

Article

Impact of Dementia on Outcomes in Patients Hospitalized with Urinary Tract Infections

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Abstract

Background: People living with dementia (PLWD) are at increased risk for medical complications, including urinary tract infections (UTIs), which are often presented atypically with delirium or behavioral changes. These atypical presentations frequently prompt psychiatric consultation and complicated medical management. As the aging population grows, understanding how dementia influences UTI-related outcomes is critical for C-L psychiatrists working at the interface of medicine and psychiatry. **Methods:** This retrospective cohort study used the 2021 National Inpatient Sample (NIS) to identify adult inpatients with a principal diagnosis of UTI. Patients were stratified by the presence of a comorbid dementia diagnosis. Multivariate logistic and linear regression models adjusted for demographic, clinical, and hospital-level covariates were used to examine associations between dementia and outcomes: in-hospital mortality (primary), length of stay (LOS), hospital charges, and discharge disposition (secondary). Adjusted models included available demographic, socioeconomic, comorbidity, and hospital-level covariates, including age, sex, race/ethnicity, median household income quartile by patient ZIP code, insurance type, Charlson Comorbidity Index, hospital region, urban hospital location, and hospital teaching status. **Results:** Among 295,494 hospitalizations for UTI, 78,990 (26.7%) involved patients with dementia. Compared to those without dementia, PLWD were significantly older (mean age 82.5 vs. 69.5 years), more likely to be female, and had greater comorbidity burden. Adjusted analyses revealed that dementia was linked to higher odds of in-hospital mortality (aOR: 1.28, 95% CI: 1.03–1.58), longer LOS (+0.93 days, $p < 0.01$), and increased hospital charges (+\$3243.50, $p < 0.01$). Additionally, PLWD had lower odds of discharge to home (aOR: 0.53) and higher odds of discharge to skilled nursing facilities (aOR: 1.94). **Conclusions:** Among patients hospitalized with a principal diagnosis of UTI, comorbid dementia was linked with higher in-hospital mortality, longer length of stay, higher hospital charges, and lower likelihood of discharge home. These findings should be interpreted in the context of important limitations of administrative data, including residual confounding and inability to distinguish symptomatic UTI from asymptomatic bacteriuria.

Keywords: dementia; urinary tract infection; national inpatient study; consultation liaison psychiatry; people living with dementia; delirium



Academic Editor: Takao Yamasaki

Received: 12 April 2026

Revised: 29 May 2026

Accepted: 6 July 2026

Published: 21 July 2026

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1. Introduction

Dementia refers to a group of neurologic disorders, which are characterized by a decline in cognitive functions, affecting daily activities as well as quality of life. In dementia, one or more of the major cognitive domains, which include language, memory, attention, social cognition, executive function, and perceptual motor function, are affected. It is the seventh major cause of death and one of the primary reasons for disability, particularly among elderly people [1]. It affects about 6.9 million Americans aged greater than 65 years, with Alzheimer's disease constituting 60–80% of the total cases [2]. The prevalence of dementia appears to be rising, related to the increased elderly population. In 2021, 57 million people had dementia worldwide, and this number is believed to triple by 2050 [2]. The economic cost of dementia was greater than 1.3 trillion U.S. dollars globally in 2019, with a large proportion related to informal care provided by caregivers [2]. The burden of dementia is extensive, affecting not only the patient but also their families, as well as the entire healthcare system.

Urinary tract infections (UTIs) represent one of the most common bacterial infections worldwide and a leading cause of acute hospitalization, particularly among older adults. In the United States, UTIs account for approximately 7.7 million emergency department visits annually and contributed to over 2.8 million hospitalizations in 2018 [3]. People living with dementia (PLWD) are disproportionately susceptible to UTIs due to factors including impaired mobility, urinary incontinence, inadequate fluid intake, and difficulty communicating symptoms [4]. As a result, UTIs are among the most frequently diagnosed infections in this population, with two-thirds of nursing home residents with advanced dementia suspected of experiencing an infection within any given 12-month period [5].

The clinical presentation of UTIs in PLWD is frequently atypical, posing significant diagnostic challenges. Rather than the classic symptoms of dysuria, urinary frequency, or fever, PLWD often manifest with acute behavioral changes, increased agitation, functional decline, or delirium—a phenomenon sometimes referred to as “delirium superimposed on dementia” [6]. These atypical presentations can mask the underlying infection, leading to delays in diagnosis and treatment, and increasing the risk of serious complications such as urosepsis, prolonged hospitalization, and elevated morbidity and mortality [6]. Conversely, the overlap of behavioral symptoms with pre-existing neuropsychiatric features of dementia also raises the risk of erroneous diagnosis and inappropriate antibiotic use, contributing to growing concerns about antibiotic resistance [7].

