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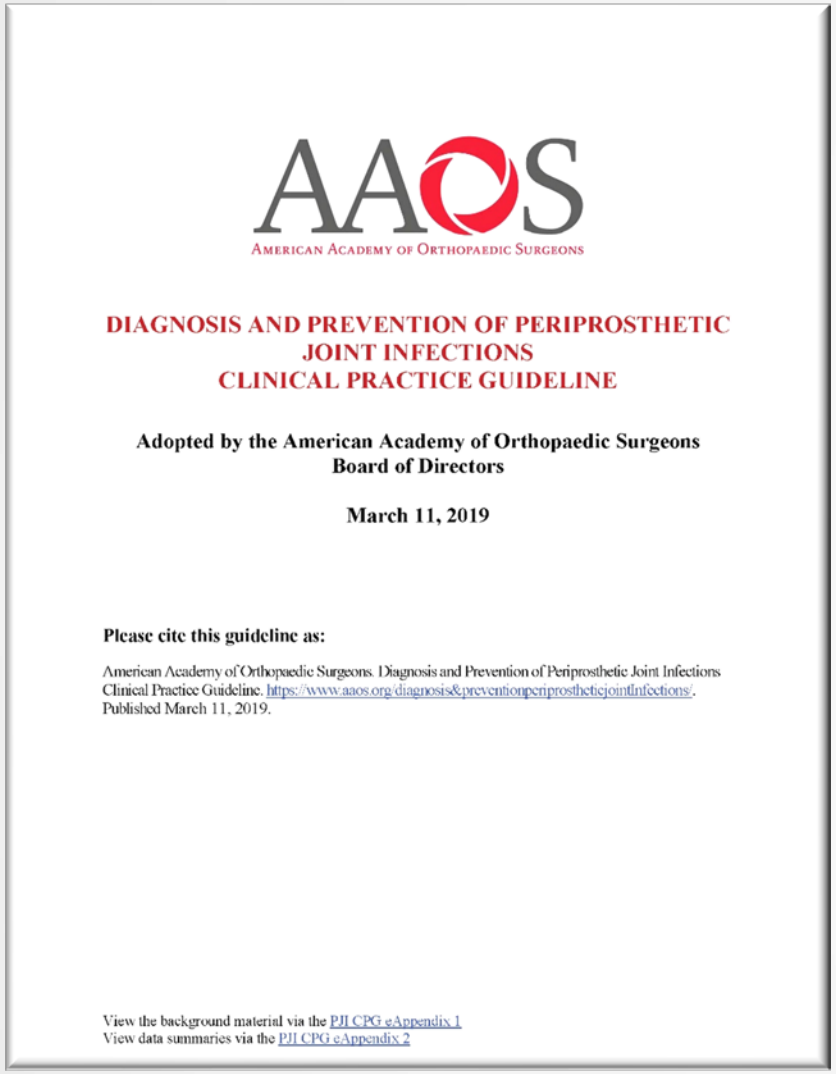
Diagnosis and Prevention of Periprosthetic Joint Infections Evidence-Based Clinical Practice Guideline

Adopted by the American Academy of Orthopaedic Surgeons (AAOS) Board of Directors

March 11, 2019



The American Academy of Orthopaedic Surgeons 2019 Clinical Practice Guideline on the Diagnosis and Prevention of Periprosthetic Joint Infections

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WHAT IS A CLINICAL PRACTICE GUIDELINE?

Clinical Practice Guideline

A clinical practice guideline is a series of recommendations created to inform clinicians of best practices, based on best available evidence

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GOALS AND RATIONALE OF A CLINICAL PRACTICE GUIDELINE

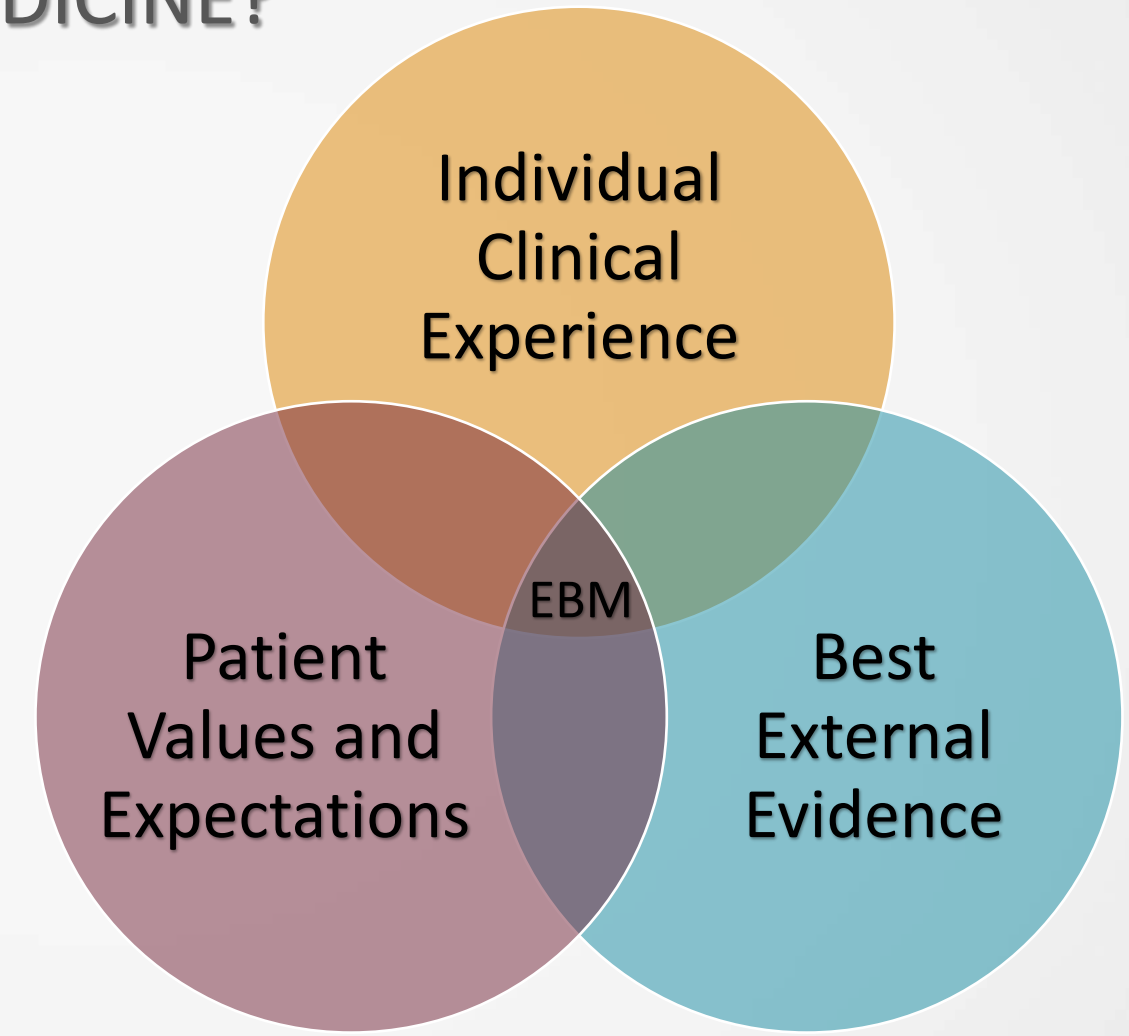
- Improve treatment based on current best evidence
- Guides qualified physicians through treatment decisions to improve quality and efficiency of care
- Identify areas for future research

CPG recommendations are not meant to be fixed protocols; patients' needs, local resources, and clinician independent medical judgement must be considered for any specific procedure or treatment

WHAT IS EVIDENCE-BASED MEDICINE?

Evidence-Based Medicine is a Combination of:

- *Individual Clinical Experience*
- *Best External Evidence*
- *Patient Values and Expectations*



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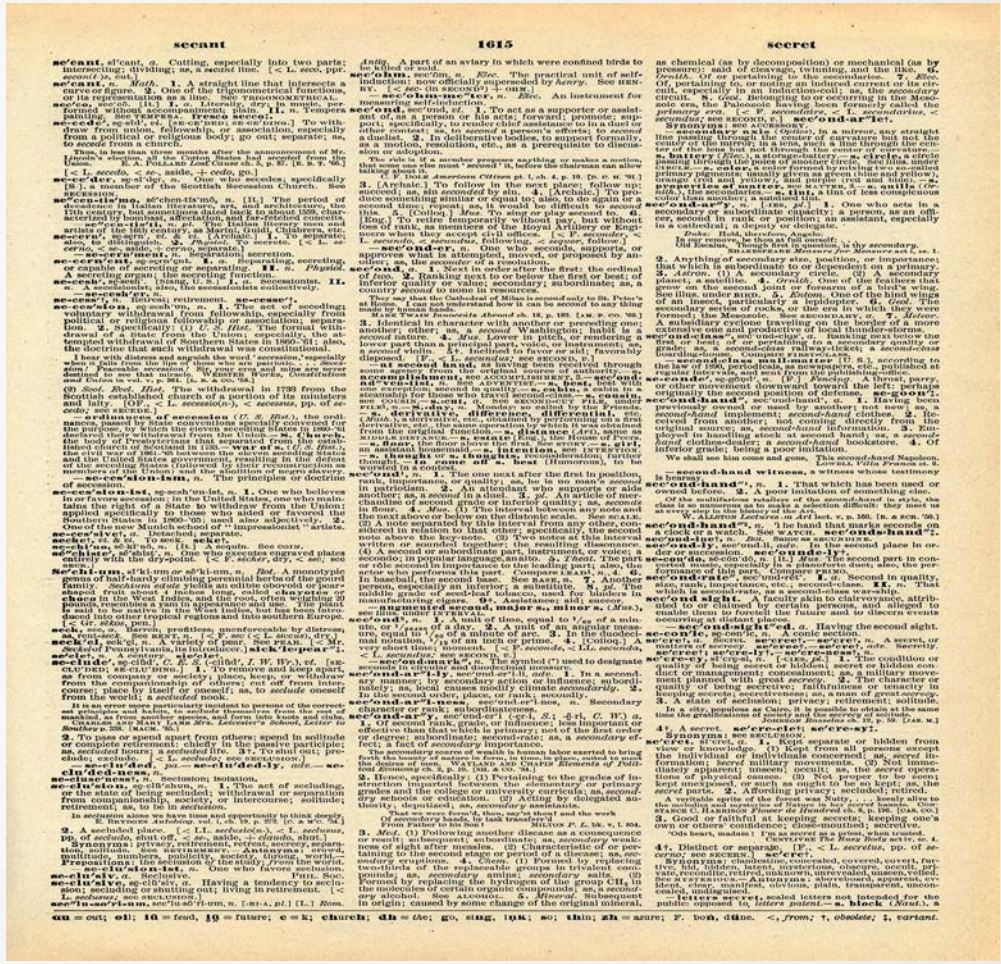
WHAT IS EVIDENCE-BASED MEDICINE?

