treating dental infections in children, awareness of antibiotic prescribing guidelines for dental infections in children, and preparedness in antibiotic prescribing, and their association with compliance with the existing professional guidelines. Overall, the present study findings indicate poor adherence to the recommended guidelines on the use of antibiotics to treat dental infections in children.This finding is consistent with previously reported resulted among dental practitoners in USA[(101).].

Overall adherence ranged between 11% and 19%. This low adherence could be attributed to the fact that most of the study sample were dentists and dental trainees who did not receive sufficient training on antibiotic prescribing.The data demonstrated that adherence to antibiotic prescribing guidelines was way higher among specialists than that among general dental practitioners and internship dental trainees. This discrepancy could be explained by the present study finding that showed that most of the pediatric dentists had received training in antibiotics prescribing, and felt well prepared in antibiotic prescribing for dental infections in children, where as, more than half of general dental practitioners and intern dental students reported that they had not receiving any antibiotic prescribing training in the past ,and felt not well prepared in antibiotic prescribing for dental infections in children.

Likewise, dentists who treated more than one child per week appear more prepared in antibiotics prescribing for dental infections in children. Putting these finding together with the above-mentioned findings, it can be suggested that experience and postgraduate training are key

determinants of proper use of antibiotics among Libyan dental practitioners. However, the findings of this study sheds light on the undergraduate dental training given that the scenarios are hypothetical and considerable proportion of study participants were dental interns who supposedly should have fresh information and updated. For example, in case 1, less number of dental trainees indicated that they would prescribe antibiotics for children with pain only, compared to dental practitioners. On the other hand, dental trainees appear to prescribe unnecessarily antibiotic to children with local swelling or no radiographic evidence of pathology.

This might be explained by limited clinical training and extensive information provided in dental education. Previous study on preparedness of dental graduates from the University of Benghazi highlighted that the currently implemented undergraduate education programme in Benghazi dental school does not provide dentists with the required attitude and skills to fulfil their role in providing health services. (Arheiametal)[102]. This finding, however, raises important questions on the dental education at the faculty of dentistry, University of Benghazi. The teaching of antibiotic prescribing subject should be evaluated. Meanwhile, effective efforts are required to raise awareness of antibiotic usage and potential resistance caused by their misuse.

An interesting finding in the current research was that whenfever was added to the signs and symptoms, the overall adherence level dropped to 11.6% (Case 2), and when the fever removed and a draining fistula is added (Case 3) to the collective sign and symptoms the overall adherence level was 18.4% table [8], table [9] . It is unclear why, but it could be the case that fever is a common symptom of many health problems in

children and it is not directly linked to odontogenic infections. However, this remain an assumption and further investigations are required to fully understand the antibiotic prescribing practices among Libyan dental practitcioners.

Another important finding in this study was that , in cases 4 and 5 which is the weekend cases the adherence rate to the professional guide lines was 19% for case 4, and 18.7 % for case 5, according to ADA professional guidelines state that to prescribe antibiotic to patient you should make an accurate diagnosis, that means you should see the patient before prescribe any antimicrobial, less than one fourth of the dentists reported that they will see the patient first. The misuse of antibiotics is a common reason and antibacterial resistance which is a worldwide problem[(103).]. A review of Libyan literature suggested that the problem of antibiotic resistance is on increase in Libya, and called for immediate action by the health authorities to address this problem urgently[(104).]

Although more than half (67.7%) of all participants reported awareness of antibiotic prescribing guidelines for dental infections in children, awareness of general dental practitioners and intern dental students was significantly lower than that of specialists. Although this might reflect a deficiency in the training programs, it could be the case that these guidelines are not considered as appropriate source for undergraduate training or the educators did not use them in their teaching. However, the ADA guidelines do not include clinical scenarios to illustrate prescribing practices.

Although most clinical situations are specific to the patient, the guidelines might be more helpful if they contained representative clinical cases to illustrate recommended prescribing patterns ,the AAPD

guidelines appear to be more specific than the ADA guidelines, but these too could be expanded or explained further.

6.3Study limitations:

Our study had some limitations which need to be considered. First, the cross-sectional study design, although, useful for developing baseline data and for informing programme planning and research particularly in low resourced countries such as Libya [105], it does not allow for establishing any causal relationship [106]. Second, there is a potential risk of social desirability bias which is very likely in this kind of studies where self-administered questionnaires were used [107]. However, the respondents were asked to report their usual practices and assured that the aim is to describe the actual practices and related variations rather than challenging their level of knowledge or judging their practices [108]. Third, recall bias is another source of uncertainty which may possibly affect the validity of responses of the participants. Finally, we were not able to get the exact number of pediatric dentists and general dental practitioners working in Benghazi city even from the dental syndicate which affected the recruitment of study participants. However, the study sample was representative of different dental practitioners at different stages of their career.

