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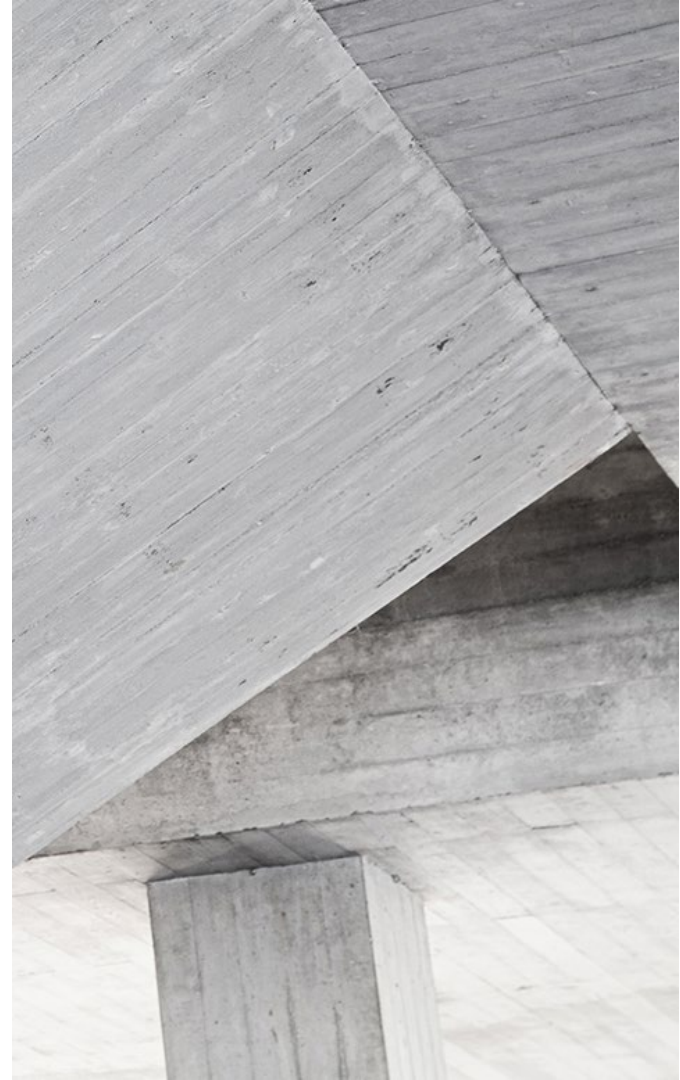
School of Medicine

# Rapid recovery after joint replacement: a cost-effective post-recovery path from the German payer's perspective

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Intro

# Intro | Rapid recovery to decrease costs and increase quality of care

Hip and knee replacement:

- Growing number of procedures
  - Evolution of medical technologies
    - Improvements in surgical techniques and post-operative care enhance patient outcomes and reduce complication rates
- High volume: even modest advancements translate into considerable aggregate benefits
- Better outcomes: also alleviate financial pressures on healthcare systems by decreasing post-operative and disability costs

# Intro | Rapid recovery

Improvement: progressive shift from a conventional care (CC) path to a rapid recovery (RR) path after joint replacement

→ RR: fast-track post-operative care path with several pre- and post-operative elements, such as optimized preoperative preparation, minimally invasive surgical techniques, and early mobilization (i.e., within 6 hours post-surgery)

Findings from the literature:

- Reduced length of stay
- Cost savings for hospitals
- Beneficial outcomes for patients
- Cost-effectiveness

# Intro | Research gap & research question

- To fully assess patient outcomes, use of generic and disease-specific PROMs is recommended
- Implications not only for hospitals but also for health insurance companies
  - Cost savings for the hospitals might shift to other areas (e.g., rehabilitation), increasing overall costs for health insurers → crucial to consider the payer's perspective

To the best of our knowledge, no existing study has so far evaluated the cost-effectiveness of RR from the payer's perspective and by considering both generic and disease-specific PROMs:

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RQ

Is RR the preferable post-operative care path in terms of generic and disease-specific PROMs from the payer's perspective in Germany?

