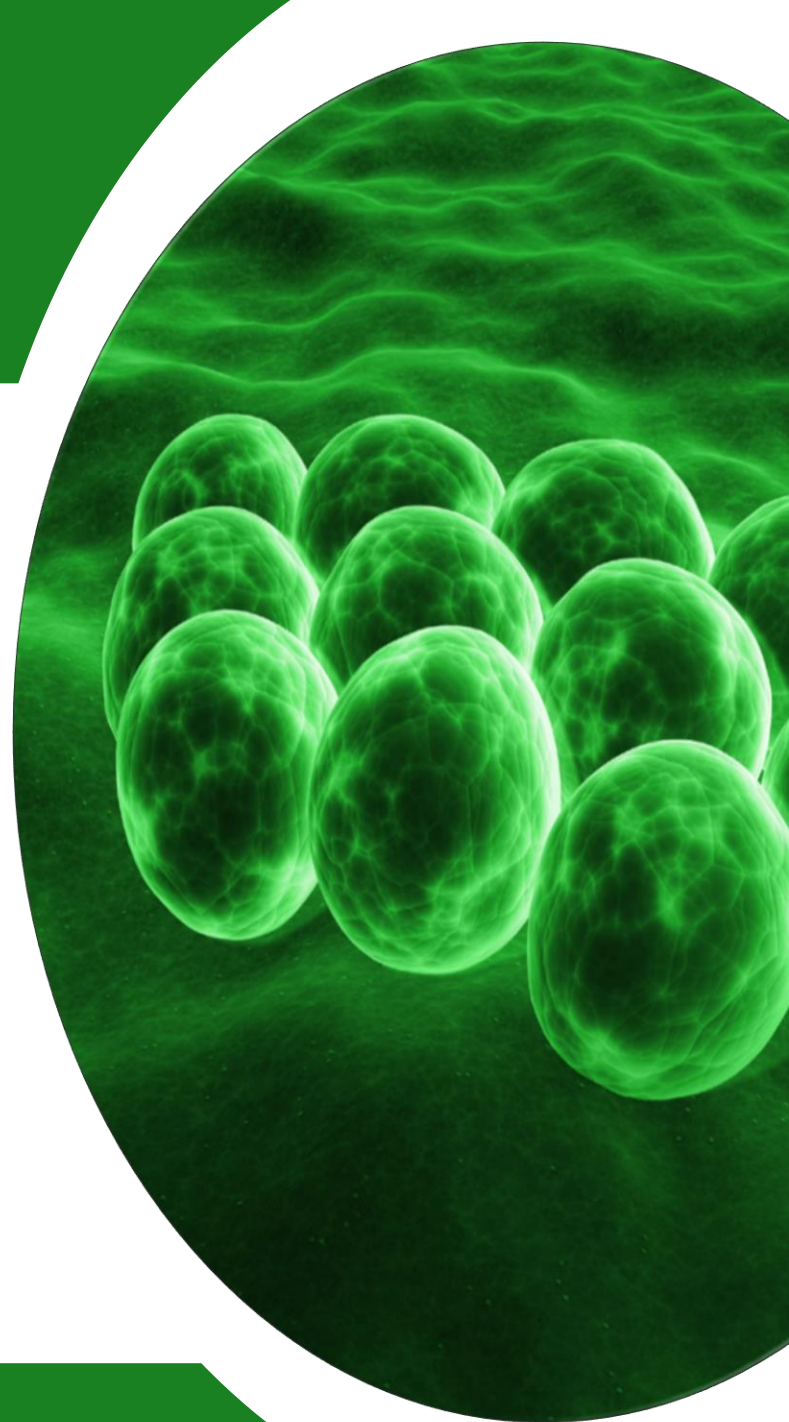
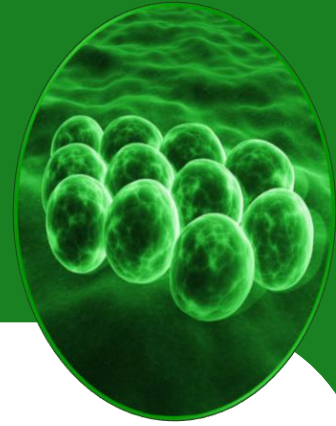


Periprosthetic Joint Infection





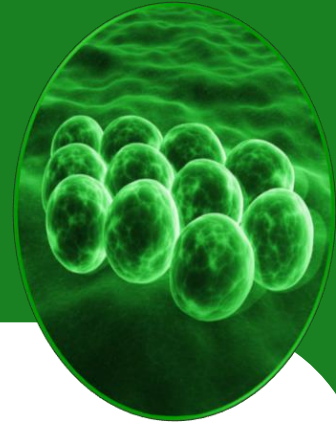
Continuing Education Provider



Funds Provided By

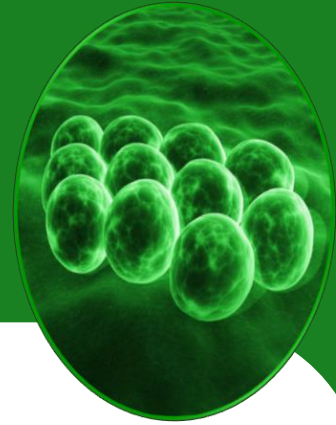


Objectives



- Explain how periprosthetic joint infection (PJI) affects patients and the healthcare system
- List risk factors for PJI and actions that can be taken to reduce those risks
- Discuss the properties of biofilms and why they are particularly challenging to treat
- Identify ways to diagnose PJI
- Describe prevention and treatment options for PJI

