A Review of Guidelines for Antibiotic Prophylaxis before Invasive Dental Treatments

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Abstract: Bacteraemia associated with invasive dental treatments can propagate infective endocarditis in high-risk cardiac patients. Over the past decade, antibiotic prophylaxis before dental treatment has been questioned. This review aims to compare the variations between the UK, European and American antibiotic prophylaxis guidelines before dental treatments. Antibiotic prophylaxis guidelines by the National Institute for Health and Care Excellence (NICE)—Clinical Guideline 64, Scottish Dental Clinical Effectiveness Programme (SDCEP), American Heart Association (AHA), European Society of Cardiology (ESC), European Society of Endodontology (ESE) and Belgian Health Care Knowledge Centre (KCE) position statements were compared regarding the indications, high-risk patients and prophylaxis regimens before dental treatments. In the United Kingdom, the NICE—Clinical Guideline 64 and SDCEP—Implementation Advice do not advise the prescription of prophylactic antibiotics for the majority of high-risk cardiac patients undergoing routine dental treatments. On the contrary, the AHA, ESC and KEC recommend the prescription of antibiotics prior to invasive dental procedures in high-risk cardiac individuals. The ESE also indicates prophylaxis before endodontic procedures for patients with other conditions, including impaired immunologic function, prosthetic joint replacement, high-dose jaw irradiation and intravenous bisphosphonates. Among these guidelines, there are variations in antibiotic prophylaxis regimens. There are variations regarding the indications and antibiotic prophylaxis regimens before invasive dental treatments among these available guidelines.

Keywords: antibiotic prophylaxis; endocarditis; dental treatment; dentistry

1. Introduction

Infection of the heart lining (usually a heart valve), also known as infective endocarditis, is usually a life-threatening condition which affects 3.6 in every 1,000,000 individuals per year in the general population [1]. It can cause several consequences or complications such as heart murmurs, pyrexia, petechiae, embolic phenomena, anaemia and endocardial vegetations leading to valvular incompetence, myocardial abscess or mycotic aneurysm. It is also reported to affect the central nervous system (CNS), including toxic encephalopathy, stroke, brain abscess, transient ischemic attack and subarachnoid haemorrhage. Thus, clinicians should aim to minimise the risk of infective endocarditis in patients who are at high risk of developing such an infection.

The major predisposing factors for developing infective endocarditis include various cardiovascular diseases which affect the heart and blood vessels, such as bicuspid or calcific aortic valves, prosthetic heart valves, congenital heart defects, rheumatic valvular disease, intracardiac devices, mitral valve prolapse and hypertrophic cardiomyopathy [2].
Furthermore, intravenous drug abusers and immunocompromised patients also have a higher possibility of developing infective endocarditis. Cardiovascular diseases are a cause of global burden as they are the prime cause of death worldwide [3]. By the year 2030, the global economic cost of cardiovascular diseases is estimated to reach $1044 billion [4].

The pathogenesis of infective endocarditis is thought to be from a bacterial infection arising from transient bacteraemia. In fact, the causes of infective endocarditis are multifactorial, including alteration in the vessels which would cause deposition of platelets and compromise the endothelium of the cardiac valve, or a surgically formulated pulmonary shunt must exist, along with bacteraemia arising from, for example, oral trauma [5]. Bacteraemia could either be low grade but repeated, which occurs from repeated activities such as chewing, toothbrushing or flossing, or it could be high grade caused by invasive dental procedures [6]. Bacteraemia following invasive dental treatment is well documented in the literature. It can occur during tooth extractions or treatment of periodontal and endodontic infections due to the proximity of both infections with the blood circulation [7]. Based on expert opinion as mentioned in the Scottish Dental Clinical Effectiveness Programme (SDCEP)—Implementation Advice [8], invasive dental procedures that can lead to bacteraemia are presented in Table 1.