# Data & Methods

# Data | Patient-level observational data

**Dataset:** Patient-level observational data from the German Innovation Fund study “PROMoting Quality” from 2019 to 2020 from nine German hospitals

## Outcome measures:

- Disease-specific PROMs HOOS and KOOS for the assessment of joint-associated problems and functionality
- Generic PROM EQ-5D-5L to capture HRQoL

## Costs

- Payer's perspective: health insurance patient-level cost data from one year pre- to one year post-surgery

## Other variables

- Patients' demographics, previous treatments, comorbidities, and mobilization time
- Patients mobilized within 6 hours from their surgery follow a RR path



# Datasets | Focus on hip replacement patients

- Two analyses, one with the EQ-5D-5L as outcome measure, and one with the HOOS as outcome measure
- For each model, the Average Treatment Effect (ATE) is estimated separately for the effects and for the costs

Hip replacement			
Outcome measure			
EQ-5D-5L		HOOS	
Sample size			
ATE on effects	3119	ATE on effects	3083
ATE on costs	335	ATE on costs	330

# Methods | ICER and Average Treatment Effects

- Incremental Cost-Effectiveness Ratio (ICER): ratio of mean incremental costs between treatment and control group and their mean incremental benefits → additional cost that a decision maker expects to pay to receive an additional unit of health benefit

$$\text{ICER} = \frac{\Delta E}{\Delta C} = \frac{E_1 - E_0}{C_1 - C_0}$$

- We estimate  $\Delta E$  and  $\Delta C$  through the calculation of the ATE on costs and effects:

$$\tau = E[Y_i(d=1) - Y_i(d=0)]$$

# Methods | Non-randomization and causal forest

Retrospective setting: treatment assignment to RR or CC is non-random (potential bias) → propensity scores

→ ATE estimation using the augmented inverse-probability weighted scores by Robins et al. (1994) and the causal forest developed by Wager & Athey (2018):

$$\hat{\tau} = \frac{1}{n} \sum_{i=1}^n \hat{\Gamma}_{i,ate}$$

Where  $\hat{\Gamma}_i$  is defined as:

$$\hat{\Gamma}_i = \hat{\mu}_{(1)}(X_i) - \hat{\mu}_{(0)}(X_i) + \frac{d_i}{\hat{e}(X_i)} (Y_i - \hat{\mu}_{(1)}(X_i)) - \frac{1 - d_i}{1 - \hat{e}(X_i)} (Y_i - \hat{\mu}_{(0)}(X_i))$$

# Methods | Models and sensitivity analyses

## Models:

- One model for the ATE on effects, one for the ATE on costs
  - **Dependent variables:** EQ-5D-5L change, HOOS change, total costs
  - **Independent variable of interest:** being on the RR path (i.e., mobilized within 6h post-surgery)
  - **Control variables:** socio-demographic variables (age, sex, living situation, job, job effort, and education), medical variables (pre-surgery PROM score, height, weight, comorbidities, pre-surgery hip and knee problems and treatments), and variables related to the surgery (hospital, duration, complications)

## Sensitivity analyses:

- PSA to account for uncertainty in our model inputs
- CEAC to assess the probability of cost-effectiveness for countries without a cost-effectiveness threshold

# Results

# Discussion

# Discussion | Key take-aways

- Innovative approach to determine the cost-effectiveness of RR for hip and knee replacement patients
- Contributions:
  - Focus on the payer's perspective
  - Use of generic and disease-specific PROM
  - New methodology for economic evaluations with retrospective data
- Findings:
  - RR is the dominant strategy for hip replacement patients
  - For knee replacement patients, RR significantly increased KOOS but not HR-QoL (→ joint functionality improvement as main aim)
  - We conclude that RR is a cost-effective post-operative path from the German payer's perspective for hip and knee replacement patients



# Discussion | Limitations and future research

1. Limited number of hip and knee replacement patients with cost data on rehabilitation costs could be included for ATE on costs → smaller power
  - Future research would profit from the inclusion of a larger number of observations with complete cost information for the whole patient path
2. Identification of the effect of the RR path as a whole
  - Of interest to understand specific components' effects on outcomes and costs



# Discussion | Conclusions and policy implications

- RR is the recommended post-recovery path for hip and knee replacements in Germany
- Inconsistent adoption due to organizational and logistical challenges → Centralization and educational initiatives
- Health insurers should promote RR while at the same time providing financial incentives and support for centralized care models and professional development programs

