

## BRIEF RESEARCH REPORT

## Geriatrics

# Association of dementia diagnosis with urinary tract infection in the emergency department

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**Abstract**

**Objectives:** Overdiagnosis of urinary tract infections (UTI) among people living with dementia is a nationally recognized problem associated with morbidity from antibiotics as well as multidrug-resistant bacteria. However, whether this problem also exists in the emergency department (ED) is currently unknown.

**Methods:** To examine the association between dementia and UTI diagnosis in the ED we performed a retrospective analysis of Medicare beneficiaries older than 65 years old who presented to an ED in 2016. A diagnosis of UTI was present in 58,580 beneficiaries, and 321,479 beneficiaries without a diagnosis of UTI served as the comparison group. Our logistic regression model controlled for dementia, older age, female sex, Medicaid status, skilled nursing facility residence, history of prostate cancer, recent urinary catheter use, recurrent UTI, and multiple comorbidities.

**Results:** In our model, people living with dementia had over twice the odds (odds ratio = 2.27, 95% confidence interval = 2.21, 2.33) of being diagnosed with a UTI in the ED compared to those without dementia despite their lower prevalence of symptoms and signs localizing to the genitourinary tract (3.8% vs 8.9%, respectively).

**Conclusion:** This is the first study from a national database that examines the association of dementia with UTI diagnosis among older adults who visit the ED. Our study could not establish whether the UTI diagnoses in the ED were accurate but does imply a disproportionate burden of UTI diagnoses in people living with dementia despite their lower prevalence of clinical criterion. Antimicrobial stewardship in the ED should address the complexity of UTI diagnosis in dementia.

**KEYWORDS**

dementia, geriatrics, UTI

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## 1 | INTRODUCTION

### 1.1 | Background

Up to 50% of people living with dementia present to the emergency department in a given year (compared to 30% of people without dementia) and their most frequent diagnosis on discharge from the ED is urinary tract infection (UTI), including both cystitis and pyelonephritis.<sup>1</sup> Accurate diagnosis of UTI in the ED is critical not only to minimize complications from UTI (eg, sepsis may develop in up to 0.5% of UTIs<sup>2</sup>) but also to prevent antibiotic-associated morbidity (eg, such as *Clostridium difficile* colitis) and multidrug-resistant bacteria.

Although diagnostic criteria for UTI are straightforward, requiring both symptoms (eg, new dysuria, frequency, or urgency) and laboratory evidence (eg, positive urine culture), the presence of cognitive impairment complicates UTI diagnosis. For example, people living with dementia may have atypical clinical manifestations, struggle to express symptoms, and have higher rates of asymptomatic bacteriuria, particularly if they live in long-term care facilities where false positive urine cultures occur in up to 50% of older adults.<sup>3</sup> Accounting for these nuances in a rapid-paced, high-acuity ED only further complicates an already challenging diagnosis.

### 1.2 | Importance

Although several guidelines address the diagnostic challenges of UTI in older adults with cognitive impairment, their practical application in an ED setting is limited. For example, the Infectious Disease Society of America's (IDSA) 2008 *Clinical Practice Guideline for Long-term Care Facilities* specifies dysuria as a key criterion for UTI diagnosis,<sup>3</sup> yet many people living with dementia cannot articulate dysuria, especially to an ED physician or nurse unfamiliar with their communication pattern. To offset this difficulty, IDSA also allows for a change in a patient's baseline urinary habits or temperature to count as UTI criterion, but these baseline variables are frequently unknown to the ED physician or nurse assessing the patient. Protocols for UTI diagnosis in community-dwelling older adults<sup>4</sup> are similarly impractical for the ED setting. For example, Mody et al proposed that prior to sending a urine dipstick, a frail older adult with nonspecific symptoms should be observed for 24–48 hours,<sup>4</sup> which may be neither safe nor feasible for a person living with dementia in the ED.

### 1.3 | Goals of the investigation

Although prior research has examined diagnostic patterns of UTI among older adults in the ED,<sup>5</sup> little is known about the prevalence of UTI diagnosis specifically in older people living with dementia who visit the ED. Given the challenges of UTI diagnosis posed by cognitive impairment in acute care, our objective was to examine the association between dementia and UTI diagnosis in the ED.

#### The Bottom Line

This study found that patients with dementia had higher odds of being diagnosed with UTI in the ED, compared to patients without dementia. These patients had lower prevalence of genitourinary symptoms and signs.