**Table 1. Dental procedures which are considered to be invasive [8].**

| Invasive Dental Procedures |
|-----------------------------|
| • Matrix band placement      |
| • Subgingival rubber dam and clamp |
| • Fixed prosthesis extending subgingivally |
| • Root canal treatment before establishment of an apical stop |
| • Prefabricated metal crowns |
| • Six-point pocket charting in diseased tissue |
| • Surgical subgingival scaling and root planning |
| • Abscess incision and drainage |
| • Tooth extractions |
| • Surgical treatment requiring manipulation of a mucoperiosteal flap or mucogingival area (e.g., apicectomy) |
| • Dental implants involving temporary anchorage devices, mini-implants |
| • Implant substructures uncovering |

Endodontic infections are polymicrobial; they are of close anatomic proximity with the bloodstream, which can result in bacteraemia during root canal treatment [9]. Moreover, in contrast to periodontal infections, the epithelial barrier is not found between the highly vascular periapical granulomatous tissue and the necrotic infected root canal. Thus, endodontic infections are an enfolded primary infective focus for dissemination via periapical vasculature of microbes from the root canal during endodontic treatment into systemic environment. Dissemination of microorganisms into the blood stream can occur in a few seconds following an oral procedure and may reach the lungs, heart and peripheral blood capillary system from the infected site [10]. In high-risk patients, some important measures could be taken before invasive dental procedures such as endodontic treatments are carried out. Even though Cahill et al. [11] suggested in their meta-analysis that bacteraemia in patients having dental treatment could be reduced by prophylactic antibiotics, the prescription of antibiotic prophylaxis before dental treatment has become debatable. The risk–benefit analysis has shifted towards the reduced utilisation of antibiotic prophylaxis due to the lack of information on the effectiveness of antibiotic prophylaxis in preventing infective endocarditis and adverse reaction to the drugs. In a recent systematic review, Cervino et al. highlighted the protocols used for antibiotic prophylaxis for extracted teeth and found a variation of protocols and papers which either support or discourage the use of antibiotic prophylaxis [12]. Therefore, this study aims to highlight the variation.
between different guidelines (US, UK and Europe) for prophylactic antibiotic use before dental treatment to minimise the risk of developing infective endocarditis.

2. Materials and Methods
2.1. Review of Guidelines
2.1.1. Guidelines for Antibiotic Prophylaxis for Minimising the Risk of Infective Endocarditis in Cardiac Patients Receiving Invasive Dental Treatment

Depending on the practitioner’s global location, local guidelines differ. In the United Kingdom, the National Institute for Health and Care Excellence (NICE) in 2008 published Clinical Guideline 64 (CG64), recommending not to prescribe antibiotics prior to dental treatment. Recommendation 1.1.3 suggested that “antibiotic prophylaxis is not recommended for people undergoing dental procedures” [13]. Following the introduction of these guidelines, a significant decrease in antibiotic prescription and a surge in infective endocarditis cases were reported in 2015 (Table 2) [14]. Similarly, in the United States, it was revealed that antibiotic prophylaxis prescription was significantly decreased in both moderate- and high-risk individuals even though this decrease was not complying with American Heart Association (AHA) guidelines [15]. Furthermore, a Canadian study also revealed that a significant reduction in antibiotic prophylaxis prescription in moderate-risk patients and a minor change in individuals of high risk were evident [16]. In 2016, NICE reviewed their guidelines by recommending that “antibiotic prophylaxis is not recommended routinely for people undergoing dental procedures” [13]. However, the definition of which patients should be considered for “nonroutine” dental procedures and what is the appropriate antibiotic regimen(s) for use in dental management was not explained in these amended NICE guidelines, leading to confusion among UK dentists. To address this challenging problem, the Scottish Dental Clinical Effectiveness Programme (SDCEP) [8] developed an implementation advice to enable practice of the NICE guidelines. The NICE recommendation 1.1.1 lists which heart conditions are considered to be at an increased risk of developing infective endocarditis (Table 3). The SDCEP explained that the majority of these high-risk patients undergoing “routine” dental procedures will not require antibiotic prophylaxis and further included a subgroup of high-risk patients requiring special consideration and antibiotic prophylaxis for “nonroutine” dental treatments (Table 3).

Table 2. Incidence of infective endocarditis.

| Country                        | Incidence before Guidelines | Incidence after Guidelines |
|--------------------------------|-----------------------------|---------------------------|
| United States of America [17]  | 11–12 per 100,000           | 14–15 per 100,000        |
| Europe [18]                    | 33 per 1,000,000            | 32 per 1,000,000         |
| United Kingdom [19]            | 22.2–41.3 per 1,000,000     | 42–67.7 per 1,000,000    |

Table 3. High-risk patients for developing infective endocarditis.

