Prevention of Artificial Joint Infections

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Objectives

- Discuss risk and consequences of orthopedic infections (prosthetic joint infections)
- Discuss bacterial resistance and potential impact on post op infections
- Discuss best practice and impact of pre-op screening and preparation prior to surgery
- Discuss optimal use and timing of antimicrobial therapy to prevent post-op infections

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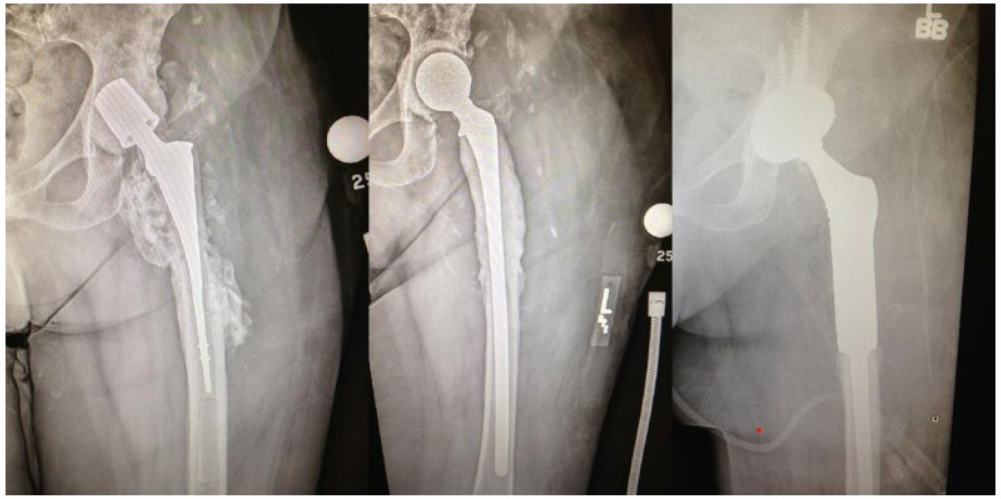
Prosthetic Joint Infections (PJI)

- Treatment requires antimicrobial therapy, surgery or both
- Antimicrobial therapy often requires several weeks of IV and oral antibiotics and sometimes given in bone cement in a “two stage” replacement.
- Often develop bone infection (osteomyelitis)



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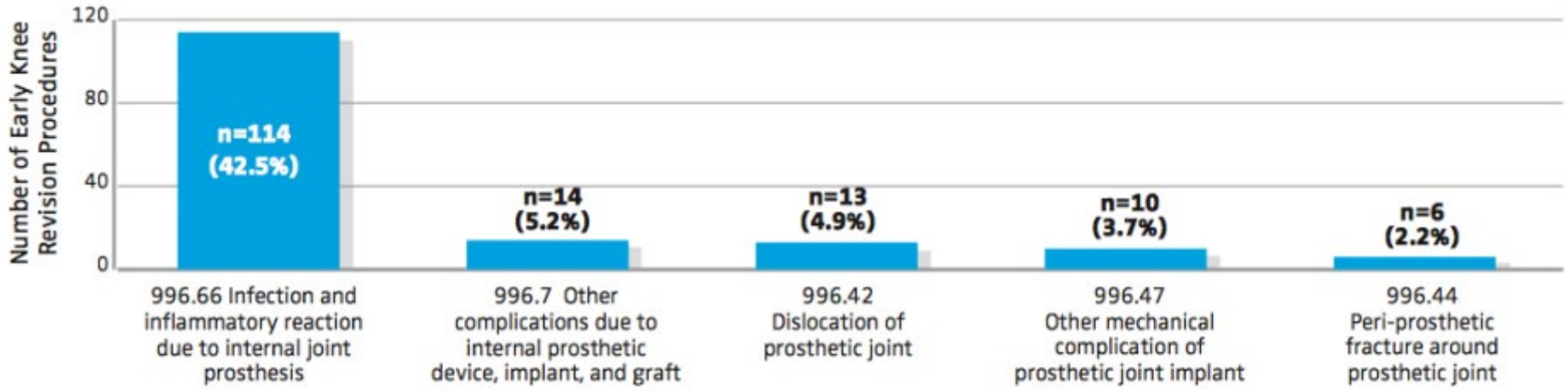
Incidence of Prostatic Joint Infections

Figure 39: Most Frequently Reported ICD-9 Diagnosis Codes for Early Knee Revisions (<3 Months to Revision) (N=268)



AJRR 2014 annual report

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Prosthetic Joint Infections (PJI)