## 2 | METHODS

### 2.1 | Study design and data source

We retrospectively analyzed a 5% sample of national claims-level data from the Centers for Medicare and Medicaid Services from January 2016 to December 2016. We analyzed claims from beneficiaries aged 65 years or older with continuous enrollment in traditional Medicare Fee for Service (FFS) plans (ie, Parts A & B) who presented to a Medicare-certified ED. All analyses used the Medicare beneficiary as the unit of analysis.

Our study compared 2 cohorts: a UTI cohort and a comparison group of beneficiaries without a documented UTI. Inpatient and outpatient claims associated with an ED visit between January 2016 and December 2016 were included as a qualifying encounter. Of 380,059 eligible beneficiaries, UTI was identified based on the presence of a claim in 2016 with select International Classification of Diseases, Tenth Revision (ICD-10) diagnosis codes. UTI diagnosis was determined by the presence of an ICD-10 code within any of the 3 diagnosis fields for UTI including cystitis or pyelonephritis based on the Agency for Healthcare Research and Quality's Prevention Quality Indicator classification for UTI Diagnosis (see Supplement Appendix A for selected UTI diagnosis codes). The no-UTI cohort consisted of beneficiaries without the presence of a documented UTI ICD-10 diagnosis.

### 2.2 | Outcome measures

The primary outcome was the proportion of patients presenting to the ED that had diagnostic claims for UTI. We then stratified our analysis based on whether a diagnosis of dementia was coded at the ED encounter. The diagnosis of dementia during an ED encounter was determined by the presence of ICD-10 codes indicating Alzheimer's Disease and Related Disorders or Senile Dementia consistent with codes used in prior publications on dementia<sup>1</sup> (see Supplement Appendix B).

### 2.3 | Statistical analysis

We used a logistic regression model to examine the relative odds of a UTI diagnosis in older patients with dementia compared to patients without dementia who visit the ED. We controlled for potential confounders associated with both dementia and UTI, including older

**TABLE 1** Demographic characteristics of study population with and without a urinary tract infections (UTI) diagnosis

Characteristics	Urinary tract infection	Comparison group (No urinary tract infection)	P
Total	58,580 (100)	321,479 (100)	...
Dementia	...	...	...
Dementia diagnosis	12,639 (21.6)	25,681 (8.0)	<0.0001
Disposition	...	...	...
ED to inpatient	23,098 (39.4)	75,718 (23.6)	<0.0001
ED only (discharged)	35,482 (60.6)	245,761 (76.4)	<0.0001
Skilled nursing facility (SNF) utilization	...	...	...
ED outpatient visit dispositioned to SNF or ED inpatient visit admitted from SNF	1983 (0.52)	4049 (1.07)	<0.0001
Age	...	...	...
65–69	10,110 (17.3)	84,821 (26.4)	<0.0001
70–74	10,316 (17.6)	72,442 (22.5)	<0.0001
75–79	10,865 (18.5)	60,055 (18.7)	<0.0001
80–84	10,954 (18.7)	48,117 (15.0)	<0.0001
85+	16,335 (27.9)	56,044 (17.4)	<0.0001
Mean age	78.8	76.1	...
Sex	...	...	...
Female	43,241 (73.8)	181,063 (56.3)	<0.0001
Male	15,339 (26.2)	140,416 (43.7)	<0.0001
Past medical history	...	...	...
Prostate cancer	1918 (0.50)	13,197 (3.47)	<0.0001
History of UTI	5271 (12.12)	3369 (7.75)	<0.0001
Use of catheter	313 (0.08)	446 (0.12)	<0.0001
Modified Charlson Comorbidity Scores (no dementia)	...	...	...
None (0)	234 (0.4)	628 (0.2)	<0.0001
One (1)	8158 (13.9)	59,529 (18.5)	<0.0001
Two (2)	8142 (13.9)	49,057 (15.3)	<0.0001
Three (3)	7531 (12.9)	39,261 (12.2)	<0.0001
Four (4)	6249 (10.7)	28,897 (9.0)	<0.0001
Five or more (5+)	21,343 (36.4)	79,046 (24.6)	<0.0001
Mean Charlson Comorbidity Index score	4.0	3.0	...
Dual enrollment status	...	...	...
Medicaid	13,032 (22.2)	48,169 (15.0)	<0.0001

age, female sex, dual eligibility status, skilled nursing facility residence, history of prostate cancer, recent urinary catheter use, recurrent UTI, and the Charlson Comorbidity Index, modified to exclude dementia.<sup>6</sup>

