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Thirty-Day Periprosthetic Joint Infection After Hip and Knee Arthroplasty: Clinical Correlates and Microbiology in a Tertiary Referral Cohort

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Abstract

Background: Early periprosthetic joint infection (PJI) is often pooled with later events despite distinct surveillance implications. We evaluated the burden, correlates, and microbiology of PJI diagnosed within 30 days after hip or knee arthroplasty.

Methods: This secondary retrospective cohort included 975 primary or revision total hip and knee arthroplasty procedures performed at our institution in 735 adults from 2008 through 2023. The primary outcome was registry-recorded PJI on days 0-30. Patient-clustered logistic regression included revision status, age, diabetes, rheumatic disease, and corticosteroid exposure. Modified Poisson and sensitivity analyses assessed robustness; pathogen distributions were compared by timing.

Results: Thirty-six procedures developed 30-day PJI (3.7%; 95% confidence interval [CI], 2.7%-5.1%), representing 59.0% of 61 first-year events; 58/61 (95.1%) were diagnosed by day 90. Early PJI occurred after 8/87 revisions (9.2%) and 28/888 primary procedures (3.2%). Revision arthroplasty was the most consistent correlate (adjusted odds ratio [aOR], 3.28; 95% CI, 1.49-7.24). Rheumatic disease showed a positive but imprecise association (aOR, 2.73; 95% CI, 0.98-7.63) that varied across model specifications. Gram-negative organisms accounted for 15/36 (41.7%) early and 3/25 (12.0%) later events (exploratory odds ratio, 5.24; 95% CI, 1.32-20.74).

Conclusions: Most first-year PJIs were diagnosed within 90 days, with nearly 60% occurring during the first month. Revision arthroplasty was the most consistent correlate of 30-day PJI, supporting intensified early surveillance and continued first-year follow-up in complex revision patients.

Clinical trial number: not applicable.

Background

Periprosthetic joint infection (PJI) remains one of the most consequential failures after total hip arthroplasty (THA) and total knee arthroplasty (TKA), exposing patients to repeated surgery, prolonged antimicrobial treatment, functional decline, and mortality. Diagnosis is not reducible to a single test: contemporary frameworks integrate clinical findings, microbiology, serum and synovial markers, histology, and intraoperative evidence [1–4]. This distinction matters in registry research, in which a treating-team diagnosis may be valid for surveillance yet lack the component data needed for retrospective re-adjudication.

Time from arthroplasty to diagnosis is both clinically and methodologically important. A contemporary analysis of more than 1.6 million procedures reported substantially higher 30-day and 1-year PJI rates after revision than after primary arthroplasty [5]. Prospective Canadian surveillance found a median detection time of 21 days and identified more than 90% of hip and knee PJI by 90 days, while still missing a clinically meaningful fraction of deep infections after that boundary [6]. Registry work from Arthroplasty Today likewise showed that limiting surveillance to 90 days undercounts first-year infection

[7]. Other cohorts indicate that the factors associated with infection can differ by timing [8,9]. Thus, day 30 is useful as an operational window for intensified surveillance, but it is not a biological border beyond which infection ceases to occur.

Risk arises from the interaction of host vulnerability and procedural burden. Diabetes, obesity, inflammatory arthritis, prior surgery, immunosuppression, and greater comorbidity have been associated with PJI in large cohorts and meta-analyses [10–16]. In rheumatic disease, medication exposure and systemic involvement coexist with a diagnostic problem: inflammatory flares may resemble PJI, and standard biomarkers can lose specificity [16–18]. Revision surgery adds previous incisions, altered tissue planes, bone loss, implant burden, longer exposure, and the possibility of unrecognized infection [19]. These relationships are especially entangled in tertiary referral centers enriched for multimorbidity and complex reconstruction.

The institutional registry used for this study has also supported a companion analysis of rheumatic disease and revision arthroplasty in relation to PJI during the first postoperative year. The present study addresses a distinct timing-specific question. Its primary objective was to estimate associations between readily available clinical characteristics and registry-recorded PJI diagnosed within 30 days. Secondary objectives were to test whether the principal findings persisted under alternative outcome and model definitions and to compare the recorded primary pathogen profile of early and later PJI. We expected revision status to be the most reproducible correlate; we treated host and medication estimates as potentially unstable because only 36 early events were available.

Methods

We conducted a secondary, single-center retrospective cohort analysis using a hip and knee arthroplasty registry from a national high-specialty tertiary referral hospital in Mexico City. The analytic period extended from January 1, 2008, through December 31, 2023. The hospital disproportionately receives patients with systemic rheumatic disease, multimorbidity, prior procedures, and complex reconstructive pathology. Accordingly, the observed proportions describe an institutional case mix and are not population incidence estimates.

Patients were eligible if they were aged 18 years or older and underwent primary or revision total hip arthroplasty (THA) or total knee arthroplasty (TKA) at our institution during the study period. Eligible procedures had to be performed by the institutional arthroplasty service, recorded in the registry, and have sufficient postoperative information to determine 30-day PJI status. All included patients had accepted participation and provided written informed consent for the use of their de-identified clinical information in this study.

Procedures performed outside our institution were excluded, as were patients who did not continue postoperative follow-up at our center and therefore had insufficient institutional information to ascertain the early outcome. Records lacking the minimum information needed to establish procedure eligibility, 30-day PJI status, or documented written informed consent were not eligible. Because the source

registry was restricted to procedures performed at our institution and all included patients had signed informed consent, no outside-hospital arthroplasties or patients without consent entered the analyzed cohort. A follow-up period shorter than 1 year was not, by itself, an exclusion criterion when 30-day outcome status was documented; follow-up-related uncertainty was examined in sensitivity analyses. After application of these criteria, the analytic cohort comprised 975 procedures in 735 patients. The procedure was the unit of analysis; 203 patients contributed more than one procedure, with a maximum of four. Six procedures lacked joint-site coding. They remained eligible for analyses not requiring joint site and were excluded only from the expanded joint-adjusted model. Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [20].

The registry included age, gender, body mass index (BMI), diabetes, hypertension, hypothyroidism, hepatopathy, human immunodeficiency virus infection, neoplasia, rheumatic diagnosis, systemic corticosteroid exposure, biologic therapy, joint site, primary versus revision status, operative time, estimated blood loss, recorded follow-up, PJI status, time to PJI diagnosis, and one primary pathogen code. Spreadsheet-formatted date entries in the BMI field were restored to their intended one-decimal numeric values by cross-checking the stored day and month components, and two obvious decimal-separator typographical entries were normalized; all 975 BMI values were recoverable. No outcome or covariate was imputed.

Any rheumatic disease combined rheumatoid arthritis, systemic lupus erythematosus, juvenile idiopathic arthritis, ankylosing spondylitis, and other registry-coded rheumatic diagnoses. This composite was used for statistical precision and does not imply biological equivalence among diagnoses. Corticosteroid and biologic exposure were binary registry fields; dose, duration, specific agent, disease activity, and perioperative timing were unavailable. The registry did not retain the indication for revision or reliably distinguish aseptic revision from revision undertaken for known or suspected infection.