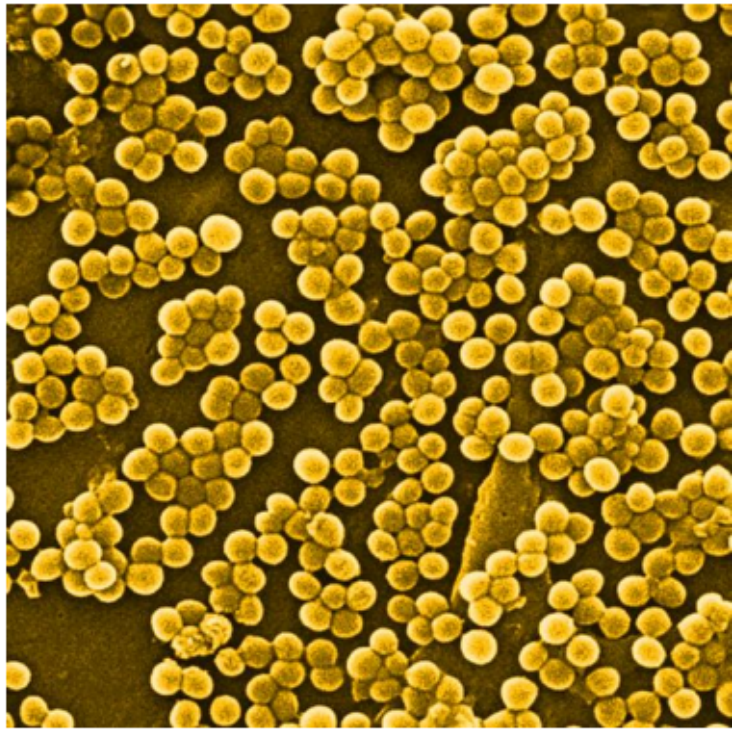
- Incidence by procedure
  - 0.5-2.0% in knees
  - 0.5-1.0 % in Hips
  - < 1.0 % in Shoulder
- Incidence in the untied States fell from 1.4% to in 2002-2006 to 0.76% from 2011 from 2014.
- Usually occurs in the first two years post joint replacement.

Risk factors (PJI)

- Co-morbid conditions (Rheumatoid Arthritis, Diabetes mellitus, kidney disease, obesity.
- Use of corticosteroids (prednisone) and biologic disease modifying anti-rheumatics.
- Prior or second orthopedic surgery.
- Methicillin Resistant Staph Aureus

Organisms that Cause PJI

- Coagulase-negative staph and S. aureus are the most common organism in the US[1]
- 10% cases are culture (-)
- Most challenging are MRSA and methicillin-resistant coagulase-negative staph species[2]
  - More than half of PJIs in some institutions
- Gram-negative and polymicrobial (MRSA and anaerobes) (5-23%)

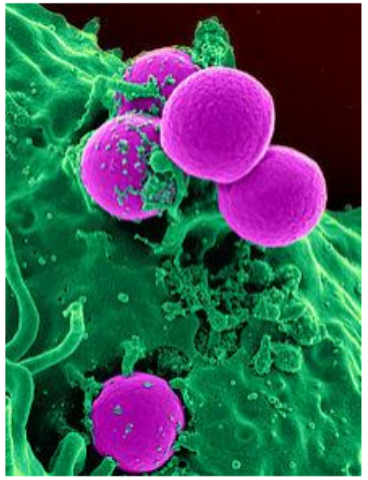


1. Del Pozo JL, et al. *NEJM*. 2009;361(8):784-94.
2. Parvizi J, et al. *JOA*. 2010;25(6)(suppl):103-7.

Prosthetic Joint Infections

Two–Stage Exchange Arthroplasty

MRSA infections 10 times (OR) more likely to fail[1]



1. Salgado C, et al. *CORR*. 2007;461:48-53
2. Image: en.Wikipedia.org

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Prosthetic Joint Infections

PREVENTION

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Several Strategies for prevention

- Staph aureus decolonization
  - Both MSSA and MRSA nasal screening
  - Mupirocin ointment nasal decolonization (apply into each nostril twice daily for 5-10 days prior to surgery
  - Consider on discharge form hospital if known MRSA.
- Chlorhexidine bathing prior to surgery
- Betadine Nasal swabs on admission