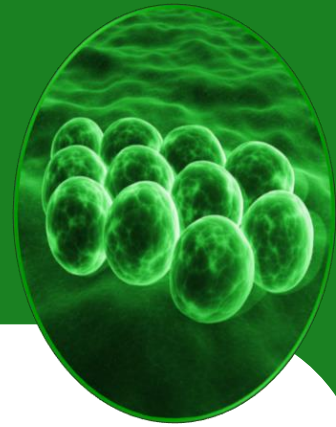
Total Joint Arthroplasties



- Nearly one million joint arthroplasties performed annually
- Number will increase with aging population
- Can improve quality of life
- Pose a risk of infection

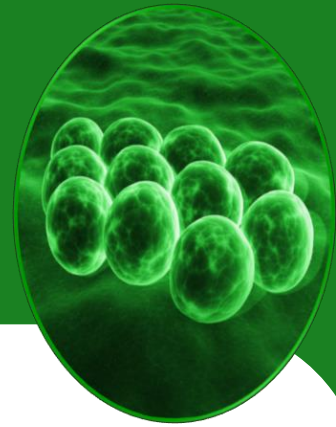


What is a Periprosthetic Joint Infection?



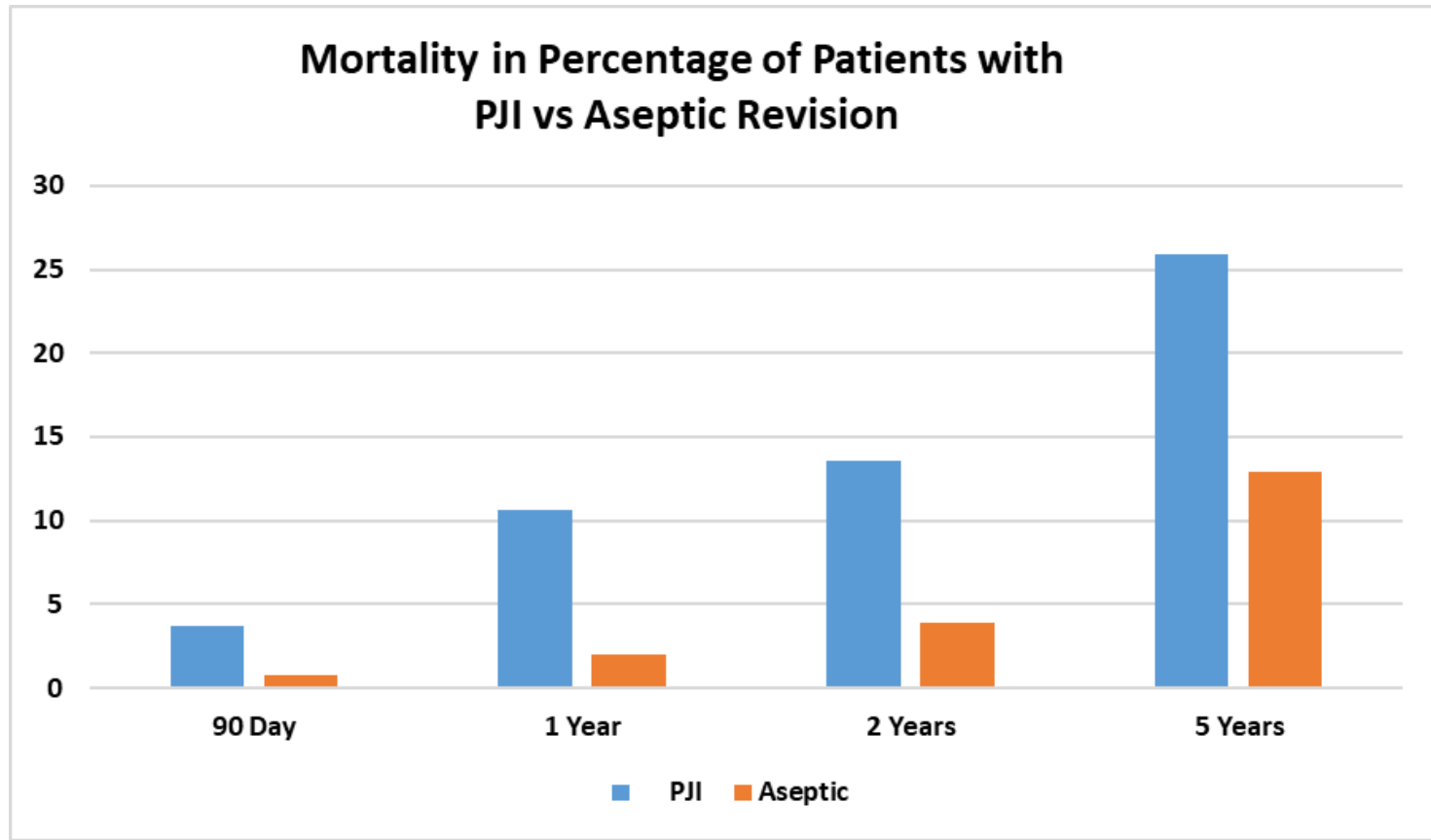
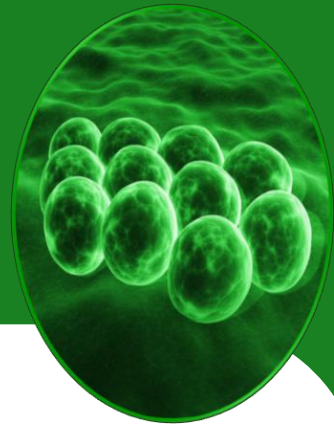
The invasion and multiplication of microorganisms involving an orthopedic implant and adjacent tissue.