The primary outcome was treating-team, registry-recorded PJI diagnosed from postoperative day 0 through day 30. An event required both a PJI code and a recorded interval within that window. Procedures without PJI during the first 30 days formed the reference group, including procedures with PJI diagnosed later. Registry-recorded PJI within 90 days was a secondary outcome. Two PJI diagnoses were coded on postoperative day 0. They were retained in the primary analysis and excluded in a sensitivity analysis because they could represent infection recognized at revision rather than a new postoperative event. Because revision indication was unavailable, this sensitivity analysis could not fully exclude index revisions related to pre-existing infection.

The registry did not preserve the complete serum, synovial, histological, culture-count, and intraoperative elements needed to independently re-adjudicate every event using International Consensus Meeting (ICM) or European Bone and Joint Infection Society criteria. We therefore use the term registry-recorded PJI throughout and do not equate it with prospectively adjudicated infection.

Each PJI procedure had one primary pathogen code. Organisms were summarized individually and grouped as Gram-positive, Gram-negative, or fungal/mycobacterial. The registry did not retain isolate-

level multiplicity, antimicrobial susceptibility, or complete culture sets; therefore, the analysis cannot reconstruct polymicrobial or culture-negative components. Gram-negative versus non-Gram-negative pathogen coding was compared between PJI diagnosed within 30 days and PJI diagnosed on days 31–365 using Fisher exact testing. This comparison was exploratory and was not adjusted for multiple testing.

Potential selection bias was reduced by including all eligible procedures in the registry. The same definitions were applied across procedures, repeated procedures were accounted for analytically, and discordant or incompletely followed records were examined in sensitivity analyses. Misclassification, unmeasured confounding, and referral bias could not be eliminated. No a priori sample-size calculation was performed because the full registry was analyzed; precision was judged from event counts, confidence intervals, and stability across sensitivity analyses.

Continuous variables were summarized as mean and standard deviation or median and interquartile range; categorical variables were summarized as counts and percentages. Wilson 95% confidence intervals (CIs) were calculated for PJI proportions. Baseline differences were described with standardized mean differences rather than univariate significance tests. In regression models, age was scaled per 10 years, BMI per 5 kg/m², operative time per 30 minutes, and estimated blood loss per 500 mL.

The timing-specific question was developed as a secondary analysis after review of the available registry fields and the companion first-year study. Before fitting the reported 30-day regression models, we fixed the model specification. Because 36 events limited model complexity, the primary logistic model contained five clinically central terms: revision versus primary arthroplasty, age per 10-year increase, diabetes, any rheumatic disease, and systemic corticosteroid exposure. No stepwise or outcome-driven variable selection was used. Some patients contributed multiple procedures; therefore, all inferential models used patient-clustered sandwich standard errors [21]. Adjusted odds ratios (aORs), 95% CIs, and two-sided P values are reported, with emphasis on the magnitude and precision of estimates rather than a binary significance threshold.

Sensitivity analyses added BMI, expanded further to gender, BMI, joint site, and biologic therapy, added operative time and blood loss, restricted the reference group to procedures with at least 1 recorded year of follow-up, excluded day-0 diagnoses, excluded three non-PJI records containing a nonzero timing or pathogen field, restricted the cohort to primary arthroplasty, and expanded the outcome to 90-day PJI. A modified Poisson model with patient-clustered robust variance estimated adjusted risk ratios (aRRs) [22]. Analyses were performed in Python 3.13 using pandas, NumPy, SciPy, statsmodels, and Matplotlib.

The protocol was reviewed and approved on 21 October 2024 by the Research Committee and the Research Ethics Committee of the National Institute of Medical Sciences and Nutrition Salvador Zubirán (Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán; Research Ethics Committee registration CONBIOETICA-09-CEI-011-20160627; approval letter No. OFICIO MCONTROL-2246/2024;

protocol reference 5293). All included patients provided written informed consent for participation and for the use of their de-identified clinical data.

Results

The cohort included 975 procedures in 735 patients: 888 primary arthroplasties (91.1%) and 87 revisions (8.9%). Joint-site coding identified 507 hip and 462 knee procedures; six lacked joint-site coding. Mean age was 56.4 ± 16.7 years; 776 procedures (79.6%) were in female patients; mean BMI was 26.7 ± 5.6 kg/m², 623 procedures (63.9%) had a rheumatic diagnosis, and 228 (23.4%) had recorded systemic corticosteroid exposure (Fig. 1).

The full registry included 975 procedures in 735 patients. The primary model included all procedures and 36 events; the expanded joint-site model excluded six procedures with missing joint coding.

Sixty-one registry-recorded PJIs occurred within 365 days (6.3%). Thirty-six were diagnosed by day 30, corresponding to 3.7% of all procedures (95% CI, 2.7%-5.1%) and 59.0% of all first-year events. Fifty-eight of 61 PJIs (95.1%) were diagnosed by day 90. Median time to diagnosis was 23 days (interquartile range, 15–55), and the maximum was 300 days (Fig. 2).

Thirty-six events (59.0%) were diagnosed by day 30 and 58 (95.1%) by day 90.

Thirty-day PJI occurred after 28/888 primary procedures (3.2%; 95% CI, 2.2%-4.5%) and 8/87 revisions (9.2%; 95% CI, 4.7%-17.1%). The absolute risk difference was 6.0 percentage points (95% CI, 1.4–14.0). Early PJI occurred after 21/507 hip procedures (4.1%) and 14/462 knee procedures (3.0%); one event occurred among the six procedures with missing joint site. It was recorded in 27/623 rheumatic procedures (4.3%) and 9/352 non-rheumatic procedures (2.6%), and in 10/228 procedures with versus 26/747 without corticosteroid exposure (4.4% versus 3.5%).

The largest baseline imbalance was revision status (22.2% among procedures with early PJI versus 8.4% among those without; standardized mean difference, 0.39). Rheumatic disease was also more frequent among early events (75.0% versus 63.5%; standardized mean difference, 0.25). Operative time averaged 136.9 ± 71.2 minutes in early-PJI procedures and 125.9 ± 41.2 minutes in the reference group (Table 1).