Evidence-Based Medicine

Evidence-based medicine is the conscientious, explicit, and judicious use of current best evidence from clinical care research in the management of individual patients


secant 1615 secret

Haynes, Sackett et al, 1996 Transferring evidence from research into practice
Sacket et al, 1996, BMJ EBM: what it is and isn't

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IOM STANDARDS FOR DEVELOPING TRUSTWORTHY GUIDELINES

- Establish Transparency
- Management of Conflict of Interest
- Guideline Development Group Composition
- Clinical Practice Guideline-Systematic Review Intersection
- Establish Evidence of Foundations for and Rating Strength of Recommendations
- Articulation of Recommendations
- External Review
- Updating

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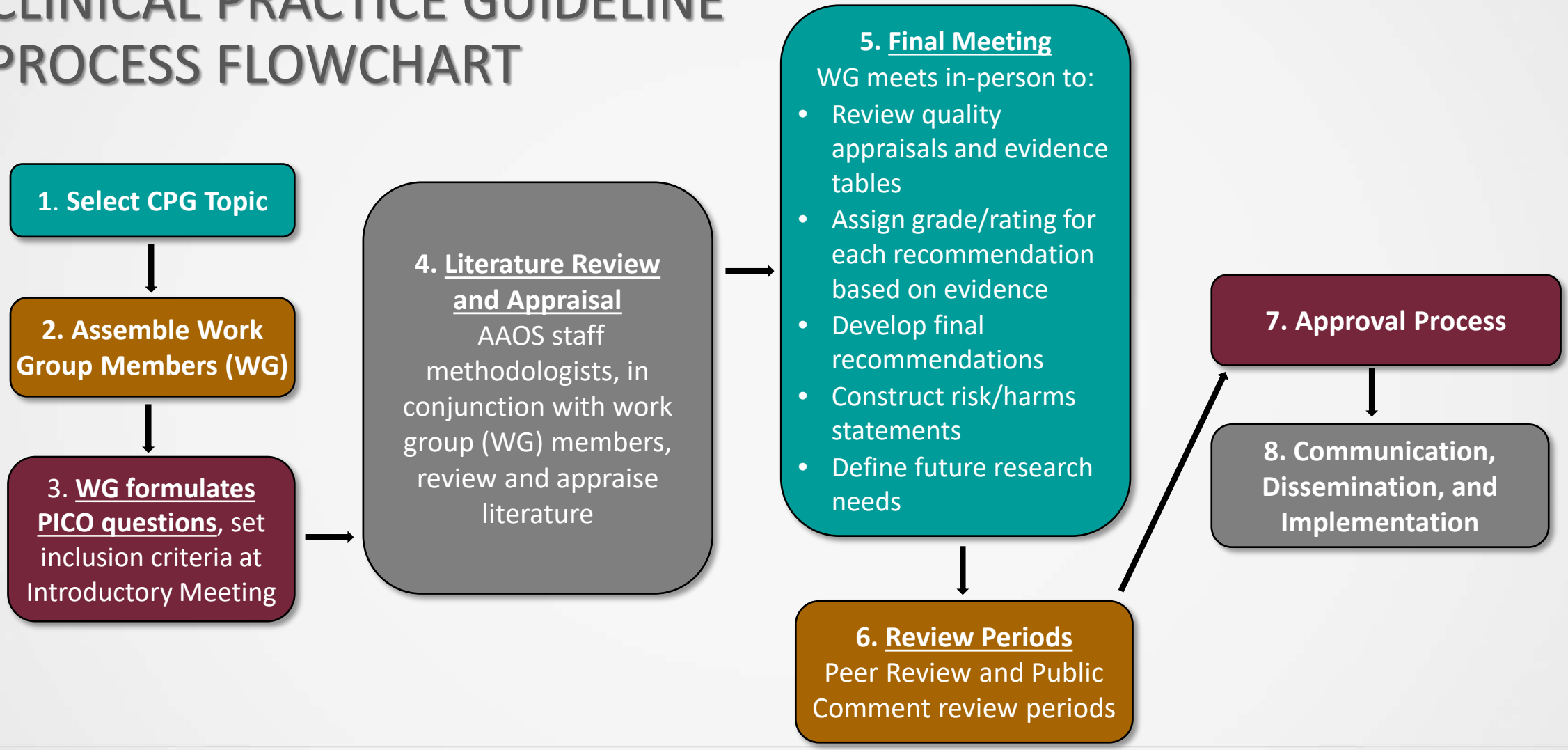
CLINICAL PRACTICE GUIDELINE PROCESS FLOWCHART



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FORMULATING PICOs

"P" = Patient Population

"I" = Intervention or variable of Interest

"C" = Comparison

"O" = Outcome

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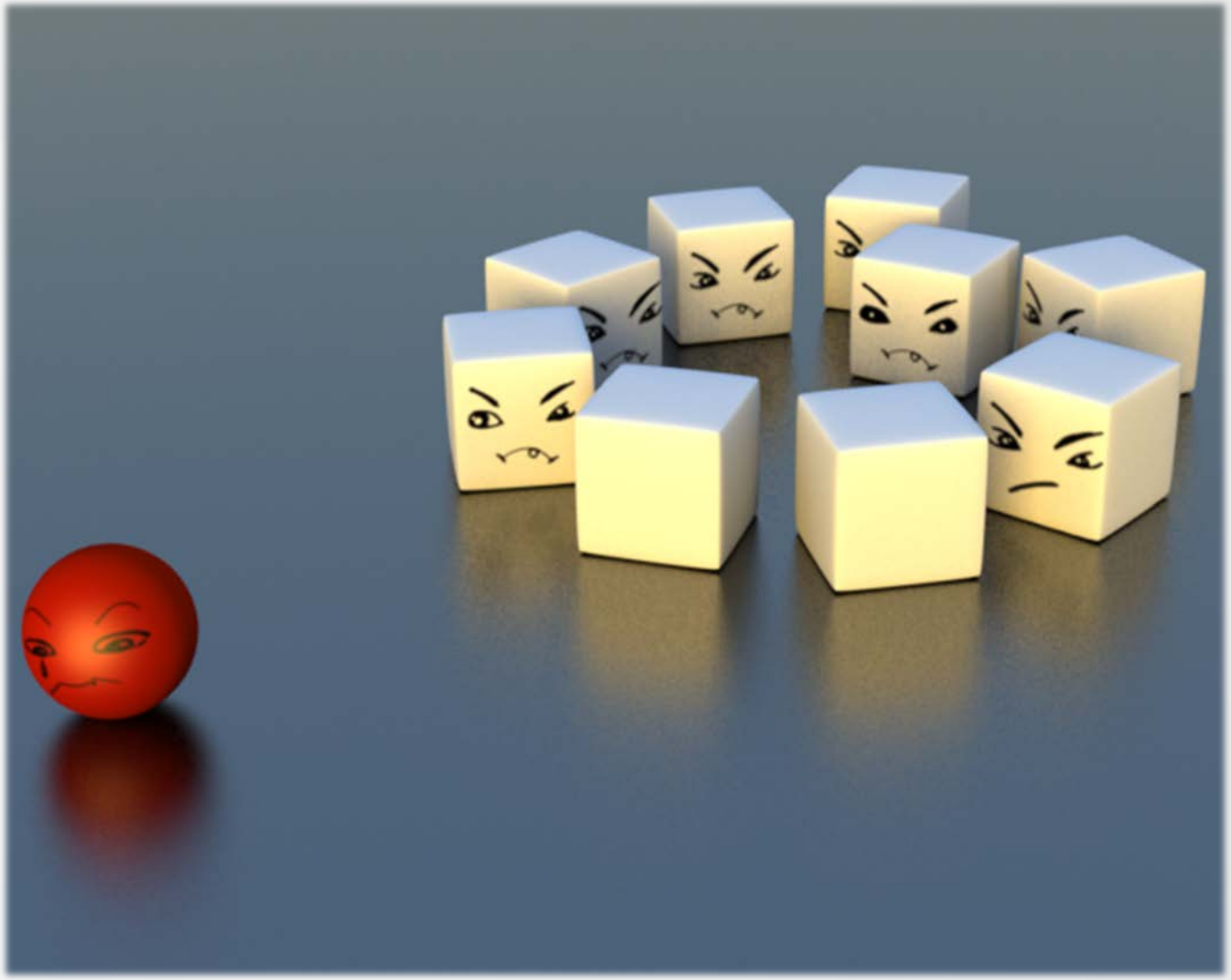
INCLUSION/EXCLUSION CRITERIA

Standard inclusion criteria include:

- Must study humans
- Must be published in English
- Must be published in or after 1966
- Can not be performed on cadavers

Work group members define additional exclusion criteria based on PICO question



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LITERATURE SEARCHES

- Databases used:
  - PubMed
  - EMBASE (Excerpta Medica dataBASE)
  - CINAHL (Cumulative Index of Nursing and Allies Health Literature)
  - Cochrane Central Register of Controlled Trials
- Search using key terms from work group's PICO questions and inclusion criteria
- Secondary manual search of the bibliographies of all retrieved publications for relevant citations
- Recalled articles evaluated for inclusion based on the study selection criteria

BEST EVIDENCE SYNTHESIS

- Include only highest quality evidence for any given outcome if available
- If there are fewer than two occurrences of an outcome of this quality, the next lowest quality is considered until at least two occurrences have been acquired.

