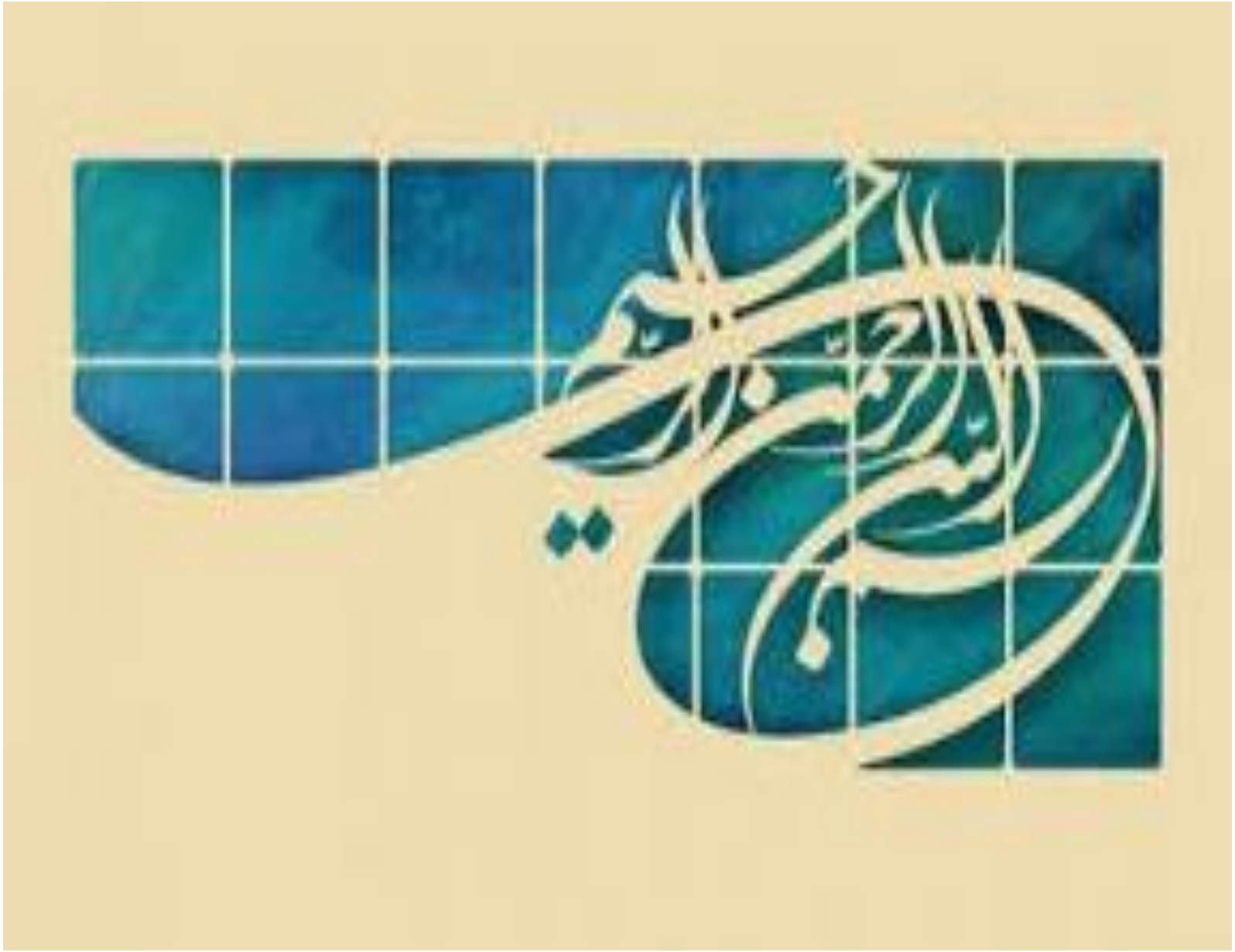


Infective Endocarditis & Prevention of Infective Endocarditis

Dr Najmeh Namazee
Infectious Diseases Specialist

Infective Endocarditis: Definition

Infective endocarditis (IE) is a :

- ✓ **Serious, life-threatening** infection
- ✓ **Caused by microbes**
- ✓ Settle on the **endothelial surface** of the **heart or heart valves**

Why it is important for us?

- IE is a disease that is difficult to treat and has significant morbidity and mortality.
- Therefore, emphasis has

long been directed toward prevention.