# References

- Deakin, A. H., Smith, M. A., Wallace, D. T., Smith, E. J., & Sarungi, M. (2019). Fulfilment of preoperative expectations and postoperative patient satisfaction after total knee replacement. A prospective analysis of 200 patients. *The Knee*, *26*(6), 1403–1412. <https://doi.org/10.1016/j.knee.2019.07.018>
- OECD. (2023). *Hip and knee replacement | Health at a Glance 2023: OECD Indicators | OECD iLibrary*. <https://www.oecd-ilibrary.org/sites/e1a77af6-en/index.html?itemId=/content/component/e1a77af6-en>
- Ibrahim, M. S., Khan, M. A., Nizam, I., & Haddad, F. S. (2013). Peri-operative interventions producing better functional outcomes and enhanced recovery following total hip and knee arthroplasty: an evidence-based review. *BMC Medicine*, *11*(1). <https://doi.org/10.1186/1741-7015-11-37>
- Singh, J. A., Yu, S., Chen, L., & Cleveland, J. D. (2019). Rates of Total Joint Replacement in the United States: Future Projections to 2020–2040 Using the National Inpatient Sample. *The Journal of Rheumatology*, *46*(9), 1134–1140. <https://doi.org/10.3899/JRHEUM.170990>
- Culliford, D. J., Maskell, J., Kiran, A., Judge, A., Javaid, M. K., Cooper, C., & Arden, N. K. (2012). The lifetime risk of total hip and knee arthroplasty: results from the UK general practice research database. *Osteoarthritis and Cartilage*, *20*(6), 519–524. <https://doi.org/10.1016/j.joca.2012.02.636>
- Losina, E., Paltiel, A. D., Weinstein, A. M., Yelin, E., Hunter, D. J., Chen, S. P., Klara, K., Suter, L. G., Solomon, D. H., Burbine, S. A., Walensky, R. P., & Katz, J. N. (2015). Lifetime medical costs of knee osteoarthritis management in the United States: impact of extending indications for total knee arthroplasty. *Arthritis Care & Research*, *67*(2), 203–215. <https://doi.org/10.1002/ACR.22412>
- Kehlet, H. (2013). Fast-track hip and knee arthroplasty. *The Lancet*, *381*(9878), 1600–1602. [https://doi.org/10.1016/S0140-6736\(13\)61003-X](https://doi.org/10.1016/S0140-6736(13)61003-X)
- Gordon, D., Malhas, A., Goubran, A., Subramanian, P., Messer, C., & Houlihan-Burne, D. (2011). Implementing the rapid recovery program in primary hip and knee arthroplasty in a UK state run hospital. *European Journal of Orthopaedic Surgery and Traumatology*, *21*(3), 151–158. <https://doi.org/10.1007/S00590-010-0690-9/TABLES/4>
- Büttner, M., Mayer, A. M., Büchler, B., Betz, U., Drees, P., & Susanne, S. (2020). Economic analyses of fast-track total hip and knee arthroplasty: a systematic review. *European Journal of Orthopaedic Surgery & Traumatology: Orthopédie Traumatologie*, *30*(1), 67–74. <https://doi.org/10.1007/S00590-019-02540-1>
- Berg, U., W-Dahl, A., Rolfson, O., Naclér, E., Sundberg, M., & Nilsson, A. (2020). Influence of fast-track programs on patient-reported outcomes in total hip and knee replacement (THR/TKR) at Swedish hospitals 2011–2015: an observational study including 51,169 THR and 8,393 TKR operations. *Acta Orthopaedica*, *91*(3), 306–312. <https://doi.org/10.1080/17453674.2020.1733375>
- Steinbeck, V., Langenberger, B., Schöner, L., Wittich, L., Klausner, W., Mayer, M., Kuklinski, D., Vogel, J., Geissler, A., Pross, C., & Busse, R. (2023). Electronic Patient-Reported Outcome Monitoring to Improve Quality of Life After Joint Replacement: Secondary Analysis of a Randomized Clinical Trial. *JAMA Network Open*, *6*(9), e2331301–e2331301. <https://doi.org/10.1001/JAMANETWORKOPEN.2023.31301>
- Nilsson, A. K., Lohmander, L. S., Klässbo, M., & Roos, E. M. (2003). Hip disability and osteoarthritis outcome score (HOOS) - Validity and responsiveness in total hip replacement. *BMC Musculoskeletal Disorders*, *4*(1), 1–8. <https://doi.org/10.1186/1471-2474-4-10/TABLES/5>
- Ciminata, G., Geue, C., Wu, O., Deidda, M., Kreif, N., & Langhorne, P. (2022). Propensity score methods for comparative-effectiveness analysis: A case study of direct oral anticoagulants in the atrial fibrillation population. *PLOS ONE*, *17*(1), e0262293. <https://doi.org/10.1371/JOURNAL.PONE.0262293>
- Wager, S., & Athey, S. (2018). Estimation and inference of heterogeneous treatment effects using random forests. *Journal of the American Statistical Association*, *113*(523), 1228–1242. <https://doi.org/10.1080/01621459.2017.1319839>
- Larsen, K., Sørensen, O. G., Hansen, T. B., Thomsen, P. B., & Søballe, K. (2008). Accelerated perioperative care and rehabilitation intervention for hip and knee replacement is effective: A randomized clinical trial involving 87 patients with 3 months of follow-up. *Acta Orthopaedica*, *79*(2), 149–159. <https://doi.org/10.1080/17453670710014923>
- Husted, H. (2012). Fast-track hip and knee arthroplasty: clinical and organizational aspects. *Acta Orthopaedica. Supplementum*, *83*(346), 1–39. <https://doi.org/10.3109/17453674.2012.700593>

# Thank you!

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