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STRENGTH OF RECOMMENDATIONS

STRENGTH	OVERALL STRENGTH OF EVIDENCE	STRENGTH VISUAL
STRONG	Two or more HIGH Strength Studies with consistent findings	
MODERATE	1 HIGH OR 2 MODERATE strength studies with consistent findings	
LIMITED	One or more LOW strength studies and/or only 1 MODERATE strength study with consistent findings or evidence from a single, or the evidence is insufficient, or conflicting	
CONSENSUS	Expert opinion (no studies) No supporting evidence in the absence of reliable evidence. Work group is making a recommendation based on their clinical opinion	

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TRANSLATING RECOMMENDATIONS IN A CPG

STRENGTH OF RECOMMENDATION	PATIENT COUNSELING TIME	DECISION AIDS	IMPACT OF FUTURE RESEARCH
Strong	Least	Least important, unless the evidence supports no difference between two alternative interventions	Not likely to change
Moderate	Less	Less important	Less likely to change
Limited	More	More	Possible / Anticipates
Consensus	Most	Most Important	Impact unknown

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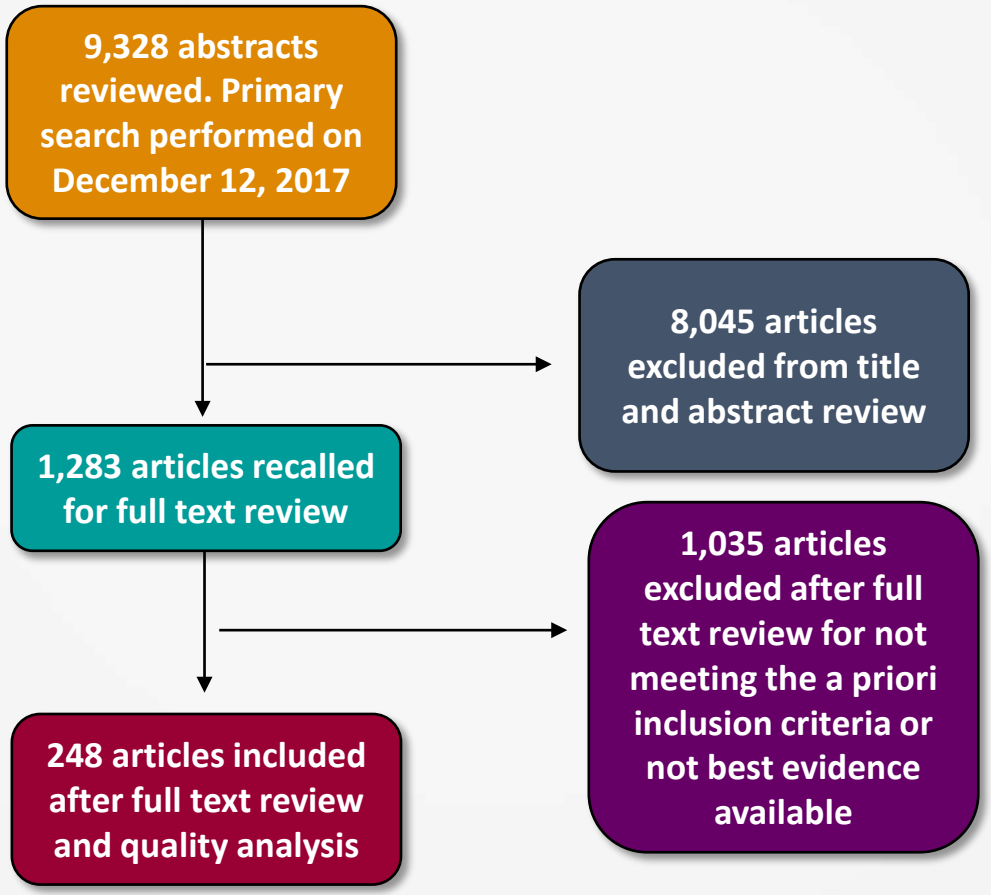
ASSESSING QUALITY OF EVIDENCE

All included studies undergo a quality assessment

Each study's design is evaluated for risk of bias and receives a final quality grade, depending on the number of study design flaws

Study quality tables are made available to the work group in the final data report and the final publication of the guideline/systematic review

RESULTS OF QUALITY ASSESSMENT: STUDY ATTRITION FLOWCHART



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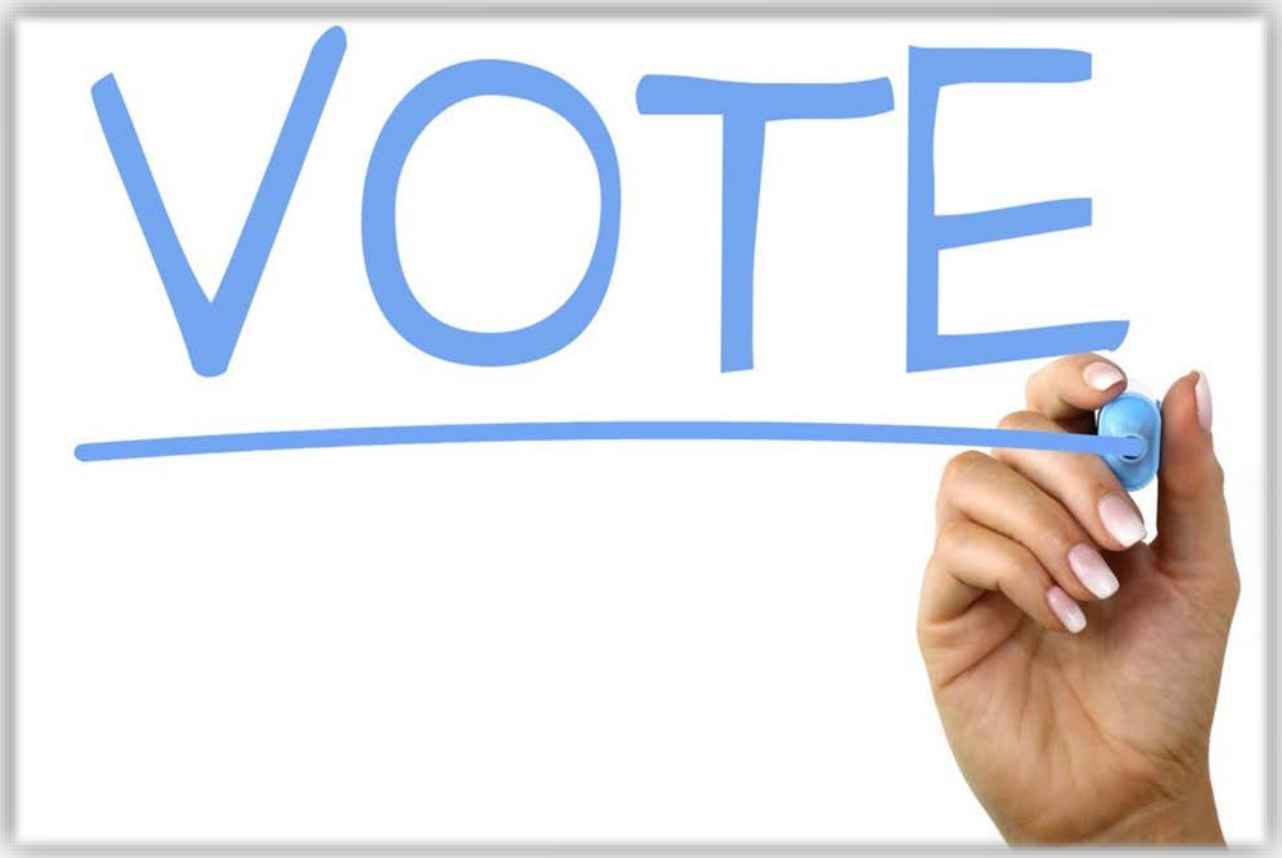
VOTING ON THE RECOMMENDATIONS

Recommendations and recommendation strengths voted on by work group during final meeting

Approved and adopted by simple majority (60%) when voting on every recommendation

If disagreement, further discussion to whether the disagreement could be resolved



GUIDELINE LANGUAGE STEMS

GUIDELINE LANGUAGE STEMS	STRENGTH OF RECOMMENDATION
Strong evidence supports that the practitioner should/should not do X, because…	STRONG
Moderate evidence supports that the practitioner could/could not do X, because…	MODERATE
Limited evidence supports that the practitioner might/might not do X, because…	LIMITED
In the absence of reliable evidence, it is in the opinion of this guideline work group that…	CONSENSUS

PEER REVIEW

Guideline draft sent for peer review to external experts

Comments and draft of responses reviewed by work group members

Recommendation changes required a majority vote by work group

A detailed report of all resulting revisions is published with the guideline document

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PUBLIC COMMENT

Following peer review modifications, CPG undergoes public commentary period

Comments are solicited from:

AAOS Board of Directors

AAOS Council on Research and Quality

AAOS Committee on Evidence-Based Quality and Value

AAOS Board of Councilors

AAOS Board of Specialty Societies

200 commentators have the opportunity to provide input

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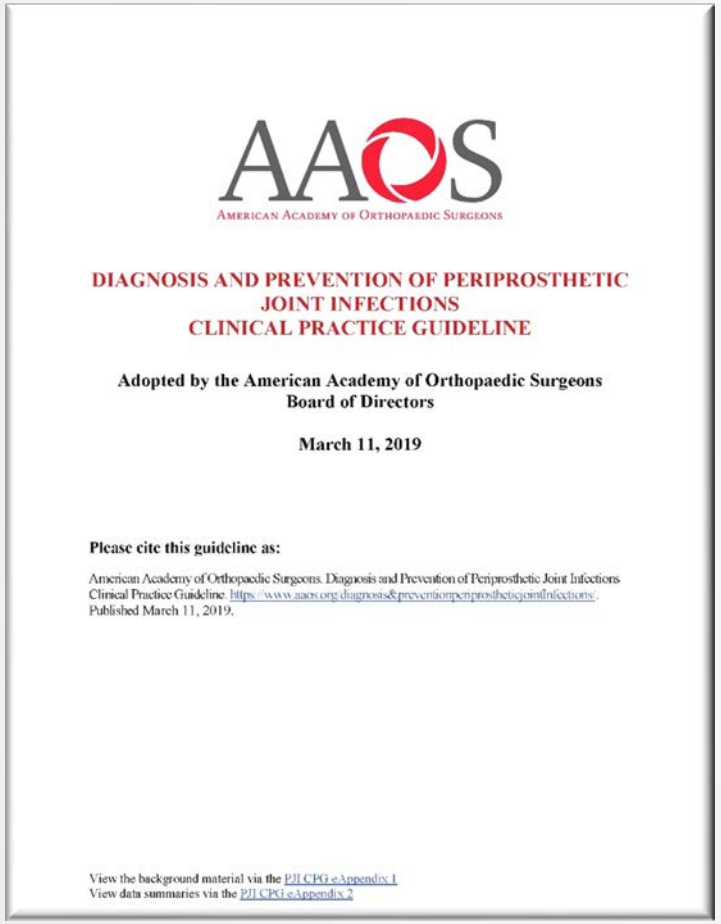
FINAL MEETING

The work group is charged with:

- Review of data summaries
- Final recommendation language
- Rationale and risk/harm construction
- Future research

DIAGNOSIS AND PREVENTION OF PERIPROSTHETIC JOINT INFECTIONS CLINICAL PRACTICE GUIDELINE OVERVIEW



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DIAGNOSIS AND PREVENTION OF PERIPROSTHETIC JOINT INFECTIONS CLINICAL PRACTICE GUIDELINE

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Please cite this guideline as:

American Academy of Orthopaedic Surgeons. Diagnosis and Prevention of Periprosthetic Joint Infections Clinical Practice Guideline. https://www.aaos.org/diagnosis&preventionperiprostheticjointInfections/. Published March 11, 2019.