Table 1
Characteristics by registry-recorded PJI within 30 days

Characteristic	PJI within 30 days (n = 36)	No PJI within 30 days (n = 939)	SMD
Age, years	57.8 ± 13.2	56.3 ± 16.9	0.10
Female gender	30/36 (83.3%)	746/939 (79.4%)	0.10
Body mass index, kg/m²	27.5 ± 6.8	26.6 ± 5.5	0.13
Diabetes mellitus	10/36 (27.8%)	198/939 (21.1%)	0.16
Hypertension	11/36 (30.6%)	406/939 (43.2%)	-0.27
Hypothyroidism	9/36 (25.0%)	171/939 (18.2%)	0.17
Hepatopathy	1/36 (2.8%)	57/939 (6.1%)	-0.16
HIV infection	0/36 (0.0%)	8/939 (0.9%)	-0.13
Neoplasia	1/36 (2.8%)	61/939 (6.5%)	-0.18
Any rheumatic disease	27/36 (75.0%)	596/939 (63.5%)	0.25
Systemic corticosteroid exposure	10/36 (27.8%)	218/939 (23.2%)	0.10
Biologic therapy	1/36 (2.8%)	35/939 (3.7%)	-0.05
Revision arthroplasty	8/36 (22.2%)	79/939 (8.4%)	0.39
Knee arthroplasty, recorded sites	14/35 (40.0%)	448/934 (48.0%)	-0.16
Operative time, min	136.9 ± 71.2	125.9 ± 41.2	0.19
Estimated blood loss, mL	497.2 ± 342.7	456.3 ± 302.6	0.13
Recorded follow-up, years	4.0 [1.0–9.0]	5.0 [2.0–9.0]	-0.14

Values are mean ± standard deviation, median [interquartile range], or n/N (%). Positive standardized mean differences (SMDs) indicate a higher mean or proportion in the 30-day PJI group. Knee denominators exclude six procedures with missing joint-site coding, including one 30-day PJI.

The primary model included all 975 procedures, 735 patients, and 36 events. Revision arthroplasty had the largest adjusted association with 30-day PJI (aOR, 3.28; 95% CI, 1.49–7.24; P = .003). Rheumatic disease showed a positive but imprecise estimate (aOR, 2.73; 95% CI, 0.98–7.63; P = .056). Estimates for age, diabetes, and binary corticosteroid exposure also included the null (Table 2; Fig. 3). Modified Poisson regression produced similar aRRs for revision arthroplasty (3.03; 95% CI, 1.47–6.24) and rheumatic disease (2.60; 95% CI, 0.98–6.89).

Table 2
Primary patient-clustered models for PJI within 30 days

Variable	Scale/reference	Logistic aOR (95% CI)	P value	Modified Poisson aRR (95% CI)	P value
Revision arthroplasty	Revision vs primary	3.28 (1.49–7.24)	0.003	3.03 (1.47–6.24)	0.003
Age	Per 10 years	1.18 (0.92–1.51)	0.191	1.17 (0.93–1.48)	0.191
Diabetes mellitus	Yes vs no	1.64 (0.70–3.89)	0.257	1.60 (0.71–3.59)	0.253
Any rheumatic disease	Any vs none	2.73 (0.98–7.63)	0.056	2.60 (0.98–6.89)	0.055
Systemic corticosteroid exposure	Yes vs no	1.04 (0.48–2.23)	0.925	1.03 (0.50–2.13)	0.926

Both models included 975 procedures in 735 patients and 36 events. Models included all listed terms and used patient-clustered sandwich standard errors. aOR, adjusted odds ratio; aRR, adjusted risk ratio; CI, confidence interval.

Adjusted odds ratios and 95% confidence intervals from the primary patient-clustered logistic regression model. The vertical dashed line indicates the null value.

The revision estimate was stable across reasonable specifications: 3.32 after adding BMI, 3.22 in the expanded host/joint model, 3.01 after adding operative time and blood loss, 3.23 after restricting non-events to at least 1 year of follow-up, 3.49 after excluding day-0 diagnoses, and 4.22 for the 90-day outcome. By contrast, the rheumatic estimate changed enough for its CI to exclude 1 after BMI was added (aOR, 2.89; 95% CI, 1.08–7.72) and in the expanded model (aOR, 3.09; 95% CI, 1.16–8.21), but not in the primary, follow-up-restricted, day-0-excluded, procedural, or 90-day models. That model dependence is reported as uncertainty rather than resolved by selecting the most favorable specification (Table 3).

Table 3
Sensitivity analyses for registry-recorded PJI within 30 days

Analysis	N	Events	Effect	Revision estimate (95% CI)	Rheumatic estimate (95% CI)
Primary cluster-robust model	975	36	OR	3.28 (1.49–7.24)	2.73 (0.98–7.63)
Primary model plus BMI	975	36	OR	3.32 (1.50–7.32)	2.89 (1.08–7.72)
Expanded host/joint model	969	35	OR	3.22 (1.45–7.15)	3.09 (1.16–8.21)
Modified Poisson model	975	36	RR	3.03 (1.47–6.24)	2.60 (0.98–6.89)
Model adding operative time and blood loss	975	36	OR	3.01 (1.28–7.05)	2.71 (0.96–7.67)
30-day PJI event or at least 1 year of follow-up	938	36	OR	3.23 (1.47–7.11)	2.66 (0.94–7.48)
Excluding postoperative day 0 diagnoses	973	34	OR	3.49 (1.57–7.75)	2.30 (0.81–6.52)
Excluding internally discordant non-PJI records	972	36	OR	3.26 (1.48–7.21)	2.72 (0.97–7.61)
Primary arthroplasties only	888	28	OR	Not estimated	3.23 (1.03–10.15)
Outcome expanded to PJI within 90 days	975	58	OR	4.22 (2.22–8.02)	1.96 (0.92–4.16)

All rows used patient-clustered robust variance. The primary model included revision status, age, diabetes, any rheumatic disease, and corticosteroid exposure. The expanded host/joint model added gender, body mass index, joint site, and biologic therapy and excluded six procedures with missing joint-site coding. Estimates are odds ratios except where the measure is RR. The primary-only row does not estimate revision status.

Staphylococcus aureus was the most frequently recorded primary organism (24/61, 39.3%), followed by Staphylococcus epidermidis (9/61, 14.8%) and Pseudomonas spp. (8/61, 13.1%). Gram-positive organisms accounted for 18/36 (50.0%) PJI diagnosed within 30 days and 18/25 (72.0%) diagnosed later. Gram-negative organisms accounted for 15/36 (41.7%) early and 3/25 (12.0%) later events. The exploratory odds of a Gram-negative code were higher among early PJI (odds ratio, 5.24; 95% CI, 1.32–20.74; Fisher P = .021), corresponding to a risk difference of 29.7 percentage points (95% CI, 6.6–47.6) (Table 4; Fig. 4). Fungal or mycobacterial organisms accounted for 3/36 (8.3%) early and 4/25 (16.0%) later events.

Table 4
Primary microorganism by timing of PJI diagnosis

Recorded primary microorganism	0–30 days (n = 36)	31–365 days (n = 25)	Total (n = 61)
Staphylococcus aureus	14	10	24
Staphylococcus epidermidis	4	5	9
Pseudomonas spp.	7	1	8
Escherichia coli	4	1	5
Klebsiella pneumoniae	3	1	4
Candida spp.	2	2	4
Mycobacterium porcinum	1	1	2
Enterobacter cloacae	1	0	1
Histoplasma capsulatum	0	1	1
Kocuria spp.	0	1	1
Staphylococcus lugdunensis	0	1	1
Streptococcus agalactiae	0	1	1

One primary pathogen code was available per PJI procedure; polymicrobial and culture-negative components could not be reconstructed. Gram-negative organisms accounted for 15/36 (41.7%) early and 3/25 (12.0%) later PJI (exploratory odds ratio, 5.24; 95% CI, 1.32–20.74; Fisher P = 0.021).

