Excess Days in Acute Care (EDAC) After Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA) Measure Submission to PQM: Supplemental Attachment

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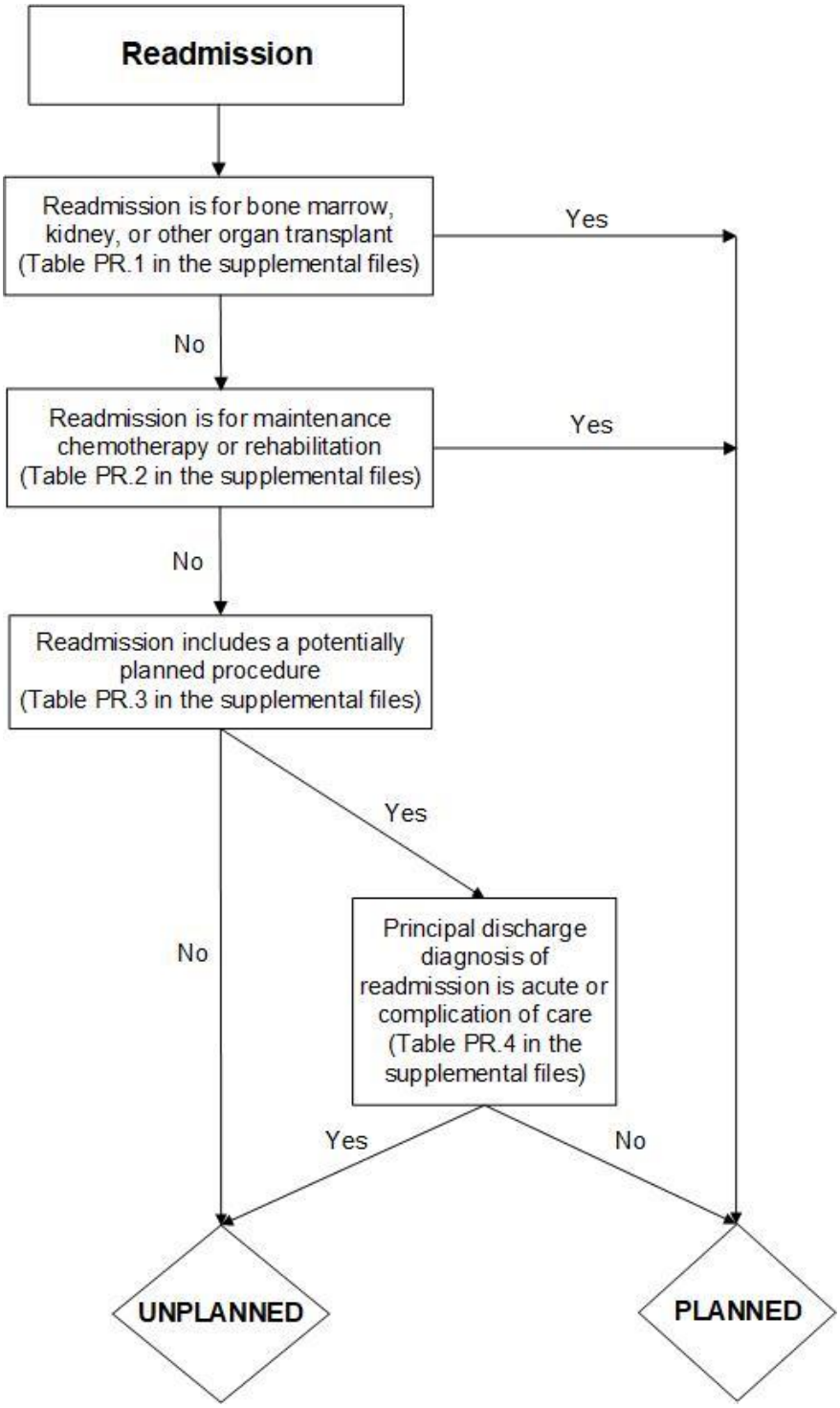
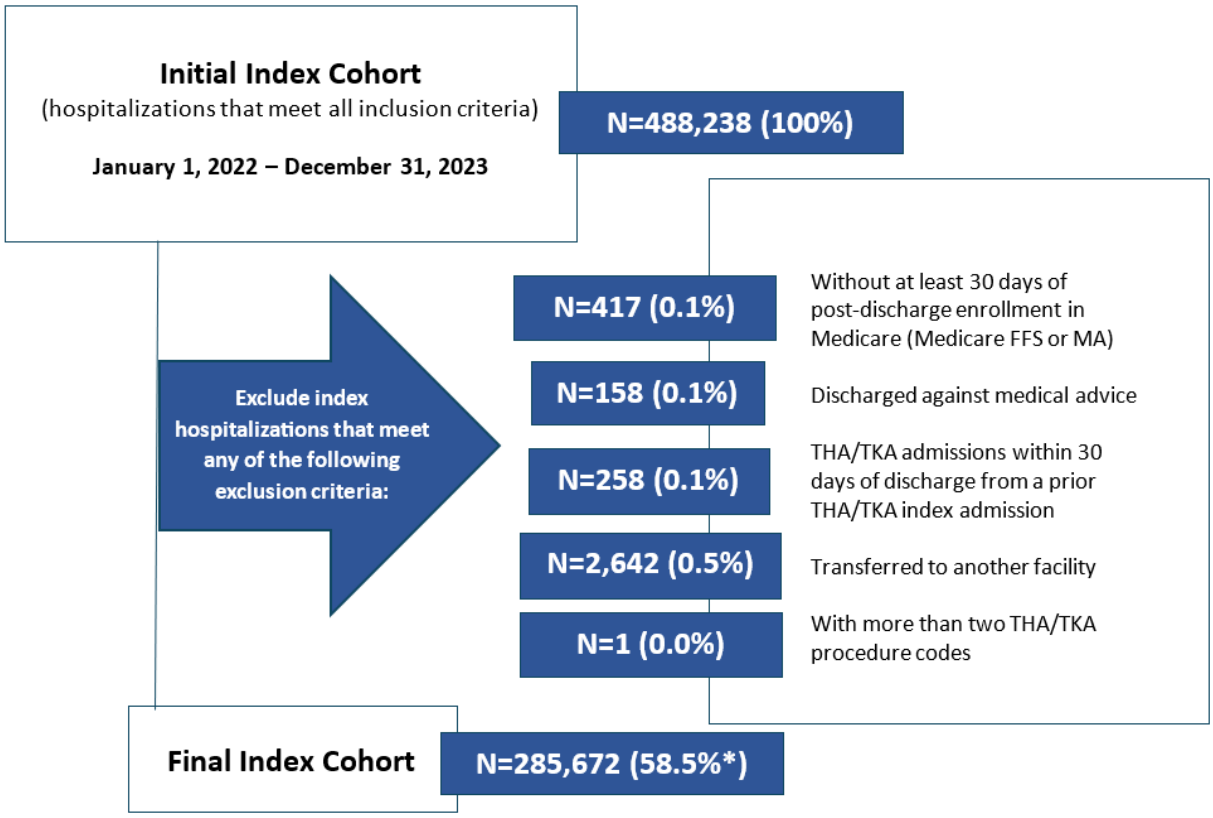