- Although **bacteria** most often cause these diseases, **fungi and other microorganisms** may cause such infection.

- Various dental procedures have been reported to be a significant cause of IE

  Because:

- Bacterial species found in the mouth frequently have been implicated as the causative agent.

ETIOLOGY

- **VGS (a-hemolytic streptococci),** constituents of the

  normal oral flora and gastrointestinal (GI) tract, remain

  the **most common cause of community-acquired NVE**

  causing about 15%e35% of cases of IE.
- **Group D streptococci,** which include

  Streptococcus bovis and the ***enterococci (Enterococcus***

  faecalis), are normal inhabitants of the GI tract and account for 5%e18% of cases of IE.

- In large medical centers,

Staphylococci are the most common pathogen identified in IE, accounting for 30%e35% of infections.

- Staphylococcal IE is associated **with IDU, health care contact, and acute IE.**

- Between 75% of staphylococcal IE are caused by coagulase-positive **S. aureus.**
- **Staphylococcus aureus** often affects the right side of the heart (tricuspid valve), and in most cases, the cardiac valves are normal before infection.
- S. aureus also is the most common pathogen in **nonvalvular cardiovascular device infections**.
- Of note, **S. aureus** is **not a normal** constituent of the **oral flora**.

PATHOPHYSIOLOGY

The sequential events leading to infection

usually starts with:

injury or damage to an endothelial surface, most often a cardiac valve leaflet.

Although IE can occur on normal endothelium, most cases begin with a damaged surface

usually in proximity to an **anatomic defect or prosthesis**

- The endothelial damage can result from any of a variety of events:

✓ Directed flow from a highvelocity jet onto the endothelium

✓ Flow from a high- to a low-pressure chamber

✓ Flow across a narrowed orifice at high velocity

Complications

- Severe **valvular insufficiency** that may lead to *heart failure and death*
- Embolization of vegetation fragments often leads to *complications such as* ***stroke***
- Myocardial infarction **(MI)** can occur as the result of *embolism of the coronary arteries*

CLINICAL PRESENTATION

- Fever (80%e95% of patients)
- Heart murmur
- Vegetative mass seen on echocardiography
- Dyspnea
- Fatigue
- Flu-like symptoms
- New or changing heart murmurs, (80%e85% of patients)

- Emboli or immunologic responses are less frequently seen since the advent of antibiotics,
- They manifest as :
- Petechiae of the palpebral conjunctiva the buccal and palatal mucosa, and the extremities

- Osler nodes (small, tender, subcutaneous nodules that develop in the distal pads of the digits)

- Petechiae on buccal mucosa

FIG. 2.10 Osler node in infective endocarditis. (From Fowler VG Jr, Bayer AS. Infective endocarditis. In Goldman L, Ausiello D, eds. *Cecil Medicine*. 23rd ed. Philadelphia: Saunders; 2008.)