Comorbid chronic conditions further complicate the clinical picture. Evidence suggests that PLWD with diabetes, for example, face a significantly higher risk of mortality when hospitalized with a UTI compared to patients without dementia [8]. Patients between infections and cognitive decline, whereby systemic and neuroinflammatory pathways triggered by infections may accelerate dementia progression, while dementia itself increases susceptibility to preventable infectious complications during hospitalization [9]. Patients with dementia also demonstrate substantially greater healthcare utilization across all care settings, including longer hospital stays, higher readmission rates, and increased mortality compared to cognitively intact patients [10].

Despite the high prevalence of both UTIs and dementia in hospitalized older adults and the well-recognized clinical complexity of their intersection, large-scale contemporary data specifically examining the impact of comorbid dementia on outcomes for patients admitted with a principal diagnosis of UTI remain limited. Understanding these disparities is essential for healthcare planning. Using data from the 2021 National Inpatient Sample (NIS)—the largest all-payer inpatient database in the United States—this study aims to evaluate the impact of comorbid dementia on in-hospital mortality, length of stay (LOS), hospital charges, and discharge disposition among patients hospitalized with a principal

diagnosis of UTI. Prior studies have largely examined general UTI hospitalization outcomes or focused on opioid use and sepsis, whereas the present study specifically evaluates the additive burden of comorbid dementia on outcomes including discharge disposition, length of stay, and hospital charges, using the most recently available NIS data.

2. Methods

2.1. Study Design and Database Description

This study utilized the 2021 National Inpatient Sample (NIS) [11], a comprehensive all-payer database created by the Healthcare Cost and Utilization Project (HCUP) under the Agency for Healthcare Research and Quality (AHRQ) [12]. Covering data from 48 participating states, the NIS represents 97% of the U.S. population and 96% of discharges from community hospitals, excluding rehabilitation and long-term acute care facilities. It is designed as a 20% stratified sample of discharges, ensuring representativeness based on hospital characteristics such as ownership, bed size, teaching status, and location. Its self-weighting structure minimizes error margins, providing reliable national estimates while maintaining patient confidentiality by omitting state and hospital identifiers. The large sample size enhances statistical power, allowing for the detection of differences in patient populations and outcomes, making it a valuable tool for healthcare research. Since the data is de-identified and publicly available, Institutional Review Board (IRB) approval and informed consent were not required for this study.

2.2. Study Population

Hospitalizations for UTI were identified using ICD-10-CM diagnosis codes listed in Supplementary Table S1. To improve specificity for clinically significant UTI-related hospitalization, we restricted the cohort to adult hospitalizations in which UTI was coded as the principal diagnosis. Dementia was identified using ICD-10-CM codes in secondary diagnosis fields. The ICD-10-CM code list was selected based on clinically relevant diagnostic codes used to identify UTI and dementia in administrative data.

2.3. Outcomes

The primary outcome of interest in this study was in-hospital mortality, comparing patients with and without dementia who were admitted with a principal diagnosis of UTI. Secondary outcomes included length of stay, total hospital charges, discharge home, and discharge to skilled nursing facility. Discharge home and discharge to skilled nursing facility were evaluated as separate binary outcomes.

3. Statistical Analysis

Data analysis was conducted using Stata version 18. Because the NIS uses a complex survey design, all analyses accounted for the NIS sampling structure. The survey design was specified using DISCWT as the discharge-level weight, NIS_STRATUM as the stratification variable, and HOSP_NIS as the hospital-level clustering variable. Weighted national estimates were generated. Survey-adjusted analyses were used for group comparisons and regression modeling. Survey-weighted logistic regression was used for binary outcomes, and survey-weighted linear regression was used for continuous outcomes including length of stay and total hospital charges. Separate survey-weighted logistic regression models were used to evaluate discharge home versus all other dispositions and discharge to skilled nursing facility versus all other dispositions among hospitalizations with a principal diagnosis of UTI.