Figure 2. THA/TKA EDAC: Index Cohort (January 1, 2022 – December 31, 2023)



** Admissions may have been counted in more than one exclusion category because they are not mutually exclusive.*

Figure 3. THA/TKA EDAC: Histogram Displaying Hospital Distribution of Risk-Adjusted Measure Scores per 100 Discharges, January 1, 2022 - December 31, 2023 (N = 3,128)

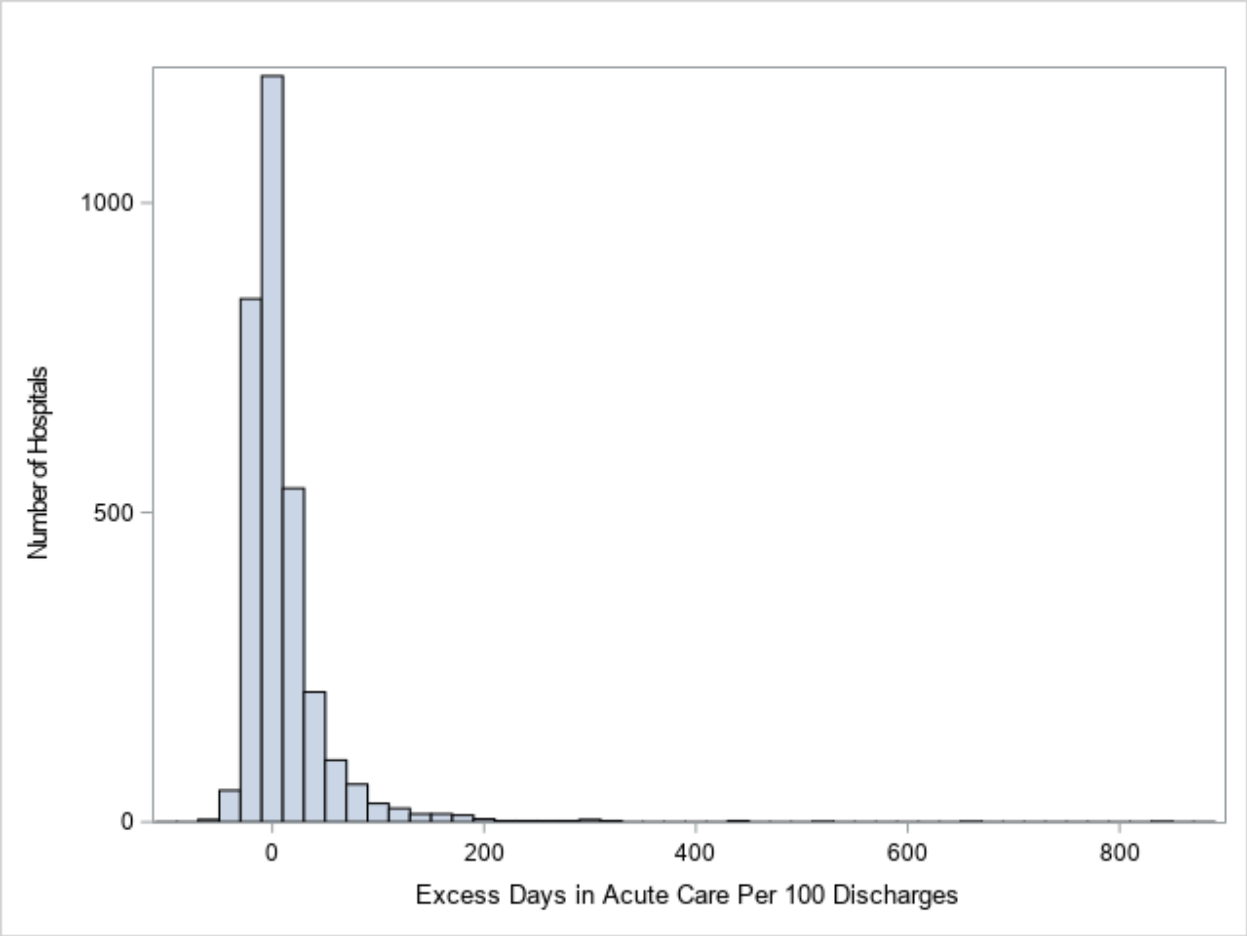
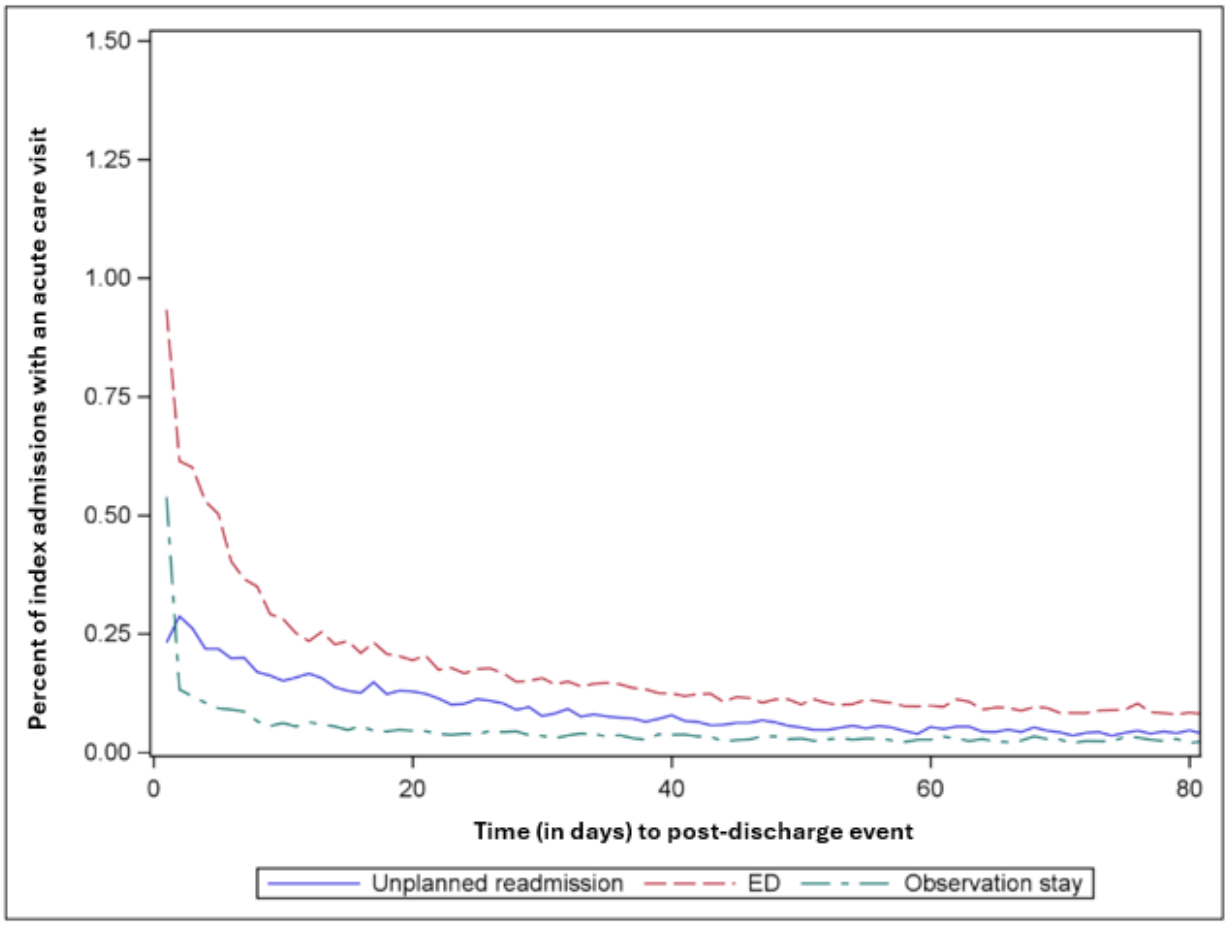