| Conditions                                                                 |
|---------------------------------------------------------------------------|
| 1. Stenosis or regurgitation of heart valves                              |
| 2. Cardiomyopathy “hypertrophic”                                         |
| 3. History of infective endocarditis                                     |
| 4. Surgically corrected congenital heart disease or palliated structural conditions, but not including defects of the septal artery, fully repaired ventricular septal defect or patent ductus arteriosus which is fully repaired and endothelialised closure devices |
| 5. Restoration of a valve                                                 |
Table 3. Cont.

| Conditions                                                                 |
|----------------------------------------------------------------------------|
| Special considerations subgroup                                           |
| 1. The use of a prosthetic valve, such as transcatheter valve, or valve repair with any prosthetic material |
| 2. History of infective endocarditis                                      |
| 3. Congenital heart defects (CHD)                                          |
| a. Cyanotic CHD “any type”                                                 |
| b. CHD repaired with a prosthetic material, using either surgical or percutaneous techniques, for 6 months following the procedure or lifelong if residual shunt or valvular regurgitation remains |
| European Society of Cardiology (ESC) [6] and Scottish Dental Clinical Effectiveness Programme (SDCEP) [8] |
| 1. Prosthetic cardiac valves, including transcatheter-implanted prostheses and homograft |
| 2. Cardiac valve repair using a prosthetic material, such as annuloplasty rings and chords |
| 3. Previous episode of infective endocarditis                             |
| 4. Congenital heart disease “cyanotic” or repaired congenital heart disease, with valvular regurgitation or residual shunts at the site of or adjacent to the site of the prosthetic patch or prosthetic device |
| 5. Valve regurgitation due to abnormal valve in heart transplant patient   |
| American Heart Association (AHA) [20]                                    |
| 1. Valve repair using prosthetic material or a prosthetic valve           |
| 2. History of infective endocarditis                                      |
| 3. Congenital heart disease such as                                       |
| a. Cyanotic with residual defects, palliative shunts or conduits without surgical repair |
| b. Congenital heart disease with full reconstruction with prosthesis whether placed surgically or by percutaneous technique up to 6 months after the procedure |
| c. Persistence of a residual defect at the site of implementation of a prosthetic material or device by cardiac surgery or percutaneous technique |
| Belgian Health Care Knowledge Centre (KCE) Report 332 [21]                |

On the contrary, the American Heart Association (AHA), European Society of Cardiology (ESC) and, most recently, the Belgian Health Care Knowledge Centre (KCE) report 332 [21] recommend that prescription of antibiotic prophylaxis to minimise the possibility of developing infective endocarditis is reasonable before any dental procedure involving the handling of the gingiva as well as the periapical region of teeth and in cases of perforation of the oral mucosa in all patients with a high risk of developing infective endocarditis [6,20–22] rather than just a subgroup of high-risk patients as indicated by the SDCEP. Although these guidelines accept that the evidence base is weak and that an adverse drug reaction risk is present, the rationale for this recommendation is based on the fact that high-risk individuals are more likely to have a poorer outcome from an infective endocarditis event. The conditions associated with high-risk cardiac patients according to the NICE, SDCEP, ESC, AHA and KCE report 332 guidelines are summarised in Table 3.

The NICE guidelines do not recommend antibiotic prophylaxis for the majority of high-risk patients undergoing routine dental procedures. The SDCEP recommends that
cardiac patients from the “special considerations subgroup” (Table 3) may require antibiotic prophylaxis for nonroutine dental management and this should be assessed in consultation with their cardiologists. The AHA, ESC and KCE support antibiotic prophylaxis for their enlisted high-risk cardiac patients (Table 3). Thus, the variations in these recommendations suggest the need for globally accepted consensus guidelines to prevent any confusion among healthcare providers and patients.

2.1.2. Antibiotic Prophylaxis Guidelines against Infection in Patients with Immunosuppressive Conditions Undergoing Endodontic Treatment

Along with cardiovascular diseases, immunosuppressive conditions have also been indicated for antibiotic prophylaxis. Patients with impaired immune response could encounter complications following dental treatment, such as spread of infection. Both nonsurgical root canal treatment and endodontic surgery can initiate detectable bacteremia. It is well documented that the incidence of bacteremia following root canal treatment and endodontic surgery is up to 20% [23] and 83.3%, respectively [24]. The European Society of Endodontology (ESE) published a position statement on antibiotics in endodontics. Along with cardiac conditions, the authors also mentioned a list of other conditions, including impaired immunologic function, prosthetic joint replacement, high-dose irradiation of jaws and intravenous bisphosphonates, where prophylactic antibiotics are indicated for patients having certain endodontic treatment procedures [25] (Table 4). The abovementioned patient groups, either due to their immune deficiency or decreased tendency of wound healing, are more prone to infections and are thus indicated for antibiotic prophylaxis in endodontics according to the ESE.