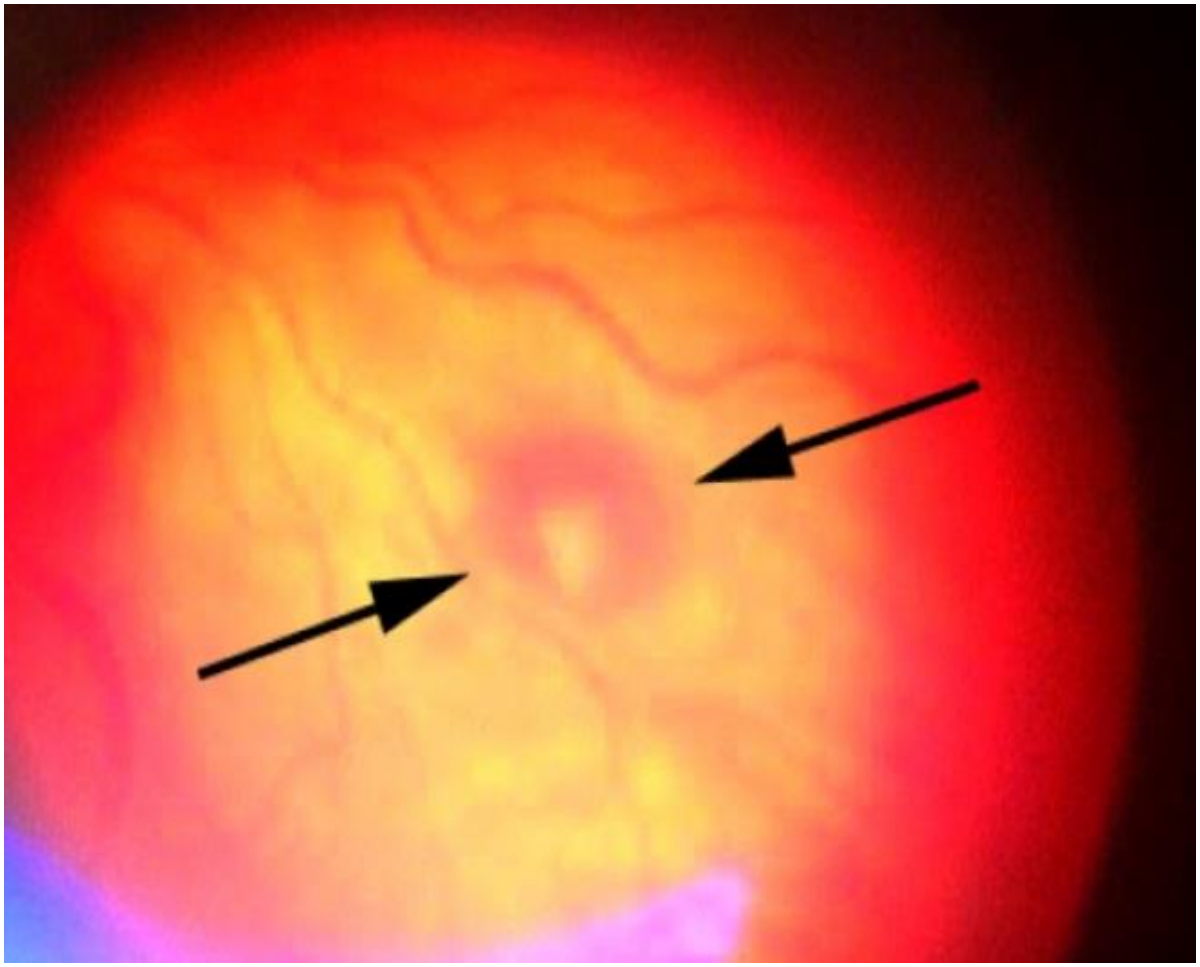
- Janeway lesions

  (small, erythematous/hemorrhagic, nontender macules on the palms and soles)
- Splinter hemorrhages (dark-red linear lesions in the nail beds)
- Roth spots (oval retinal hemorrhage with small clear centers)