Adjusted models included available demographic, socioeconomic, comorbidity, and hospital-level covariates, including age, sex, race/ethnicity, median household income

quartile by patient ZIP code, insurance type, Charlson Comorbidity Index, hospital region, urban hospital location, and hospital teaching status.

4. Results

4.1. Patient and Hospital Characteristics

The NIS dataset included 33.3 million observations, of which 295,494 patients were admitted with a principal diagnosis of UTI. Of these, 78,990 (26.73%) had a comorbid diagnosis of dementia. Table 1 provides a detailed comparison of patient and hospital characteristics for patients with and without a dementia diagnosis.

Of 295,494 patients admitted with a principal diagnosis of urinary tract infection (UTI), 78,990 (26.73%) had a comorbid diagnosis of dementia. Compared to patients without dementia, those with dementia were predominantly female (74.73% vs. 68.08%, $p < 0.01$) and significantly older, with a mean age of 82.47 years (95% CI: 82.34–82.59) versus 69.49 years (95% CI: 69.1–69.89) ($p < 0.01$).

Table 1. Patient and hospital characteristics.

	No Dementia	Dementia	<i>p</i> Value
Female (%)	150,000 (68.08)	59,000 (74.73)	<0.01
Mean age (95% conf. interval)	69.49 (69.1–69.89)	82.47 (82.34–82.59)	<0.01
Race/ethnicity (%)			<0.01
White	160,000 (74.17)	59,000 (76.23)	
Black	25,000 (11.89)	9650 (12.48)	
Hispanic	20,000 (9.45)	5490 (7.1)	
Asian or Pacific Islander	3790 (1.79)	1470 (1.9)	
Native American	1170 (0.55)	230 (0.3)	
Other	4530 (2.14)	1545 (2.0)	
Median annual income in patient's zip code, US\$, no. (%)			<0.01
\$1–\$51,999	66,000 (31.14)	21,000 (27.29)	
\$52,000–\$65,999	56,000 (26.4)	19,000 (24.94)	
\$66,000–\$87,999	48,000 (22.47)	19,000 (24.24)	
\$88,000 or more	43,000 (20)	18,000 (23.54)	
Insurance type, no. (%)			<0.01
Medicare	160,000 (74.88)	72,000 (92.84)	
Medicaid	24,000 (11.26)	1410 (1.81)	
Private insurance, including Health Maintenance Organizations (HMO)	25,000 (11.84)	3705 (4.77)	
Self-pay	4290 (2.03)	455 (0.59)	
Hospital region, no. (%)			<0.01
Northeast	42,000 (19.27)	16,000 (20.52)	
Midwest	50,000 (23)	18,000 (22.33)	
South	92,000 (42.63)	34,000 (43.37)	
West	33,000 (15.1)	11,000 (13.79)	
Urban location (%)	190,000 (85.54)	69,000 (87.18)	<0.01
Teaching hospital	140,000 (65.1)	52,000 (65.96)	0.1

Table 1. *Cont.*

	No Dementia	Dementia	<i>p</i> Value
Charlson Comorbidity Index score, no. (%)			<0.01
0	53,000 (24.29)	55 (0.0007)	
1	44,000 (20.25)	22,000 (27.72)	
2	40,000 (18.48)	18,000 (22.52)	
≥3	80,000 (36.99)	39,000 (49.69)	

Racial distribution varied slightly, with a higher proportion of White patients in the dementia group (76.23% vs. 74.17%), while Black (12.48% vs. 11.89%) and Hispanic (7.1% vs. 9.45%) representation was lower. Patients with dementia were more likely to reside in higher-income ZIP codes, with 23.54% living in areas with a median income of \$88,000 or more, compared to 20% in the non-dementia group ($p < 0.01$).

Medicare was the predominant insurance type in both groups, but significantly more patients with dementia were covered under Medicare (92.84% vs. 74.88%, $p < 0.01$), while Medicaid (1.81% vs. 11.26%) and private insurance (4.77% vs. 11.84%) coverage was lower.

Regional distribution showed the highest proportion of patients in the South (43.37% dementia vs. 42.63% non-dementia), followed by the Midwest (22.33% vs. 23%), Northeast (20.52% vs. 19.27%), and West (13.79% vs. 15.1%) ($p < 0.01$). The majority of admissions occurred in urban hospitals (87.18% dementia vs. 85.54% non-dementia, $p < 0.01$), with no significant difference in the proportion of admissions at teaching hospitals (65.96% vs. 65.1%, $p = 0.1$).

