Comparative Outcomes and Costs of DAIR, One-Stage, and Two-Stage Exchange for Periprosthetic Joint Infection

Jacob Oeding, PhD; Matthew J. Dietz, MD

West Virginia University School of Medicine · Department of Orthopaedics · Morgantown, WV, USA

Takeaway: Exchange strategies provide greater infection-free survival than DAIR, but at higher procedural cost; mortality comparisons should be interpreted cautiously because of cross-study confounding.

Introduction

- **Periprosthetic joint infection (PJI)** remains a major complication following hip and knee arthroplasty.
- Common treatment strategies include **DAIR, one-stage exchange, and two-stage exchange**.
- Each approach differs in treatment burden, infection control, mortality, and cost.
- Direct comparison is challenging because available evidence comes from **heterogeneous study designs and populations**.

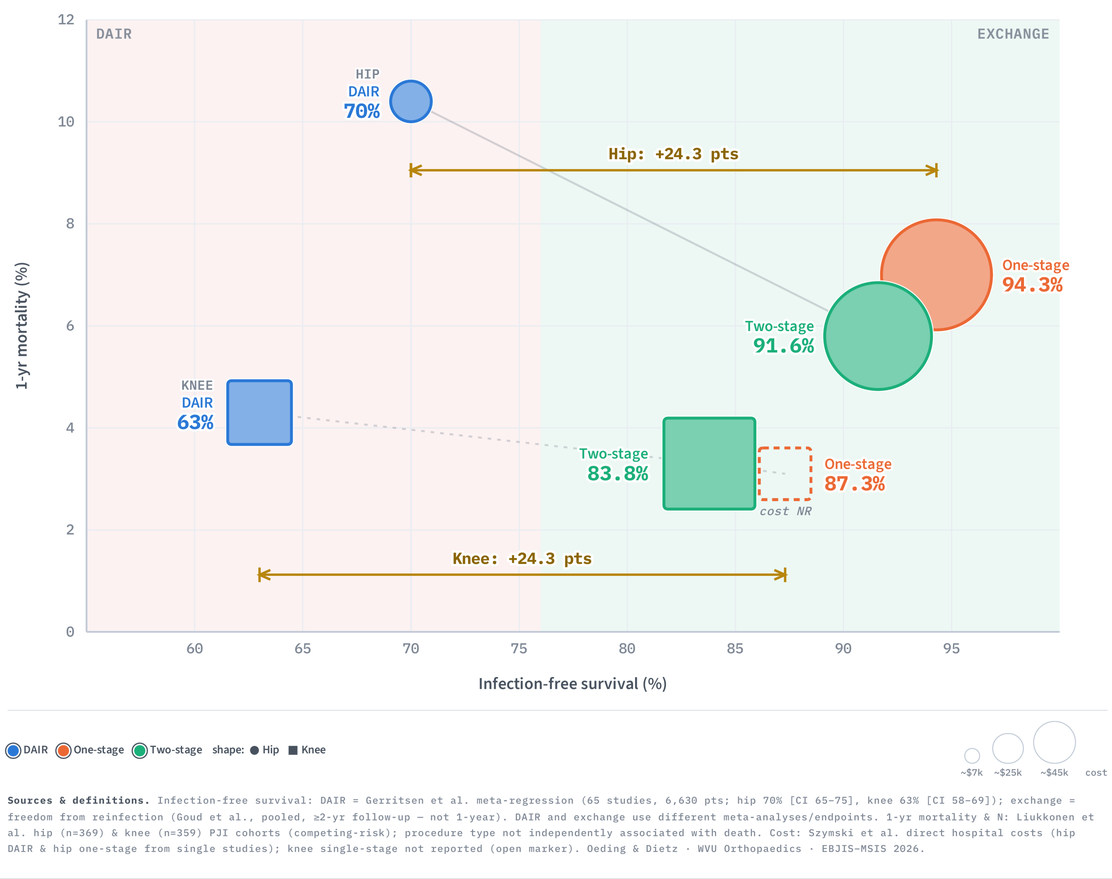
Objective

To synthesize published evidence and visually compare DAIR, one-stage exchange, and two-stage exchange using standardized measures of infection-free survival, 1-year mortality, and direct hospital procedural cost.

Methods

- **Structured synthesis of published literature** evaluating hip and knee PJI treatment.
- Outcomes included **infection-free survival, 1-year mortality, and direct hospital procedural cost**.
- Infection-control estimates were derived from meta-analyses; mortality was obtained from strategy-specific cohort studies; cost estimates were obtained from a systematic review of economic studies.
- Results were integrated into a **two-panel bubble plot**: x-axis = infection-free survival, y-axis = mortality, and bubble size = procedural cost.

