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Hospital Admission Patterns in Adult Patients with Complicated Urinary Tract Infections: Identification of Potentially Avoidable Hospital Admissions Across US Hospitals

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ABSTRACT

Background: There is an increase in hospital admissions for cUTI in the US despite apparent reductions in the severity of admissions. However, there are scant data on cUTI hospital admission rates from the emergency department (ED) stratified by age, infection severity, and presence of comorbidities. This study described US hospitalization patterns among adults who present to the ED with a cUTI. We sought to quantify the proportion of admissions that were potentially avoidable based on presence of sepsis and associated symptoms as well as Charlson Comorbidity Index (CCI) scores.

Methods: A retrospective multi-center study using data from the Premier Healthcare Database (2013-18) was performed. Inclusion criteria: (1) age ≥ 18 years, (2) primary cUTI ED/inpatient discharge diagnosis, (3) positive blood or urine culture between index ED service days -5 to +2. Transfers from acute care facilities were excluded. Based on ICD-9/10 diagnosis codes present on admission, incidence of hospital admissions were stratified by age (≥ 65 years vs. < 65 years), presence of sepsis (S), sepsis symptoms but no sepsis codes (SS) (e.g., fever, tachycardia, tachypnea, leukocytosis, etc.), and CCI.

Results: 187,789 patients met inclusion criteria. The mean (SD) age was 59.7 (21.9), 40.4% were male, 29.4% had sepsis, 16.7% had at least 1 SS symptom (but no S), and 53.9% had no evidence of S or SS. The median [IQR] CCI was 1 [0, 3]. 119,668 out of 187,789 (63.7%) were admitted to hospital. Among inpatients, median [IQR] length of stay (LOS) and total costs were 5 [3, 7] days and $7,956 [$4,834, $13,960] USD.

Incidence of hospital admissions by age, presence of S/SS, and CCI score are shown in the Table. 18.9% of admissions (22,644/119,668) occurred in patients with no S/SS and a CCI ≤ 2. Their median [IQR] LOS and total costs were 3 [2, 5] days and $5,575 [$3,607, $9,133].

Conclusion: Nearly 1 in 5 cUTI hospital admissions may be avoidable. Given the resources associated with the management of inpatients with cUTIs, these findings highlight the critical need for healthcare systems to develop well-defined criteria for hospital admission based on presence of comorbid conditions and infection severity. Preventing avoidable hospital admissions has the potential to save the healthcare system substantial costs.

Patients < 65 years

CCI		Number of Sepsis Symptoms (SS) 0	1	2	3	Sepsis (Diagnosis)
0	All patients (#)	44,858	1,787	274	62	7,192
	Inpatients (%)	14.0	81.4	97.8	98.4	99.8
1	All patients (#)	9,465	999	204	61	4,437
	Inpatients (%)	28.5	92.8	100.0	100.0	99.9
2	All patients (#)	4,822	1,369	291	59	4,255
	Inpatients (%)	52.2	97.9	100.0	100.0	100.0
3	All patients (#)	1,950	839	250	53	2,479
	Inpatients (%)	63.3	98.3	100.0	100.0	100.0
4	All patients (#)	936	685	207	61	1,567
	Inpatients (%)	67.7	100.0	100.0	100.0	99.9
≥ 5	All patients (#)	1,320	1,353	490	117	2,812
	Inpatients (%)	75.1	99.8	99.8	100.0	99.9

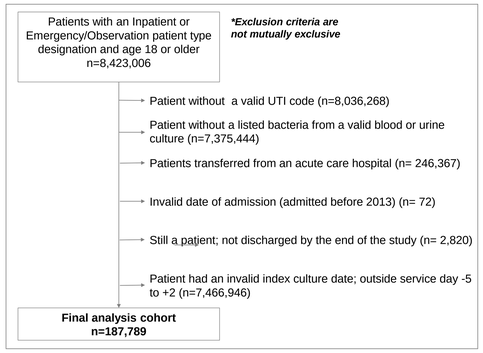
Patients ≥ 65 years

CCI		Number of Sepsis Symptoms (SS) 0	1	2	3	Sepsis (Diagnosis)
0	All patients (#)	11,781	1,485	338	53	3,951
	Inpatients (%)	26.2	94.7	99.1	100.0	99.7
1	All patients (#)	8,845	2,195	559	87	5,812
	Inpatients (%)	48.2	97.3	99.6	100.0	100.0
2	All patients (#)	6,265	2,761	800	163	6,099
	Inpatients (%)	60.5	98.8	99.8	100.0	99.9
3	All patients (#)	4,125	2,725	847	215	5,255
	Inpatients (%)	70.2	99.0	99.8	100.0	100.0
4	All patients (#)	2,656	2,316	838	201	4,008
	Inpatients (%)	75.5	99.2	99.9	100.0	99.9
≥ 5	All patients (#)	4,131	4,360	1,784	494	7,476
	Inpatients (%)	82.2	99.5	99.9	100.0	99.9