Recorded primary pathogen category among PJI diagnosed on days 0–30 and days 31–365. The comparison is exploratory because the registry retained only one primary pathogen code per event.

Discussion

This timing-specific analysis yielded four findings. First, the institutional burden was markedly front-loaded: 59.0% of first-year PJI was diagnosed within 30 days and 95.1% within 90 days. Second, revision arthroplasty was the largest and most reproducible correlate of early infection. Third, rheumatic disease generated a positive signal, but its precision and nominal statistical significance depended on model specification. Fourth, Gram-negative organisms occupied a larger share of the recorded primary pathogens among early than later events. The first two findings are robust enough to inform surveillance priorities; the latter two are hypotheses that require validation.

The 3.7% overall 30-day proportion is high compared with unselected primary-arthroplasty populations. A 2026 Arthroplasty Today analysis of more than 1.6 million procedures reported 30-day PJI rates of

0.25% after primary TKA and 0.46% after primary THA, but 3.26% after revision TKA and 4.80% after revision THA [5]. Our denominator mixed primary and revision procedures and came from a national tertiary center enriched for rheumatic disease, immunosuppression, and prior surgery. The contrast is therefore informative about case mix, not evidence that one institution performs worse than another. This is a center-specific registry burden and should not be promoted as a regional incidence estimate.

The temporal distribution is nevertheless clinically coherent. Our median diagnosis time of 23 days is close to the 21-day median reported in prospective Canadian surveillance, which identified 92%-93% of hip and knee PJI by 90 days [6]. Yet Roth et al. also showed that a 90-day horizon misses some deep infections, and Muscatelli et al. reached the same conclusion using a large quality registry [7]. In our cohort, 22 additional events occurred on days 31–90 and three after day 90. The defensible implication is therefore two-sided: surveillance should be front-loaded because risk is concentrated early, but quality ascertainment and patient access should continue through the first year. Day 30 is an operational checkpoint, not an etiologic boundary.

Revision arthroplasty remained associated with approximately threefold higher odds or risk of 30-day PJI across logistic, modified Poisson, follow-up-restricted, and procedural models, and with more than fourfold higher odds at 90 days. This consistency matters more than the exact coefficient. Early aseptic reoperation has been associated with later PJI [19], while contemporary national data show that infection rates after revision remain several-fold higher than after primary arthroplasty [5]. Adding operative time and blood loss attenuated the estimate only modestly, suggesting that those two variables did not capture the full pathway. Revision status likely aggregates indication, previous operations, scarred tissue, implant burden, bone loss, and possible occult infection. Because the registry did not retain revision indication, part of the association may reflect revisions performed for known or suspected infection or differential diagnostic intensity rather than susceptibility created by the index procedure alone. The study supports treating revision as a pathway-level marker of complexity; it does not identify which component of that pathway is causal.

The rheumatic result deserves deliberate restraint. The primary aOR was 2.73, but the CI crossed 1. Adjustment for BMI increased the estimate enough for the CI to exclude 1, whereas follow-up restriction, exclusion of day-0 diagnoses, inclusion of operative variables, and expansion to 90 days returned imprecise intervals. The apparent gain in significance after BMI adjustment should not be mistaken for proof; the change across defensible models is itself the result. Prior studies have reported increased infection or complications in rheumatoid and inflammatory arthritis [13–16,23], but diagnosis, disease activity, organ involvement, steroid dose, biologic timing, and comparator population all alter risk. Moreover, inflammatory flares can produce synovial and serum abnormalities that overlap with PJI [18]. Our composite rheumatic variable is therefore a signal for diagnosis-specific research, not a universal rheumatic risk coefficient.

Binary corticosteroid exposure was not associated with early PJI after simultaneous adjustment. That null coefficient cannot adjudicate safety. The registry lacked dose, duration, indication, cumulative

exposure, perioperative interruption, and disease activity. In rheumatoid arthritis cohorts, glucocorticoid dose has shown a more consistent association with postoperative infection than biologic class [16], and contemporary guidance recommends individualized perioperative management [17]. The present finding says only that a yes/no registry field did not discriminate 30-day risk in this dataset.

The microbiological comparison is clinically interesting but not prescriptive. S. aureus remained the most frequent organism overall, consistent with large PJI datasets [24]. The proportion coded as Gram-negative was 41.7% within 30 days and 12.0% later. That difference could reflect perioperative acquisition, referral patterns, local ecology, or chance. The CI was wide, only one organism code was available per event, and the registry could not reconstruct polymicrobial or culture-negative infection. Accordingly, this signal does not justify routine broad-spectrum prophylaxis or empiric treatment for every suspected early PJI. It supports maintaining current local antibiograms, obtaining adequate samples before antibiotics when clinically feasible, and validating the pattern with isolate-level data.

The Third International Consensus Meeting on Musculoskeletal Infection, held in Istanbul in 2025, provides a useful frame for these limitations. Its research-priority workgroup emphasized standardized sampling, reproducible definitions, clinically relevant minimum datasets, attention to diverse pathogens, and multicenter data collection [25,26]. Broader reviews, the 2025 ICM risk-factor workgroup, and a contemporary 13,197-procedure academic cohort likewise support systematic collection of revision status and richer perioperative variables, including body mass index, American Society of Anesthesiologists class, and operative duration [27–29]. Our study illustrates why those priorities matter: a registry can identify timing and generate risk signals, but it cannot substitute for criterion-level adjudication, dose-resolved medication data, or complete microbiology. The appropriate response is not to overstate the registry; it is to use the registry to define the next study.

The immediate practical contribution is a surveillance proposition rather than a validated intervention. Patients undergoing revision—especially those with multimorbidity or rheumatic disease—may merit earlier wound review, explicit return precautions, coordinated contact between arthroplasty and infectious-disease teams, and a lower threshold for structured diagnostic evaluation during the first month. These measures are plausible, but this study did not compare surveillance strategies and cannot claim that they reduce infection or improve implant retention. Similarly, the analysis is not a prediction score and should not be used to assign individual probabilities.

Strengths include use of the complete institutional registry, a clinically explicit 30-day outcome, patient-clustered inference for repeated procedures, presentation of both odds and risk ratios, transparent reporting of model dependence, follow-up and coding sensitivity analyses, and linkage of timing to recorded microbiology. The companion first-year analysis and the present timing-specific analysis answer different questions, but their complete source-cohort overlap must be disclosed to editors and readers.