Exchange lifts infection-free survival ~24 points over DAIR in both hip and knee



Sources & definitions. Infection-free survival: DAIR = Gerritsen et al. meta-regression (65 studies, 6,630 pts; hip 70% [CI 65–75], knee 63% [CI 58–69]); exchange = freedom from reinfection (Goud et al., pooled, ≥2-yr follow-up — not 1-year). DAIR and exchange use different meta-analyses/endpoints. 1-yr mortality & N: Liukkonen et al. hip (n=369) & knee (n=359) PJI cohorts (competing-risk); procedure type not independently associated with death. Cost: Szymski et al. direct hospital costs (hip DAIR & hip one-stage from single studies); knee single-stage not reported (open marker). Oeding & Dietz · WVU Orthopaedics · EBJIS–MSIS 2026.

Results

Exchange strategies gave higher infection-free survival than DAIR in both joints; DAIR was cheapest but had the lowest survival and highest mortality.

HIP PJI

Strategy	Infxn-free surv.†	1-yr mort. (n)‡	Direct cost§
DAIR	70% ¶	10.4% (134)	$7,120 ◊
One-stage	94.3%	7.0% (114)	$44,594 ◊
Two-stage	91.6%	5.8% (121)	$42,166

KNEE PJI

Strategy	Infxn-free surv.†	1-yr mort. (n)‡	Direct cost§
DAIR	63% ¶	4.3% (141)	$19,476
One-stage	87.3%	3.1% (98)	*not reported*
Two-stage	83.8%	3.3% (120)	$37,980

† **Infection-free survival** — exchange values are freedom from reinfection (Goud, pooled, minimum 2-yr follow-up). This is **not** a 1-year endpoint; label it accordingly and do not present it as 1-year.
¶ **DAIR survival** — the joint-specific 70% (hip) / 63% (knee) comes from the **Gerritsen et al. meta-regression** (65 studies, 6,630 patients; hip 70% CI 65–75, knee 63% CI 58–69), **not** Salman (who pools hip+knee and compares single vs. double DAIR). Note DAIR "success" (Gerritsen) and exchange "freedom from reinfection" (Goud) are different endpoints from different meta-analyses.
‡ **1-year mortality & N** — Liukkonen hip (369) and knee (359) single-center PJI cohorts, competing-risk estimates. In both, procedure type was **not** independently associated with death after adjustment (ASA class/comorbidity drove it) — direct support for the confounding-by-indication caveat.
§ **Direct hospital cost** — Szymski (European direct hospital costs). **No knee single-stage cost exists in the source**s
Single-study cost cells — hip DAIR ($7,120, n=8) and hip one-stage ($44,594, n=60) each rest on a **single** European study; only hip two-stage and both knee costs are pooled from multiple studies. Treat the single-study hip figures as illustrative, not precise.

Conclusions

- One-stage and two-stage exchange demonstrated substantially greater infection-free survival than DAIR for both hip and knee PJI.
- DAIR had the lowest upfront procedural cost, whereas staged revision strategies were more costly.
- 1-year mortality was low and similar across strategies for knee PJI (3.1–4.3%).
- Observed mortality differences should not be interpreted as causal because treatment selection and cross-study heterogeneity introduce potential confounding by indication.
- Additional studies should be performed to further evaluate costs in PJI treatment settings

References

1. Salman LA, et al. Success rate of single versus multiple debridement, antibiotics, and implant retention (DAIR) in hip and knee periprosthetic joint infection: a systematic review and meta-analysis. Eur J Orthop Surg Traumatol. 2024;34:3859-3872. doi:10.1007/s00590-024-04091-6.

2. Goud AL, et al. Reinfection rates after one- and two-stage revision surgery for hip and knee arthroplasty: a systematic review and meta-analysis. Arch Orthop Trauma Surg. 2023;143. doi:10.1007/s00402-021-04190-7.

3. Liukkonen R, Honkanen M, Skyttä E, Eskelinen A, Karppelin M, Reito A. Clinical outcomes after revision hip arthroplasty due to prosthetic joint infection—a single-center study of 369 hips at a high-volume center with a minimum of one year follow-up. J Arthroplasty. 2024;39(3):806-812.e3. doi:10.1016/j.arth.2023.08.078.

4. Liukkonen R, et al. Clinical outcomes after revision knee arthroplasty due to periprosthetic joint infection: a single-centre study of 359 knees at a high-volume centre with a minimum of one year follow-up. Knee Surg Sports Traumatol Arthrosc. 2025;33:3906-3914. doi:10.1002/ksa.12762.

5. Szymski D, Walter N, Hierl K, Rupp M, Alt V. Direct hospital costs per case of periprosthetic hip and knee joint infections in Europe—a systematic review. J Arthroplasty. 2024;39(7):1876-1881. doi:10.1016/j.arth.2024.01.032.

6. Gerritsen M, Khawar A, Scheper H, van der Wal R, Schoones J, de Boer M, Nelissen R, Pijls B. Modular component exchange and outcome of DAIR for hip and knee periprosthetic joint infection: a systematic review and meta-regression analysis. Bone Joint Open. 2021;2(10):806-812. doi:10.1302/2633-1462.210.BJO-2021-0090.R1

WVU ORTHOPAEDICS