Figure 4. Signal-To-Noise Formula

$$\frac{\sigma^2_{facility-to-facility}}{\sigma^2_{facility-to-facility}+\frac{\sigma^2_{facility-error}}{n}}.$$

Figure 5. THA/TKA EDAC: Daily Percentage of Index Admissions with an Acute Care Hospital Visit, by Post-Discharge Day (CY2022/2023 Data)



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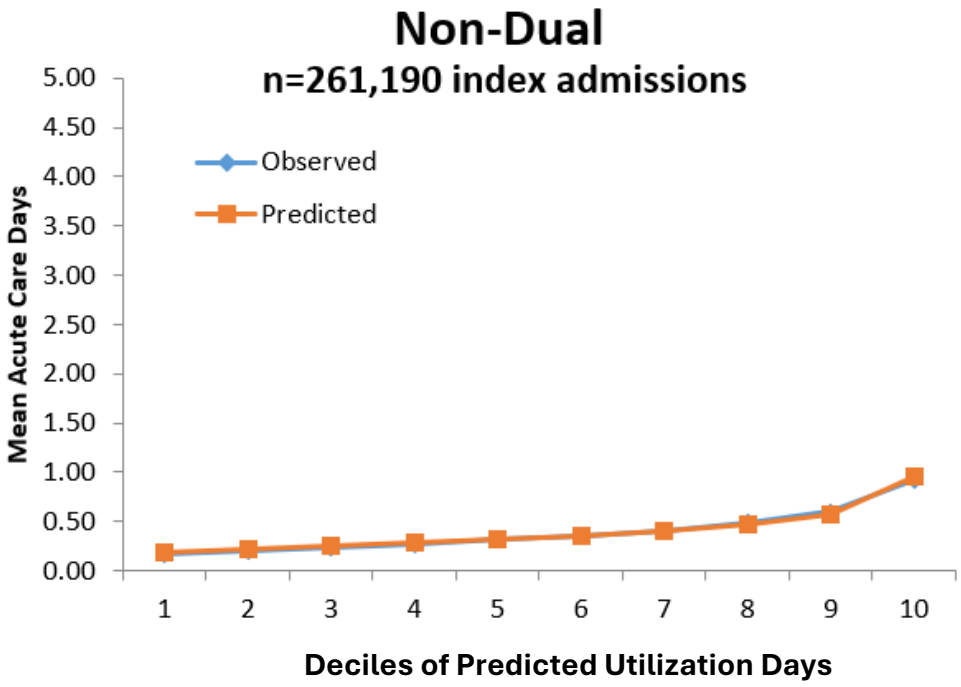