The referral cohort was not composed of otherwise comparable patients differing by a single exposure. Many patients had overlapping rheumatic, metabolic, endocrine, oncologic, infectious,

immunosuppressive, and prior-surgical conditions, and these categories were not mutually exclusive. Most were recorded only as binary registry fields, preventing reliable assessment of disease severity, cumulative multimorbidity burden, temporal relationships, and interactions among conditions. Residual confounding from clustered multimorbidity and selective tertiary referral is therefore likely, and individual adjusted coefficients should not be interpreted as isolated biological effects of single diagnoses. Limitations are substantial. PJI was recorded by treating teams and could not be re-adjudicated with complete ICM or EBJIS components. Selective referral limits generalizability and likely increases the observed burden relative to unselected primary-arthroplasty or population-based settings. Only 36 early events constrained model complexity and subgroup precision. Important confounders—including disease activity, steroid dose, biologic timing, conventional disease-modifying therapy, smoking, ASA class, nutrition, transfusion, wound drainage, prophylactic antibiotics, and calendar period—were unavailable. Follow-up for non-events was recorded in years rather than exact censoring dates. Day-0 diagnoses may represent infection recognized during revision, and unavailable revision indications prevent complete separation of aseptic revisions from procedures related to known or suspected infection; this could bias the revision estimate away from the null. A single pathogen field cannot reconstruct polymicrobial or culture-negative episodes. Finally, observational associations do not establish causation. These limitations narrow the claim, but they do not erase the consistent revision signal or the sharply early timing distribution.

In summary, nearly three fifths of first-year registry-recorded PJI were diagnosed within 30 days and more than 95% within 90 days. Revision arthroplasty was the most stable clinical correlate, whereas the rheumatic-disease and microbiological findings remained less precise and require external validation. These results support front-loaded, risk-focused surveillance nested within continued first-year follow-up and reinforce the need for standardized, multicenter, criterion-level PJI datasets.

Conclusions

In this tertiary referral cohort, nearly 60% of first-year periprosthetic joint infections were diagnosed within 30 days, and more than 95% were identified within 90 days. Revision arthroplasty was associated with approximately threefold higher odds of 30-day PJI. It remained the most consistent correlate across sensitivity analyses, identifying revision patients as the group with the greatest observed need for structured early postoperative surveillance. Rheumatic disease showed a clinically relevant but less precise association. Together, these findings support risk-stratified follow-up during the first postoperative month, continued surveillance throughout the first year, and multidisciplinary evaluation of patients undergoing complex revision arthroplasty.

Abbreviations

aOR, adjusted odds ratio; aRR, adjusted risk ratio; ASA, American Society of Anesthesiologists; BMI, body mass index; CI, confidence interval; EBJIS, European Bone and Joint Infection Society; HIV, human

immunodeficiency virus; ICM, International Consensus Meeting; PJI, periprosthetic joint infection; RR, risk ratio; SMD, standardized mean difference; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Declarations

Ethics approval and consent to participate

The protocol was reviewed and approved on 21 October 2024 by the Research Committee and the Research Ethics Committee of the National Institute of Medical Sciences and Nutrition Salvador Zubirán (Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán; Research Ethics Committee registration CONBIOETICA-09-CEI-011-20160627; approval letter No. OFICIO MCONTROL-2246/2024; protocol reference 5293). All included patients provided written informed consent for participation and for the use of their de-identified clinical data.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analysed during the current study are not publicly available because of institutional and participant-privacy restrictions but are available from the corresponding author on reasonable request and with institutional approval.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CHHR contributed to methodology. ARPI contributed to data curation. EDB contributed to conceptualization. JMV contributed to writing - review and editing. GJMS contributed to writing - original draft. All authors read and approved the final manuscript.

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None.

References

1. Patel R. Periprosthetic joint infection. N Engl J Med. 2023;388(3):251-262. https://doi.org/10.1056/NEJMra2203477.
2. Osmon DR, Berbari EF, Berendt AR, Lew D, Zimmerli W, Steckelberg JM, et al. Diagnosis and management of prosthetic joint infection: clinical practice guidelines by the Infectious Diseases Society of America. Clin Infect Dis. 2013;56(1):e1-e25. https://doi.org/10.1093/cid/cis803.
3. Parvizi J, Tan TL, Goswami K, Higuera C, Della Valle C, Chen AF, et al. The 2018 definition of periprosthetic hip and knee infection: an evidence-based and validated criteria. J Arthroplasty. 2018;33(5):1309-1314.e2. https://doi.org/10.1016/j.arth.2018.02.078.
4. McNally M, Sousa R, Wouthuyzen-Bakker M, Chen AF, Soriano A, Vogely HC, et al. The EBJIS definition of periprosthetic joint infection: a practical guide for clinicians. Bone Joint J. 2021;103-B(1):18-25. https://doi.org/10.1302/0301-620X.103B1.BJJ-2020-1381.R1.
5. Trudeau MT, Wang E, Schaffer O, Aggarwal V, Rozell JC, Schwarzkopf R. Timing and trends of periprosthetic joint infections following over 1,500,000 primary and revision total knee and hip arthroplasty cases. Arthroplast Today. 2026;39:102031. https://doi.org/10.1016/j.artd.2026.102031.
6. Roth VR, Mitchell R, Vachon J, Alexandre S, Amaratunga K, Smith S, et al. Periprosthetic infection following primary hip and knee arthroplasty: the impact of limiting the postoperative surveillance period. Infect Control Hosp Epidemiol. 2017;38(2):147-153. https://doi.org/10.1017/ice.2016.256.
7. Muscatelli S, Zheng H, Muralidharan A, Tollemar V, Hallstrom BR. Limiting the surveillance period to 90 days misses a large portion of infections in the first year after total hip and knee arthroplasty. Arthroplast Today. 2022;16:90-95. https://doi.org/10.1016/j.artd.2022.04.009.
8. Hasenauer MD, Ho H, Engh CA 3rd, Engh CA Jr. Factors associated with the incidence and timing of total knee arthroplasty infection. J Arthroplasty. 2022;37(6 Suppl):S276-S280.e3. https://doi.org/10.1016/j.arth.2022.02.034.
9. Tekin-Tas Z, Ozger HS, Kanatli U, Hizel K. The incidence and risk factors of early periprosthetic joint infections. Infect Dis Clin Microbiol. 2024;6(2):93-101. https://doi.org/10.36519/idcm.2024.332.
10. Bozic KJ, Lau E, Kurtz S, Ong K, Rubash H, Vail TP, Berry DJ. Patient-related risk factors for periprosthetic joint infection and postoperative mortality following total hip arthroplasty in Medicare patients. J Bone Joint Surg Am. 2012;94(9):794-800. https://doi.org/10.2106/JBJS.K.00072.
11. Kunutsor SK, Whitehouse MR, Blom AW, Beswick AD. Patient-related risk factors for periprosthetic joint infection after total joint arthroplasty: a systematic review and meta-analysis. PLoS One. 2016;11(3):e0150866. https://doi.org/10.1371/journal.pone.0150866.
12. Ren X, Ling L, Qi L, Liu Z, Zhang W, Yang Z, et al. Patients' risk factors for periprosthetic joint infection in primary total hip arthroplasty: a meta-analysis of 40 studies. BMC Musculoskelet Disord. 2021;22:776. https://doi.org/10.1186/s12891-021-04647-1.
13. Ravi B, Escott B, Shah PS, Jenkinson R, Chahal J, Bogoch E, et al. A systematic review and meta-analysis comparing complications following total joint arthroplasty for rheumatoid arthritis versus osteoarthritis. Arthritis Rheum. 2012;64(12):3839-3849. https://doi.org/10.1002/art.37690.