Nasal Decolonization for Staph

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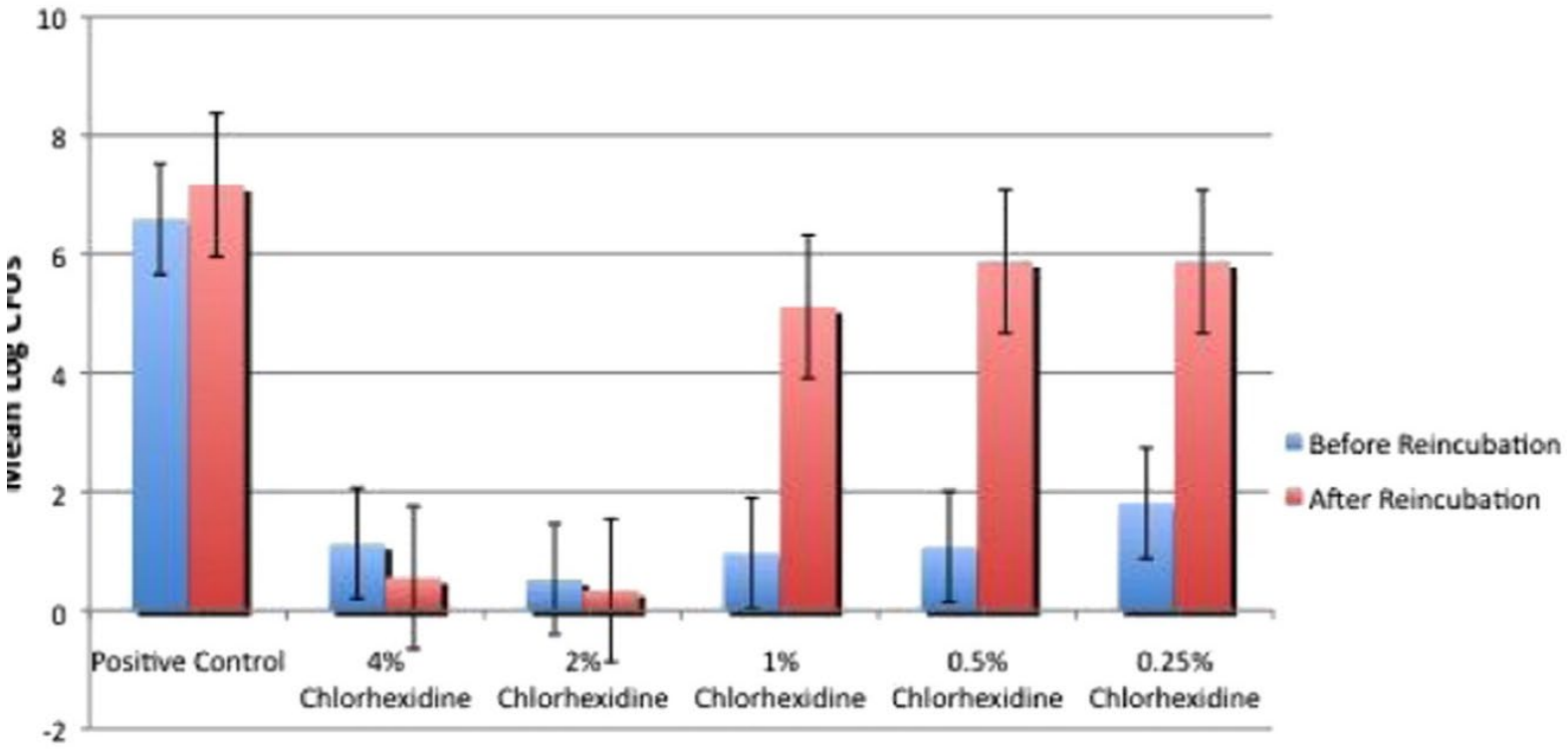
Chlorhexidine Bathing



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Antimicrobial Prophylaxis –Screening for MRSA History

Table 3. Results of Multivariate Logistic-Regression Analyses to Identify Potential Risk Factors for MRSA Infection.*

Characteristic	Adjusted Odds Ratio (95% CI)*
Race	
Non-Hispanic white	1.0†
Non-Hispanic black	1.9 (1.1–3.4)
Other	0.3 (0.1–1.0)
Use of any antibiotic in past mo (vs. no use)	2.4 (1.3–4.3)
Reported spider bite (vs. other cause of infection)	3.0 (1.6–5.7)
Underlying illness (vs. no underlying infection)	0.3 (0.2–0.6)
History of MRSA infection (vs. absence of such history)	3.4 (1.1–10)
Close contact with person with similar infection (vs. no close contact)	3.8 (1.6–9.3)

* Estimates were adjusted for all other variables in the table. CI denotes confidence interval.
† This group served as the reference group for other race variables.

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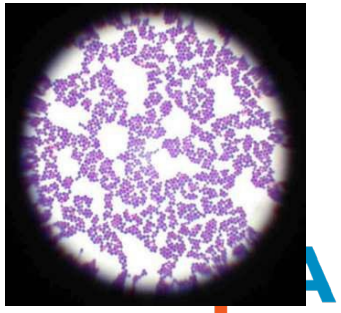
Antibiotics for Prophylaxis

- Approximately 5% of patients in U.S. hospitals carry MRSA in their nose or on their skin
- If no risk factors or history of MRSA a single antibiotic (Cefazolin) is considered adequate
- If at risk for MRSA give Vancomycin **AND** Cefazolin as Cefazolin has better activity against Methicillin Sensitive Staph Aureus (MSSA) than Vancomycin



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Comparative Study > Clin Orthop Relat Res. 2012 Oct;470(10):2702-7.
doi: 10.1007/s11999-012-2255-1.

