EBJIS–MSIS 2026 · E-POSTER PRESENTATION

From Probability to Action: Specific Thresholds in Suspected Chronic Periprosthetic Joint Infection

Alvaro Ayala[1], **Daisuke Furukawa**[1], **Derek Amanatullah**[2], **Natalie Medvedeva**[1], **Elizabeth Thottacherry**[1]

[1] Division of Infectious Diseases & Geographic Medicine, Stanford University School of Medicine, Stanford, CA · [2] Division of Orthopedic Surgery, Stanford University School of Medicine, Stanford, CA

BACKGROUND & AIM

- Diagnosing chronic prosthetic joint infection (PJI) relies on diagnostic frameworks that combine inflammatory markers such as serum c-reactive protein (CRP), synovial leukocyte esterase (LE), synovial white blood cell count (sWBC), and percent polymorphonuclear neutrophils (PMN%).
- Combining similar tests like this can falsely elevate diagnostic confidence. Bayesian inference handles this by discounting redundant tests and carrying uncertainty forward instead of compounding it.
- When paired with a Pauker-Kassirer decision-threshold model, post-test probability of infection translates to patient tailored action thresholds (“stop testing,” “keep testing,” or “treat”). We applied this approach to the work-up of chronic PJI.
- **Aim:** propose a literature-derived Bayesian decision framework for the suspected chronic PJI diagnostic pathway.

METHODS

1 **Published data—** Sensitivity (share of PJI cases testing positive) and specificity (share of non-cases testing negative) from systematic reviews and meta-analyses for serum CRP and synovial LE [3,5] and synovial WBC and PMN% [4]. Pretest probability reflects clinical context: 10–30% based on published data.

2 **Update the probability with every result (Bayes’ rule) —** Each result becomes a likelihood ratio that increases or decreases the probability of PJI. A redundant result is discounted rather than double-counted.

LR+ = sens / (1 − spec) · LR− = (1 − sens) / spec · post-test odds = pretest odds × LR

3 **Set patient-specific thresholds (Pauker–Kassirer) —** Balancing the harms of further invasive testing, missed infection, and unnecessary treatment yields two cutoffs per profile. Action thresholds were calculated using the Pauker-Kassirer method, which weighs the harms of missing a PJI, additional testing, and treating non infected patient across three patient profiles : 1) a reference healthy patient 2) a frail multimorbid patient (conservative risk), and 3) a patient already undergoing revision or reimplantation surgery (risk averse).

Defer = H(test) / (H(miss) + H(test)) = 4.8% · Treat = H(over-treat) / (H(over-treat) + H(miss)) = 70.0%

4 **Repeat 100,000 times (Monte Carlo) —** Accuracy and pretest probability are redrawn from their published uncertainty ranges on every run, so thresholds and post-test probabilities are medians with 95% intervals, honest ranges, not single numbers.

MODELED PATHWAY - EXAMPLE

Clinical context → pretest probability
worked example: 20% suspicion (odds 1:4)

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Serum: CRP negative → LR 0.27
post-test probability: 6%

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Synovial aspiration: WBC, PMN%
worked example: indeterminate → no change

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Reflex rule-in: LE positive → LR 22
post-test probability: 60%

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60% vs. thresholds → patient-specific action
Reference: keep testing · Revision: TREAT

RESULTS

- **Thresholds shift by patient profile:** action thresholds for deferral and treatment varied widely (Table 1): no-test **2.1–7.4%**, treat **49.5–85.2%**.
- **Synovial tests changed clinical decision:** from a 20% pretest, serum CRP refined suspicion but rarely changed action (CRP+ **46.6%**; CRP− **6.1%**), whereas synovial results crossed thresholds (LE+ **84.9%**; WBC ≥3,000/µL **93.7%**; PMN ≤65% **1.3%**).
- **Same probability → opposite actions:** 59.9% after CRP−/LE+ stayed in the work-up zone for the reference patient but exceeded the treat threshold in **98.9%** of revision/reimplantation patients (risk averse); **84.9%** after LE+ triggered treatment in **100%** of reference patients but only **45.3%** of frail patients.