| Table 4. Antibiotic prophylaxis in endodontics according to the European Society of Endodontology position statement: the use of antibiotics in endodontics [25]. |
| --- |
| **Patient Group** | **Indications** |
| Immunocompromised patients (Uncontrolled diabetes; dialysis; Leukaemia; end-stage renal disease; HIV/AIDS; patients on chemotherapy, steroids or immunosuppressives following transplant medications; or with inherited genetic defects) | Patients undergoing nonsurgical root canal treatment and, especially, endodontic surgery. The clinician should consider:  
  • The state of the infection  
  • Complications related to the infection  
  • Reaction to drugs.  
If the operator is in doubt, discussion with the physician should be sought prior to treatment. |
| Joint replacement | Nonsurgical and surgical root canal treatment |
| Patients receiving high-dose irradiation | Nonsurgical and surgical root canal treatment During the first 3 months after joint operations |
| Patients on intravenous bisphosphonate treatment | Nonsurgical and surgical root canal treatment |

Recently, the American Dental Association (ADA) published guidelines on the use of antibiotics for emergency handling of pulpal and periapical dental pain and oral swelling. They concluded that antibiotics are not recommended in fit and healthy adults diagnosed with symptomatic irreversible pulpitis with or without symptomatic apical periodontitis, pulp necrosis and symptomatic apical periodontitis, but they advised that those patients should be referred for definitive dental treatment. When dental treatment is not feasible and patients’ symptoms get worse, a delayed prescription for amoxicillin or penicillin V potassium administered orally for patients diagnosed with pulp necrosis and symptomatic apical periodontitis is recommended. On the contrary, the expert panel suggested the pre-
scription of antibiotics along with urgent dental treatment in immunocompromised patients diagnosed with pulp necrosis and acute apical abscess with systemic involvement [26].

2.1.3. Guidelines for Antibiotic Prophylaxis Regimens

Antibiotic prophylaxis regimens also vary among different regions of the world. There is similarity in the recommendations between the “European Society of Endodontology (ESE) position statement on the use of antibiotics in endodontics” [25] and “The antibiotic Prophylaxis 2017 Update” recommendations by the American Association of Endodontists (AAE) [22], which is based on the 2017 American Heart Association and American College of Cardiology focused update of the 2014 AHA/ADA Guideline (Table 5). The British National Formulary (BNF) [27] lacks information on prophylactic antibiotics for infective endocarditis in dentistry. The SDCEP Antibiotic Prophylaxis Against Infective Endocarditis—Implementation Advice [8] recommends regimens for adults based on the 2006 British Society for Antimicrobial Chemotherapy report [28], while the doses for children are based on the 2015 ESC guidelines [6]. There is a difference between the SDCEP antibiotic prophylaxis regimen and the ESE, AAE and KCE report 332 recommendations (Table 5).

Table 5. Recommendations on antibiotic prophylaxis regimens in endodontics according to the European Society of Endodontology position statement: the use of antibiotics in endodontics [25]; American Association of Endodontics—Antibiotic Prophylaxis 2017 Update [22]; Scottish Dental Clinical Effectiveness Programme—Antibiotic Prophylaxis Against Infective Endocarditis—Implementation Advice 2018 [8]; and the Belgian Health Care Knowledge Centre (KCE) Report 332 [21].

| European Society of Endodontology Position Statement: The Use of Antibiotics in Endodontics [25] |
|---|
| **Patient group** | **Antibiotic** | **Route** | **Adult dose** | **Child dose** | **Timing before procedure** |
| General prophylaxis | Amoxicillin | PO | 2 g | 50 mg/kg | 1 h |
| Unable to take oral medication | Ampicillin | IV or IM | 2 g | 50 mg/kg | Within 30 min |
| | | | | | |
| Allergic to penicillin | Clindamycin | PO | 600 mg | 20 mg/kg | 1 h |
| | Cephalaxin or cefadroxil | | 2 g | 50 mg/kg | |
| | Clarithromycin or azithromycin | | 500 mg | 15 mg/kg | |
| If the patient is allergic to amoxicillin/penicillin/ampicillin and is unable to take the medication orally | Clindamycin | IV | 600 mg | 20 mg/kg | Within 30 min |
| | Cefazolin | | 1 g | 25 mg/kg | |