Patients with dementia had a higher Charlson Comorbidity Index score, with 49.69% having a score of ≥ 3 compared to 36.99% in the non-dementia group ($p < 0.01$), indicating a higher overall burden of comorbid conditions.

4.2. Primary Outcome

Among the 295,494 patients admitted with a principal diagnosis of UTI, 2225 (0.7%) died during hospitalization. In the unadjusted analysis, dementia was linked with significantly higher odds of in-hospital mortality (OR: 1.62, 95% CI: 1.33 to 1.98; $p < 0.01$). After adjusting for potential confounders including age, gender, race, median income of the patient's ZIP code, hospital region, urban location, teaching hospital status, and Charlson Comorbidity Index (CCI) score, dementia remained significantly linked with increased odds of in-hospital mortality (Adjusted OR: 1.28, 95% CI: 1.03 to 1.58; $p = 0.02$).

These findings, summarized in Table 2, indicate that dementia was linked to higher odds of in-hospital mortality among patients hospitalized for UTI, even after accounting for baseline health status and comorbidities.

Table 2. Primary outcome.

Outcome	Exposure	Odds Ratio (OR)	95% Confidence Interval (CI)	<i>p</i> -Value
Mortality (Unadjusted)	Dementia	1.62	1.33–1.98	<0.01
Mortality (Adjusted)	Dementia	1.28	1.03–1.58	0.02

4.3. Secondary Outcomes

Patients with dementia had significantly longer hospital stays and higher healthcare costs than those without dementia. After adjusting for potential confounders, the mean length of hospital stay was 0.93 days longer (95% CI: 0.81–1.05; $p < 0.01$), and total hospital charges were \$3243.50 higher (95% CI: \$2406.58–\$4080.40; $p < 0.01$) in the dementia group.

Regarding discharge disposition, patients with dementia had lower odds of being discharged home (OR: 0.53, 95% CI: 0.51–0.55; $p < 0.01$) and higher odds of discharge to a skilled nursing facility (OR: 1.94, 95% CI: 1.86–2.03; $p < 0.01$). Patients with dementia had longer adjusted length of stay and higher adjusted hospital charges compared with patients without dementia. Given the skewed nature of LOS and charge data in administrative datasets, these findings should be interpreted as evidence of increased resource utilization rather than precise estimates of individual-level cost differences as seen in Table 3.

Table 3. Secondary outcomes.

Adjusted Secondary Outcomes	Value	95% Confidence Interval (CI)	<i>p</i> -Value
Mean Length of Stay (dementia)	0.93 days longer	0.81–1.05 days	<0.01
Total Hospital Charges (dementia)	\$3243.50 higher	\$2406.58–\$4080.40	<0.01
Odds of Discharge Home	0.53	0.51–0.55	<0.01
Odds of Discharge to Skilled Nursing Facility	1.94	1.86–2.03	<0.01

5. Discussion

This large-scale, nationally representative study suggests that comorbid dementia may contribute to worse clinical and economic outcomes in patients hospitalized with a principal diagnosis of urinary tract infection. Patients with dementia experienced higher in-hospital mortality, longer hospital stays, greater hospital charges, and were substantially less likely to be discharged home compared to their cognitively intact counterparts.

In terms of mortality, in our study, dementia was linked to higher odds of in-hospital mortality, with an adjusted odds ratio of 1.28 (95% CI: 1.03–1.58; $p = 0.02$), consistent with prior literature suggesting a relationship between dementia and adverse outcomes in acute medical illness. Rozzini et al. reported that older adults with dementia admitted for acute medical conditions had significantly higher short-term mortality compared to cognitively intact patients, attributable in part to delayed recognition of clinical deterioration and reduced physiologic reserve [13]. More specifically relevant to infections, a population-based study by Beard et al. found that people living with dementia (PLWD) had substantially elevated infection-related mortality, with UTI and pneumonia being the leading infectious causes of death in this group [8,14]. The attenuated but persistent mortality signal after multivariate adjustment in our study may partly reflect vulnerabilities beyond age and comorbidity burden [15].

The observed increase in mortality is consistent with prior population-based studies demonstrating worse outcomes in patients with dementia during acute infectious illnesses. Lai et al. reported that UTIs in people living with dementia are associated with increased mortality compared to matched controls, particularly among those with coexisting conditions such as diabetes [8]. Similarly, Bouza et al. found that dementia independently increased in-hospital mortality among elderly patients hospitalized with sepsis (adjusted OR 1.32), despite a lower incidence of organ dysfunction, suggesting that dementia contributes to poorer outcomes beyond traditional markers of disease severity [16]. These findings are consistent with the concept that reduced physiological reserve, frailty, and impaired host response may contribute to adverse outcomes.