Periprosthetic Joint Infections

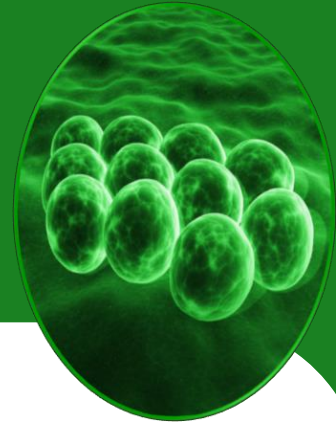


- Life and limb-threatening complication
- Occurrence
 - 2.0% of THA's
 - 2.4% of TKA's
- Can present acutely or chronically following surgery
- Associated with high mortality rates and significant costs

Mortality

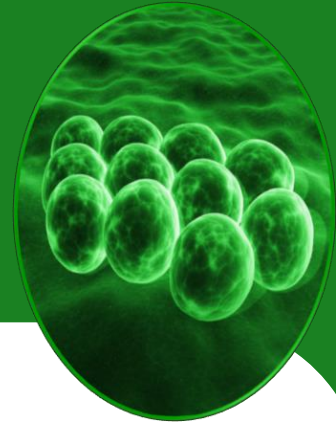


Economic Burden



Hospital costs
Readmissions
Patient costs
Length of stay

How Pathogenic Bacteria can Enter a Joint



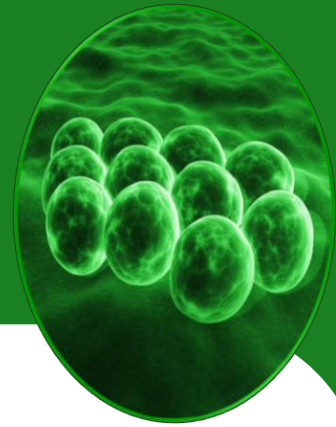
Sources

- Patient's own flora
- Perioperative personnel/environment
- Hematogenous
 - Enters through bloodstream

Microorganisms

- *S. Aureus* = 50-60%
- Strep + enterococci = 10%
- Gram-negative bacilli = 10%

Forms of Bacteria in the Body



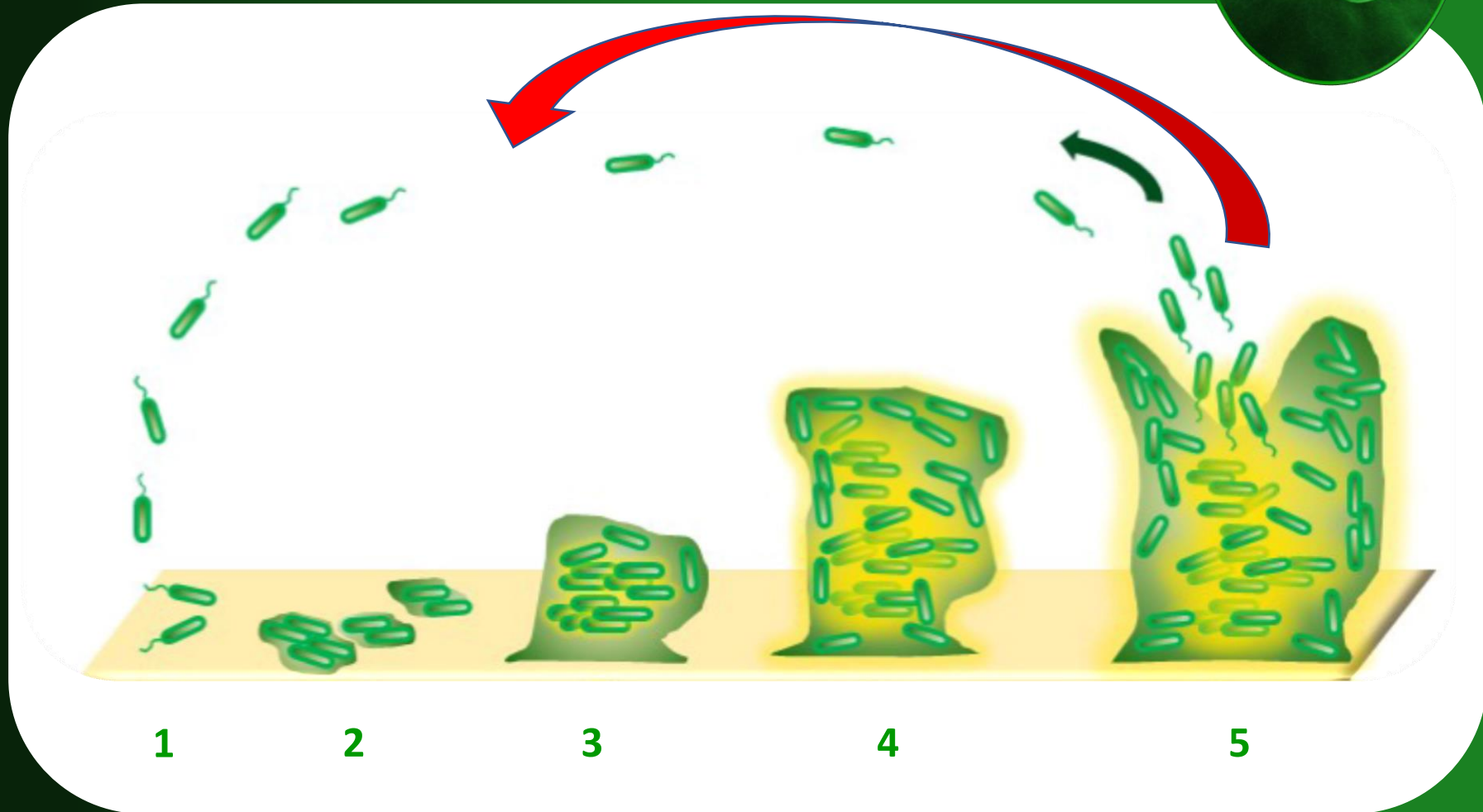
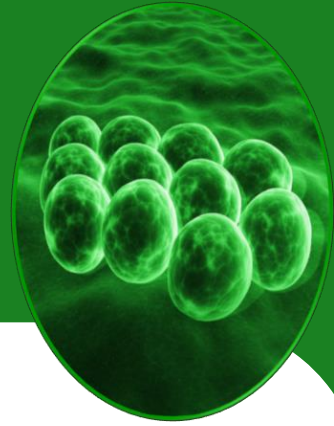
Planktonic