Does dual antibiotic prophylaxis better prevent surgical site infections in total joint arthroplasty?

Amy Sewick [1], Amun Makani, Chia Wu, Judith O'Donnell, Keith D Baldwin, Gwo-Chin Lee

Affiliations + expand

PMID: 22290130 PMCID: PMC3441989 DOI: 10.1007/s11999-012-2255-1

Free PMC article

Does Dual Antibiotic Prophylaxis Better Prevent Surgical Site Infections in Total Joint Arthroplasty?

Sewick A et al. *Clin Orthop Relat Res*. 2012;470(10):2702-2707

- Retrospectively reviewed 1,828 primary total joint arthroplasties (TJAs)
- Intervention:
  - Dual antibiotic regimen of cefazolin + vancomycin vs. cefazolin alone
- Objective:
  - To determine the rate of surgical site infections (SSIs) as well as the microbiology of subsequent SSIs
- Outcome:
  - Total of 22 SSIs (1.2%) with no significant difference in the infection rate between the dual antibiotic prophylaxis group compared to the single antibiotic regimen (1.1 and 1.4% respectively, p = 0.636)
  - While addition of vancomycin did not decrease the rate of SSIs, it did decrease the incidence of MRSA infections (0.08 vs. 0.8% p = 0.022), but with a high number needed to treat (NNT = 138)

The NEW ENGLAND JOURNAL of MEDICINE

October 19, 2023
N Engl J Med 2023; 389:1488-1498
DOI: 10.1056/NEJMoa2301401

ORIGINAL ARTICLE

Trial of Vancomycin and Cefazolin as Surgical Prophylaxis in Arthroplasty

Trisha N. Peel, M.B., B.S., Ph.D., Sarah Astbury, B.Nurs., Allen C. Cheng, M.B., B.S., M.Biostat., Ph.D., David L. Paterson, M.B., B.S., Ph.D., Kirsty L. Buising, M.B., B.S., M.D., Tim Spelman, M.B., B.S., Ph.D., An Tran-Duy, Ph.D., Sam Adie, M.B., B.S., M.P.H., Ph.D., Glenn Boyce, M.B., B.S., Catherine McDougall, M.B., B.S., Robert Molnar, M.B., B.S., Jonathan Mulford, M.B., B.S., et al., for the ASAP Trial Group*

4239 patients

4113 in mITT

1º or revision surgery

54% knee, 45% hip

Cefazolin + NS placebo

Cefazolin + 1.5g vancomycin

11 Australian centers from 2019-2021

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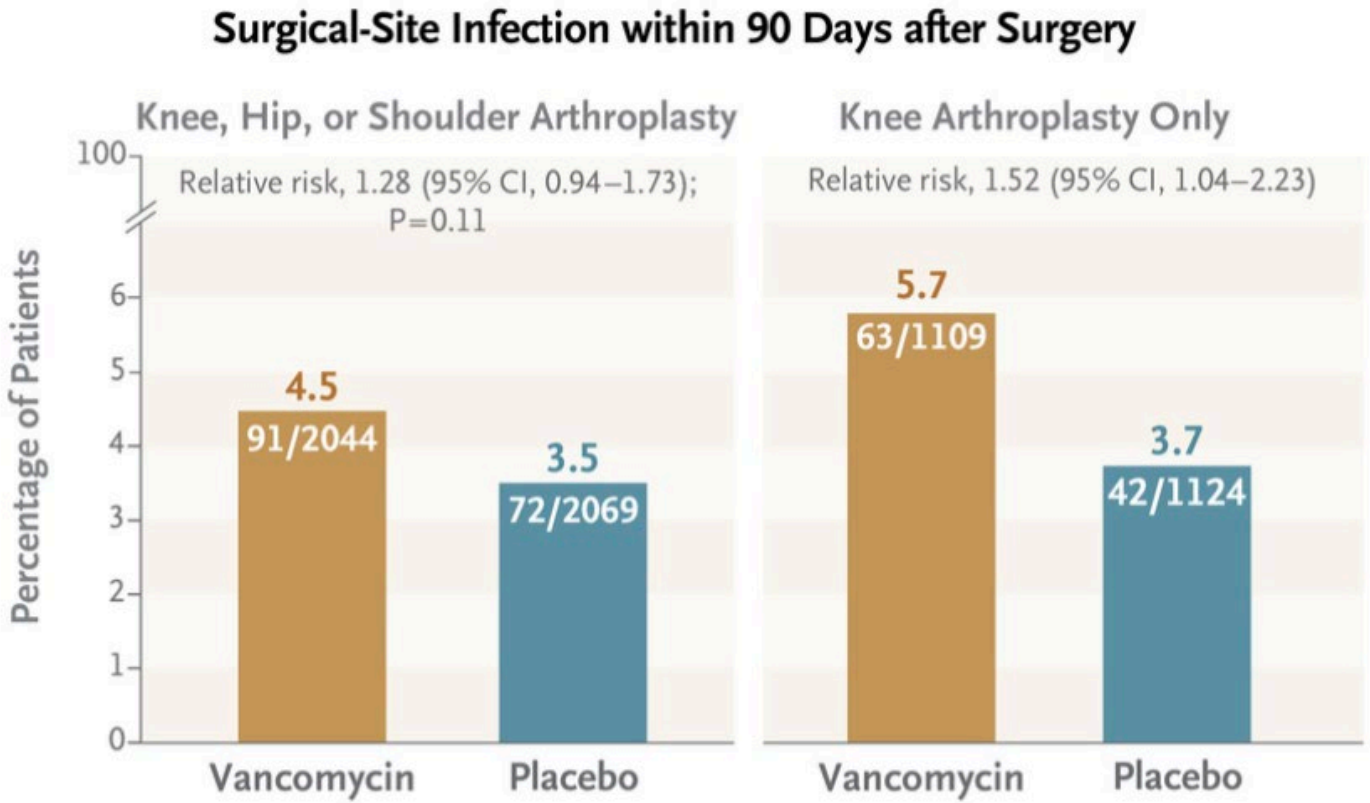
ASAP Trial – Primary Outcome