Skilled nursing facility residence was determined by a discharge code indicating SNF or intermediate care facility (ICF) (for index encounters discharged from the outpatient setting) or admittance code indicating SNF or ICF (for index encounters originating in the ED that were discharged from the inpatient setting). History of prostate cancer was identified by ICD-9 code of 185 or ICD-10 code of C61 with the maximum look-back period possible given available data (2012

through the start of the index encounter). Recent catheter use was classified by presence of Healthcare Common Procedure Coding System codes 51701, 51702, 51703, and/or P9612 in the 7 days preceding the index visit. Recurrent UTI (rUTI) was defined as 3 or more UTI episodes during the previous 12 months,<sup>7</sup> using the same UTI codes previously listed. Secondary analyses examined the prevalence of non-specific and localizing clinical characteristics of UTI in both the dementia and non-dementia cohort. We conducted a Pearson chi-square analysis to compare prevalence of localizing clinical characteristics (eg, dysuria, urinary urgency, and frequency) and non-specific symptoms

**TABLE 2** Adjusted<sup>a</sup> odds of urinary tract infections (UTI) diagnosis in emergency department (ED) encounters for older adults with and without a dementia diagnosis

Covariate	Odds ratio	95% confidence limits
Dementia	2.266	2.207, 2.326
Modified comorbidity score	1.092	1.089, 1.095
Male	0.465	0.455, 0.476
Age	1.025	1.023, 1.026
Skilled nursing facility residence	1.280	1.205, 1.359
Recent catheterization	4.305	3.682, 5.032
History of prostate cancer	1.017	0.964, 1.073
Recurrent UTI history	6.354	6.067, 6.655
Medicaid dual eligibility	0.783	0.765, 0.802

<sup>a</sup>Max-rescaled R-Square of logistic regression model: 0.1247.

(eg, altered mental status, sepsis, other malaise) between people living with dementia versus without dementia. All analyses were conducted using SAS Studio version 3.71.

### 3 | RESULTS

In ED encounters, older adults with a diagnosis of dementia were more likely to be older (78.8 vs 76.1 years of age), female (73.8% vs 56.3%), and dually eligible for both Medicare and Medicaid (22.2% vs 15.0%) compared to those without a dementia diagnosis. However, comorbidity scores were similar in both cohorts (4.0 vs 3.0) (see Table 1).

Results from our logistic regression model are presented in Table 2. Although being older, skilled nursing facility residence, history of prostate cancer, or greater number of comorbidities were associated with an increased likelihood of a UTI diagnosis, a diagnosis of dementia had a stronger association with UTI than these well-established risk factors. Two of our covariates (recent catheter and rUTI) had an even stronger association with UTI than dementia. After controlling for all of the covariates in our model, people living with dementia still had 2.27 times the odds of a UTI diagnosis compared to older adults without dementia (95% confidence interval = 2.21;2.33).

Among beneficiaries diagnosed with a UTI, people living with dementia had a lower proportion of localizing clinical characteristics (3.8% vs 8.9%) and higher proportion of non-specific clinical characteristics (30.6% vs 16.5%) compared to those without dementia. Table 3 shows how the prevalence of clinical characteristics commonly ascribed and used to diagnose UTI differ between groups.

### 4 | DISCUSSION

Our retrospective analysis of a national Medicare claims dataset suggests that older adults living with dementia are more than twice as

likely to be diagnosed with a UTI in the ED compared to older adults without dementia even when controlling for age, sex, skilled nursing facility, history of prostate cancer, recent urinary catheter use, rUTI, multimorbidity, and Medicaid eligibility. Overall, a UTI diagnosis was present in 33.8% of all ED encounters for people living with dementia, compared to only 13.4% of encounters for older adults without dementia. This is in spite of the fact that people living with dementia had a lower prevalence of localizing clinical characteristics (such as dysuria, genitourinary discomfort, or change in urinary habits) but higher prevalence of non-specific clinical characteristics associated with UTI. These findings beg the question as to whether the higher proportion of UTI diagnoses in people living with dementia reflects a different presentation of true UTI disease versus a more liberal approach to UTI diagnosis in patients who are less able to articulate their chief complaint.

Our findings expand current understanding of patterns of UTI diagnosis in older adults with dementia in several ways. First, we utilized a representative national database to demonstrate that dementia in the ED is an even stronger risk factor for UTI diagnosis than traditionally established risk factors such as age and comorbidities. This association is concerning given research in long-term care facilities showing how the overdiagnosis of UTIs in people living with dementia has led to widespread multidrug-resistance. Second, whereas the majority of known risk factors for UTI in the ED relate to a patient's biology or environment (such as age, residence, and physical comorbidities<sup>5</sup>), our findings suggest that cognition may also affect UTI diagnosis (such as if a patient's ability to report symptoms or provide a clean catch specimen is compromised).