- Free-floating unicellular organisms
- Adhere to implant or tissue surfaces and replicate
- Easily identified
- Cleared by host's defense system or antibiotics

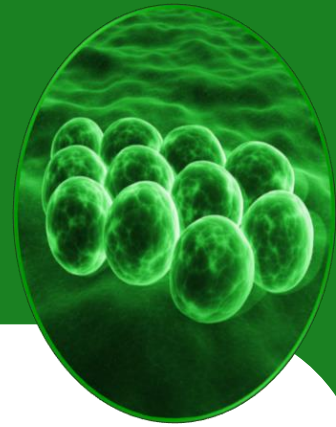
Biofilm

- Complex microbial community embedded in an extracellular matrix
- Firmly attach to implant and tissue surfaces
- Difficult to detect
- Resistant to natural immune systems and antibiotics
- Major cause of PJI

Biofilm Lifecycle



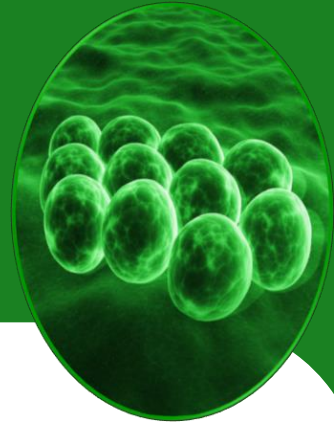
Timeline for Biofilm Development & Maturation



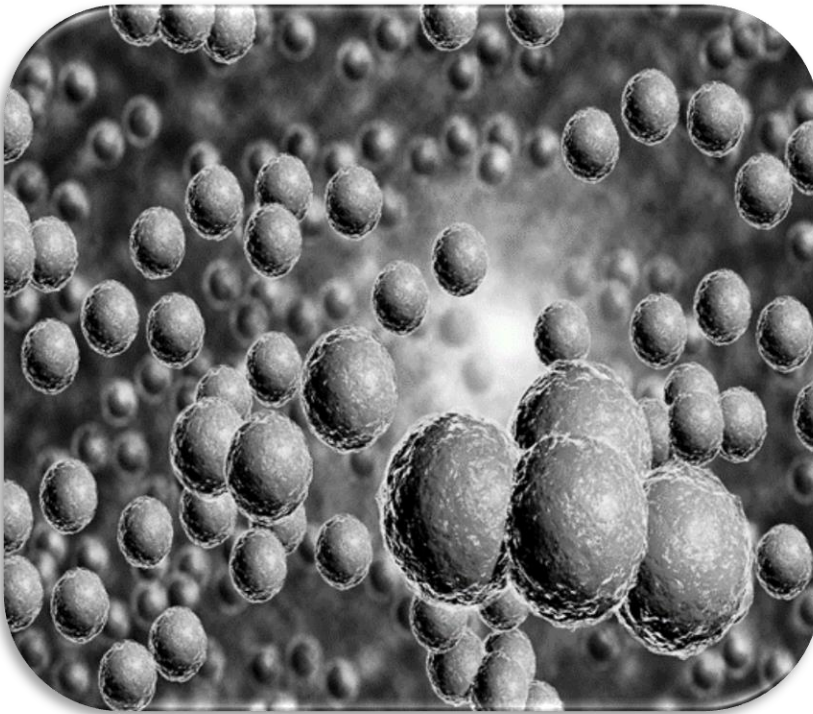
Biofilm Stage	Timeline
Free-floating planktonic bacteria attach to a surface	minutes
Firmly attached microcolonies form	2-4 hours
Extracellular matrix develops	6-12 hours
Fully mature biofilm entering a dormant “persister” state	2-4 days
Biofilm re-forms after dispersion	24 hours

Source: Fehring TK, Odum SM, Berend KR, et al. Failure of irrigation and debridement for early postoperative periprosthetic infection. *Clin Orthop Relat Res.* 2013;471(1):250-257.