CCI; Charlson Comorbidity Index

RESULTS

Figure 1: Cohort Attrition



- **The mean (SD) age was 59.7 (21.9)**
- **40.4% were male**
- **70.7%, 14.8%, 13.4%, 1.2%, and 8.5% of patients were White, Black, Other, Unknown, and Hispanic, respectively**
- **31.8% of patients were insured through Medicare, 26.1% Medicaid, 18.9% Managed Care, 5.7% Commercial, 14.2% Self-Pay, and 3.7% Other**
- **29.4% had S, 16.7% had at least 1 SS but no S, and 53.9% had no evidence of either S or SS**
- **The median (IQR) CCI was 1 (0, 3)**
- **64% percent of patients (119,668 out of 187,789) were hospital inpatients**
- **Overall, mortality was low (2.94% in all inpatients, 0.07% in ED patients) and was 0.4% in low acuity inpatients**

Table 1: Incidence of Hospital Admission by CCI and Presence of Sepsis/Systemic Symptoms — *Low Acuity*

Number of Patients Presenting to ED (% Admitted)

CCI	Sepsis	3 SS, no S	2 SS, no S	1 SS, no S	No S, no SS
0	11,143 (99.8)	115 (99.1)	612 (98.5)	3,272 (87.5)	***56,639 (16.6)***
1	10,249 (99.9)	148 (100)	763 (99.7)	3,194 (95.9)	***18,310 (38.0)***
2	10,264 (99.9)	222 (100)	1,091 (99.8)	4,130 (98.5)	***11,087 (56.9)***
3+	23,597 (99.9)	1,141 (100)	4,416 (99.9)	12,278 (99.2)	15,118 (73.8)

ED; Emergency Department. CCI; Charlson Comorbidity Index, S; Sepsis, SS; Systemic Symptoms

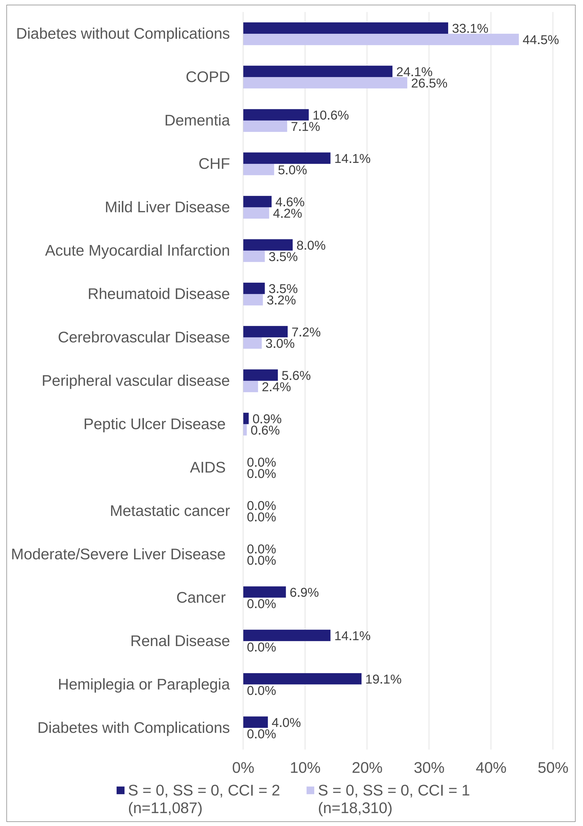
Table 3: Outcomes Among Hospitalized Patients by CCI and Presence of Sepsis/Systemic Symptoms — *Low Acuity*