- OSLER Node
  &
  Janeway lesions

- **Yellow arrow: Osler node**
- **Blue arrows :Janeway lesion**

- Splinter hemorrhage



- Roth spot

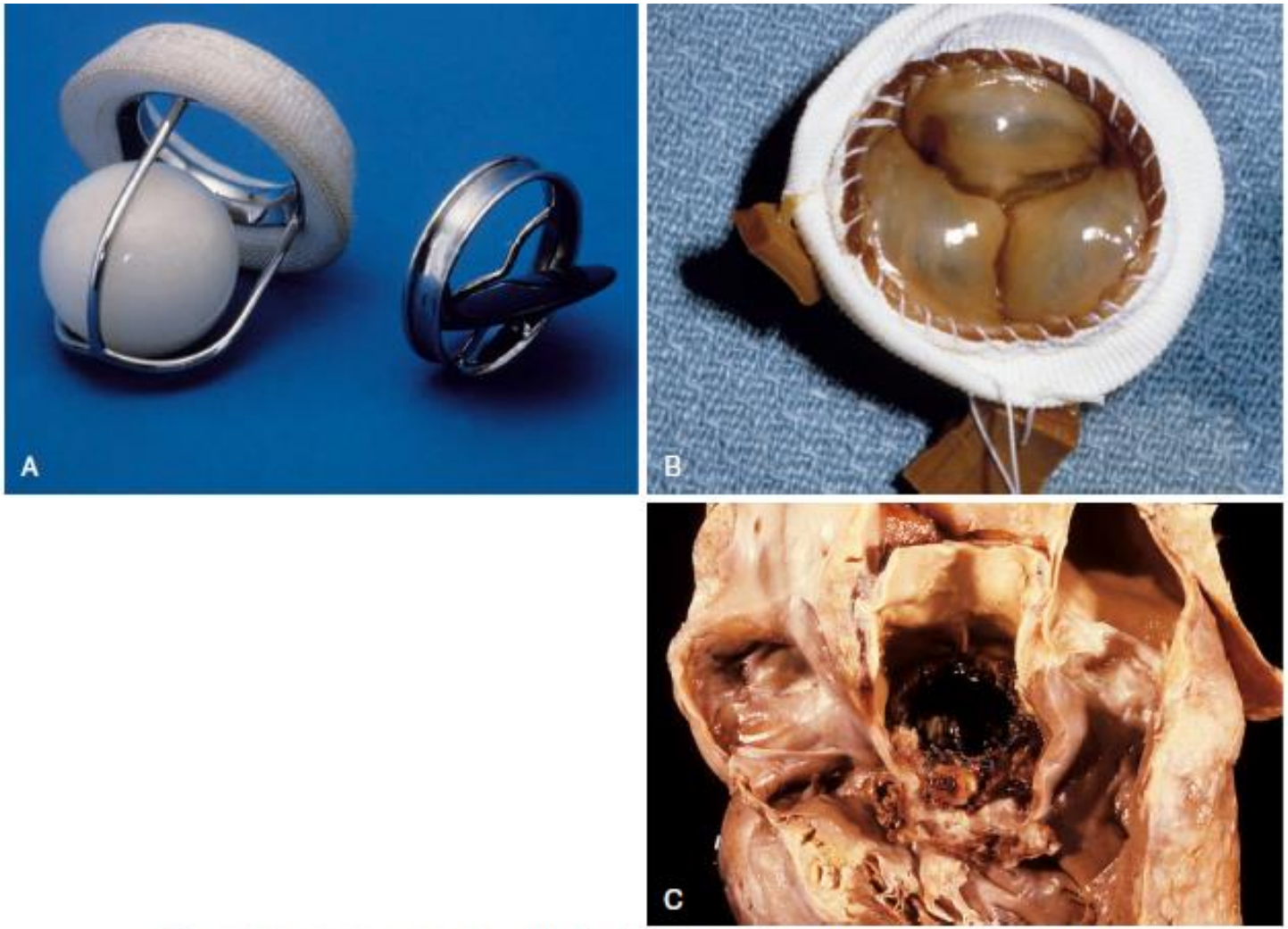


FIG. 2.6 Prosthetic cardiac valves. (**A**) Starr–Edwards caged ball mechanical valve. (**B**) Hancock porcine bioprosthetic valve. (**C**) Prosthetic valve endocarditis.

DENTAL MANAGEMENT

DENTAL MANAGEMENT

What should we do?

- Dental management continues to focus primarily on the
- prevention of VGS IE.

✓ Emphasis is on minimizing daily bacteremia of dental origin through good oral hygiene

✓ Providing prophylactic antibiotics when indicated.

- It is undisputed that many dental procedures can cause bacteremia
- bacteremia can result from many normal daily activities :

✓ toothbrushing
✓ flossing
✓ manipulation of toothpicks
✓ use of oral water irrigation devices
✓ chewing

TABLE 2.5 Reported Frequency of Bacteremia Associated With Various Dental Procedures and Oral Manipulation

Dental Procedure or Oral Manipulation	Reported Frequency of Bacteremia (%)
Tooth extraction	10–100
Periodontal surgery	36–88
Scaling and root planning	8–80
Teeth cleaning	≤40
Rubber dam matrix or wedge placement	9–32
Endodontic procedures	≤20
Toothbrushing and flossing	20–68
Use of wooden toothpicks	20–40
Use of water irrigation devices	7–50
Chewing food	7–51

As the result :

- These findings imply that emphasis on maintaining **good oral hygiene** and **eradicating dental or oral disease** is **key to decreasing** the **frequency of bacteremia** produced by normal **daily activities**.

CURRENT AMERICAN HEART ASSOCIATION RECOMMENDATIONS (2021)

- The current (2021) AHA guidelines recommend antibiotic prophylaxis based on three risk factors:
- **Underlying cardiac** conditions
- **Dental procedure** being performed
- **Oral microbe(s)** mostly likely to contribute to bacteremia that causes IE.

Underlying Cardiac Conditions for Which Antibiotic Prophylaxis Is Suggested

The 2021 AHA guidelines identify the underlying cardiac

disorders at "**greatest risk of adverse outcomes**" (i.e.,*significant morbidity and mortality*) from VGS IE, not the lifetime risk for acquiring IE as was used in past guidelines.