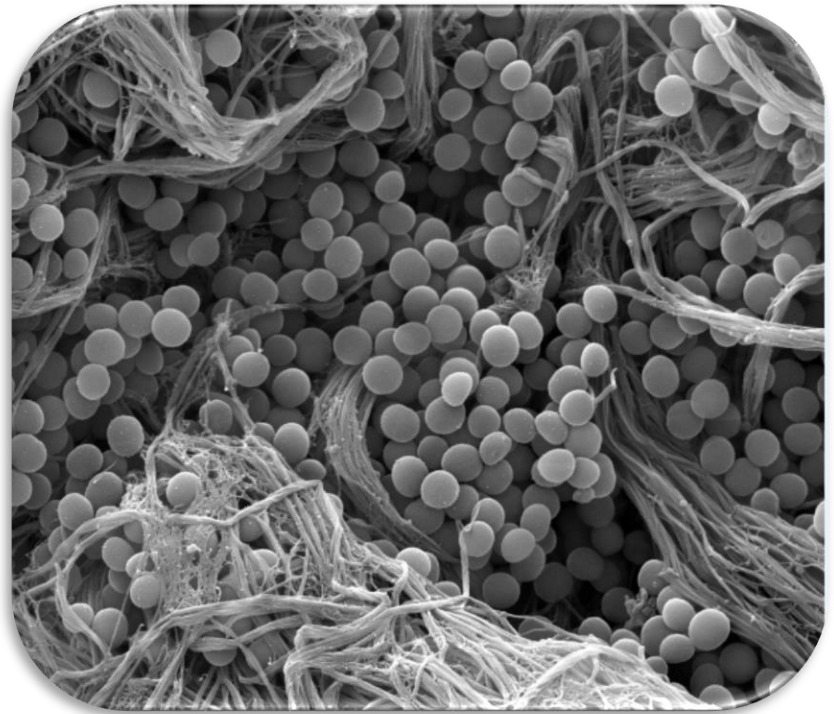
Planktonic and Biofilm Forms *S. Aureus*