SSI within 90 days of surgery

3.5% placebo vs 4.5% vanco (RR 1.28, 95%CI 0.94-1.73, p = 0.11)

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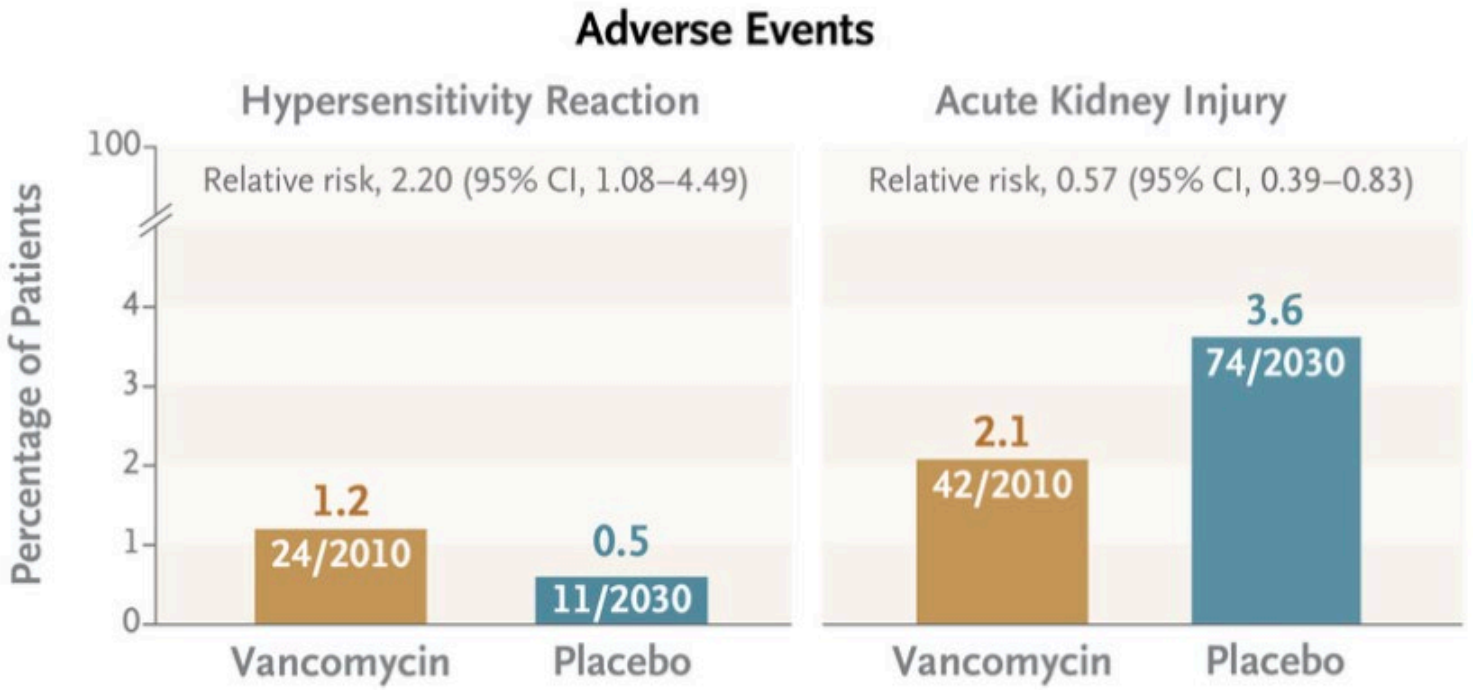
ASAP Trial – Secondary Outcomes