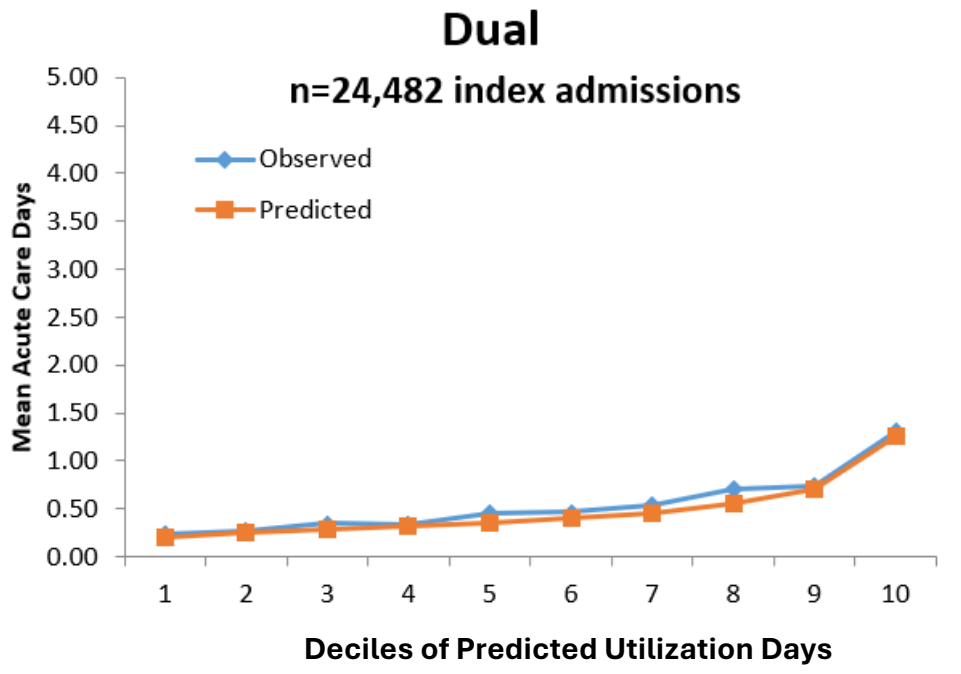

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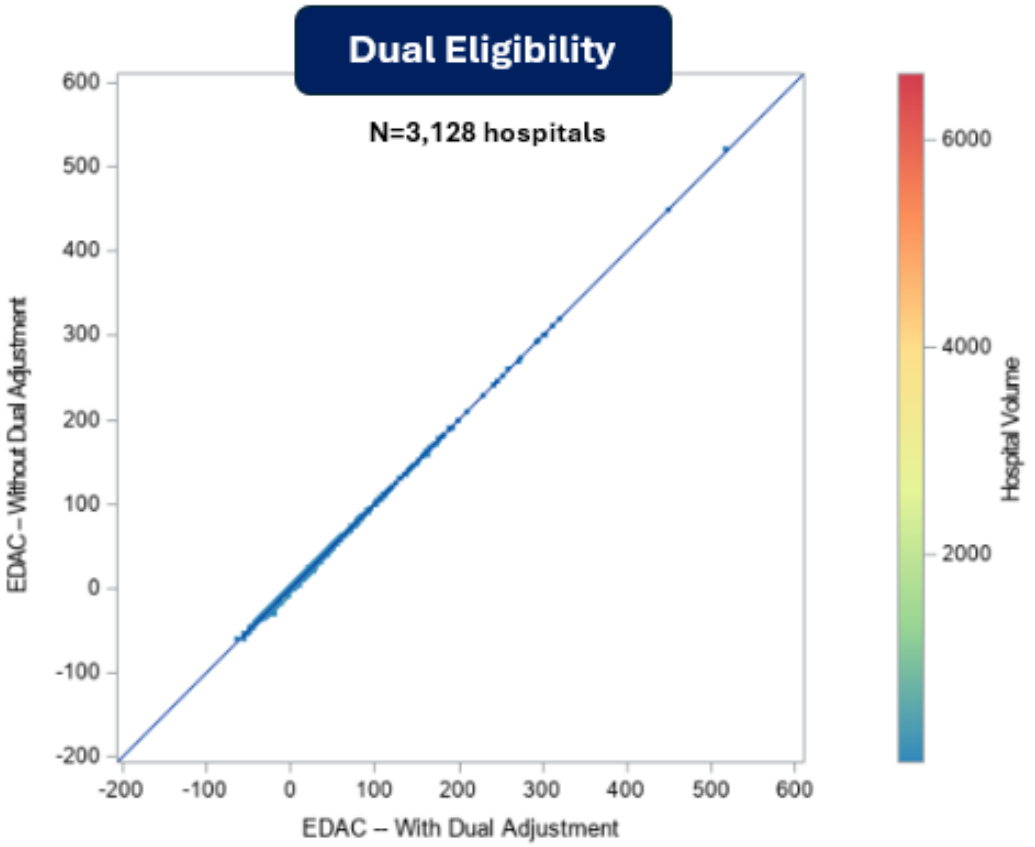