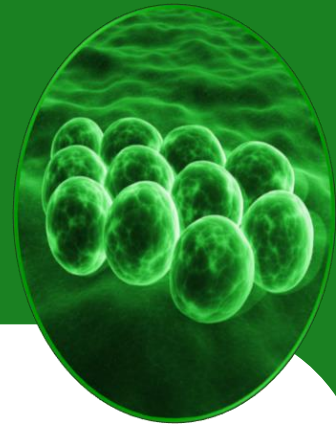
Planktonic



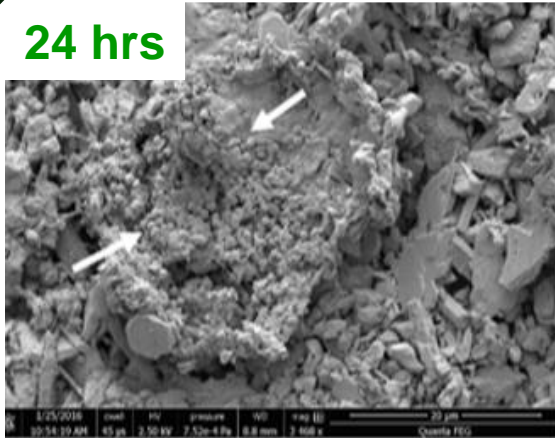
Biofilm



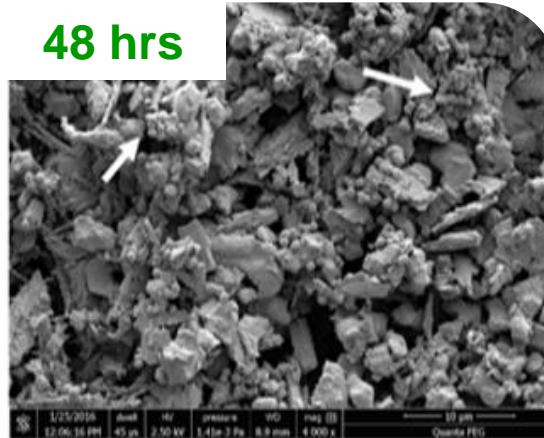
Surface Colonization of MRSA



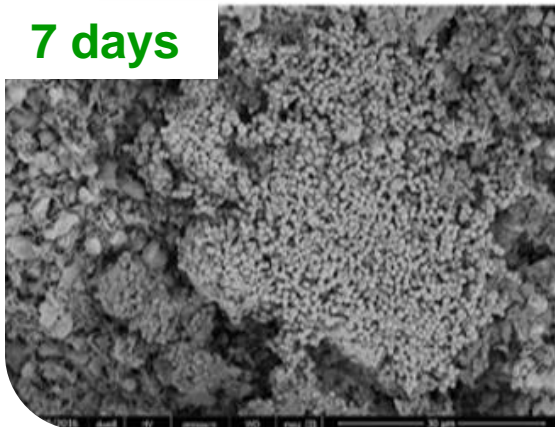
24 hrs



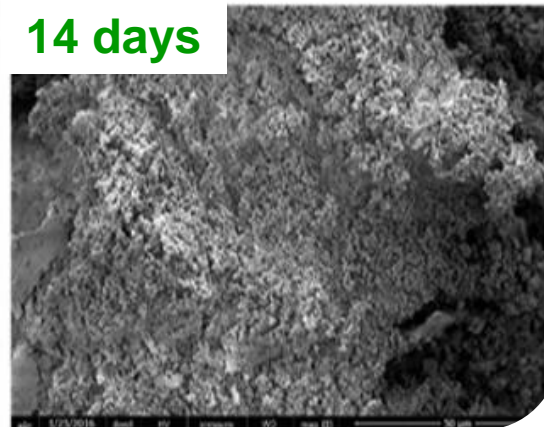
48 hrs



7 days



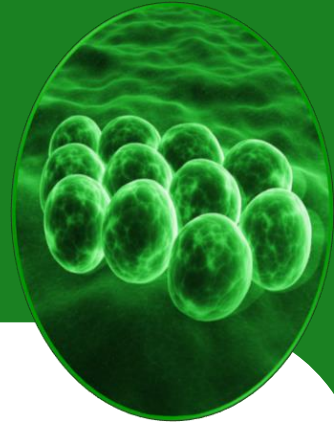
14 days



SEM images of bvf with *S. epidermidis*

- 24 & 48 hours
 - Surface colonization
- 7 & 14 days
 - Microcolony and biofilm formation

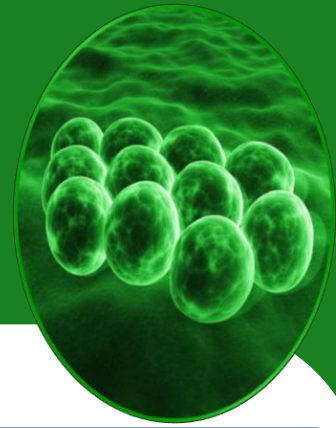
Resistance to Antibiotics



- Material properties
- Immune system resistance
- Persister cells



PJI Classification System



Early Acute PJI

- Within 4 weeks
 - Pain
 - Poor healing
 - Erythema
 - Prolonged wound drainage

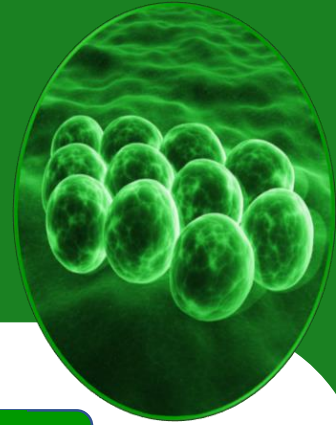
Late Acute PJI

- Years after surgery
 - Previously well-functioning joint replacement
- Hematogenous spread
 - Infection from another part of the body
 - Acute onset of pain, erythema & joint effusion

Late Chronic PJI

- More than 4 weeks postop
- Chronic pain may be only symptom

Acute & Chronic Infections



Acute Infection

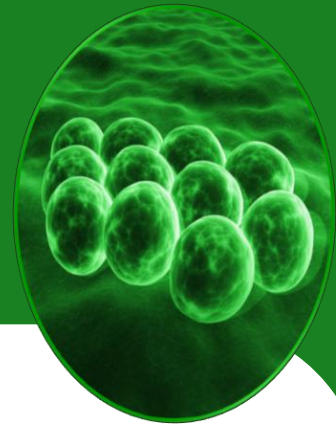
- Biofilm is not established
- Treatment focuses on implant preservation
 - Copious lavage
 - Radical debridement
 - Modular bearing exchange

Chronic Infection

- Biofilm is established
- Treatment focuses on eradication of infection
 - Implants must be removed
 - Radical debridement
 - Two-stage procedures are common

Risk Factors

- Morbid obesity
- Uncontrolled diabetes
- Smoking
- Malnutrition
- Hyperglycemia
- Rheumatoid arthritis
- Preoperative anemia
- Cardiovascular disorders
- Chronic renal failure
- Alcohol abuse
- Depression

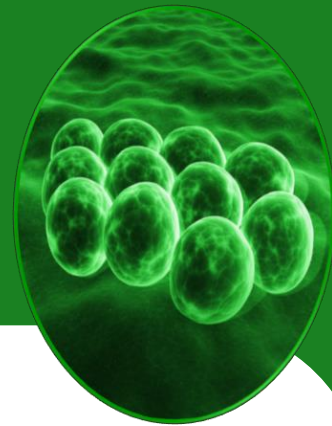


Prevention

- Environmental Controls in O.R.
 - HEPA-filtered air handling
 - Limiting personnel and traffic
 - Spacesuit scrubs
 - Skin disinfection
 - Surgical drapes
- Prophylactic Antibiotics
 - Narrow window of effectiveness
- Implant Characteristics
 - Strategies to prevent the development of biofilms