4Groups

- The **four "highest risk" categories** of cardiac conditions recommended for antibiotic prophylaxis to prevent adverse outcomes from VGS IE :
- Prosthetic cardiac valve or material used for cardiac valve repair or other implantable cardiac devices
- Previous, relapse or recurrent IE
- Congenital heart disease **(CHD)**
- Cardiac transplant recipients who develop cardiac valvulopathy

BOX 2.1 Cardiac Conditions Associated With the Highest Risk of Adverse Outcomes From Endocarditis for Which Antibiotic Prophylaxis With Dental Procedures Is Recommended

- **Prosthetic cardiac valve or material**
  - Presence of cardiac prosthetic valve
  - Transcatheter implantation of prosthetic valves
  - Cardiac valve repair with devices, including annuloplasty, rings, or clips
  - Left ventricular assist devices or implantable heart
- **Previous, relapse, or recurrent infective endocarditis**
- **Congenital heart disease (CHD)**[a]
- Unrepaired cyanotic CHD, including palliative shunts and conduits
  - Completely repaired CHD with prosthetic material or device, whether by surgery or transcatheter during the first 6 months after the procedure[b]
  - Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device
  - Surgical or transcatheter pulmonary artery valve or conduit placement such as Melody valve and Contegra conduit
- **Cardiac transplant recipients who develop cardiac valvulopathy**

[a]Except for the conditions listed in this box, antibiotic prophylaxis is no longer recommended for any other form of CHD.

[b]Prophylaxis is recommended because endothelialization of prosthetic material occurs within 6 months after the procedure.

Note: Moderate Risk Categories, which include rheumatic fever, non-rheumatic valve disease, congenital valve anomalies, have risk for adverse outcomes from IE but are not recommended to receive antibiotic prophylaxis based on the current guidelines. Antibiotic prophylaxis is also NOT suggested for implantable electronic devices (i.e., pacemaker similar devices) septal defect closure devices when complete closure is achieved, peripheral vascular grafts and patches, including those used for hemodialysis, coronary artery stents or other vascular stents, CNS ventriculoatrial shunts, vena cava filters, and pledgets.

From Wilson W, Gewitz M, Lockhart PB, et al. *Circulation*. 2021;143(20):e963–e978.

Left Ventricular Assisted Device

- Melody Transcatheter Pulmonary Valve (TPV)

Cardiac Conditions for Which Antibiotic Prophylaxis Is Not Suggested

- There are several cardiac conditions that increase the lifetime risk for IE; however, these conditions **are not recommended for antibiotic prophylaxis to prevent VGS IE.**
- mitral valve prolapse (MVP)with or without a murmur/regurgitation
- RHD
- bicuspid valve disease
- calcified aortic stenosis
- hypertrophic cardiomyopathy
- implantable pacemaker
- atrial or ventricular septal defect
- cardiac defibrillator
- coronary artery bypass graft(CABG)

Nonvalvular Cardiovascular Devices: Antibiotic Prophylaxis Is Not Suggested

TABLE 2.6 Nonvalvular Cardiovascular Device–Related Infection Rates—Not Recommended for Antibiotic Prophylaxis

Type of Device	Incidence of Infection (%)
Intracardiac	
Pacemaker and implantable cardioverter defibrillator	0.13–3.2
Total artificial hearts	To be determined
Ventriculoatrial shunts	2.4–9.4
Pledgets	Rare
Patent ductus arteriosus occlusion devices	Rare
Atrial septal defect and ventriculoseptal defect closure devices	Rare
Conduits	Rare
Patches	Rare
Arterial	
Peripheral vascular stents	Rare
Peripheral vascular grafts and patches, including for hemodialysis	1.0–6
Intraaortic balloon pumps	≤5–26
Angioplasty or angiography	<1
Coronary artery stents or other vascular stents	Rare
Patches	1.8
Venous	
Vena cava filters	Rare

From Baddour LM, Bettmann MA, Bolger AF, et al. Nonvalvular

Intravascular Catheters: Antibiotic Prophylaxis Is Not Suggested

The causative microorganisms in these infections include coagulase-negative staphylococci, S. aureus, enterococci, gram-negative rods, Escherichia coli, Enterobacter and Candida spp., P. aeruginosa, and Klebsiella pneumoniae.

- **None of these, with the exception of Candida, are normal inhabitants of the oral cavity**; thus, they do ***not introduce risk for infection with oral procedures***.
- Current national guidelines do not include a recommendation for antibiotic prophylaxis for patients with any of these devices who are undergoing dental procedures.