Our study highlights a need for further prospective research to evaluate the disparity in UTI diagnoses between older adults with and without dementia, as a better understanding could have significant implications for patient care. For example, if people living with dementia have a higher burden of true UTI disease, then modifiable physiologic risks that logically relate to dementia could be targeted for infection control in the outpatient or skilled nursing facility setting before the patient arrives to the ED. Conversely, if UTI is in fact overdiagnosed in people living with dementia who visit the ED, then we might want to consider adaptation of the Centers for Disease Control and Prevention's antimicrobial stewardship guidelines for the long-term care setting to include guidance for the acute care setting as well. These guidelines might include ED-based workflows that address potential non-infectious causes of altered mental status in people living with dementia, such as medications, pain, constipation, and dehydration. In a clinically stable patient without sepsis, these quickly treatable entities might be considered before urinary studies are sent (especially given the high false positive rate of urinary studies in people living with dementia). Finally, the importance of further understanding diagnostic patterns of UTI is critical from a cost and antimicrobial stewardship perspective.

#### 4.1 | Limitations

There are several limitations to this study. First, we were unable to determine severity of dementia from our dataset, which may have provided important clues for the associations we found. Second, our study

**TABLE 3** Characteristics of urinary tract infections (UTI) diagnosis in an emergency department (ED) encounter for Medicare beneficiaries with and without dementia

Clinical characteristics	Beneficiaries with a UTI diagnosis				P
	Dementia		No Dementia		
	Count	Percentage	Count	Percentage	
Symptoms and signs localizing to the genitourinary tract					
Dysuria	126	1%	1,686	3.7%	<0.0001
Urgency of urination	20	0.2%	299	0.7%	<0.0001
Urinary frequency	113	0.9%	987	2.1%	<0.0001
Suprapubic pain	38	0.3%	258	0.6%	0.0002
Kidney and urinary tract signs and symptoms	4	0.0%	104	0.2%	<0.0001
Gross hematuria	159	1.3%	618	1.3%	0.448
Acute prostatitis	8	0.1%	76	0.2%	0.0072
Epididymitis	7	0.1%	52	0.1%	0.0696
Total	475	3.8%	4080	8.9%	
Non-specific symptoms and signs					
Altered mental status	673	5.3%	922	2.0%	<0.0001
Other fatigue	158	1.3%	870	1.9%	<0.0001
Other malaise	578	4.6%	967	2.1%	<0.0001
Rigors	19	0.2%	60	0.1%	0.5925
Fever	150	1.2%	779	1.7%	<0.0001
Leukocytosis	383	3.0%	922	2.0%	<0.0001
Sepsis	1901	15.0%	3,066	6.7%	<0.0001
Total	3862	30.6%	7586	16%	
Total beneficiaries	12,639	100%	45,941	100%	

captured dementia only if listed as a diagnosis during the encounter and may underestimate the true prevalence of dementia because it is typically underdiagnosed (though this would have affected each UTI cohort equally).<sup>8</sup> Third, claims data have a tendency to selectively capture more advanced cases of dementia, in which case our study may overestimate the association between mild-moderate dementia and UTI diagnosis. Fourth, we were unable to control for potentially important confounders such as urinary incontinence and immobility, known risk factors for UTI that are also commonly associated with dementia. However, these variables seem more likely to be part of the mechanism of UTI in people living with dementia (eg, people living with dementia may be more likely to have incontinence and immobility negatively affecting hygiene and infection risk) than independent confounders. Finally, because our study did not include data about urinary tests and antibiotic prescriptions, we cannot know the extent to which a UTI diagnosis reflects health care delivery, though prior studies suggest that the vast majority of UTI diagnostic claims are associated with antibiotic prescriptions.

## 5 | CONCLUSION

Dementia is strongly associated with UTI diagnosis in the ED and nearly one third of people living with dementia who visit the ED are

diagnosed with a UTI. Although it remains unclear why there is a disproportionate burden of UTI diagnoses in people living with dementia who visit the ED, it is imperative to further examine modifiable risk factors for UTI that can be addressed before the ED visit, as well as how the ED approaches UTI diagnosis in older adults with cognitive impairment. Additional research could examine the frequency of, and reasons for, sending urinary studies in people living with dementia who visit the ED, the accuracy of the diagnoses made, and the potential impact of ED protocols that address potential non-infectious causes of nonspecific symptoms in people living with dementia before urinary studies are sent.

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### CONFLICT OF INTEREST

The authors of this study have no conflict of interest to disclose.

### AUTHOR CONTRIBUTIONS

LCY, AL, and KJK contributed to study design. TJK and JSI performed the data analysis. LCY led drafting of the article, with additional article writing performed by AL, JSI, and KJK. LCY, AL, JSI, and KJK critically revised the article.

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