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ASAP Trial Conclusions

- **Vancomycin was not superior** to placebo in combination with cefazolin for the prevention of surgical site infections in joint arthroplasty and was associated with an increased incidence of infection in knee arthroplasty surgery
  - **Only 24 patients out of the ~4,000** had history of MRSA colonization
  - Vancomycin group has more SSI but less AKI - difficult to make sense of
- Hypersensitivity Secondary Outcome
  - Hypersensitivity reactions more than doubled in the vancomycin group
  - Vancomycin infusion reactions – many providers only worry about penicillin allergies and the possibility of cross-reactivity with cefazolin
- Overall – **Use Cefazolin alone if no history of MRSA as Vancomycin unlikely to add any benefit in reducing the risk of SSI in the absence of MRSA colonization**

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Antibiotic Allergy Considerations

- Cross-reactivity between penicillins and cephalosporins is not a class effect but an allergic reaction to antibiotics with **similar side chains** in their chemical structure

Table 1: Penicillin and other beta-lactams (If allergy to a specific antibiotic, avoid use if similar class and/or side chain)

Avoid antibiotics in the same column if true allergy due to risk of same class or similar side-chain cross-reactivity							
Penicillin	Penicillin Amoxicillin Ampicillin Ampicillin-Sulbactam Piperacillin-Tazobactam						
Cephalosporin	Cephalexin Cefadroxil Cefaclor	Cefazolin	Cefotetan	Cefoxitin Cefotaxime Ceftriaxone Cefepime Cefpodoxime Cefuroxime	Ceftaroline	Ceftazidime Cefiderocol	
Monobactam						Aztreonam	
Carbapenem							Ertapenem Meropenem Imipenem Doripenem

(+) Known cross-reactive (X) Similar or same side chain	Penicillin	Amoxicillin	Ampicillin	Cephalexin	Cefazolin	Cefuroxime	Cefoxitin	Ceftriaxone	Cefotaxime	Ceftazidime	Cefepime	Cefiderocol	Aztreonam
Penicillin		+	+	+									
Amoxicillin	+		+	+									
Ampicillin	+	+		X									
Cephalexin	+	+	X										
Cefazolin													
Cefuroxime							X	X	X		X		
Cefoxitin						X							
Ceftriaxone						X			X		X		
Cefotaxime						X		X			X		
Ceftazidime												X	X
Cefepime						X		X	X				
Cefiderocol										X			X
Aztreonam										X		X	