Mean (SD) Hospital Length of Stay and Costs by CCI and Presence of S/SS

CCI	S		≥3 SS, no S		2 SS, no S		1 SS, no S		No S, no SS	
	LOS (days)	Cost ($)	LOS (days)	Cost ($)	LOS (days)	Cost ($)	LOS (days)	Cost ($)	LOS (days)	Cost ($)
0	4.8 (4.3)	8893 (10729)	6.4 (6.7)	11491 (12828)	5.0 (4.8)	9119 (8969)	4.4 (4.4)	7785 (8350)	***3.6 (3.2)***	***6504 (6910)***
1	5.8 (5.8)	11308 (13463)	6.9 (6.7)	13151 (13502)	6.1 (7.3)	11384 (14813)	5.1 (4.4)	9197 (10118)	***4.7 (8.4)***	***8421 (10404)***
2	7.0 (6.6)	14013 (17422)	7.2 (6.6)	14645 (14837)	6.8 (6.4)	12808 (13918)	6.1 (7.3)	11236 (15704)	***5.3 (5.5)***	***9872 (12988)***
≥3	8.6 (9.3)	18287 (28133)	8.4 (7.1)	17174 (19665)	7.6 (6.8)	15279 (20826)	7.0 (7.9)	12996 (16136)	6.4 (7.3)	12243 (16262)

SD; Standard Deviation. CCI; Charlson Comorbidity Index, S; Sepsis, SS; Systemic Symptoms. LOS; Length of Stay.

Table 2: Distribution of CCI Components in Low Acuity Patients



COPD; Chronic Obstructive Pulmonary Disease. CHF; Congestive Heart Failure. AIDS; Acquired Immunodeficiency Syndrome. CCI; Charlson Comorbidity Index, S; Sepsis, SS; Systemic Symptoms

INTRODUCTION

- **One of the most important considerations across all therapeutics domains is the initial site of care (i.e., outpatient vs inpatient).[1]**
- **This is especially important for common and costly conditions like cUTIs.[2,3]**
- **Despite the increased emphasis of optimizing the quality and efficiency of healthcare delivery[1], data indicate that there is an increase in hospital admissions for cUTI in the US despite apparent reductions in severity of UTI admissions[1,4].**
- **Few studies have quantified the proportion of admissions for cUTIs that may be preventable[5].**
- **This study sought to describe hospitalization patterns among adult patients who present to the emergency department (ED) with a cUTI by their age, disease acuity, and comorbid conditions and determine the proportion of admissions that were of low acuity and potentially avoidable.**

METHODS

- **A retrospective multi-center analysis using data from the Premier Research Database (PHD) from 2013-18 was performed examining cUTI patients presenting to the ED.**
- **Inclusion criteria: Age ≥ 18 yrs, cUTI diagnosis, positive blood or urine culture between index ED/hospital days -5 to +2.**
- **Exclusion criteria: Patients transferred from other acute care facilitates.**
- **Incidence of hospital admissions were stratified by presence of Sepsis (S), presence of systemic symptoms (SS) but no S, Charlson Comorbidity Index (CCI), and age (≥ 65 years vs. < 65 yrs).**
  - **SS included: Fever, tachycardia, tachypnea, altered mental status, hypoglycemia, hyperglycemia, leukocytosis, leukopenia, hypotension, hypoxemia, oliguria, coagulation abnormalities, thrombocytopenia, hyperbilirubinemia, acute lung injury/acute respiratory failure.**
- **We defined patients with no S or SS and CCI ≤ 2 to be low acuity.**
- **For hospitalized patients, length of stay (LOS), hospital costs, in-hospital mortality, and 30-day readmissions post discharge were tabulated across resultant S/SS-CCI categories.**
- **All analyses were conducted using Stata/MP 15.1 for Windows (StataCorp LLC, College Station, TX).**

CONCLUSIONS

- **In this study of hospital admissions patterns in over 250 US hospitals, we found that ~1 in 5 adults admitted for a cUTI had a low-acuity and thus may be potentially avoidable.**
- **These findings highlight the need for healthcare systems to develop well-defined criteria for hospital admission based on presence of comorbid conditions and infection severity.**
- **Findings also highlight the need for PK/PD dosed optimized oral antibiotics with favorable susceptibility and safety profiles to facilitate outpatient treatment in low acuity cUTI patients.**
- **As with all studies of this nature, the findings need to be prospectively validated.**
- **For now, these findings can serve as the basis for an ED antimicrobial stewardship initiative to assess the hospital admission patterns among low acuity patients with cUTIs.**

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