View the background material via the PJI CPG e-Appendix 1
View data summaries via the PJI CPG e-Appendix 2

- Based on a systematic review of published studies
- Addresses the diagnosis and prevention of hip and knee periprosthetic joint infections in patients over the age of 18
- Highlights limitations in literature and areas requiring future research
- Trained physicians and surgeons are intended users

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RISK FACTORS FOR PJI

- Moderate strength evidence supports that obesity is associated with increased risk of periprosthetic joint infection (PJI).

Strength of Recommendation: Moderate

RISK FACTORS FOR PJI

- Limited strength evidence supports that patients in which one or more of the following criteria are present are at an increased risk of periprosthetic joint infection (PJI) after hip and knee arthroplasty:

- *Cardiac disease (arrhythmia, CAD, congestive heart failure, other)*
- *Immunocompromised status (other than HIV), including transplant, cancer*
- *Peripheral vascular disease*
- *Inflammatory arthritis*
- *Prior joint infection*
- *Renal disease*
- *Liver disease (hepatitis, cirrhosis, other)*
- *Mental health disorders (including depression)*
- *Alcohol use*
- *Anemia*
- *Tobacco use*
- *Malnutrition*
- *Diabetes*
- *Uncontrolled diabetes*

Strength of Recommendation: Limited 

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RISK FACTORS FOR PJI

- In the absence of reliable evidence, it is the opinion of this work group that in the case that one or more of the following conditions are present, the practitioner should carefully consider the risk before proceeding with surgery:

- *Active infection (strongly caution against proceeding with surgery given the risks)*
- *Anticoagulation status, active thomboprophylaxis (proceed only after careful consideration of the risks)*
- *Autoimmune disease (proceed only after careful consideration of the risks)*
- *HIV status (proceed only after careful consideration of the control and risks)*
- *Institutionalized patients (proceed only after careful consideration of the risks)*
- *Prior bariatric surgery (proceed only after careful consideration of the risks)*

Strength of Recommendation: Consensus

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RISK FACTORS FOR PJI

- In the absence of reliable evidence, it is the opinion of this work group that the following conditions have an unclear effect on risk of PJI:
  - *Age (conflicting evidence)*
  - *Dementia (imprecise effect estimates)*
  - *Poor dental status (inadequate evidence for a recommendation)*
  - *Asymptomatic bacteriuria (conflicting evidence)*

Strength of Recommendation: Consensus

INJECTIONS PRIOR TO ARTHROPLASTY

- Limited evidence suggests intra-articular injection performed prior to total joint arthroplasty may have a time-dependent association for increased risk of PJI.

Strength of Recommendation: Limited 

BLOOD TESTS FOR PREOPERATIVE DIAGNOSIS

- Strong evidence supports the use of the following to aid in the preoperative diagnosis of prosthetic joint infection (PJI):
  - *Serum erythrocyte sedimentation rate (ESR)*
  - *Serum C-reactive protein (CRP)*
  - *Serum interleukin-6*

Strength of Recommendation: Strong

BLOOD TESTS FOR PREOPERATIVE DIAGNOSIS

- Moderate strength evidence does not support the clinical utility of the following to aid in the diagnosis of PJI:
  - *Peripheral blood leukocyte count*
  - *Serum tumor necrosis factor-α*

Strength of Recommendation: Moderate 

DIAGNOSIS OF INFECTED JOINT REPLACEMENTS SYNOVIAL FLUID TESTS

- Moderate strength evidence supports the use of the following to aid in the diagnosis of prosthetic joint infection (PJI):
  - *Synovial fluid leukocyte count and neutrophil percentage*
  - *Synovial fluid aerobic and anaerobic bacterial cultures*
  - *Synovial fluid leukocyte esterase*
  - *Synovial fluid alpha-defensin (α-defensin)*
  - *Synovial fluid C-reactive protein (CRP)*
  - *Synovial fluid nucleic acid amplification testing [e.g., polymerase chain reaction (PCR)] for bacteria*

Strength of Recommendation: Moderate 

DIAGNOSIS OF INFECTED JOINT REPLACEMENTS INTRAOPERATIVE TESTS

- Strong evidence supports the use of histopathology to aid in the diagnosis of PJI.

Strength of Recommendation: Strong 

DIAGNOSIS OF INFECTED JOINT REPLACEMENTS INTRAOPERATIVE TESTS

- Moderate strength evidence supports the use of the following to aid in the diagnosis of prosthetic joint infection (PJI):
  - *Multiple aerobic and anaerobic bacterial periprosthetic tissue cultures*
  - *Implant sonication fluid aerobic and anaerobic bacterial cultures*
  - *Implant sonication fluid nucleic acid amplification testing (e.g., PCR) for bacteria*

Strength of Recommendation: Moderate

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DIAGNOSIS OF INFECTED JOINT REPLACEMENTS INTRAOPERATIVE TESTS

- Limited strength evidence supports that periprosthetic tissue nucleic acid amplification testing for bacteria is not useful in the diagnosis of PJI.

Strength of Recommendation: Limited 

DIAGNOSTIC IMAGING

- Limited strength evidence supports the use of the following to aid in the diagnosis of PJI:
- ^{18}F-FDG PET/CT
- ^{18}F-NaF PET/CT
- CT

Strength of Recommendation: Limited 

DIAGNOSTIC IMAGING

- Limited strength evidence supports the clinical utility of nuclear imaging to aid in the diagnosis of PJI.

Strength of Recommendation: Limited 

DIAGNOSTIC IMAGING

- In the absence of reliable evidence for Gallium-67 imaging it is the opinion of this work group that this radiopharmaceutical does not have a role in the workup of prosthetic joint infection.

Strength of Recommendation: Consensus

GRAM STAIN

- Moderate strength evidence supports that the practitioner avoid the use of intraoperative gram stain to rule out periprosthetic joint infection.

Strength of Recommendation: Moderate

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AVOIDING ANTIMICROBIALS TWO WEEKS PRIOR TO OBTAINING INTRA-ARTICULAR CULTURE

- Limited evidence supports withholding antimicrobials for a minimum of two weeks prior to obtaining intra-articular culture to establish the diagnosis of PJI.

Strength of Recommendation: Limited 

INITIATING ANTIMICROBIALS PRIOR TO OBTAINING INTRA-ARTICULAR CULTURE

- Moderate evidence supports avoiding administration of antimicrobials in patients suspected of having a periprosthetic joint infection until cultures have been obtained and a diagnosis has been established.

Strength of Recommendation: Moderate

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ANTIBIOTICS WITH LOW PREOPERATIVE SUSPICION OF PJI OR ESTABLISHED PJI WITH A KNOWN PATHOGEN

- Strong evidence supports that preoperative prophylactic antibiotics be given prior to revision surgery inpatients at low preoperative suspicion for periprosthetic infection and those with an established diagnosis of periprosthetic joint infection of known pathogen who are undergoing reoperation.

Strength of Recommendation: Strong 

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PERIOPERATIVE ANTIBIOTIC SELECTION - (Limited)

- Limited strength evidence supports the use of any of the following perioperative antibiotics in reducing risk of PJI, though no studies reviewed were powered to detect a significant difference among those listed:
  - *1st generation cephalosporin (e.g. cefazolin)*
  - *2nd generation cephalosporin (e.g. cefuroxime)*
  - *Glycopeptide (e.g. vancomycin)*

Strength of Recommendation: Limited 

PERIOPERATIVE ANTIBIOTIC SELECTION - (Consensus)

- In the absence of reliable evidence comparing other antibiotics and antibiotic combinations, including those listed in the guideline, it is the opinion of this work group that perioperative antibiotics should be selected based on principles of responsible stewardship, balancing the risk of PJI and antibiotic resistance. Selection should reflect the antibiogram of the individual institution, the individual risk factors of the patient, and multidisciplinary support of institutional infection control experts. There is no current reliable evidence to support one antibiotic versus the other (examples provided in the rationale).

Strength of Recommendation: Consensus 

ANTIBIOTIC CEMENT

- Limited evidence suggests the routine use of antibiotics in the cement does not reduce the risk of periprosthetic joint infections for patients undergoing cemented TKA.

Strength of Recommendation: Limited 

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ANTIBIOTIC CEMENT

- Limited evidence suggests the use of antibiotics in the cement may reduce the risk of periprosthetic joint infections for patients undergoing cemented total hip arthroplasty (THA).

Strength of Recommendation: Limited 

PREOPERATIVE SCREENING AND DECOLONIZATION

- Limited strength evidence supports the use of universal preoperative chlorhexidine cloth decolonization to reduce PJI after total hip arthroplasty (THA) and total knee arthroplasty (TKA).

Strength of Recommendation: Limited 

PREOPERATIVE SCREENING AND DECOLONIZATION

- In the absence of reliable evidence for screening and nasal decolonization, it is the opinion of this work group that preoperative nasal mupirocin decolonization is a low-risk, reasonable option prior to hip and knee arthroplasty in patients who are MRSA carriers.

Strength of Recommendation: Consensus

INTRAOPERATIVE TECHNICAL FACTORS

- In the absence of reliable evidence for the use of an antiseptic wash during total hip or knee arthroplasty, it is the opinion of this work group that dilute betadine lavage be used as a method to decrease infection risk in hip or knee arthroplasty.