14. Richardson SS, Kahlenberg CA, Goodman SM, Russell LA, Sculco TP, Sculco PK, et al. Inflammatory arthritis is a risk factor for multiple complications after total hip arthroplasty: a population-based comparative study of 68,348 patients. J Arthroplasty. 2019;34(6):1150-1154.e2. https://doi.org/10.1016/j.arth.2019.02.018.
15. Bongartz T, Halligan CS, Osmon DR, Reinalda MS, Bamlet WR, Crowson CS, et al. Incidence and risk factors of prosthetic joint infection after hip or knee replacement in patients with rheumatoid arthritis. Arthritis Rheum. 2008;59(12):1713-1720. https://doi.org/10.1002/art.24060.
16. George MD, Baker JF, Winthrop K, Alemao E, Chen L, Connolly S, et al. Risk of biologics and glucocorticoids in patients with rheumatoid arthritis undergoing arthroplasty: a cohort study. Ann Intern Med. 2019;170(12):825-836. https://doi.org/10.7326/M18-2217.
17. Goodman SM, Springer BD, Chen AF, Davis M, Fernandez DR, Figgie M, et al. 2022 American College of Rheumatology/American Association of Hip and Knee Surgeons guideline for the perioperative management of antirheumatic medication in patients undergoing elective total hip or total knee arthroplasty. Arthritis Rheumatol. 2022;74(9):1464-1473. https://doi.org/10.1002/art.42140.
18. Goodman SM, Mannstadt I, Tam K, Mehta B, Kochen V, Shakib S, et al. Periprosthetic joint infection in patients with inflammatory arthritis: optimal tests to differentiate from flares. J Clin Rheumatol. 2024;30(8):309-314. https://doi.org/10.1097/RHU.0000000000002157.
19. Goldman AH, Osmon DR, Hanssen AD, Pagnano MW, Berry DJ, Abdel MP. Aseptic reoperations within 1 year of primary total knee arthroplasty markedly increase the risk of later periprosthetic joint infection. J Arthroplasty. 2020;35(12):3668-3672. https://doi.org/10.1016/j.arth.2020.06.054.
20. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology statement: guidelines for reporting observational studies. PLoS Med. 2007;4(10):e296. https://doi.org/10.1371/journal.pmed.0040296.
21. Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika. 1986;73(1):13-22. https://doi.org/10.1093/biomet/73.1.13.
22. Zou G. A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol. 2004;159(7):702-706. https://doi.org/10.1093/aje/kwh090.
23. de Araujo LCT, Westerholt A, Sandiford AN, Gursche A, Kendoff D. Periprosthetic joint infections in patients with rheumatoid arthritis are associated with higher complication and mortality rates. Arch Orthop Trauma Surg. 2024;144(12):5101-5109. https://doi.org/10.1007/s00402-024-05248-y.
24. Tai DBG, Patel R, Abdel MP, Berbari EF, Tande AJ. Microbiology of hip and knee periprosthetic joint infections: a database study. Clin Microbiol Infect. 2022;28(2):255-259. https://doi.org/10.1016/j.cmi.2021.06.006.
25. Oral E, Chisari E, Choe H, Cichos KH, Coenye T, Coraca-Huber DC, et al. The 2025 International Consensus Meeting on Musculoskeletal Infection: research priorities and future directions. J Orthop Res. 2026;44(4):e70179. https://doi.org/10.1002/jor.70179.
26. Parvizi J, Gehrke T, editors. Consenso Internacional de Infecciones Musculoesqueleticas: Estambul 2025. Tercer Consenso Internacional. Barcelona: Aysen Research; 2025. ISBN:978-84-09-79549-9.

27. Xiong X, Xu J, Zhou B, Luo M, Gao J, Bi Q, et al. Periprosthetic joint infection after arthroplasty: advances and future prospects. J Orthop Surg Res. 2025;20:850. https://doi.org/10.1186/s13018-025-06257-2.
28. Heckmann N, Hoveidaei AH, Mortazavi SMJ, Ahmed SO, Enayatollahi M, Rezaie AA, et al. 2025 ICM: Risk Factors for Surgical Site Infection (SSI)/Periprosthetic Joint Infection (PJI). J Arthroplasty. 2025;41(1S1):S6-S18. https://doi.org/10.1016/j.arth.2025.10.101.
29. Cullen GD, Salinas JL, Furukawa D. A retrospective cohort study of early prosthetic joint infections at a US academic medical center (2014-2023). Cureus. 2025;17(7):e87744. https://doi.org/10.7759/cureus.87744.