TABLE 2.7 Catheters Used for Venous and Arterial Access

Catheter Type	Entry Site	Comments
Peripheral venous catheters (short)	Usually inserted into veins of forearm or hand	Phlebitis with prolonged use; rarely associated with bloodstream infection
Peripheral arterial catheters	Usually inserted into radial artery; can be placed in femoral, axillary, brachial, or posterior tibial arteries	Low infection risk; rarely associated with bloodstream infection
Midline catheters	Inserted through antecubital fossa into proximal basilica or cephalic veins; does not enter central veins or peripheral catheters	Anaphylactoid reactions have been reported with catheters made of elastomeric hydrogel; lower rates of phlebitis than with short peripheral catheters
Nontunneled central venous catheters	Percutaneously inserted into central veins (subclavian, internal jugular, or femoral)	Account for most catheter-related bloodstream infections
Pulmonary artery catheters	Inserted through a Teflon introducer into a central vein (subclavian, internal jugular, or femoral)	Usually heparin bonded; similar rates of bloodstream infection as central venous catheters
Peripherally inserted central venous catheters	Inserted into basilica, cephalic, or brachial veins and advanced to superior vena cava	Lower rate of infection than nontunneled central venous catheters
Tunneled central venous catheters	Implanted into subclavian, internal jugular, or femoral veins	Cuff inhibits migration of organisms into catheter tract; lower rate of infection than with nontunneled central venous catheters
Totally implantable	Tunneled beneath skin with subcutaneous port access with a needle; implanted in subclavian or internal jugular vein	Lowest risk for catheter-related bloodstream infections; improved patient self-image; no need for local catheter site care; surgery required for catheter removal
Umbilical catheters	Inserted into umbilical vein or umbilical artery	Risk for catheter-related bloodstream infection similar with use of umbilical vein and with use of artery

Dental Procedures for Which Antibiotic Prophylaxis Is Recommended

3Groups

- Who undergo any dental procedure that involves the:
- ✓ Manipulation of gingival tissues
- ✓ Manipulation of the peri-apical region of a tooth
- ✓ Those procedures that perforate the oral mucosa

Antibiotic prophylaxis is NOT recommended

for :

- routine local anesthetic injections through noninfected tissue,
- taking of dental radiographs
- placement of removable prosthodontic or orthodontic appliances
- adjustment of orthodontic appliances
- shedding of deciduous teeth
- bleeding from trauma to the lips or oral mucosa

BOX 2.2 Dental Procedures in Patients With Cardiac Conditions for Which Infective Endocarditis Prophylaxis Is Recommended

- All dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa
- This includes all dental procedures except the following procedures and events:
  - Routine anesthetic injections through noninfected tissue
  - Taking of dental radiographs
  - Placement of removable prosthodontic or orthodontic appliances
  - Adjustment of orthodontic appliances
  - Shedding of deciduous teeth and bleeding from trauma to the lips or oral mucosa

Antibiotic Prophylaxis Regimens

- The current 2021 AHA guidelines provide four antibiotic prophylaxis regimens for at-risk patients.

  The categories are based on those who are
- (i) able to take oral medications
- (ii) unable to take oral medication
- (iii) allergic to penicillin or ampicillin and can take oral medication
- (iv) allergic to penicillin or ampicillin and unable to take oral medication

Right Time

- Antibiotic prophylaxis should be administered in a:
- single dose **30e60 min before** the procedure. If the antibiotic is inadvertently not administered before the procedure,
- the dosage may be administered **up to 2 h after** the procedure

Patients Already Taking Antibiotics

- In patients who

  are taking **penicillin or amoxicillin** for ***eradication of an infection*** (e.g., sinus infection) or for ***long-term secondary prevention of rheumatic fever***, presence of VGS that are relatively resistant to **penicillin or amoxicillin** is likely.

- Therefore, a nonpenicillin antibiotic **(azithromycin,clarithromycin or doxycycline)**

should be selected for prophylaxis if treatment is necessary.