Strength of Recommendation: Consensus

FUTURE RESEARCH

- Consideration for future research, when identified, is provided for each recommendation. Review of the published literature does indicate two overarching themes: (1) complex and interrelated modifiable / non-modifiable patient factors as an important aspect in understanding risk for PJI, and (2) ongoing challenges in accurately ruling in or ruling out PJI.
- Given the severe consequences of this disease process, the workgroup strongly suggests that future, high-quality research focus on continued development of validated risk assessment tools specific to hip and knee replacement not only to identity individual risk but also guide additional research efforts to mitigate the risks.
- Specifically, the effect of preoperative risk factor modification or correction prior to a patient undergoing hip or knee arthroplasty surgery must be elucidated.

FUTURE RESEARCH

- Additionally, focused research to develop highly accurate and timely diagnostic tools, including those that can be used at the point of care, is critical to facilitate diagnostic accuracy and efficiency in the evaluation of patients suspected of PJI. This ideally can lead to better management, in addition to shortened work-up times and decreased cost by allowing providers access to immediate diagnosis.

FUTURE RESEARCH – RISK FACTORS FOR PJI

- Despite the volume of literature addressing risk factors for periprosthetic joint infection, there is a paucity of moderate-quality studies, and complete absence of high-quality studies. Future research must attempt to better control for individual confounding variables prospectively, with better delineation of disease states.
- For example, though BMI may not be the best measure of obesity overall, its stratification in many studies has helped allow for better comparison between groups, improving the quality of data available.
- Simply identifying whether or not a disease process is present based off an individual entry of a diagnostic code from the patient's potentially remote past medical history does not ensure best quality data.
- Unfortunately, the relatively low incidence of PJI requires large numbers for appropriate statistical power, making registries and large healthcare databases an optimal target for research.

FUTURE RESEARCH – RISK FACTORS FOR PJI

- Better quality abstraction for such databases is therefore necessary to help de-confound. Additional assessments of markers of disease status and their associated thresholds may also help the clinician further and more accurately stratify risk.
- Finally, identification of risk associated with a condition or stage of comorbidity does not by itself afford the provider the ability to proselytize for change, as the effect of modification and optimization of the status of a listed condition is still unclear. Future research endeavors should specifically be designed to determine if risk factor modification truly results in a reduction in the risk for PJI after hip or knee arthroplasty surgery.
- Given frequently conflicting conclusions among studies, the individual system and even provider-specific management of comorbidities – which was typically not delineated – may account for such discrepancies. Prospective, appropriately controlled studies incorporating these considerations will better afford surgeon and patient the ability to predict and potentially minimize risk of periprosthetic joint infection.

FUTURE RESEARCH – INJECTIONS PRIOR TO ARTHROPLASTY

- With conflicting reports in the literature, a prospective and randomized study comparing injection versus no injection at a defined time interval and in a large patient cohort is needed. The ubiquitous nature of preoperative injections for symptomatic management of hip and knee arthritis deserves further investigation as to the possibility of an association with periprosthetic joint infection.

FUTURE RESEARCH
BLOOD TESTS FOR PREOPERATIVE DIAGNOSIS

- As noted in the subsequent recommendation, the goal of testing for PJI is to rule in or rule out this diagnosis. No test should be used alone. In most cases, a diagnosis can be achieved without using all of the testing listed, and testing should be deployed in an algorithmic fashion; defining such an algorithm is beyond the scope of this guideline. Novel blood-based biomarkers, including procalcitonin, are currently being explored. The relative value of biomarker testing (e.g., CRP, interleukin-6) on serum versus synovial fluid remains to be defined.

FUTURE RESEARCH
DIAGNOSIS OF INFECTED JOINT REPLACEMENTS

- While multiple tests are listed, the goal, as stated above, should be to rule in or rule out PJI and if ruled in, define its microbiology. In most cases, this can be achieved without using all of the testing covered. Ideally, testing should be deployed in an algorithmic fashion; defining such an algorithm is beyond the scope of this guideline but is needed.
- The field of molecular microbiology diagnostics, including organism-specific, multiplex panels, 16S ribosomal RNA gene or other broad-range bacterial PCR followed by Sanger sequencing of amplification products, targeted metagenomic sequencing and shotgun metagenomic sequencing, is rapidly developing, which will likely impact future recommendations.

FUTURE RESEARCH
DIAGNOSIS OF INFECTED JOINT REPLACEMENTS

- Future research should address the most appropriate type of advanced diagnostic(s), which specimen-types are ideal or such testing, the ideal number of specimens to be tested, and when, in the course of testing and under which scenarios this type of testing is most appropriate (i.e., develop algorithms for appropriate test utilization).

FUTURE RESEARCH – DIAGNOSTIC IMAGING

- More high-quality evidence is needed to determine if ultrasound and MRI are useful in diagnosis of PJI, and higher quality diagnostic evidence is needed in order to create stronger recommendations.

FUTURE RESEARCH – GRAM STAIN

- Based on current evidence, Gram stain does not seem to have utility in ruling out periprosthetic joint infection.

FUTURE RESEARCH – ANTIMICROBIALS TWO WEEKS PRIOR TO OBTAINING INTRA-ARTICULAR CULTURE

- Periprosthetic joint infection can be caused by a myriad of microorganisms. Whether this recommendation applies to all microorganism-types as well as all antibiotic-types is unknown. Future research is needed to better understand the effect of varying antimicrobial agents on differing organisms and to define the ideal “antibiotic- free” time prior to specimen collection for cultures in patients with suspected PJI.

FUTURE RESEARCH – PERIOPERATIVE ANTIBIOTIC SELECTION

- Future research opportunities on the choice of perioperative antibiotics should focus on the optimal timing and the number of post-operative doses required to reduce the incidence of PJI. The Centers for Disease Control and Prevention (CDC) has issued a recommendation that a single dose of preoperative antibiotic prophylaxis is sufficient prior to lower extremity arthroplasty surgery, but there is concern that the data used to arrive at this conclusion may not be specifically applicable to the hip or knee arthroplasty patient, and as such, this recommendation has been received with a certain degree of reluctance among practicing arthroplasty surgeons (Berríos-Torres, 2017). A multi-center RCT specifically designed to answer this question is currently underway.

FUTURE RESEARCH – ANTIBIOTIC CEMENT

- Adequately powered randomized controlled trials assessing the impact of antibiotic cement on deep infection, implant survival and other patient outcomes are needed to determine which specific patient groups may benefit from this prophylactic treatment with total knee arthroplasty. Patient Expectations: There is currently very little research on optimal ways to evaluate and influence patient expectation.

FUTURE RESEARCH – PREOPERATIVE SCREENING AND DECOLONIZATION

- Large multicenter randomized controlled trials that are sufficiently powered to measure a difference in the PJI rate that ideally stratify patients based on risk profile regarding preoperative chlorhexidine, methicillin- susceptible S. aureus and MRSA nasal screening and nasal mupirocin decolonization are needed.

FUTURE RESEARCH – INTRAOPERATIVE TECHNICAL FACTORS

- The cited study outlines a specific concentration and protocol for the application of the betadine wash. Further high-quality studies are needed to corroborate the results of this study and to further define the method of use.

ACKNOWLEDGEMENTS:

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PLEASE CITE CLINICAL PRACTICE GUIDELINE AS:

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THIS GUIDELINE HAS BEEN ENDORSED BY THE FOLLOWING ORGANIZATIONS:

IDSA
Infectious Diseases Society of America

ACR®
American College of Radiology
Quality is Our Image

SNMMI | Value Initiative
Society of Nuclear Medicine & Molecular Imaging

CASE STUDY:

The American Academy of Orthopaedic Surgeons Clinical Practice Guideline "Diagnosis and Prevention of Periprosthetic Joint Infections (PJI)" is a summary of the available literature designed to help guide surgeons and other qualified physicians in the management of PJI. Obesity and intra-articular joint injections are associated with an increased risk of PJI according to this Clinical Practice Guideline. Serum erythrocyte sedimentation rate, C-reactive protein, and/or interleukin-6 should be obtained when diagnosing PJI. Synovial fluid leukocyte count, neutrophil percentage, aerobic and anaerobic bacterial cultures, leukocyte esterase, alpha-defensin, C-reactive protein, and nucleic acid amplification testing may assist with the diagnosis of PJI. Antibiotics should be held for 2-weeks before obtaining samples. Intraoperatively, Gram stains do not help with PJI diagnosis, whereas histopathology samples are helpful. These guidelines may help clinicians with the prevention and diagnosis of PJI.

HISTORY

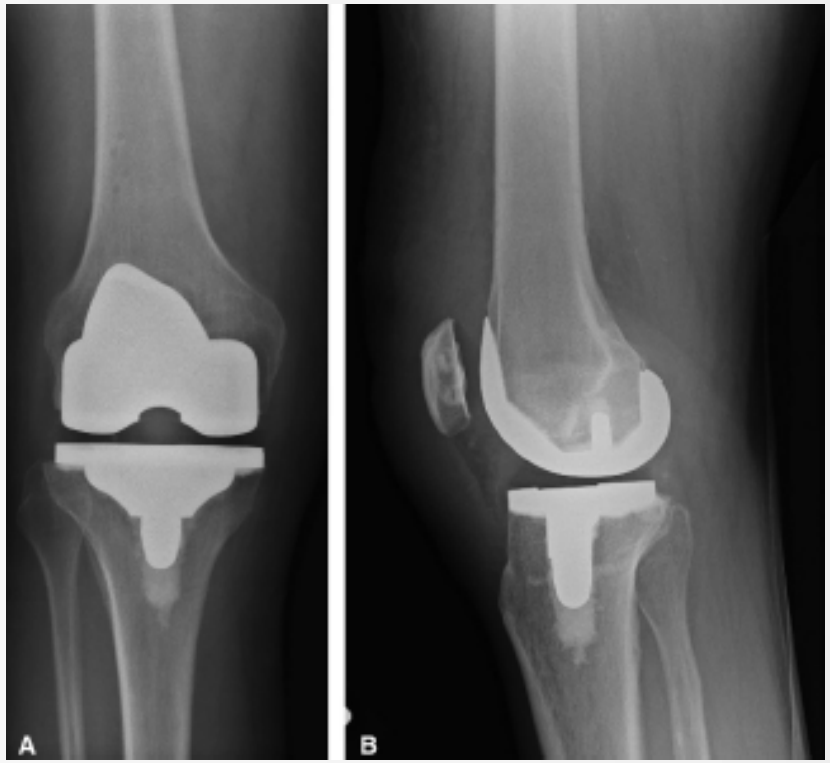
A 66-year-old male patient presented to the clinic 3-months after a right primary total knee arthroplasty (TKA) was performed. Although the patient was pain free for 1-month after surgery, he then experienced pain that persisted for 2-months, at which point in time he presented to the clinic for evaluation. The patient's general medical history was notable for benign prostatic hyperplasia, hyperlipidemia, hypertension, rosacea, sleep apnea, and anxiety. He took the following prescribed medications: albuterol, amitriptyline, lisinopril, loratadine, lorazepam, and simvastatin; he also had an allergy to Fioricet.