Despite these limitations, this study has several strengths, including being the first, to our knowledge, to report on this topic of importance and clinical relevance. Little is known about antibiotic prescribing practices of dentists in Libya, and almost nothing is known about prescribing practices in treating children.

Chapter Seven

conclusion & recommendations

7.1 Conclusion :

The results of this study show low awareness and adherence among specially the general dental practitioners and intern dental students , the pediatric dentists show better adherence to professional guide lines for prescribing antibiotics for dental infections in children ,much more effort is needed to educate dentists in how to when to prescribe systemic antibiotic for dental infections in children .

Recommendations : 7.2

1-Since 56.02 % of all participants showed that they do not had antibiotic prescribing training on the past, a complete training program is needed specially for the intern dental students on when and how to prescribe antibiotic for dental infections in children .

2 - The compliance rate for all participants was low , specially for GDP and intern dental students, lectures and education plan are important to illustrate what are the antibiotic prescribing guidelines for dental infections in children .

3- The type of antibiotic chosen and it's dosing regimen are depended upon the severity of infection and the predominant type of causative bacteria .

4- More studies should be conducted for comparison .

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Appendix

Questionaire about dentists compliance with Antibiotic prescribing guidelines for dental infections in children

1- Gender Male ☐ Female ☐

2- Age :

3- Name of dental school :

4- Speciality :

Pediatric dentist ☐

General dental practitioner (GPD) ☐

Intern dental student ☐

5- Howmany child patients you treat per week ? ☐

6-Did you have antibiotic training in the past ?

YESNO ☐ ☐

7-Did you know any antibiotic prescribing guidelines ?

YES NO ☐ ☐

8-Did you think that you are well prepared in Antibiotic prescribing for children ? ☐ ☐

YESNO

9-This table involve five clinical case scenarious involving Antibiotic prescribing decisions , please answer with yes or no :

	YES	NO
Case 1: imagine you are working in private dental clinic : A healthy 9 years old child visits during normal working hours with tooth pain in lower right quadrant , on clinical examination you notice a deep carious lesion on mandibular right primary second molar , Would you precribe antibiotic fo the following:		
Pain Only?		
Pain and local swelling with no radiographic evidence ?		
Pain and local swilling with radiographic evidence ?		
Pain and facial swelling with radiographic evidence ?		
Case 2:Imagine you are working in private dental clinic : A healthy 9 years old child visits during normal working hours with tooth pain in lower right quaderant and fever of 38.3 C , on clinical examination you notice a deep carious lesion in the lower right primary molar , Would you prescribe antibiotic for the following :		
Pain and fever ?		
Pain , fever , and local swelling without radiographic evidence ?		
Pain , fever , local swelling with radiographic evidence ?		
Pain , fever , facial swelling with radiographic evidence ?		

CASE 3 :Imagine you are working in private dental clinic : A healthy 9 years old child visits during normal working hours , with tooth pain in lower right quadrant , the child has no fever , on clinical examination you notice a carious lesion on lower right second primary molar with draining fistula , Would you prescribe antibiotic fo the following:		
Pain with draining fistula only ?		
Pain with draining fistula and local swelling with no radiographic evidence ?		
Pain with draining fistula , local swelling and radiographic evidence ?		
Pain , draining fistula , facial swelling and radiographic evidence?		
CASE 4:Imagine you are working in private dental clinic ; the parent of healthy 9 years old child telephones you on a public holiday and report that their child has pain in the lower right quadrant , Would you prescribe antibiotc for the following symptoms, if the parent can collect the prescription :		
Pain only ?		
Pain and local swelling ?		
Pain and facial swelling ?		
I would see the child before prescribing antibiotics		

	YES	NO
CASE 5 :Imagine you are working in private dental clinic , the parent of healthy 9 years old child telephones you on a public holiday and report that their child has pain on the lower right quadrant with some warmness of skin and some swelling that she noticed that morning , Would you prescribe antibiotic for the following :		
Pain , warmness of the skin and localized swelling ?		
Pain , warmness of the skin and facial swelling ?		
I would see the child before prescribing antibiotics		

THANKS FOR YOUR

PARTICIPATION

Abstract in Arabic language

مدى إلتزام أطباء أسنان الأطفال و الممارسون العامون لطب الأسنان و طلبة الأمتياز بمعايير صرف المضادات الحيوية لإلتهابات الفم و الأسنان عند الأطفال

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الملخص العربي

المقدمة :

يقوم طبيب الأسنان بوصف العديد من الأدوية , لتخفيف الألم و القضاء على الإلتهابات , و تعتبر المسكنات و المضادات الحيوية أكثر الأدوية التي يقوم أطباء الأسنان بوصفها للمرضى لعلاج و منع الإصابة بالعدوى البكتيرية .