- Because of **cross-resistance with cephalosporins**, this class of antibiotics should be avoided. *

- Current AHA recommendations are to ***wait for at least*** **10 days after completion of short-course antibiotic therapy** before administration of prophylactic antibiotics for an elective dental procedure.
- Prospective studies indicating that **amoxicillin-resistant VGS** can persist for 24 days after a single dose of 2 g amoxicillin
- Thus waiting at least 24 days **may have additional benefit**

Consecutive Dental Appointments

- Because of the potential for antibiotic resistance, the AHA also recommends:
- waiting **at least 10 days** for the administration of antibiotic prophylaxis in a high-risk patient who is : Undergoing **multiple sequential dental appointments.**

- Clinical judgment should include recognition of the benefits of using an ***alternative antibiotic regimen each session,***

- ***waiting at least 24 days between treatment sessions*** where antibiotic prophylaxis is being administered, when possible, to ***reduce the risk of antibiotic-resistant VGS strains.***

TABLE 2.8 American Heart Association Antibiotic Regimens for Dental Procedures: Single Dose 30–60 min Before the Procedure

Situation	Agent	Adults	Children
Oral	Amoxicillin	2 g	50 mg/kg
Unable to take oral medication	Ampicillin or	2 g IM or IV	50 mg/kg IM or IV
	Cefazolin or ceftriaxone	1 g IM or IV	50 mg/kg IM or IV
Allergic to PCNs or ampicillin (oral)	Cephalexin[a,b] or	2 g	50 mg/kg
	Azithromycin or clarithromycin	500 mg	15 mg/kg
	Or doxycycline	100 mg	>45 kg, 100 mg <45 kg, 4.4 mg/kg
Allergic to PCNs or ampicillin and unable to take oral medication	Cefazolin or ceftriaxone[b]	1 g IM or IV	50 mg/kg IM or IV

[a]Or other first- or second-generation oral cephalosporin in equivalent adult or pediatric dosing.

[b]Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticaria with penicillin or ampicillin. Clindamycin is no longer recommended for antibiotic prophylaxis for a dental procedure. *IM*, Intramuscular; *IV*, intravenous; *PCN*, penicillin.

From Wilson W, Gewitz M, Lockhart PB, et al. American Heart Association Young Hearts Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee of the Council on Lifelong Congenital Heart Disease and Heart Health in the Young; Council on Cardiovascular and Stroke Nursing and the Council on Quality of Care and Outcomes Research. Prevention of viridans group streptococcal infective endocarditis: a scientific statement from the American Heart Association. *Circulation*. 2021;143(20):e963–e978.

- Cephalosporins should not be used in an individual with a history of anaphylaxis, angioedema, or urticarial with penicillin or ampicillin.
- **Vancomycin** IV(Adults:15-20mg/kg not to exeed 2g,children 15mg/kg to a maximum dose 1 g)

Parenteral Antibiotics.

- The AHA states:
- In patients who are receiving parenteral antimicrobial therapy for IE or other infections and require a dental procedure,
- The **same parenteral antibiotic** may be continued through the dental procedure.

Prolonged Dental Appointment

- for a lengthy appointment, this may be a matter of concern
- Most of the penicillin-sensitive VGS have an MIC requirement of 0.2 mg/mL.
- A **2-g dose of amoxicillin should produce an acceptable MIC for at least 6 h.**
- If a procedure lasts longer than 6 h, it may be prudent to **administer an additional 2-g dose of amoxicillin** .

2.4.2. IE Prophylaxis

Recommendations for IE Prophylaxis Referenced studies that support the recommendations are summarized in Online Data Supplement 1.		
COR	**LOE**	**Recommendations**
2a	C-LD	1. Antibiotic prophylaxis is reasonable before dental procedures that involve manipulation of gingival tissue, manipulation of the periapical region of teeth, or perforation of the oral mucosa in patients with VHD who have any of the following[6–14]: a. Prosthetic cardiac valves, including transcatheter-implanted prostheses and homografts. b. Prosthetic material used for cardiac valve repair, such as annuloplasty rings, chords, or clips. c. Previous IE. d. Unrepaired cyanotic congenital heart disease or repaired congenital heart disease, with residual shunts or valvular regurgitation at the site of or adjacent to the site of a prosthetic patch or prosthetic device. e. Cardiac transplant with valve regurgitation attributable to a structurally abnormal valve.
3: No Benefit	B-NR	2. In patients with VHD who are at high risk of IE, antibiotic prophylaxis is not recommended for nondental procedures (eg, TEE, esophagogastroduodenoscopy, colonoscopy, or cystoscopy) in the absence of active infection.[15,16]

The last but not least

- The emergence of multidrug-resistant microorganisms, including VGS, is a **global threat**.
- **Antibiotic stewardship** is now a major component of combating the development of resistance and cost control.

Thanks for your attention