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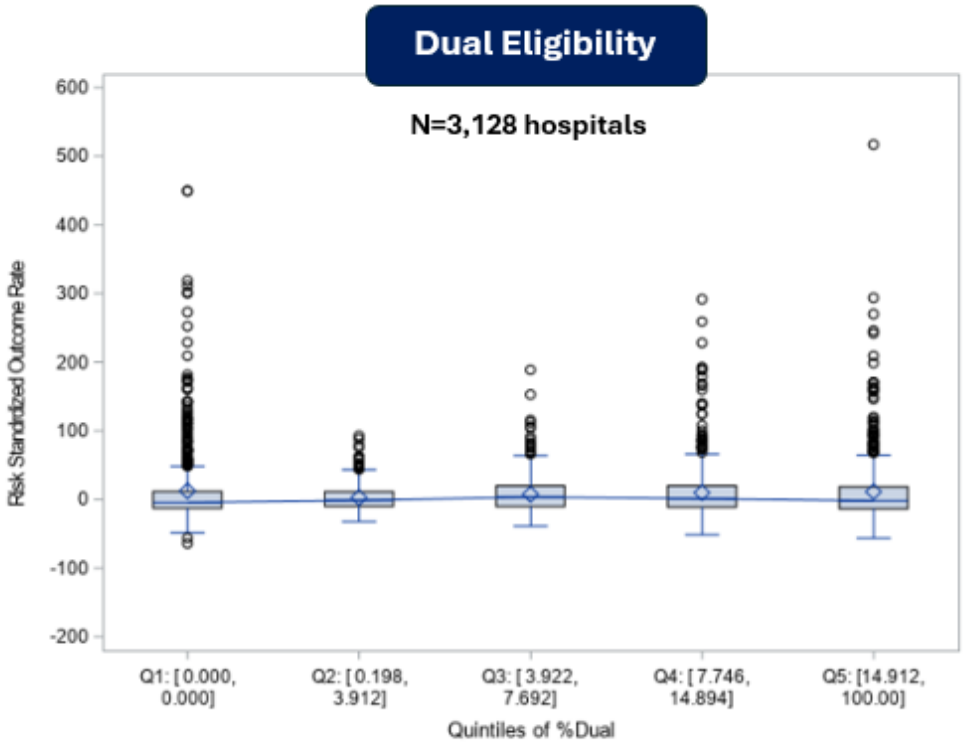
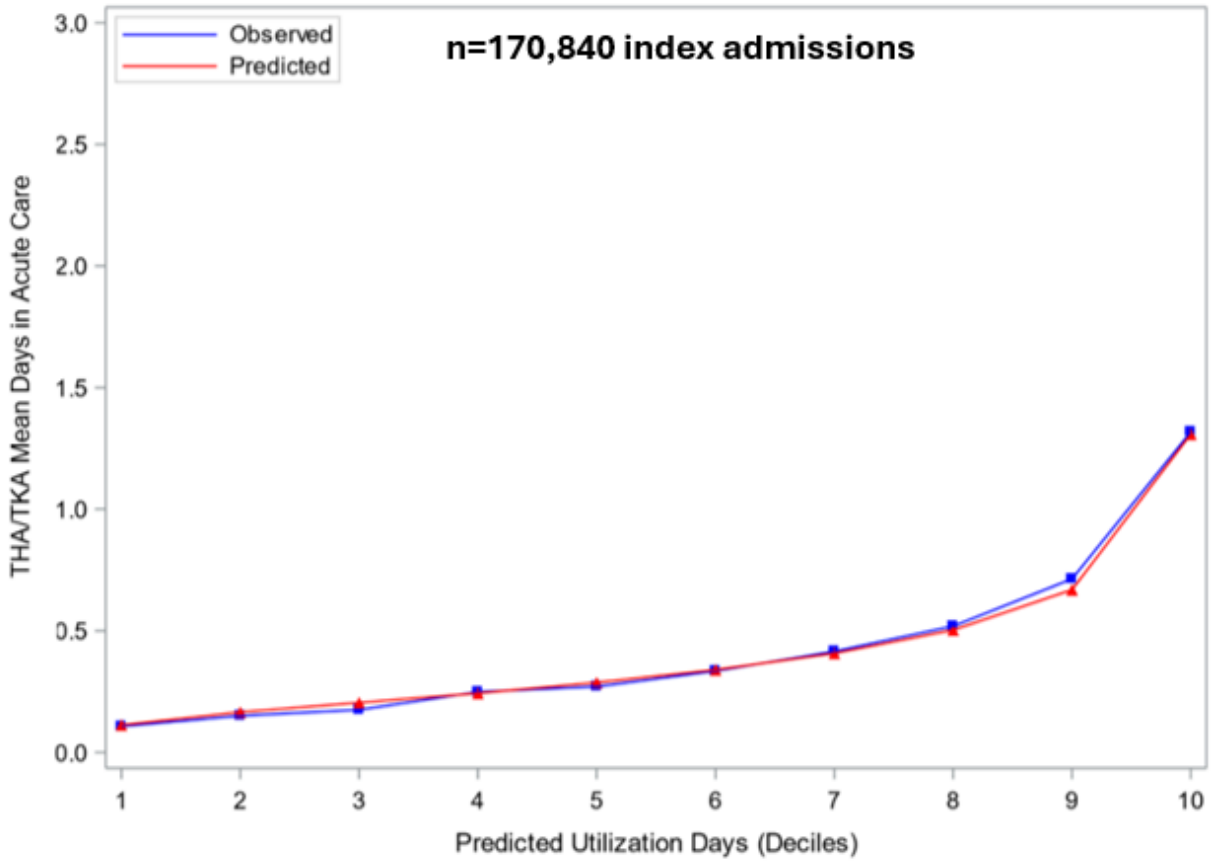


Figure 9. THA/TKA EDAC: Initial Cohort Calibration Plot (January 1, 2022 – December 30, 2022)



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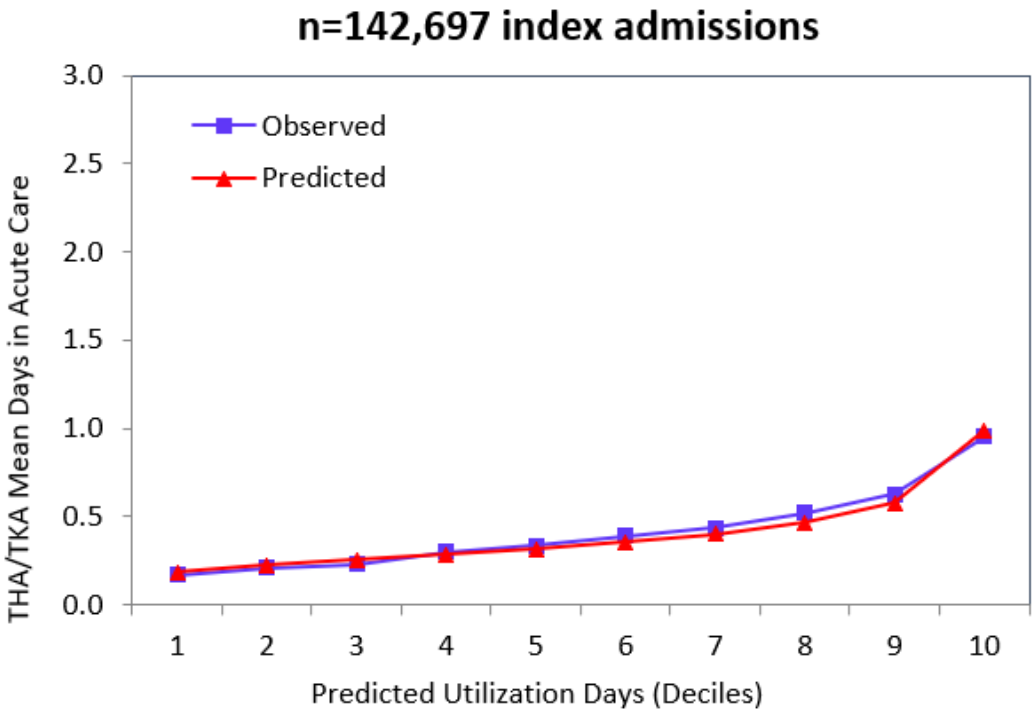