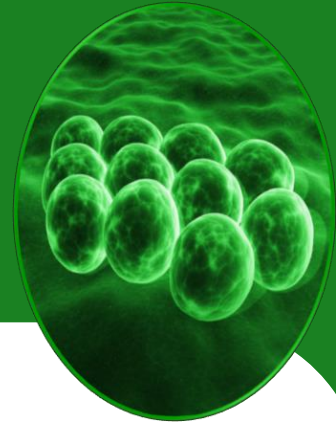


Diagnosis- MIS Criteria for PJI



Step	Criterion	Score
Step 1	Serum C-reactive protein >1 mg/dL	2
	Serum D-dimer>860 ng/mL	2
	Serum erythrocyte sedimentation rate >	1
Step 2	Synovial white blood cell count >3000 (cells/ μ L)	3
	Synovial alpha-defensin	3
	Synovial leukocyte esterase (++)	3
	Synovial polymorphonuclear % >80%	2
	Synovial C-reactive protein >6.9 mg/L	1
Step 3	Histology	3
	Purulence	3
	Single Culture	2

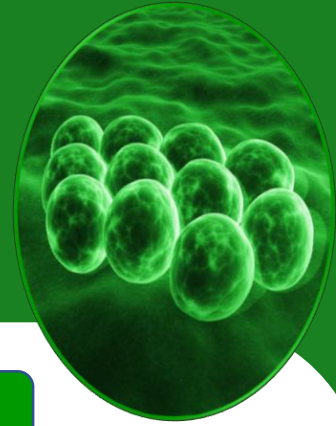
Treatment



Therapeutic Approaches

- Systemic Antibiotics
- Irrigation and Debridement
- One-Stage Revision Arthroplasty
- Two-Stage Revision Arthroplasty

Systemic Antibiotics



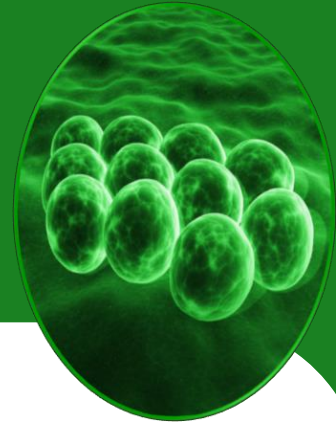
Advantages

- Nonsurgical
- Curative antibiotic treatment
- Patient unable or unwilling to undergo surgery
- Well-fixed prosthesis
- Infection with microorganisms susceptible to oral antibiotics

Disadvantages

- Unwanted side effects
- Systemic toxicity
- Antimicrobial resistance

Irrigation and Debridement with Component Retention



Procedure

- Reopen joint
 - Remove unhealthy tissues
 - Thorough antibiotic lavage
- Exchange modular components

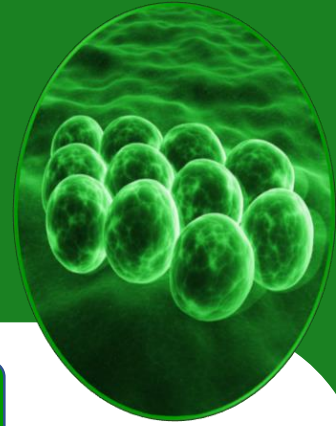
Advantages

- Retain well-fixed components
- Time-honored procedure
- Successful if done early

Disadvantages

- Multiple debridements
- Must be early in infectious process
 - Doesn't work if biofilm present
- 4-6 weeks IV antibiotics
- Unsuccessful in 2/3 of patients
 - Failure rate 100% in chronic infections
 - High failure rate in resistant and susceptible organisms

One-Stage Revision



Procedure

- Open arthrotomy
 - Debridement
 - Remove prothesis
- Implant new device

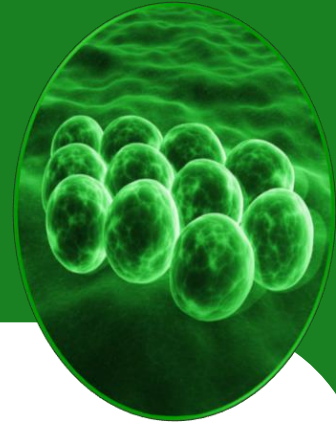
Advantages

- Comparable results to two-stage revision
- Superior to I&D
- One surgical procedure

Disadvantages

- Need skilled surgeon for aggressive debridement
- 4-6 weeks of IV antibiotics
- 3-6 months oral antibiotics

Two-Stage Revision



Stage One

- Obtain cultures
- Debride
- Remove components
- Insert spacer

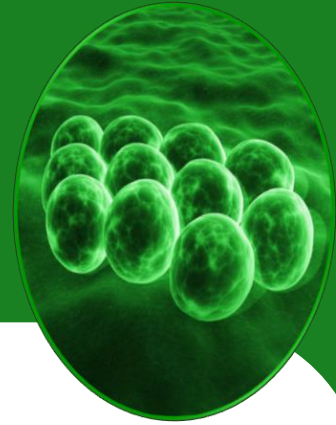
Post Surgery Stage One

- 4-6 weeks IV antibiotics
- Antibiotic-free 2-6 weeks
- Evaluation for infection

Stage Two

- Remove spacer
- Implant new device
- IV antibiotics until reimplantation culture is negative