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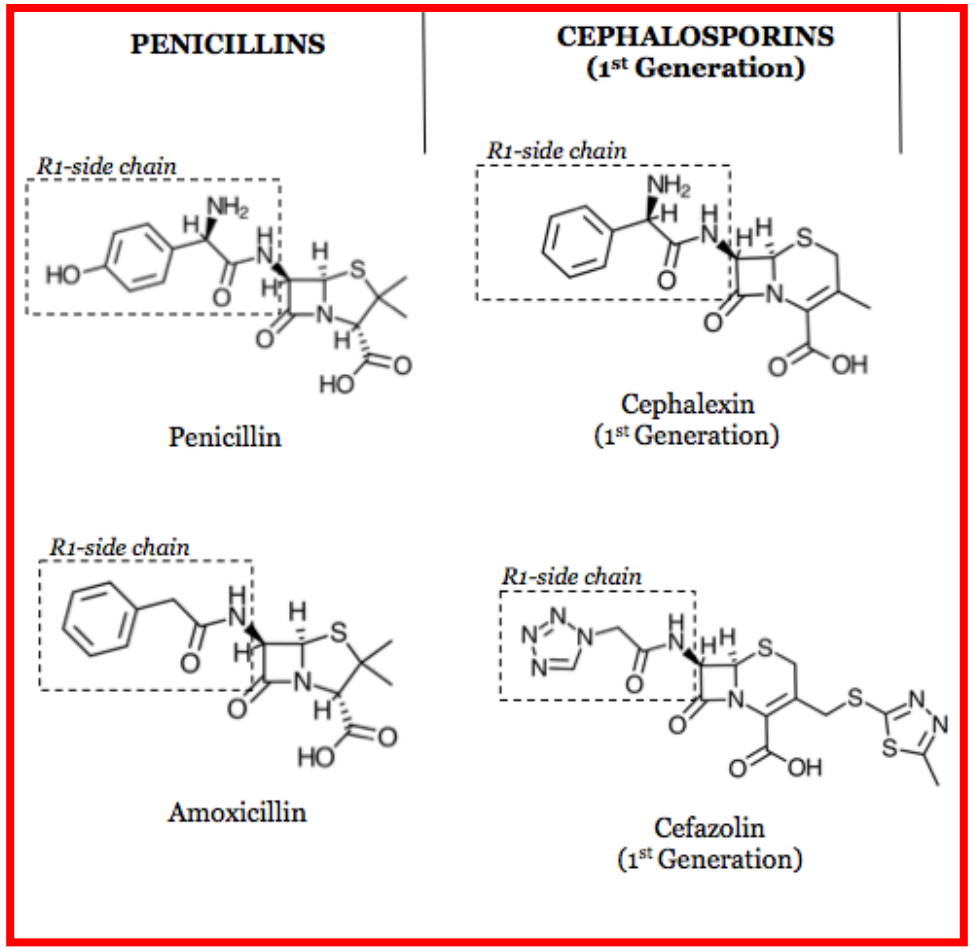
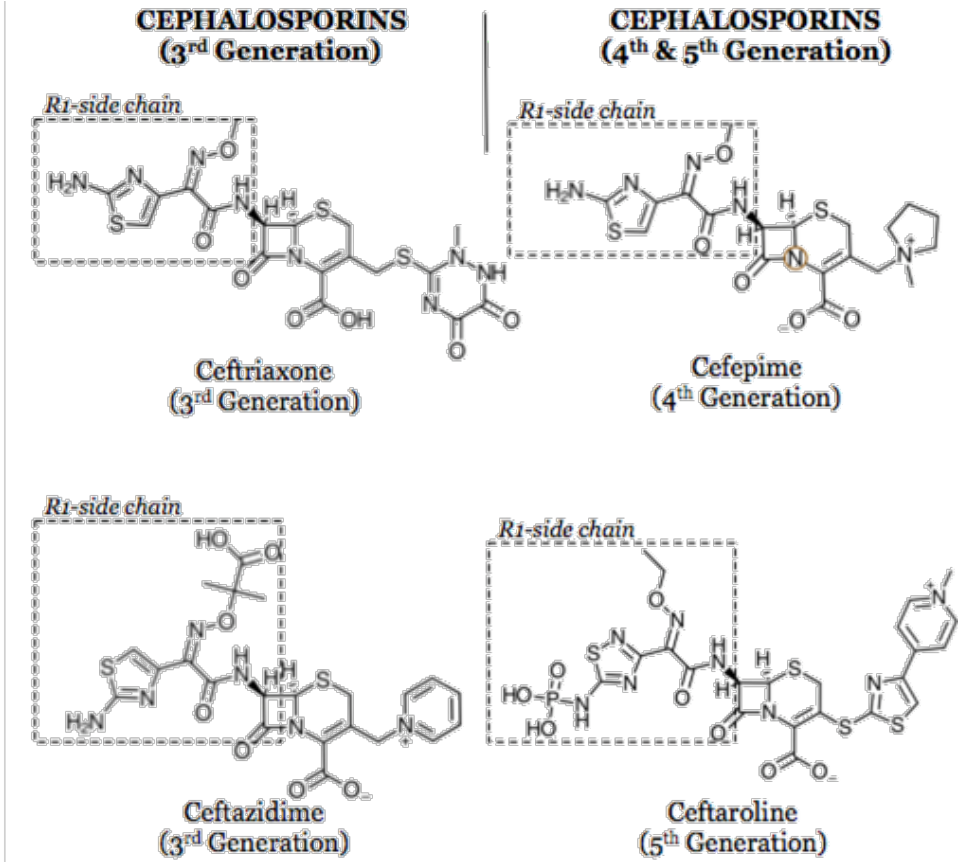
Cefazolin has a Completely Dissimilar Side Chain from all Penicillins





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Palomar Surgical Prophylaxis Guidelines

Vancomycin alone only if cefazolin allergy

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ANTIBIOTIC PROPHYLAXIS
Surgery and Procedures

Antibiotic Selection *

Specialty/Procedure	First Line	Penicillin Allergy	Severe Penicillin or First Line Med Allergy **
NEUROSURGERY	cefazolin	cefazolin	vancomycin
SPINE: lumbar discectomy (may not need abx)	cefazolin +/- vancomycin	Cefazolin +/- vancomycin	vancomycin
SPINE (other than lumbar discectomy)	Cefazolin +/- vancomycin***	Cefazolin +/-vancomycin***	vancomycin
ORTHO: ORIF closed or open fx (Gustilo type I or II)	cefazolin	cefazolin	vancomycin
ORTHO: ORIF open (Gustilo Type III)	cefazolin & gentamicin	cefazolin & gentamicin	vancomycin & gentamicin
ORTHO: Joint Replacement (primary or revision without infection)	Cefazolin +/- vancomycin ***	cefazolin +/- vancomycin ***	vancomycin
ORTHO: Revision Joint Replacement with INFECTION	MD discretion	MD discretion	MD discretion