الحالات التي تستدعي وصف مضادات حيوية في طب الأسنان محدودة جدا , معظم الحالات تحتاج لتدخل علاجي مباشر من الطبيب إما بالمعالجة اللبية للأسنان أو بخلع السن , كثرة وصف المضادات الحيوية و سوء استخدامها أدى إلى ظهور العديد من المضاعفات , بدأً بالتلبك المعوي إلى ظهور بكتيريا مقاومة للمضادات الحيوية .

نظراً للزيادة المفرطة في وصف المضادات الحيوية , قامت الجمعية الأمريكية لطب الأسنان (ADA) و الأكاديمية الأمريكية لطب أسنان الأطفال (AAPD) بوضع معايير لصرف المضادات الحيوية في طب الأسنان .

و لندرة المعلومات حول معرفة أطباء الأسنان في مدينة بنغازي – ليبيا بمعايير وصف المضادات الحيوية و مدى التزامهم بها , قمنا بإجراء هذه الدراسة .

هدف الدراسة :

الهدف من الدراسة هو تقييم معرفة و سلوك أطباء أسنان الأطفال , و أطباء الأسنان العامون , و طلبة الإمتياز بكلية طب و جراحة الفم و الأسنان جامعة بنغازي في وصف المضادات

الحيوية لإلتهابات الفم و الأسنان عند الأطفال , و مدى معرفتهم و إلتزامهم بمعايير وصف المضادات الحيوية لإلتهابات الفم و الأسنان عند الأطفال .

منهجية الدراسة :

تم جمع البيانات من أطباء أسنان الأطفال و أطباء الأسنان العامون العاملون في العيادات المجمعة العامة و العيادات الخاصة في مدينة بنغازي , و طلبة الإمتياز بكلية طب و جراحة الفم و الأسنان جامعة بنغازي , من خلال ملئ إستبيان سلم شخصياً للمستهدفين .

تكون الإستبيان من شقين ,الشق الأول مكون من المعلومات الديموغرافية (العمر , الجنس , التخصص) و بعض الأسئلة حول عدد الأطفال المعالجين في الأسبوع , و هل تدربت على وصف المضادات الحيوية ف السابق , والمعرفة بمعايير صرف المضادات الحيوية .

والشق الثاني مكون من خمس حالات لأطفال بأعراض مرضية مختلفة ، ثلاثة منها حالات سريرية ، و اثنان تواصلوا مع الطبيب عبر الهاتف خلال العطلة الرسمية ، تتضمن قرار الطبيب بوصف مضاد حيوي من عدمه .

نتائج الدراسة :

تم جمع البيانات و تحليلها باستخدام الأساليب الإحصائية المناسبة , باستخدام حزمة الإحصاء للعلوم الإجتماعية (SPSS: الإصدار الخامس و العشرون, و قد أظهرت النتائج التالي

تلقى 43,98% من المشتركين تدريباً سابقاً علي كيفية وصف المضادات الحيوية لإلتهابات الفم و الأسنان عند الأطفال ؛ و أظهر معظم أطباء أسنان الأطفال 92,85% معرفتهم بمعايير وصف المضادات الحيوية لإلتهابات الفم و الأسنان عند الأطفال , بينما 71,97% من أطباء الأسنان العامين يعرفون هذه المعايير , و كان أطباء الإمتياز 30,8% الأقل معرفة بمعايير وصف المضادات الحيوية لإلتهابات الفم و الأسنان عند الأطفال .

بصفة عامة ، مدى الإلتزام بمعايير وصف المضادات الحيوية لإلتهابات الفم و الأسنان عند الأطفال كان ضعيفاً و تراوح بين (11% _19%) لكل المشتركين في الدراسة .

و لخطورة الأمر ، نحتاج لبرنامج كامل من ورش عمل و محاضرات توعوية عن كيف و متى يحتاج طبيب الأسنان لوصف مضادات حيوية للمريض .

مدى التزام أطباء أسنان الأطفال و الممارسون العامون لطب الأسنان و طلبة الامتياز بمعايير صرف المضادات الحيوية لالتهابات الفم والأسنان عند الأطفال

قدمت من قبل :

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قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في طب أسنان الأطفال

جامعة بنغازي

كلية طب و جراحة الفم و الأسنان

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