HISTORY

Six months before his primary TKA, the patient had received a corticosteroid injection in the ipsilateral knee. The patient also underwent preoperative screening for methicillin-resistant and methicillin-sensitive Staphylococcus aureus and was found to be negative for both. However, the patient did receive the application of a chlorhexidine cloth decolonization on the day of the primary TKA. During the initial primary TKA, a first-generation cephalosporin (cefazolin) was intravenously administered immediately preoperatively and within 24-hours postoperatively. Vancomycin was not concomitantly administered. In addition, it is noteworthy that antibiotic-containing cement was not used but that dilute betadine lavage and saline were used at the end of the case before closure.

HISTORY

At the current time of presentation to the clinic, radiographs of the patient's knee demonstrated a joint effusion with no lucency under the femoral or tibial implants (Figure 1). No further medical imaging, including 18F-FDG positron emission tomography (PET)/CT, 8FNaF PET/CT, CT scan, or gallium 67 imaging, was recommended, given the patient's presentation.[4]



Preoperative radiographs of infected total knee patient (A) AP and (B) lateral.

PHYSICAL EXAMINATION

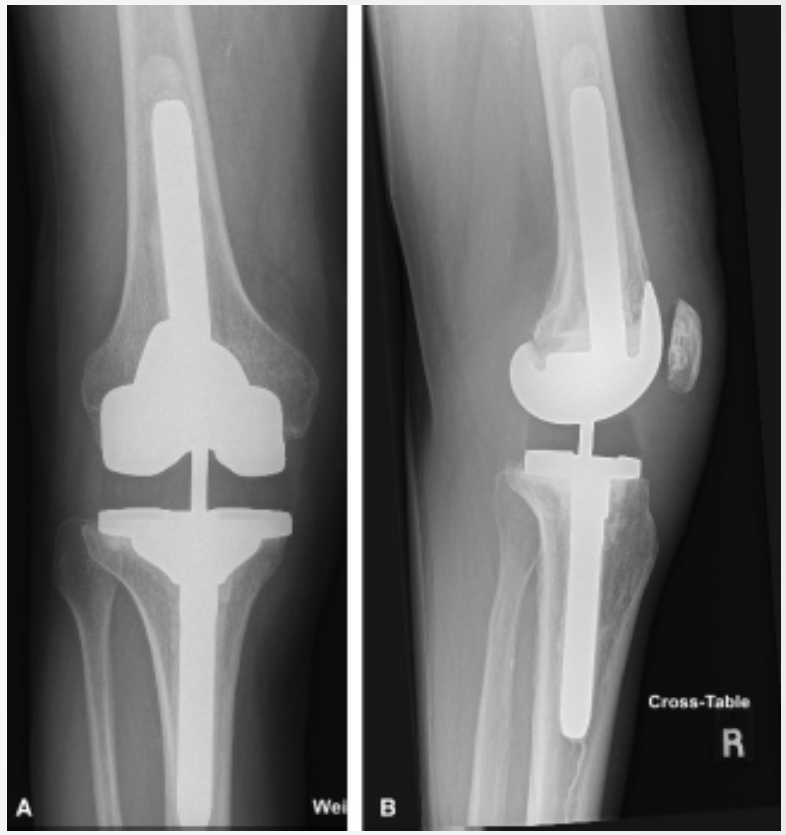
The patient was 6’ 2” and weighed 218 pounds for a body mass index of 28.0 kg/m2. The patient stated that he had no fevers or chills. A physical examination of the right lower extremity demonstrated a well-healed midline incision, a moderate joint effusion, and pain with active range of motion of the knee. The patient’s knee was stable to varus and valgus stress. He had a range of motion of 0 to 120. The patient’s quadriceps, tibialis anterior, gastrocnemius soleus, extensor hallucis longus, and flexor hallucis longus were all intact. The patient’s sensation was intact in the superficial peroneal, deep peroneal, tibialis, saphenous, and sural nerve distributions. The patient had 21 dorsalis pedis and posterior tibialis pulses bilaterally.

LABORATORY TESTS

Serum tests were performed and revealed an erythrocyte sedimentation rate (ESR) of 66 mm/hr and a C-reactive protein (CRP) of 87 mg/L. Serum white blood cell (WBC) count and serum tumor necrosis factor-a were not performed, according to the guidelines.[4] A suprapatellar aspiration of synovial fluid resulted in 31,660 synovial WBCs, 268,000 synovial red blood cells, 93% polymorphonucleocytes, no crystals, and cultures grew out Pseudomonas aeruginosa. According to the Musculoskeletal Infection Society criteria for PJI, this patient was infected based on the elevated serum ESR and CRP, elevated synovial fluid WBC and % polymorphonucleocytes, and single positive culture.[6] Thus, other synovial fluid tests that may be recommended, including leukocyte esterase, alpha-defensin, CRP, and nucleic acid amplification testing, did not need to be performed.

SURGICAL MANAGEMENT

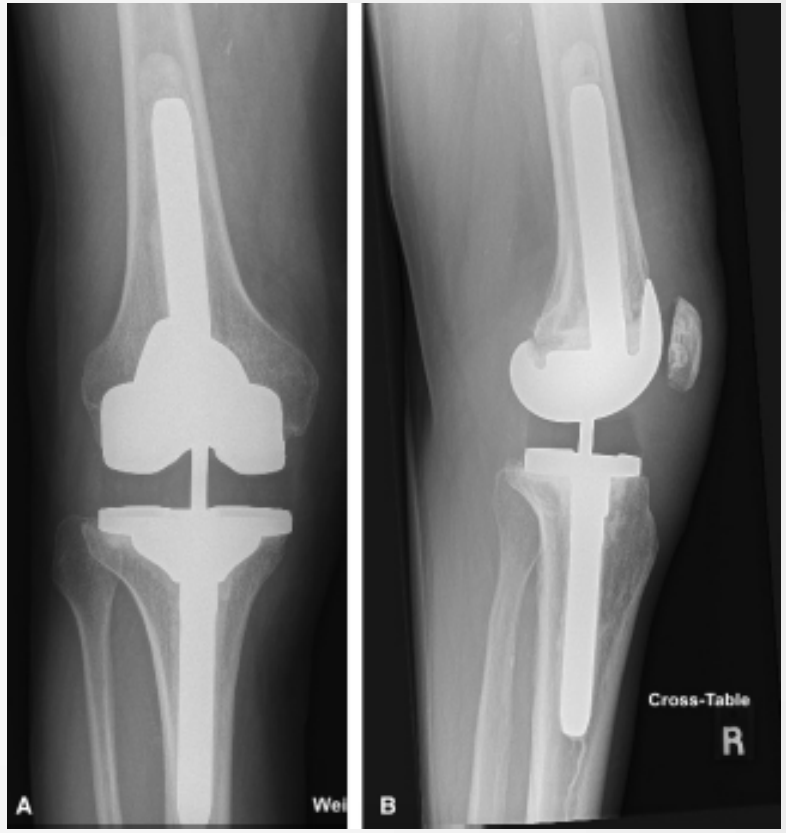
The patient was not placed on antibiotics while awaiting surgical management, according to the guidelines.[4] Once the laboratory tests came back, the patient was admitted to the hospital and underwent one-stage exchange arthroplasty (Figure 2). When performing the arthrotomy, pus was noted within the joint. After a thorough débridement and implant explantation, the wound was copiously irrigated with 3 L of saline, hydrogen peroxide, 3 L of saline, dilute povidone-iodine, and 3 L of saline. Povidone-iodine sponges were placed into the wound, and the wound was closed with a running proline suture.



Postoperative radiographs after functional spacer placement (A) AP and (B) lateral

SURGICAL MANAGEMENT

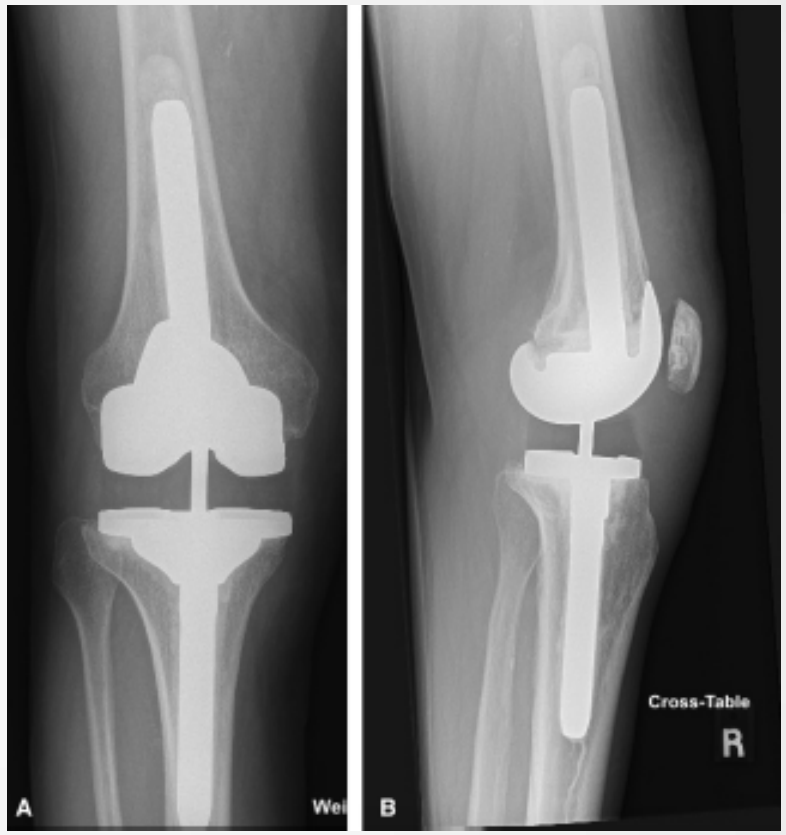
After the entire room was cleaned and new instrumentation was opened, the surgical site was débrided once again, and appropriate cuts were made for a new revision TKA. The surgical site was irrigated with saline, and the revision total knee implants were implanted using antibiotic-laden bone cement. Intraoperatively, tissues for bacterial and fungal cultures were taken from the following five anatomic sites: one femoral canal, one tibial canal, one posterior capsule, and two synovial cultures. No culture swabs were taken, and no request for Gram stain was sent becuase these have both demonstrated low yield.[4]



Postoperative radiographs after functional spacer placement (A) AP and (B) lateral

SURGICAL MANAGEMENT

The tissues were sent for aerobic and anaerobic bacterial culture, and the latter was held for 14 days. In addition, tissue was submitted for fungal and mycobacteria culture. Bacterial (aerobic/anaerobic) cultures came back positive for P aeruginosa. Fungal and mycobacteria cultures were held for 6 weeks and ultimately resulted as negative for growth.