The role of delirium as an intermediary mechanism deserves particular attention. UTIs in PLWD frequently precipitate acute delirium, a syndrome associated with significantly increased short-term mortality in hospitalized older adults [8]. The clinical overlap between delirium and the behavioral symptoms of dementia can lead to diagnostic delays and undertreatment, further compounding mortality risk. Fick et al. demonstrated that delirium superimposed on dementia carries a substantially worse prognosis than delir-

ium alone, with higher rates of functional decline, institutionalization, and death [17]. Krinitski et al., in a systematic review and meta-analysis, found a significant association between delirium and UTI in older adults (OR 2.67) [18]. In addition, Kim et al. describe a self-reinforcing cycle in which dementia increases susceptibility to both UTI and delirium, while delirium accelerates cognitive and functional decline [7]. This interaction not only complicates diagnosis but may also contribute to prolonged hospitalization, increased morbidity, and long-term functional deterioration. Delirium may further amplify the risk of institutionalization. Fong et al. demonstrated that among patients with Alzheimer disease, hospitalization was associated with a substantial increase in institutionalization risk (adjusted RR 6.9), which increased further in the presence of delirium (adjusted RR 9.3) [19]. These findings suggest that acute cognitive complications during hospitalization may play a critical role in determining discharge disposition and long-term functional outcomes.

At the same time, diagnostic uncertainty may lead to overdiagnosis and inappropriate treatment. Yourman et al. demonstrated that patients with dementia had more than twice the odds of receiving a UTI diagnosis in the emergency department despite having fewer localizing genitourinary symptoms [20]. Similarly, D'Agata et al. found that only a small proportion of suspected UTI episodes in nursing home residents with advanced dementia met minimum clinical criteria for antimicrobial initiation, yet most episodes were treated with antibiotics [21].

Patients with dementia in our cohort had a mean hospital stay 0.93 days longer (95% CI: 0.81–1.05; $p < 0.01$) and incurred \$3243.50 higher total hospital charges (95% CI: \$2406.58–\$4080.40; $p < 0.01$) compared to those without dementia. These findings are consistent with a growing body of literature documenting substantially greater resource utilization among hospitalized patients with dementia. A study by Bail et al. found that dementia was independently associated with prolonged hospitalization across medical and surgical admissions, driven by increased care complexity, higher rates of complications, and challenges in transitional planning [17]. Similarly, Zhu et al. reported that dementia significantly increased total inpatient costs, with the increment in charges attributable to longer stays, higher rates of intensive care utilization, and greater need for ancillary services such as occupational therapy, speech-language pathology, and consultation-liaison psychiatry [22].

Our findings regarding discharge disposition further highlight the functional consequences of hospitalization in this population. Patients with dementia were significantly less likely to be discharged home and more likely to require skilled nursing facility (SNF) placement. This is consistent with prior literature demonstrating that dementia is a strong independent predictor of institutionalization following acute hospitalization. In a systematic review and meta-analysis, Harrison et al. found that dementia was associated with more than a twofold increase in the odds of discharge to institutional long-term care (pooled OR 2.14) [23].

Hospitalization itself appears to be a major precipitating event for long-term care placement. Goodwin et al. reported that 5.55% of hospitalized older adults resided in a nursing home at 6 months compared to 0.54% of nonhospitalized controls, and nearly three-quarters of new nursing home placements were preceded by hospitalization [23,24]. Importantly, discharge to a SNF was associated with a markedly increased likelihood of subsequent long-term institutionalization (OR 10.83) [24].

Patterns of post-acute care utilization further support these findings. In a national cohort of Medicare beneficiaries with dementia, Burke et al. found that approximately 70% of patients were discharged to SNF compared to 30% to home health services, despite no significant differences in readmission or mortality between settings [25].