| American Association of Endodontics—Antibiotic Prophylaxis 2017 Update [22] |
|---|
| **Patient Group** | **Antibiotic** | **Route** | **Adult dose** | **Child dose** | **Timing before procedure** |
| General prophylaxis | Amoxicillin | PO | 2 g | 50 mg/kg | One dose 30–60 min |
| If the patient is unable to take oral medication | Ampicillin | IV or IM | 2 g | 50 mg/kg | One dose 30–60 min |
| | Ceftriaxone or cefazolin | | 1 g | 50 mg/kg | |
### European Society of Endodontology Position Statement: The Use of Antibiotics in Endodontics [25]

If the patient suffers from allergy to penicillin or ampicillin

- Cephalexin (or other first- or second-generation oral cephalosporin in equivalent)
- Clindamycin, clarithromycin or azithromycin

| Route | Adult Dose | Child Dose | Timing before procedure |
|-------|------------|------------|-------------------------|
| PO    | 2 g 600 mg 500 mg | 50 mg/kg 20 mg/kg 15 mg/kg | One dose 30–60 min |

If the patient is allergic to penicillin or ampicillin and unable to take oral medication

- Cefazolin or ceftriaxone
- Clindamycin

| Route | Adult Dose | Child Dose | Timing before procedure |
|-------|------------|------------|-------------------------|
| IM or IV | 1 g 600 mg | 50 mg/kg 20 mg/kg | One dose 30–60 min |

### Scottish Dental Clinical Effectiveness Programme—Antibiotic Prophylaxis Against Infective Endocarditis—Implementation Advice 2018 [8]

| Patient Group | Antibiotic | Route | Adult Dose | Child Dose | Timing before procedure |
|---------------|------------|-------|------------|------------|-------------------------|
| General prophylaxis | Amoxicillin | PO | 3 g | 6 months to 17 years 50 mg/kg (max dose 3 g) | 1 h |
| Allergic to penicillin | Clindamycin | PO | 600 mg | 17 years 20 mg/kg (max dose 600 mg) | 1 h |
| Allergic to penicillin and unable to swallow capsule | Oral suspension of azithromycin 200 mg/5 mL | PO | 500 mg (12.5 mL) | 11 years 12 mg/kg max dose 500 mg 12–17 years 500 mg | 1 h |
| Patients requiring intravenous prophylaxis | Amoxicillin | IV | 1 g | 6 months to 17 years 50 mg/kg (max dose 1 g) | Before procedure or at anaesthetic induction |
| Patients requiring intravenous prophylaxis and who are allergic to penicillin | Clindamycin | IV | 300 mg | 6 months to 17 years 20 mg/kg (max dose 600 mg) | Before procedure or at anaesthetic induction |

### Belgian Health Care Knowledge Centre (KCE) Report 332 [21]

| Patient group | Antibiotic | Dose | Timing before procedure |
|---------------|------------|------|-------------------------|
| Patient not allergic to amoxicillin or ampicillin | Amoxicillin or ampicillin | 2 g for adults and 50 mg/kg for children 600 mg for children | One dose 30–60 min before procedure |
| Patient allergic to amoxicillin or ampicillin | Clindamycin | 600 mg for adults and 20 mg/kg for children | One dose 30–60 min before procedure |

The World Health Organisation has emphasised the emergence of microbes with antibiotic resistance. In this regard, it is suggested that if the patient is recommended for antibiotic prophylaxis and is already taking an antibiotic, the clinician should choose an antibiotic from a different class; for example, for a patient already receiving oral penicillin for another condition, beta-lactams-resistant viridans group streptococci are more likely...
to be present in the oral cavity, therefore antibiotic from a different class needs to be prescribed for effective prophylaxis [8,22]. In order to encourage best practices, policy makers should make unanimous guidelines globally regarding the drugs, their doses and specific indications to avoid further emergence and spread of antibiotic resistance.

Since at present there are variations in the antibiotic prophylaxis indications and regimens among different guidelines, it is important that these should be discussed in detail with high-risk patients as part of the informed consent prior to any invasive dental treatment, such as endodontic treatment, periodontal treatment and so forth, and the outcome of the discussion should be recorded in patient notes. This would give the patient the opportunity to make an informed decision prior the commencement of invasive dental procedures.