Postoperative radiographs after functional spacer placement (A) AP and (B) lateral

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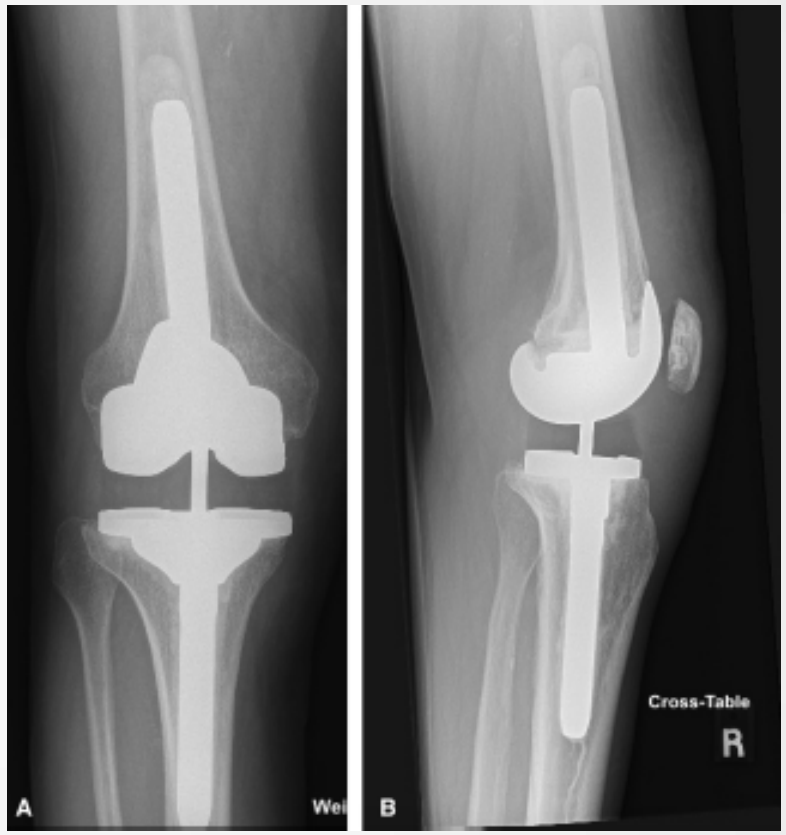
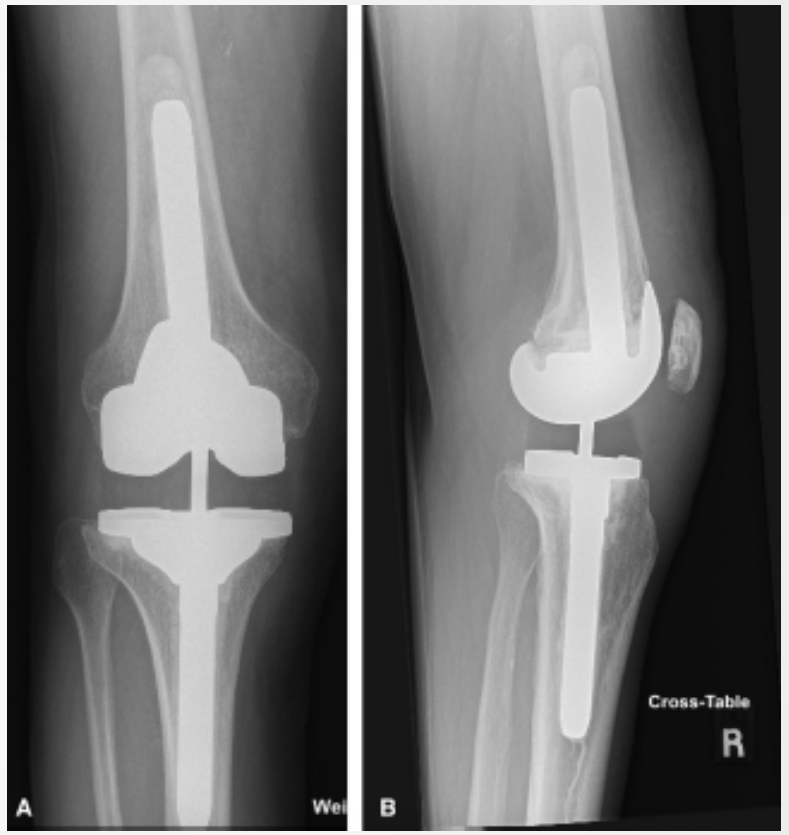


Postoperative radiographs after functional spacer placement (A) AP and (B) lateral

POSTOPERATIVE MANAGMENT

Postoperatively, the patient was full weight bearing and was administered ceftazidime 2 g intravenously every 8 hours for 6 weeks. This was followed by 3 months of oral ciprofloxacin. He is now 1-year postoperative, is no longer on suppressive antibiotics, and has no signs of infection.



Postoperative radiographs after functional spacer placement (A) AP and (B) lateral

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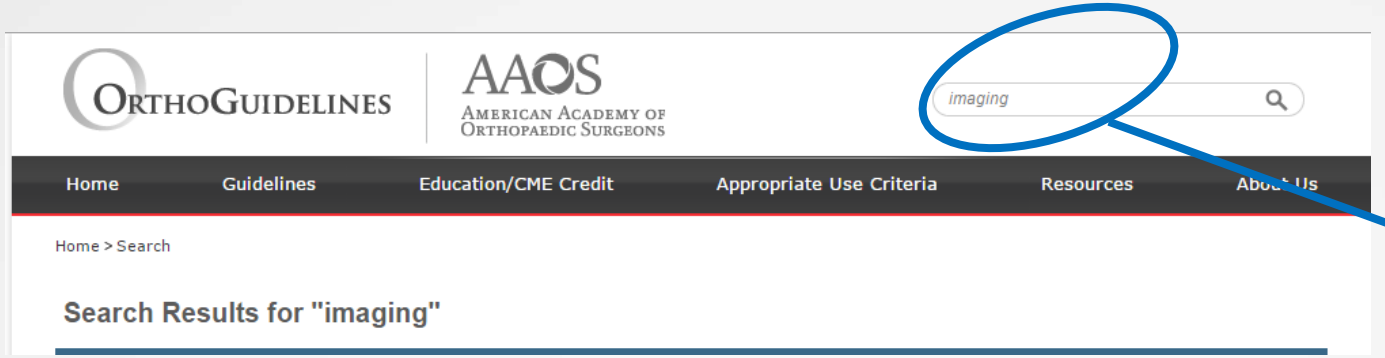

Imaging

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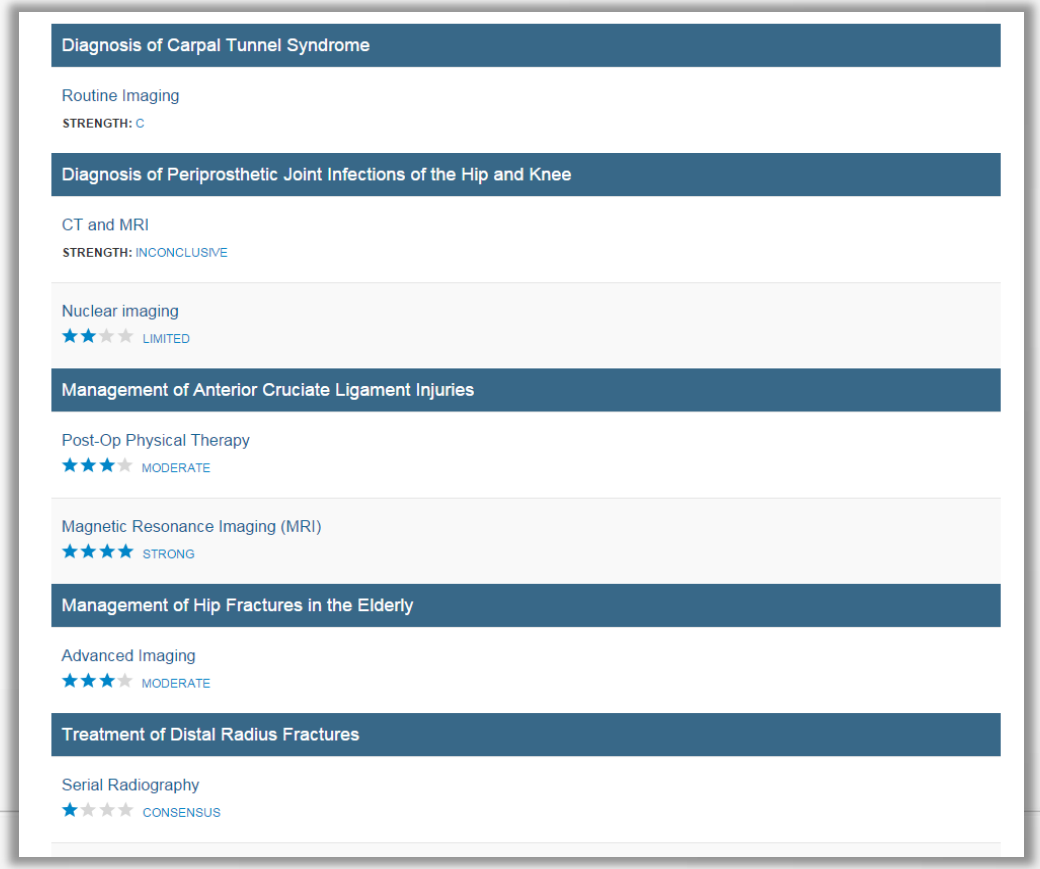