Several limitations of this study merit acknowledgment. The NIS is an administrative database that relies on ICD-10 coding for diagnosis identification, which may be subject to

coding inaccuracies, undercoding of dementia as a comorbidity, and inability to distinguish dementia subtypes or severity. Additionally, as a cross-sectional inpatient dataset, the NIS does not allow for assessment of long-term outcomes such as 30-day or 90-day readmission, post-discharge functional status, or cognitive trajectory following hospitalization. The absence of clinical variables such as delirium severity, antibiotic appropriateness, functional baseline, and microbiological data limits the depth of mechanistic interpretation. Because the NIS is an administrative database, it does not include urinalysis results, urine culture data, fever, dysuria, urinary frequency, antibiotic indication, physician adjudication, or other clinical details needed to distinguish symptomatic UTI from asymptomatic bacteriuria. This limitation is particularly relevant in patients with dementia, in whom nonspecific symptoms such as confusion, agitation, functional decline, or delirium may lead to diagnostic uncertainty and possible overdiagnosis of UTI. Residual confounding remains possible. Although the analysis adjusted for available patient- and hospital-level covariates, the NIS does not reliably capture frailty, baseline functional status, dementia severity, nursing home residence, delirium burden, catheterization details, laboratory values, vital signs, or the physiologic severity of illness. Therefore, the observed associations should not be interpreted as evidence that dementia directly causes worse UTI-related outcomes. Length of stay and hospital charges are typically right-skewed in administrative datasets. Although survey-weighted linear regression was used, alternative approaches such as log-transformed models or generalized linear models were not performed. Therefore, the LOS and charge findings should be interpreted with caution as indicators of greater resource utilization rather than as precise patient-level predictions. Discharge disposition was modeled using binary indicators for discharge home and discharge to a skilled nursing facility. In-hospital deaths were not excluded from these models and were therefore included among the non-home or non-SNF outcome categories. This modeling approach may affect the interpretation of discharge disposition results, and these findings should be treated as broad indicators of discharge patterns rather than a complete competing-risk analysis of post-hospital disposition. Acute illness severity indicators such as ICU admission, sepsis with shock, and mechanical ventilation are not reliably captured in the NIS at the encounter level. Furthermore, the NIS captures only inpatient discharges and does not include data from outpatient or long-term care settings, potentially underestimating the true burden of UTI in the dementia population. Finally, while we adjusted for multiple demographic and clinical confounders, residual confounding from unmeasured variables cannot be excluded in any observational study of this design.

The mortality finding should be interpreted cautiously. Although dementia was associated with higher adjusted odds of in-hospital mortality, the adjusted effect size was modest, and the confidence interval was close to the null. Given the observational design and the NIS's limited ability to capture frailty, baseline functional status, dementia severity, delirium burden, laboratory abnormalities, and the physiologic severity of illness, this association may partly reflect residual confounding. These findings are best interpreted as showing that dementia identifies a vulnerable hospitalized population rather than proving a direct causal effect of dementia on UTI-related mortality.

6. Conclusions

Among patients hospitalized with a principal diagnosis of UTI, comorbid dementia was linked to higher in-hospital mortality, longer length of stay, higher hospital charges, and lower likelihood of discharge home. These findings should be interpreted in the context of important limitations of administrative data, including residual confounding and inability to distinguish symptomatic UTI from asymptomatic bacteriuria.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/jdad3030036/s1>, Table S1: ICD-10-CM codes used to identify urinary tract infection (principal diagnosis) and dementia (comorbidity) in the 2021 National Inpatient Sample (NIS).

Author Contributions: Conceptualization, S.J. and A.S.; Methodology, S.J. and A.S.; Software, A.S.; Formal Analysis, S.J., A.M. and A.S.; Investigation, S.J., A.M., S.R., A.D., N.D., S.K., K.A. and A.S.; Data Curation, S.J. and A.M.; Writing—Original Draft Preparation, S.J., A.M., S.R., A.D., N.D. and S.K.; Writing—Review and Editing, S.K., K.A. and A.S.; Visualization, S.J.; Supervision, S.K., K.A. and A.S.; Project Administration, S.J. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical review and approval were waived for this study because the National Inpatient Sample (NIS) is a de-identified, publicly available administrative database. No individual patient data requiring informed consent or IRB oversight was accessed.

Informed Consent Statement: Not applicable. This study utilized a de-identified, publicly available administrative database (2021 National Inpatient Sample) and did not involve direct contact with human subjects.

Data Availability Statement: The data used in this study are publicly available from the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) at: <https://hcup-us.ahrq.gov/nisoverview.jsp> (accessed on 4 October 2025).

Conflicts of Interest: The authors declare no conflicts of interest.

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