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JAMA Surgery | Special Communication

Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017

Sandra I. Berríos-Torres, MD; Craig A. Umscheid, MD, MSCE; Dale W. Bratzler, DO, MPH; Brian Leas, MA, MS; Erin C. Stone, MA; Rachel R. Kelz, MD, MSCE; Caroline E. Reinke, MD, MSHP; Sherry Morgan, RN, MLS, PhD; Joseph S. Solomkin, MD; John E. Mazuski, MD, PhD; E. Patchen Dellinger, MD; Kamal M. F. Itani, MD; Elie F. Berbari, MD; John Segreti, MD; Javad Parvizi, MD; Joan Blanchard, MSS, BSN, RN, CNOR, CIC; George Allen, PhD, CIC, CNOR; Jan A. J. W. Kluytmans, MD; Rodney Donlan, PhD; William P. Schecter, MD; for the Healthcare Infection Control Practices Advisory Committee

Parenteral Antimicrobial Prophylaxis

1A.1. Administer preoperative antimicrobial agents only when indicated based on published clinical practice guidelines and timed such that a bactericidal concentration of the agents is established in the serum and tissues when the incision is made. (Category IB–strong recommendation; accepted practice.)

1A.2. No further refinement of timing can be made for preoperative antimicrobial agents based on clinical outcomes. (No recommendation/unresolved issue.)

1B. Administer the appropriate parenteral prophylactic antimicrobial agents before skin incision in all cesarean section procedures. (Category IA–strong recommendation; high-quality evidence.)

1C. The literature search did not identify randomized controlled trials that evaluated the benefits and harms of weight-adjusted parenteral antimicrobial prophylaxis dosing and its effect on the risk of SSI. Other organizations have made recommendations based on observational and pharmacokinetic data, and a summary of these recommendations can be found in the Other Guidelines section of the narrative summary for this question (eAppendix 1 of the Supplement). (No recommendation/unresolved issue.)

1D. The search did not identify sufficient randomized controlled trial evidence to evaluate the benefits and harms of intraoperative redosing of parenteral prophylactic antimicrobial agents for the prevention of SSI. Other organizations have made recommendations based on observational and pharmacokinetic data, and a summary of these recommendations can be found in the Other Guidelines section of the narrative summary for this question (eAppendix 1 of the Supplement). (No recommendation/unresolved issue.)

1E. In clean and clean-contaminated procedures, do not administer additional prophylactic antimicrobial agent doses after the surgical incision is closed in the operating room, even in the presence of a drain. (Category IA–strong recommendation; high-quality evidence.)

Intraoperative Risk Factors
Perioperative Appropriate Antibiotics

The goal of giving antibiotics prior to incision is to allow enough time for the antibiotic to diffuse into the tissues and to develop optimal concentrations of antibiotics in the body.

Surgeon Tools/Recommendations:

Recommendations for optimal timing of antibiotic prophylaxis:

- Within 1 hour prior to surgical procedure, with most surgeons opting for within 30 minutes of incision.
- Vancomycin and fluoroquinolones may be infused up to 2 hours before surgery due to extended infusion times and long half-lives
- Intraoperative redosing of cefazolin is recommended every 4 hours. Alternatives for patients with a true Penicillin allergy (anaphylaxis breathing issues) include clindamycin and vancomycin.
- Important to review antibiograms or consult with infectious disease team members when deciding on a preferred perioperative antibiotic strategy targeted for patient within a specific area or regions.

Preoperative Antibiotic Prophylaxis Timing

- Complete prophylaxis antibiotics 0-60 minutes prior to the surgical incision
- CDC recommendations – "timed such that a **bactericidal concentration** of the agent is established in the serum tissues when the incision is made"
- Re-dose antibiotic if:
  - Surgery greater than 2 half-lives of antibiotic
    - Usually, 4 hours with most common agents Cefotetan and Cefazolin (Cefazolin half life = ~1.8 hours)
  - Significant blood loss (>1L blood loss)

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Joint Commission National Quality Core Measures

SCIP (Surgical Care Improvement Project)

Measure Set: Surgical Care Improvement Project (SCIP)

Set Measure ID: SCIP-Inf-1

Set Measure ID	Performance Measure Name
SCIP-Inf-1a	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Overall Rate
SCIP-Inf-1b *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - CABG
SCIP-Inf-1c *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Other Cardiac Surgery
SCIP-Inf-1d *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Hip Arthroplasty
SCIP-Inf-1e *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Knee Arthroplasty
SCIP-Inf-1f *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Colon Surgery
SCIP-Inf-1g *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Hysterectomy
SCIP-Inf-1h *	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision - Vascular Surgery

* Joint Commission Only

Performance Measure Name: Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision

Thank you!
Questions?

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