Figures

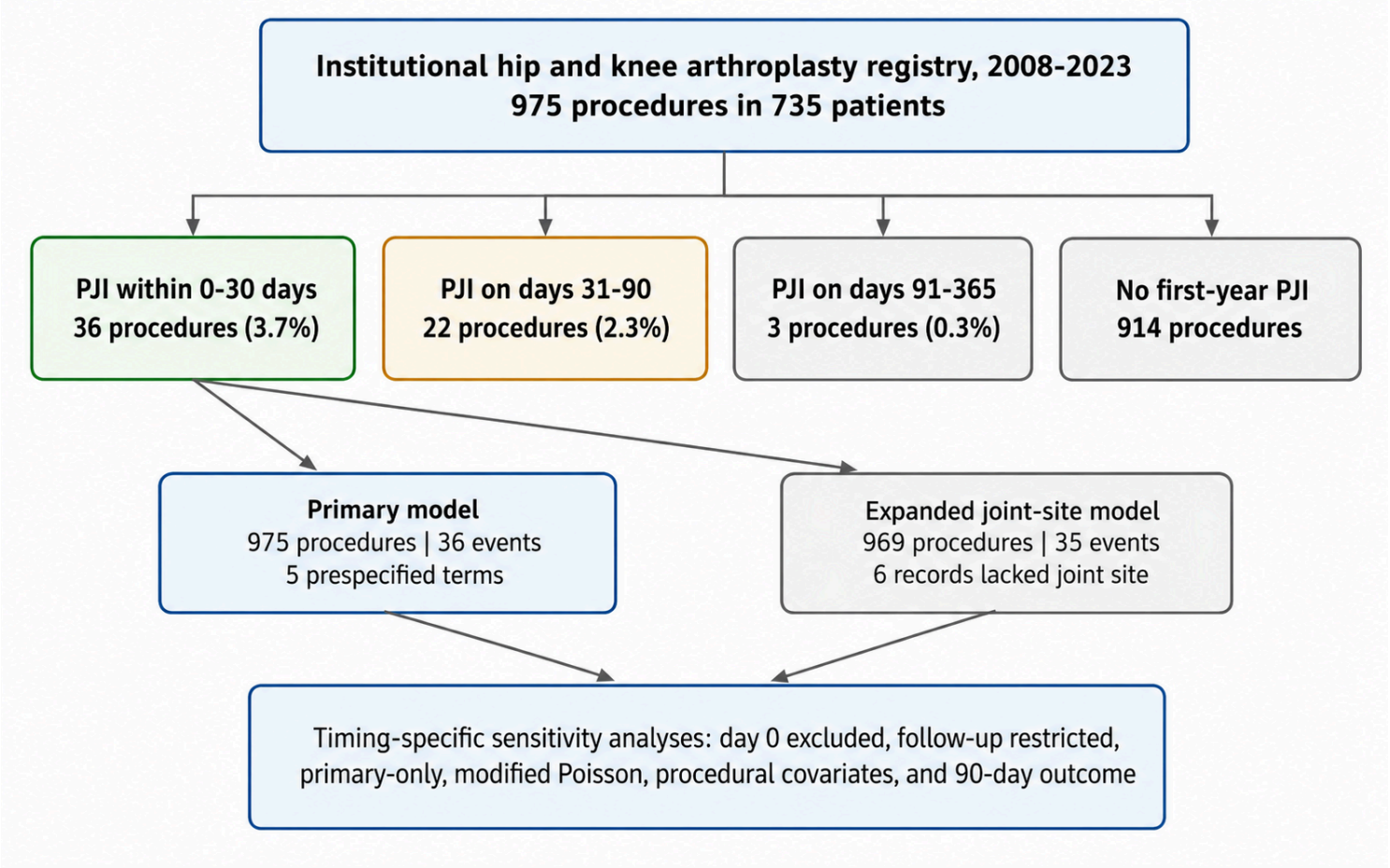


Figure 1

Study flow and timing-specific analytic cohorts

The full registry included 975 procedures in 735 patients. The primary model included all procedures and 36 events; the expanded joint-site model excluded six procedures with missing joint coding.

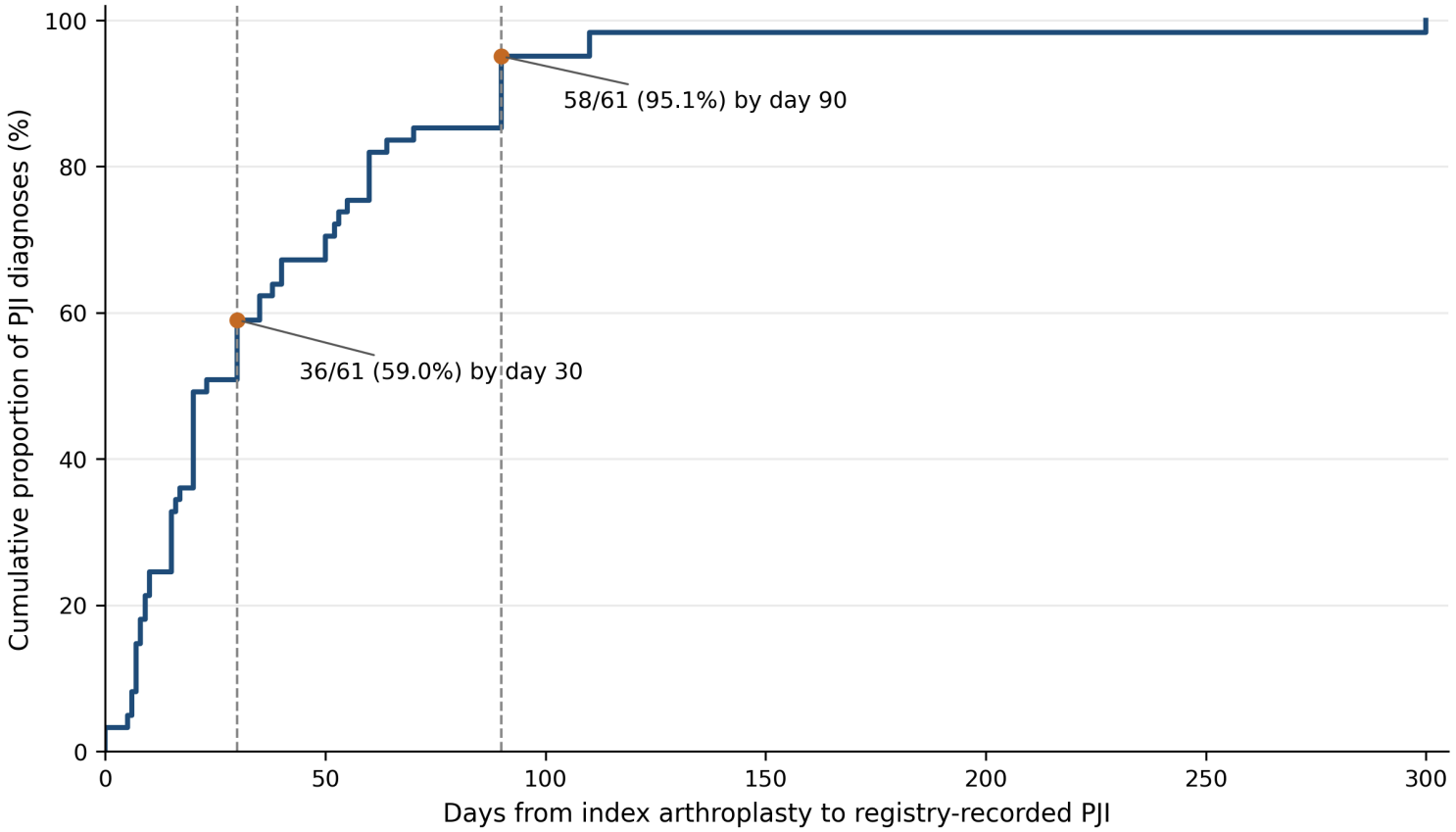


Figure 2

Cumulative timing of registry-recorded PJI diagnoses

Thirty-six events (59.0%) were diagnosed by day 30 and 58 (95.1%) by day 90.