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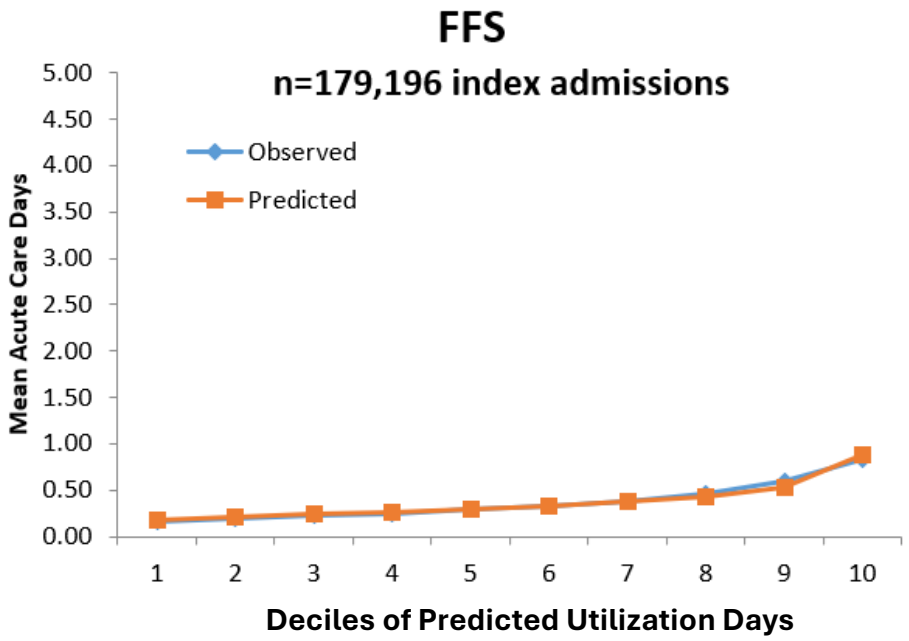

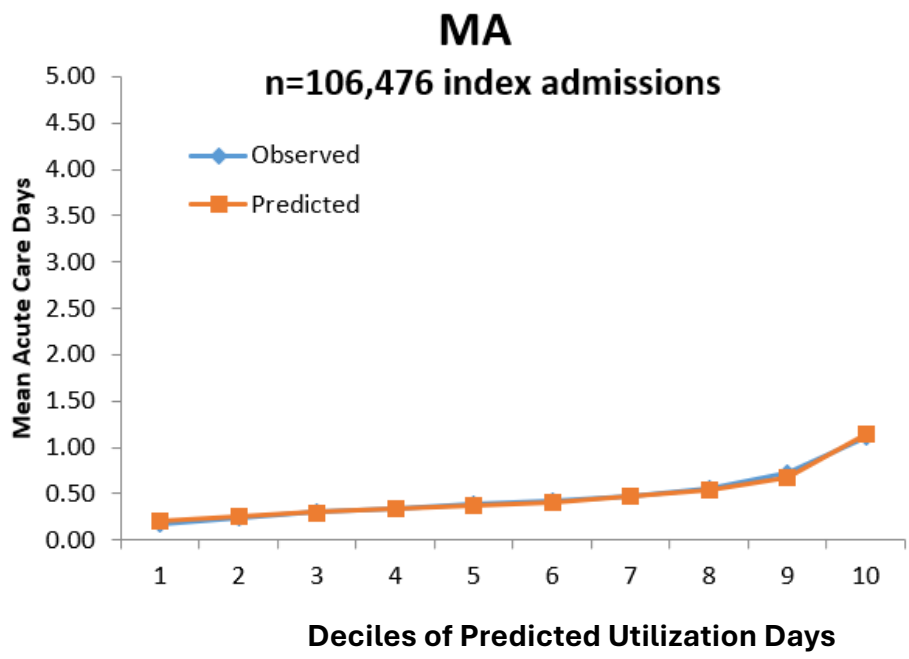

Logic Model

The THA/TKA EDAC measure assesses days spent in acute care within 30 days of discharge from an inpatient hospitalization for a THA/TKA procedure. This measure is intended to capture the care transition quality provided to discharged patients hospitalized for a THA/TKA procedure by collectively measuring a set of adverse acute care outcomes that can occur post-discharge: emergency department (ED) visits, observation stays, and unplanned readmissions at any time during the 30 days post-discharge. To aggregate all three events, each event is measured in terms of days. The outcome is adjusted to account for age and comorbidities and incorporates exposure time to account for survival times shorter than 30 days (for patients who die within 30 days of discharge). The measure cohort includes admissions for patients who are 65 years or older, are enrolled in Medicare Fee-For-Service (FFS) or Medicare Advantage (MA) and are hospitalized in non-federal short-term acute care hospitals. The final risk-adjusted measure score is calculated as the difference ("excess") between a hospital's "predicted days" and "expected days" per 100 discharges. We note that because this is an outcome measure, the goal is to have data for hospitals to use that informs their quality improvement processes, but the outcome results do not dictate which processes hospitals choose to put in place. Below in the "activities" column we state that hospitals should "apply the evidence base" because each hospital will need to address the root cause of any performance issues they see in their outcome.

Inputs	Activities	Outputs	Outcomes	Impacts
• Capacity to measure patient perspective and lived experience to create a shared decision making and informed consent education and self-management strategy for THA/TKA post-procedure, treatment regimens, and post-discharge care. • CMS reported hospital-level performance data, real-time dashboards, and Electronic Health Records (EHRs) to monitor EDAC events after THA/TKA. • Use of risk stratification tools such as the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) Surgical Risk Calculator for identifying high-risk THA/TKA patients. • Organizational commitment to Quality Improvement (QI) and investment in Enhanced Recovery After Surgery (ERAS) and transitional care pathways. • Review of American Academy of Orthopedic	• Analyze causes of high EDAC rates, including surgical site infections, venous thromboembolisms (VTEs), and poor mobility that are amenable to pre- and post-procedure medical optimization. • Aggressive early post-op mobility and bowel recovery protocols. • Apply the evidence base to standardize post-op discharge instructions including pain management, wound care, and deep vein thrombosis prevention. • Train clinical staff on guideline-concordant THA/TKA perioperative and discharge practices. Use high volume hospital publications around best practices to model periprocedural quality improvement. • Review hospital-level performance data and	• Real-time dashboard and reports tracking 30-day acute care utilization. • Standardized THA/TKA discharge and care transition checklists. • Staff trained in THA/TKA procedure post-discharge management and transitions of care. • Resource packets for patient recovery and staff protocol manuals. • Policies and procedures targeting workflow improvements ensuring warm handoffs and timely follow-ups. • Expanded use of telehealth for post-op care and remote physical therapy sessions. • Feedback systems to iteratively refine care	**Short-Term:** • Improved communication between hospital staff and patients at discharge. • Increased adherence to VTE prophylaxis, and wound care. • Early identification and management of post-operative care. • Enhanced provider satisfaction with care transition processes. • Increased outpatient orthopedic or rehab care within 30 days. • Improved mobility and independence **Intermediate-Term:** • More patients receiving timely outpatient orthopedic or rehab care. • Improved patient experience and	• Decreased variation in post-discharge acute care use across hospitals due to increased quality of life. • Enhanced efficiency and effectiveness of healthcare delivery systems. • Increased adoption of best practices in post-operative care across healthcare institutions. • Lower healthcare costs from avoidable readmissions and acute complications. • Stronger cross-system alignment across hospitals, post-acute rehab, and outpatient care. • Improved hospital performance metric