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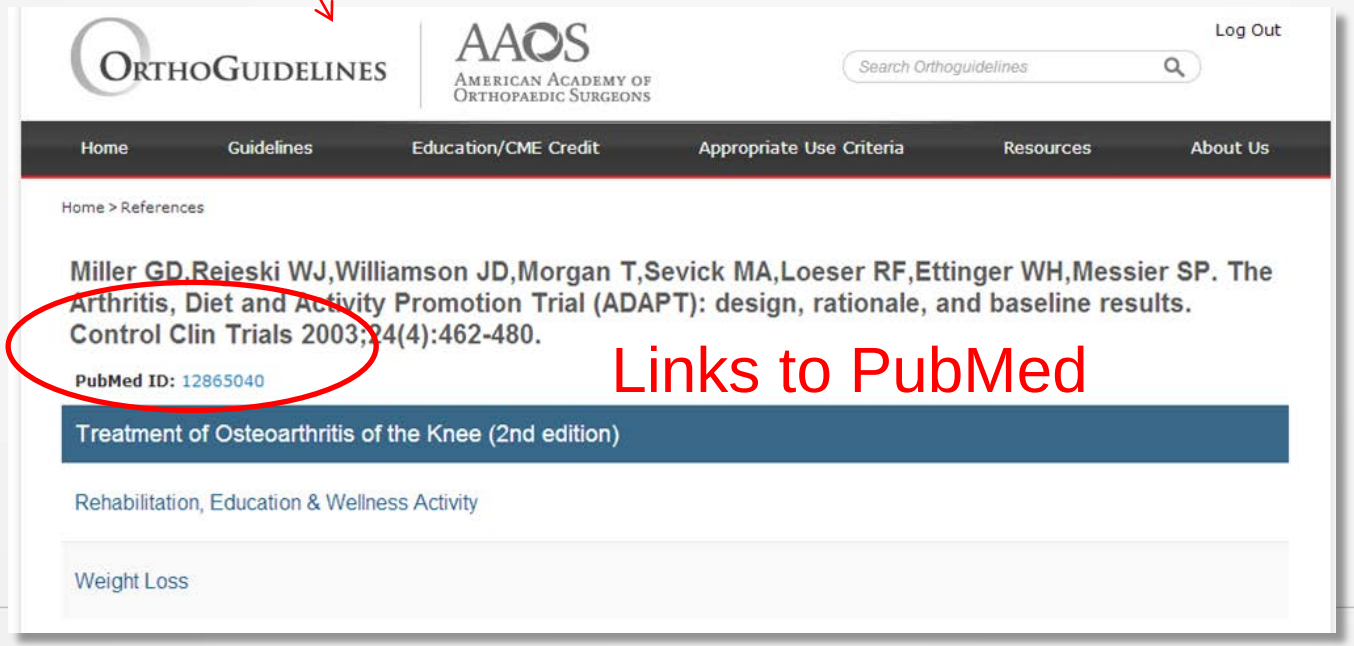
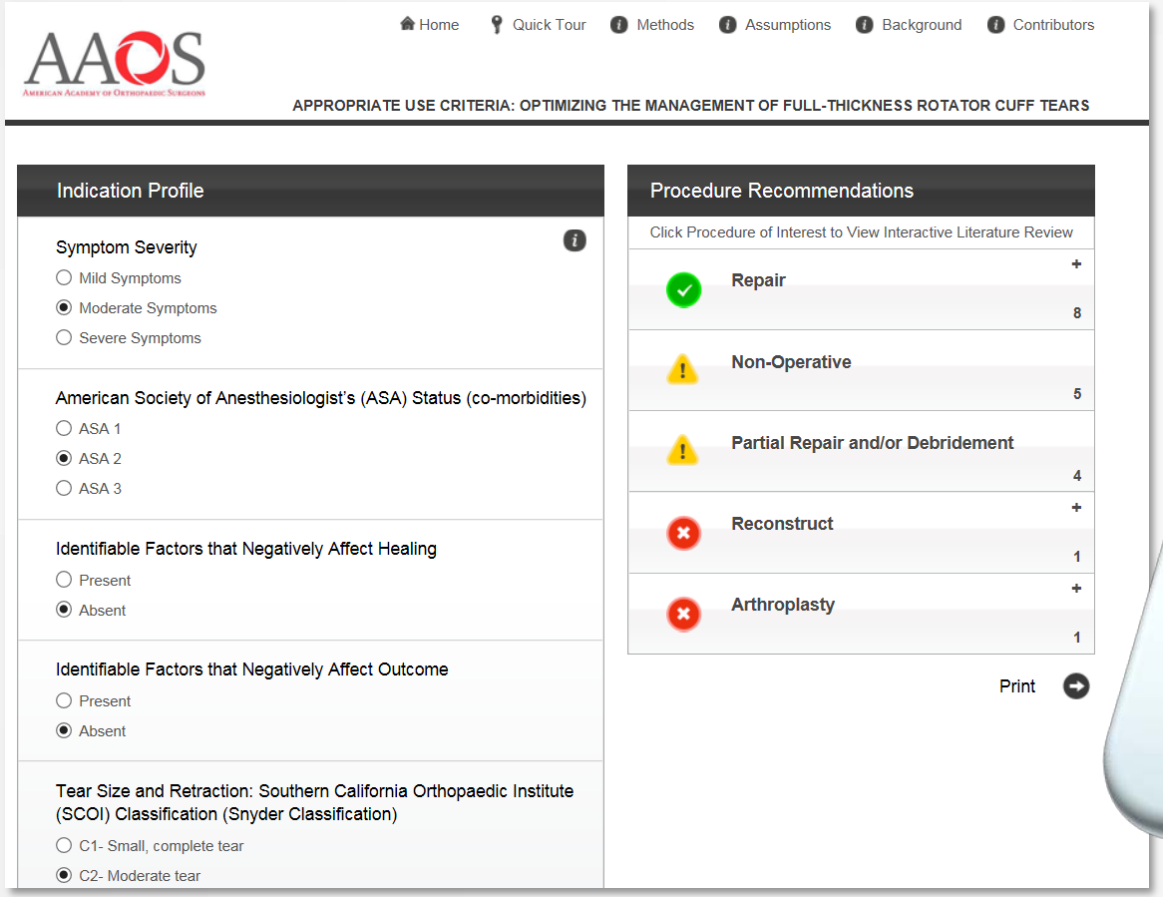
References provided for each recommendation

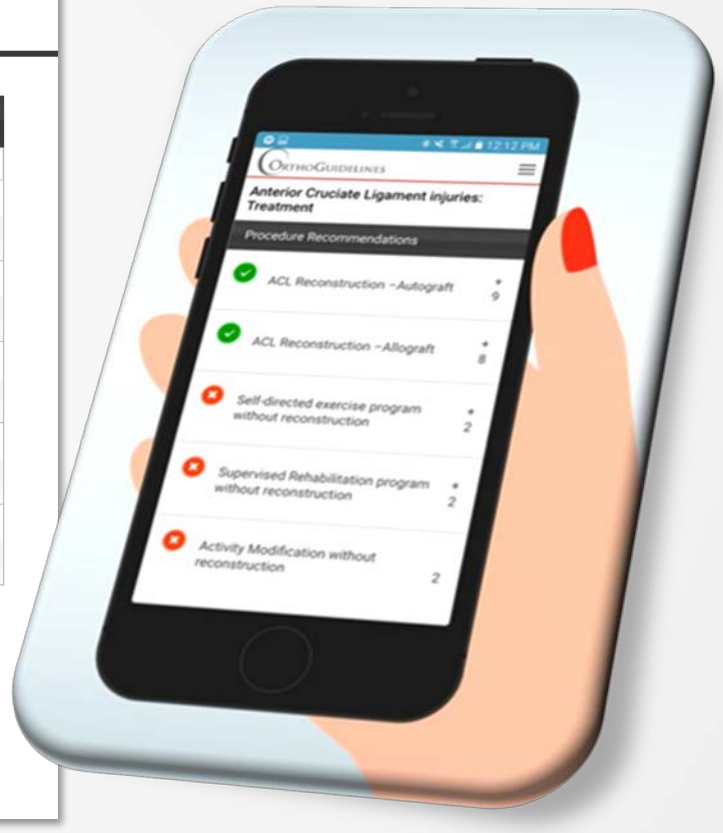
Miller GD,Rejeski WJ,Williamson JD,Morgan T,Sevick MA,Loeser RF,Ettinger WH,Messier SP. The Arthritis, Diet and Activity Promotion Trial (ADAPT): design, rationale, and baseline results. Control Clin Trials 2003;24(4):462-480.

(20) Lorig K, Lubeck D, Kraines RG, Seleznick M, Holan HR. Outcomes of self-help education for patients with arthritis. Arthritis Rheum 1985;28:680-685

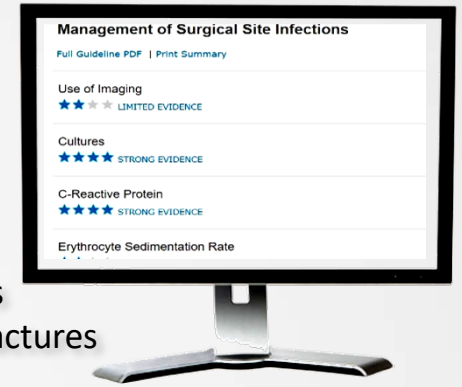


Appropriate Use Criteria Tool





PUBLISHED CLINICAL PRACTICE GUIDELINES



- Acute Compartment Syndrome
- Anesthesia and Analgesia in TJA
- Anterior Cruciate Ligament Injuries
- Carpal Tunnel Syndrome
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- Distal Radius Fractures
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- Hip Fractures in the Elderly
- Limb Salvage or Early Amputation
- Osteoarthritis of the Hip
- Osteoarthritis of the Knee (Arthroplasty)
- Osteoarthritis of the Knee (Non-Arthroplasty)
- Osteochondritis Dissecans
- Pediatric Developmental Dysplasia of the Hip in infants up to Six Months
- Pediatric Diaphyseal Femur Fractures
- Pediatric Supracondylar Humerus Fractures
- Periprosthetic Joint Infections
- Prevention of Orthopaedic Implant Infections in Patients Undergoing Dental Procedures
- Psychosocial Risk Factors Influencing Trauma Recovery
- Rotator Cuff Injuries
- Surgical Site Infections
- Treatment of Metastatic Carcinoma and Myeloma of the Femur
- VTE Disease in Patients Undergoing Elective Hip & Knee Arthroplasty
- Tranexamic Acid in Total Joint Arthroplasty (Endorsement)
- Use of Imaging Prior to Referral to a Musculoskeletal Oncologist (Endorsement)

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