2.1.4. Guidelines for Timing of Dental Screening, Treatment and Favourable Outcome before Invasive Cardiovascular Surgery

The timing of dental screening for oral disease, its treatment and favourable outcome before commencement of cardiovascular surgery is critical. This could significantly reduce the risk of infective endocarditis and systemic inflammatory burden that can trigger vascular events. The need for antibiotic prophylaxis is to prevent the development of such conditions following invasive dental procedures carried out after starting these treatments.

Several studies have linked endodontic infections with systemic diseases, including cardiovascular diseases [29]. This has raised concerns regarding the dental management of patients before undergoing cardiovascular surgery. Dental screening and management of oral infections such as caries, endodontic infections, periodontal infections and so forth, prior to any invasive cardiovascular procedure is controversial due to the available guidelines lacking detailed information in this regard [6]. However, several studies have indicated an extensive preoperative extra- and intraoral examination for the detection of any infection, overall assessment of oral hygiene and sensibility testing for every individual tooth along with radiographic examination for detection of any teeth with irreversible pulpitis, pulp necrosis, apical periodontitis, acute apical abscess and chronic apical abscess requiring endodontic treatment [30].

Available information from the American Heart Association or European Society of Cardiology does not specify how the dental screening should be carried out. These guidelines ignore the fact that it is often challenging to make an accurate diagnosis or a definite conclusion regarding the outcome of dental treatment [6]. Unfortunately, dentists are usually the last to be informed of the timing of the cardiac intervention, which makes it difficult to assess the outcome of the treatment [30]. As reported by the European Society of Endodontology, the favourable outcome of endodontic treatment could be assessed one year after the completion of root canal treatment. Favourable outcome is described as the patient being asymptomatic, the absence of swelling and sinus tracts, functional teeth and radiological evidence of normal periodontal ligament space around the root [31]. If the lesion does not resolve in one year, further review appointments should be considered up to four years. However, if after four years the lesion persists, root canal treatment is considered to have an unfavourable outcome [31]. In a recent consensus report which included cardiologists, endodontists and periodontists, it was concluded that to assess the outcome of endodontic treatment in cases of irreversible pulpitis, pulp necrosis, apical periodontitis, acute apical abscess and chronic apical abscess, follow-up time requires ranges from one week for the patient’s symptoms up to one year for radiographic evaluation. The consensus stressed the need for the development of a protocol to aid both cardiologists and dentists during the perioperative preparation phase [30]. Furthermore, in a recent study done to analyse the attitude of cardiologists and cardiovascular surgeons towards the management of endodontic infections and oral health, cardiologists believed that the cardiac health of patients with heart diseases along with endodontic infections could be negatively affected by chronic root canal infection; also, most cardiac specialists emphasised the importance of managing endodontic diseases [32].
3. Discussion

In this review, we have highlighted that there are variations between the use of prophylactic antibiotics globally. Since the introduction of the NICE guidance in the United Kingdom, antibiotic prescriptions have been massively reduced; however, the incidence of infective endocarditis has increased. In the United States, the incidence of endocarditis also increased, but when comparing it with the United Kingdom, the difference was almost doubled following the release of the guidance in 2007. Unlike in the United Kingdom and the United States, the incidence of infective endocarditis after the introduction of guidelines for the use of prophylactic antibiotics did not have any significant effect, while the prescription of antibiotics has been reduced [33]. Furthermore, variations are present not only in the protocol on whom to give antibiotic prophylaxis but also regarding the doses across different continents; for example, in the United States and Europe, amoxicillin is administered at a dose of 2 g, while in the United Kingdom, it is advised that a dose of 3 g is given as prophylaxis. Guideline variations are thought to be a consequence of the general agreement that there is a lack of evidence to support the effectiveness of prophylactic antibiotics, which could cause confusion among clinicians and put patients’ lives at risk [18,34,35].

4. Conclusions

There are variations regarding the indications and antibiotic prophylaxis regimens prior to invasive dental procedures in patients with either cardiac or other immunosuppressive conditions among the available UK, European and American guidelines. Furthermore, there is no defined protocol regarding timings for dental screening, treatment and favourable outcome before commencement of invasive cardiovascular procedure. There is a strong need for global consensus between associations and societies for the development of informative guidelines for the use of antibiotic prophylaxis prior to invasive dental treatment as well as the development of a timeline for the protocol of dental screening, treatment and favourable outcome for cardiologists, physicians and dentists during the pretreatment preparation phase. These unanimous guidelines will be pivotal for healthcare workers around the globe and will provide major health benefits.

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