Inputs	Activities	Outputs	Outcomes	Impacts
Surgeons (AAOS)/American College of Rheumatology (ACR) perioperative guidelines for elective joint arthroplasty. • A culture of multidisciplinary coordination including case managers, orthopedic surgeons, physical therapists, and primary care teams such as geriatrics. • Trained THA/TKA care teams in discharge planning including orthopedic surgeons, pharmacists, anesthesiologists, dietitians, care coordinators, and rehabilitation nurses. • Patient-facing digital tools like joint replacement recovery apps, wearable monitors, and educational brochures. • Use of remote patient monitoring platforms to monitor mobility, pain, and wound healing post-discharge. • Dedicated funding for QI projects, transitional care pilots, and provider training.	real-time dashboards to identify root causes of high EDAC rates to inform process changes. • Educate patients pre-discharge about self-care, red flag symptoms, and follow-up schedule. • Track high-risk patients using PROMs, mobility scores, and alert flags during course of hospitalization. • Enable remote check-ins, physical therapy monitoring, and nurse navigator support post-discharge. • Participate in orthopedic registries (e.g., American Joint Replacement Registry [AJRR]) to benchmark and improve quality of care. • Transitional care and post-discharge checklists that are tailored to the needs of the patient.	pathways and reduce EDAC.	satisfaction with care transitions. • Better identification and proactive management of patients identified as high-risk. • Improved quality of life. **Long-Term:** • Reduction in excess days in acute care within 30 days post-discharge (ED visits, observation stays, unplanned readmissions). • Consistent staff engagement in post-discharge quality programs. • Improved mobility management and few hospitalizations. • Improved coordination across surgical, rehab, and primary care settings.	and public reporting outcomes.

Inputs	Activities	Outputs	Outcomes	Impacts
			• Improved hospital performance on publicly reported quality measures (e.g., CMS Hospital Readmissions Reduction Program).	

Feedback Mechanisms

- Real-time dashboards to flag increases in acute care days post-THA/TKA discharge.
- Hospitals benchmark their performance against peer institutions to identify variation in patient post-discharge acute care utilization.
- Patient-reported outcomes and experiences such as confidence in self-management and satisfaction with discharge instructions are collected to inform care improvements.
- Regular multidisciplinary case review meetings to analyze post-discharge events and refine post-discharge protocols.

Assumptions

- Hospital connectivity to post-discharge ambulatory settings.
- Hospitals have systems in place to track and review THA/TKA-related hospital stays and post-discharge outcomes.
- Post-discharge interventions (physical therapy, pain control) are available and feasible.
- Provider buy-in for standardized discharge planning and follow-up protocols.
- Necessary staff including administrative, physician, nursing, discharge coordinators and ambulatory clinic staff.

External Factors

- Policy and reimbursement models for THA/TKA care transitions (CMS, private payers).
- Provider shortages, particularly physiatrists, geriatrics care and orthopedic surgeons.
- Evolution of advances in THA/TKA procedures and post-op care (minimally invasive, newer materials for prosthetic joints).
- Variability in patient access to community services and caregiver support.
- Variability in patients' ability and willingness to engage in self-management.
- Technological challenges in implementing telehealth solutions.

Summary: The THA/TKA EDAC Logic Model focuses on reducing avoidable acute care utilization—unplanned readmissions, ED visits, and observation stays—within 30 days post-discharge for Medicare patients undergoing elective THA/TKA procedures. This logic model outlines an evidence-based framework reflecting the intended impact of the measure to improve care transitions by emphasizing a standardized discharge plan, recovery protocols, and patient-centered education to strengthen care transitions. It also incorporates risk assessment, remote monitoring, telerehabilitation, and multidisciplinary coordination to address root causes of excess acute care. The goal of the measure is to promote safe recovery, improve mobility outcomes, and reduce health system burden while enhancing the quality and continuity of orthopedic surgical care. Over time, this should lead to better post-THA/TKA care, and a stronger, more coordinated system between hospital and outpatient care that ultimately improves both patient outcomes and hospital performance.

References for this section align with the narrative presented in sections 6.2.1 and 2.2.

Conceptual Model

The goal of risk adjustment is to adjust for case-mix differences across the hospitals. Risk adjustment supports fair and accurate comparison of outcomes across measured entities by including an adjustment for factors such as patient age, comorbid diseases, and indicators of patient frailty, which are clinically relevant and have relationships with the outcome. In pursuing a risk adjustment approach that best leverages the data, we used a framework based largely on individual ICD-10 codes for risk adjustment. The main advantage of leveraging ICD-10 codes in place of alternative methods that employ an ICD-10 grouper (such as CMS's Condition Categories, or CCs) is the ability to address the clinical heterogeneity found in the broadly defined CCs. Our previous research indicates that the model performance of the mortality measures is significantly improved by using individual codes instead of CCs (Krumholz et al., 2019). The THA/TKA EDAC measure adjusts for case-mix differences between hospitals based on the clinical status of the patient at the time of the index admission. Accordingly, only comorbidities that convey information about the patient at that time or in the 12 months prior, and not complications that arise during the index hospitalization, are included in the risk adjustment. The process for determining patient comorbidities present at the time of the index admission from the index admission claim/encounter data uses a present-on-admission (POA) algorithm (see Section 5.4.2 of the full submission form for details).