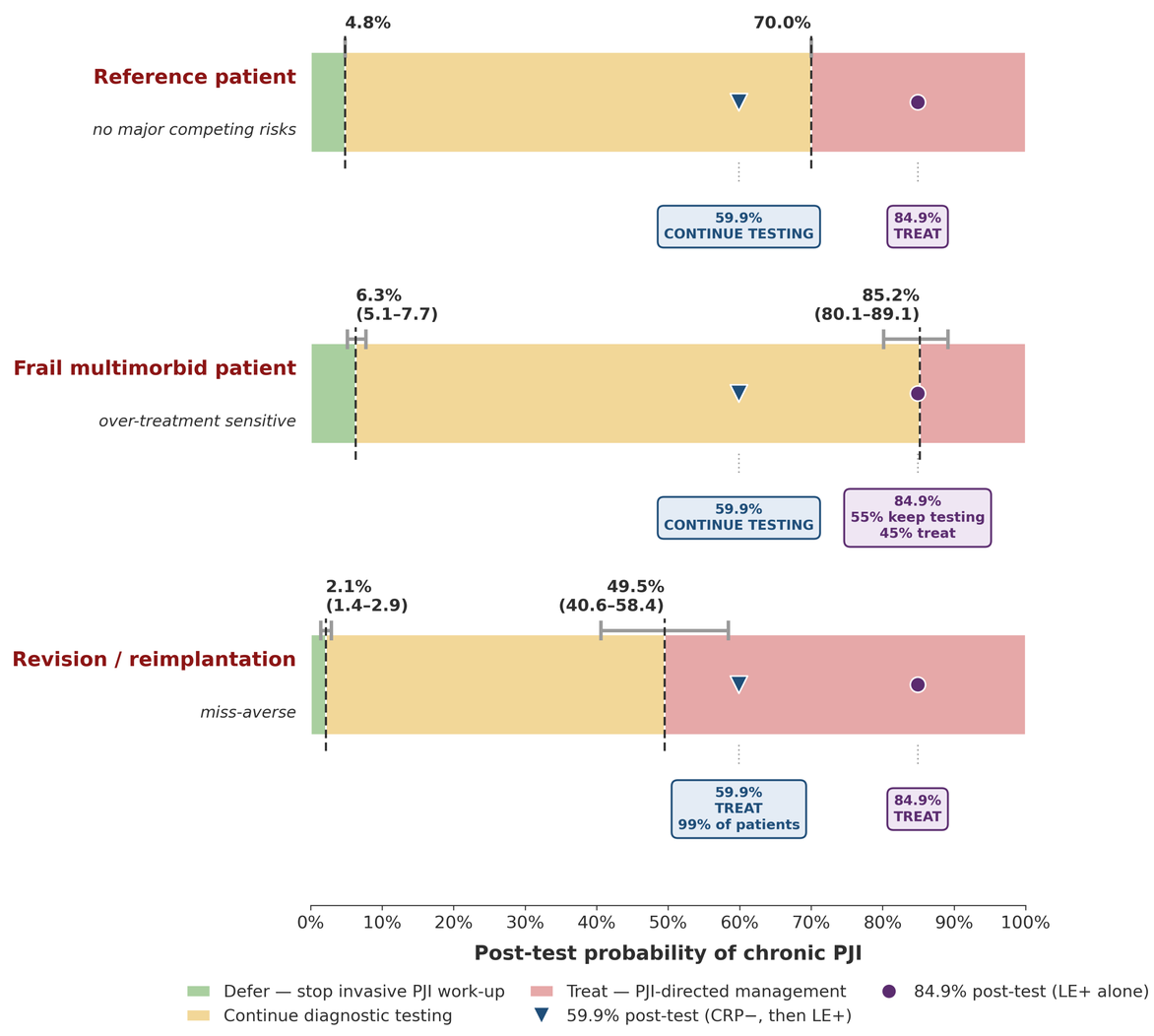

Figure 1. Action thresholds and decision zones across three clinical profiles. For each profile, the defer and treat thresholds (dashed lines: medians; whiskers: 95% intervals) define three zones. Labels under each bar show the action that each illustrative post-test probability — 59.9% (after CRP−, then LE+) and 84.9% (after LE+ alone), both from a 20% pretest.

TABLE 1 · ACTION THRESHOLDS BY CLINICAL PROFILE AND RISK AVERSION

Clinical profile	Emphasis	Defer work-up	Treat
Reference patient	balanced harms	**4.8%**	**70.0%**
Frail, multimorbid	over-treatment averse	**6.3% (5.1–7.7)**	**85.2% (80.1–89.1)**
Revision / reimplantation	miss-averse	**2.1% (1.4–2.9)**	**49.5% (40.6–58.4)**

LIMITATIONS & NEXT STEPS

- Literature-derived inputs: harms, test performance, and marker correlations require prospective validation in real patient data.
- Thresholds are illustrative, transparent decision aids — not yet a bedside clinical decision support tool.

CONCLUSIONS

- Bayesian reasoning links post-test probability to patient-specific harms rather than fixed cutoffs.
- The same probability can justify opposite decisions depending on clinical profile , a distinction consensus definitions and AI-based classifiers cannot capture.
- Requires prospective validation, but offers a transparent framework for individualized PJI management depending on each patient risk assessment.

SAME PROBABILITY → OPPOSITE DECISIONS

A post-test PJI probability of **59.9%** means “keep testing” for a reference patient but “proceed to treatment” for most revision/reimplantation patients or miss averse patients in which a late diagnosis could be harmful.

Fixed cutoffs and scoring systems cannot make this distinction.

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