Two-Stage Revision



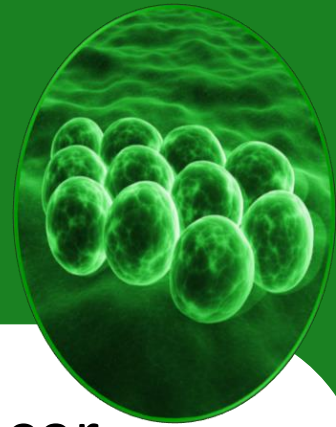
Advantages

- Gold standard for chronic PJI treatment
- Hip arthroplasty exchange success rate 87% to 100%
- Knee arthroplasty exchange success rate 72% to 95%

Disadvantages

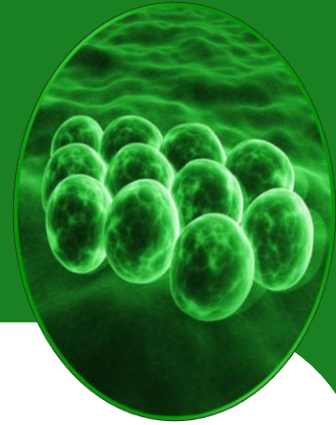
- Extended period of time to resolve infection
- Two separate surgical procedures

Two-Stage Revision Adjunct Materials



- Stage one typically requires the use of a spacer
- Bone void fillers may be utilized
- Product of choice will vary according to:
 - Product availability within the facility
 - Surgeon preference
 - Patient condition

PMMA Bone Cement



Usage

- Maintain joint space
- Antibiotic delivery
 - Controlled release
 - High local concentration

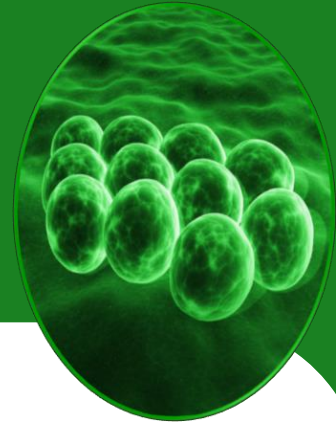
Advantages

- Significant ↓ infection rates
- Provides weight-bearing strength

Limitations

- Dense, non-resorbing
- 2nd surgery needed for removal
- Ø heat-sensitive antibiotics
- Antibiotic release quickly falls below MIC
- Can become colonized
- Microstructure may be affected by antibiotics

Calcium Sulfate



Usage

- Fill bone voids and defects
- Used as bone graft material since 1892

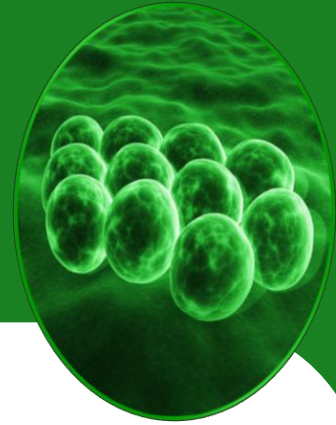
Advantages

- Absorbable and biodegradable
- No second procedure required
- Does not cause a nidus for infection

Limitations

- No long-term mechanical support

Physician Directed Use of Medical Products



Position Statement

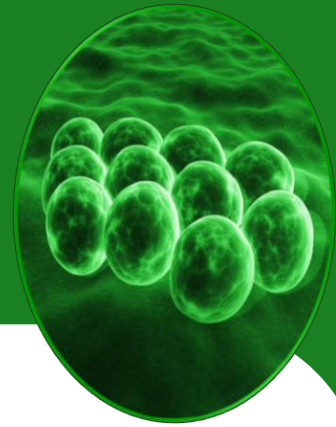
Physician Directed Use of Medical Products

This Position Statement was developed as an educational tool based on the opinion of the authors. It is not a product of systematic review. Readers are encouraged to consider the information presented and reach their own conclusions.

Definitions

Off-label is a term describing the physician directed use of prescription drugs, biologics, and approved medical devices in a manner that is not specified in the labeling approved by the U.S. Food and Drug Administration (FDA). For cleared medical devices, off-label means any use that is not included in the cleared indications for use.” Labeling is considered any written material

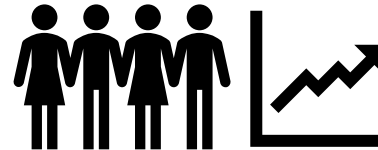
Summary



Artificial joints are beneficial



Number expected to rise



Carry risk of infection



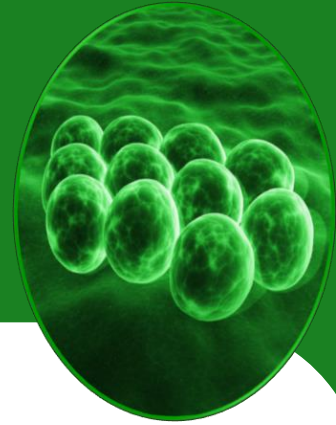
Treatment choice now two-stage revision



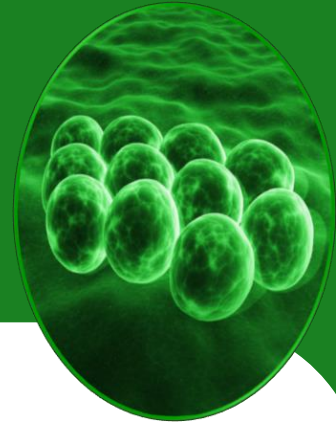
Treatment alternatives in the future



Questions?



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