The intent is for this measure to adjust for patient demographic and clinical characteristics while illuminating important quality differences. Therefore, this measure does not include an adjustment for social drivers of health because the association between social drivers of health and health outcomes can be due, in part, to differences in the quality of health care that these groups of patients receive. The measure does not adjust for patients' admission source or their discharge disposition (for example, skilled nursing facility) because these factors are associated with the structure of the healthcare system, not solely with patients' clinical comorbidities.

We also considered age, frailty, and an indicator for whether the admission was Medicare Advantage (MA) vs. Fee-for-Service (FFS). Based on evidence from the literature, expert input, guidance from the consensus-based entity for measure endorsement, the Assistant Secretary for Planning and Evaluation, input from other stakeholders, and prior testing results, we included a claims-based indicator of frailty in the final model. This indicator was developed for CMS's Multiple Chronic Conditions (MCC) measure. We did not include sex as a variable since sex can be considered a socio-demographic variable (Goodman et al., 2025). For the combined MA and FFS cohort, the risk-adjustment model was updated to include an MA indicator (versus FFS) as a main effect. This was to adjust for the generally higher prevalence of comorbidities in the MA cohort, especially among the pre-index variables that were derived from services in the outpatient setting (e.g., physician visits).

Clinical risk variables were selected using this conceptual framework together with a data-driven empiric approach as described in Section 5.4.2 of the full measure submission.

Economic Disadvantage

Because our risk variable selection process was based on an empirical approach using individual ICD-10 codes related to a patient's clinical status at admission and in the 12 months prior to admission, we separately considered variables related to economic disadvantage and their overlap with clinical risk factors. Although some recent literature has evaluated the relationship between these variables and the EDAC outcome, few studies directly address specific causal pathways or examine the role of the hospital in these pathways (see, for example: Hamadi et al., 2019; Kaiser Permanente Washington Health Research Institute, 2022; Rogstad et al., 2022; Joynt Maddox et al., 2019). Our conceptual model described below (and in the Supplemental Attachment) builds on published literature as well as our empirical analyses and identifies several overlapping pathways whereby patients may experience worse outcomes.

Conceptual Model for Clinical Factors and Factors Related to Economic Disadvantage

Our conceptual model described below builds on published literature as well as our empirical analyses and identifies several overlapping pathways whereby patients may experience worse outcomes. These pathways are not mutually exclusive.

- **Comorbidities and economic disadvantage:** Economically disadvantaged patients may have worse health at the time of hospital admission and patient comorbidities are known risk factors for post discharge acute care use in patients hospitalize for a THA/TKA procedure (Podmore et al., 2018). Patients who have lower income/education/literacy or unstable housing may have a worse general health status and may present for their hospitalization with a greater severity of underlying illness (Owens et al., 2022). These factors, which are characterized by patient-level or neighborhood-/community-level (as proxy for patient-level) variables, may contribute to worse health status at admission due to competing priorities (restrictions based on job, lack of childcare, etc.), lack of access to care (geographic, cultural, or financial), or lack of health insurance. Given that these risk factors all lead to worse general health status, this causal pathway should be largely accounted for by current clinical risk adjustment. We note that patient comorbidities and economic disadvantage variables overlap in their contribution to a higher risk of the outcome, as shown by our empirical evidence (see Section 5.3) demonstrating the attenuating impact of model variables on the odds ratios for admissions with the dual eligibility (DE) variable.
- **Differential care:** A second pathway by which economic disadvantage may contribute to post discharge acute care risk is that patients may not receive equivalent care within a facility (Lloren et al., 2019). It has been shown that for other conditions (acute myocardial infarction, pneumonia, and heart failures) across almost all hospitals (>98% of hospitals with sufficient data for assessment) that dually eligible patients have higher rates of post discharge hospital based care (readmission) when compared with patients who are not dually eligible patients in the same hospital (within hospital disparities), after accounting for comorbidities and area level variables (Silvestri et al., 2022).
- **Low-quality hospitals:** Economically disadvantaged patients may receive care at lower quality hospitals. Patients of lower income, lower education, or unstable housing may not have the same access to high quality facilities, in part, because such facilities may be less likely to be found in geographic areas with large populations of patients with these factors (Fahrenbach et. al., 2020). Thus, patients with low income may be more likely to be treated in lower quality hospitals, which can contribute to an increased risk of readmission. In addition, or alternatively, low quality hospitals may not implement evidence-based interventions to reduce the risk of readmission, such as post-discharge

follow-up; economically disadvantaged patients are known to have higher rates of post-discharge adverse outcomes (Bains et al., 2024).

- **Residual risk:** Economically disadvantaged patients may experience worse health outcomes only partially under the control of the healthcare system. Some economic factors, such as income or wealth, may affect the likelihood of readmission without directly affecting health status at admission or the quality of care received during the hospital stay. For instance, while a hospital may make appropriate care decisions and provide tailored care and education, a lower-income patient may still have a worse outcome post-discharge due to competing economic priorities or a lack of access to care outside of the hospital (Chatterjee et al., 2022).

These proposed pathways overlap and are complex to distinguish analytically. They also have different implications on the decision to risk adjust, or not, depending on the degree to which hospitals can mitigate the increased risk. Furthermore, the ongoing consolidation of the healthcare market puts more control, resources, and accountability on hospitals (that are now increasingly part of large multi-hospital systems) to invest in mitigating these risks (Levinson et al., 2024). However, in some markets, hospital systems choose to close facilities or limit access to care, based on financial decisions, rather than assessments of resource needs (Levins, 2023), including assessment of, and investment in programs that mitigate such needs.

Economic Variables Used in Testing

Based on the available literature and given the limited availability of valid and reliable variables that can be tested in claims data, we selected dual eligibility as a variable for testing:

Dual eligibility for Medicare and Medicaid is available at the patient level in the Medicare Master Beneficiary Summary File. The eligibility threshold for aged 65 or older Medicare patients considers both income and assets. There is also a body of literature demonstrating differential health care and health outcomes among dually eligible beneficiaries (ASPE, 2020).

Please see Section 5.4.2 for the details of the testing approach, results, and interpretation.

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