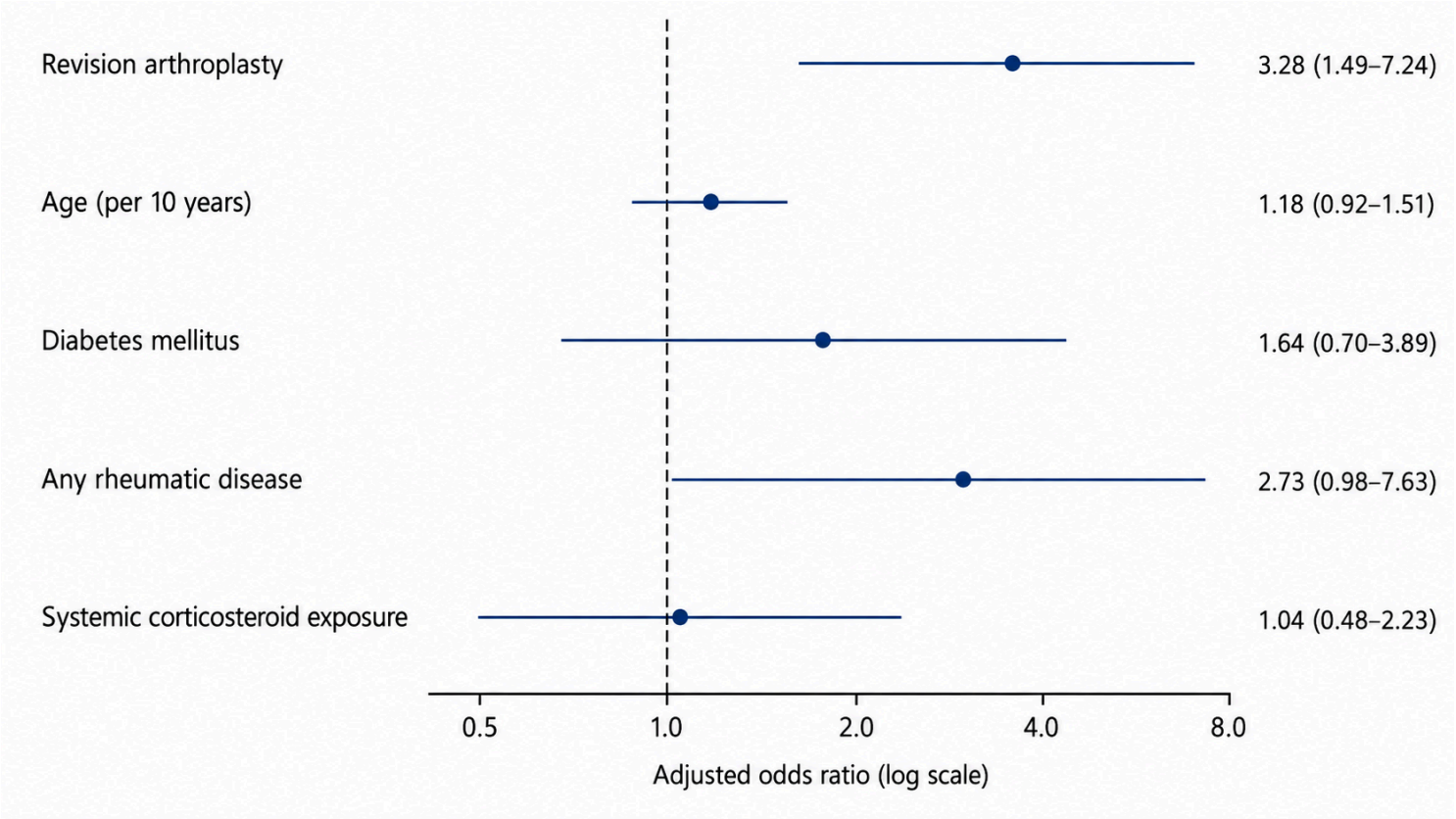


Figure 3

Adjusted associations with PJI within 30 days

Adjusted odds ratios and 95% confidence intervals from the primary patient-clustered logistic regression model. The vertical dashed line indicates the null value.

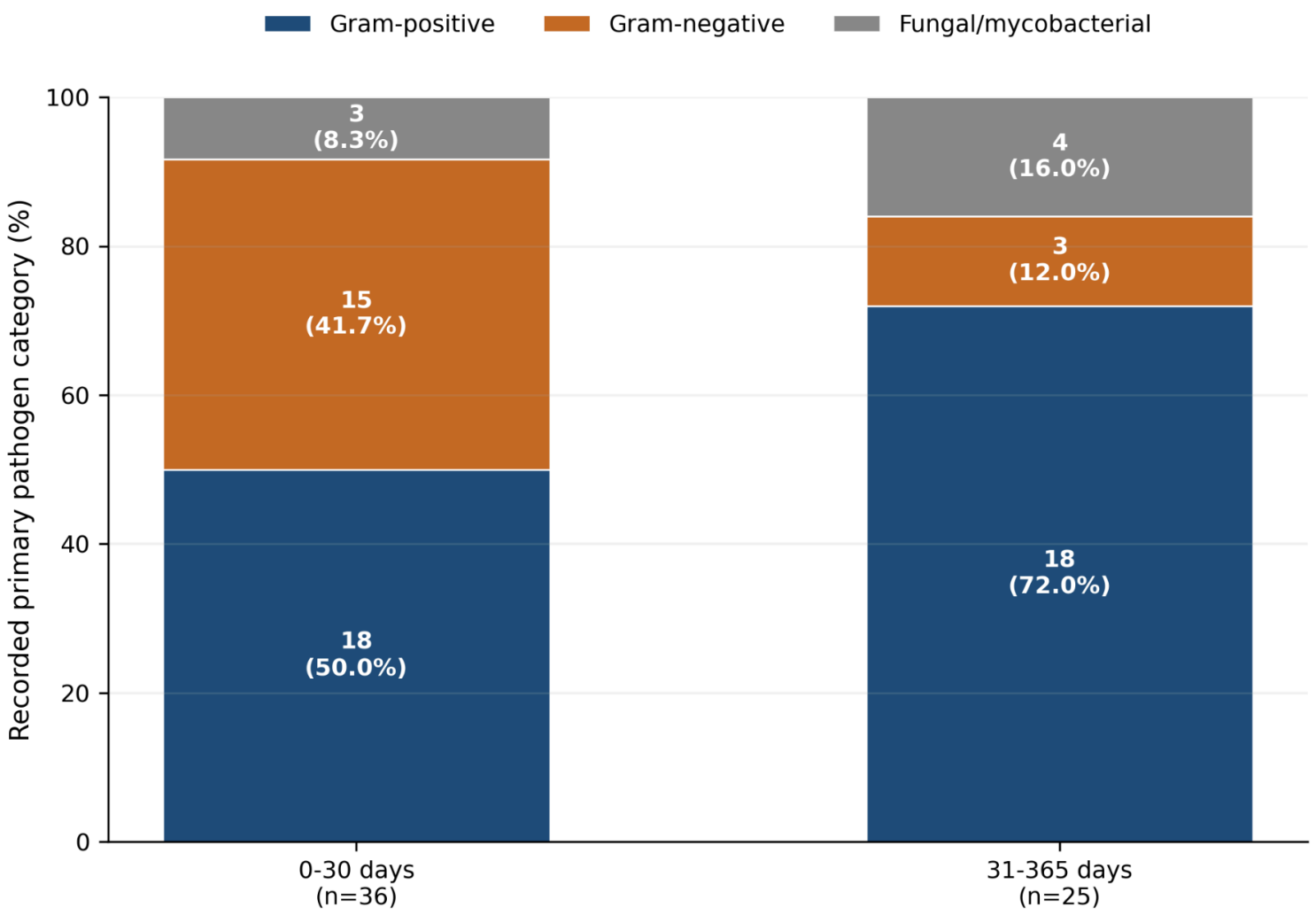


Figure 4

Primary pathogen category by timing of PJI diagnosis

Recorded primary pathogen category among PJI diagnosed on days 0-30 and days 31-365. The comparison is exploratory because the registry retained only one primary pathogen code per event.