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Major Article

A retrospective comparison of guidelines to assess hospital-diagnosed urinary tract infection in nursing home residents

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Background: Inappropriate antibiotic treatments for urinary tract infection (UTI) in nursing home (NH) residents are common and contribute to antibiotic resistance. Published guidelines aim to improve accurate assessment, diagnosis, and treatment of UTIs. This study assessed whether records from hospitalized NH residents diagnosed with UTI, while comparing the Cooper Tool and Stone criteria, supported appropriate treatment.

Methods: A retrospective chart review was conducted using electronic medical record (EMR) data from residents of 3 NHs who were diagnosed with UTI when hospitalized over a 3-year period. The Cooper Tool and Stone criteria were used to assess treatment appropriateness.

Results: Of 79 hospitalized residents treated for UTI, 11 (13.9%) were appropriately treated according to the Cooper Tool and 9 (11.4%) according to Stone. The 2 criteria agreed in 9 of the cases including 100% of those with catheters. Urinalysis was documented in 72% of residents and 24% had documentation of culture and sensitivity.

Conclusions: Appropriate UTI treatment rates using both tools were low but much higher in those with catheters. Future research is necessary to validate the use of these tools in the hospital setting which have the potential to improve treatment accuracy and reduce unnecessary antibiotics use.

INTRODUCTION

Background

The problem of nursing home (NH) residents receiving inappropriate antibiotic treatments for urinary tract infection (UTI) is well documented.[1,2] However, little evidence exists about the accuracy of hospital UTI diagnosis and treatment of NH residents who were admitted to the hospital and then transferred back to the NH.[3] Due to the widespread presence of asymptomatic bacteriuria (ASB) in NH residents, UTIs are diagnosed differently in this population than they are in community-dwelling adults.[1,4-6] It is not known whether hospital clinicians diagnose and treat NH residents based on this knowledge. While UTI guidelines have existed for use within the NH for many years, a directive toward or evidence of such use with residents transferred outside of the NH is missing.

While the Infectious Disease Society of America strongly advises against treatment of ASB,[5,6] differentiating ASB from UTI can be challenging. Because up to 50% of NH residents have ASB, a simple urinalysis cannot be used as a stand-alone diagnostic for this population.[5,7,8] A review of the literature revealed that although many studies have found inappropriate treatment rates in NHs, evidence is missing regarding UTI treatment for NH residents who were transferred to the hospital. Woodford and colleagues found that misdiagnosis of UTIs in hospitalized elderly patients is as high as 40%.[9] Furthermore, inappropriate antibiotic prescribing in emergency departments (ED) can be as high as 74% for NH residents.[10] Treating NH residents for ASB without evidence of infection can place these residents at risk for secondary infections (eg, C. difficile) and drug resistance, both of which can contribute to poor patient outcomes and increased healthcare costs.[11] In fact, a recent report of data from

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the National Health and Safety Network found that, over a 5-year period, 36% of UTIs treated in NH residents were associated with an antibiotic resistant organism.[2] To battle inappropriate antibiotic treatments, use of UTI guidelines or diagnostic tools are important.

The literature has shown that consistent use of some UTI guidelines within NHs can improve the diagnostic process and appropriate treatment, but evidence of such use in the hospital setting for NH residents is missing.[2,4,6] Even with guideline use, appropriate UTI treatment rates in NH residents is low.[1,4,6,10,12] After comparing three criteria, Eure et al. found appropriate UTI treatments in 15% of those using the Stone criteria (also referred to in the literature as the *Revised McGeer Criteria*), 30% using the Loeb criteria, and 45% using the Crnich criteria.[12] One of the first criteria used in NHs, the McGeer consensus criteria,[13] was adopted by the U.S. Department of Health and Human Services (DHHS) and the Centers for Medicare and Medicaid Services (CMS), and has been used nationwide for almost 30 years as the primary tool for UTI symptom analysis and diagnosis in NH residents.[14,15] While the McGeer criteria have been used frequently in NHs, Juthani-Mehta et al. found low diagnostic accuracy with these criteria (30% sensitive, 82% specific, PPV 57%/NPV 61%).[16]

In 2001, the Society for Healthcare Epidemiology of America (SHEA) and the Association for Professionals in Infection Control and Epidemiology released the Loeb criteria.[17] These criteria divided UTI signs and symptoms into major and minor categories and include recommendations for microbiological confirmation of UTI diagnosis. In October 2012, Stone et al. released a new set of consensus-based recommendations for UTI assessment that incorporated the McGeer and Loeb criteria. The Stone recommendations require one to four positive signs and symptoms plus a positive urine culture.[19] Moreover, the Stone criteria added new guidelines to the Loeb 2001 criteria: pain in testes/epididymis/prostate in both catheterized and noncatheterized male residents, new onset of hypotension or purulent discharge from around the catheter site in catheterized residents, and serum leukocytosis.[19]

Unlike the criterion-only based guidelines, Cooper et al. published the results of a guideline (Cooper Tool) and process, now known as the Cooper Urinary Tract Infection Program (CUTIP). It included staff education, change champions, and an algorithm to improve UTI assessment, diagnosis, and treatment for NH residents to reduce inappropriate antibiotic treatments.[4] The Cooper Tool criteria were based on several guidelines including the McGeer, Loeb, and Stone criterias.[13,17,19] With both the Cooper Tool and McGeer criteria, residents must have two to three signs and symptoms to be considered for a UTI diagnosis. The Cooper Tool further requires a positive urinalysis and urine culture.[4,13] The aim of the Cooper Tool was to prevent early, unnecessary urine dipsticks and urinalyses, as these tests were often the primary reason for inappropriate antibiotic prescriptions.[4] The results of this program included a 97% reduction in inappropriate antibiotic treatments for suspected UTI and no reported negative clinical outcomes for residents.[4] A 2019 replication study found similar outcomes, with inappropriate antibiotic treatments for suspected UTIs falling from 79% in the pre period to 5.9% in the post period.[1] Additionally, clinicians reported that the Cooper Tool was easy to use.[4]

UTI guidelines generally differ only in the number of signs and symptoms required to consider a UTI diagnosis. The Cooper Tool and Stone criteria are similar in that both require UTI signs and symptoms and a positive urine culture. They are dissimilar in the pathway to arrive at a UTI diagnosis. Cooper requires two or three signs and symptoms and an algorithm to guide the user toward or against urine testing. The Stone criteria requires a variable level of signs and symptoms depending on which symptoms the resident presents with, making it more intricate and less intuitive for the user. Overall, the literature supported the idea that insufficient evidence existed to support a conclusive number or a specific set of signs and symptoms that must be present to diagnose a UTI in NH residents. Appendix A summarizes the Cooper Tool and Stone criteria for UTI diagnosis.

The objective of this study was to retrospectively determine whether hospitalized NH residents were appropriately diagnosed and treated for UTIs when comparing the Cooper Tool and Stone criteria. By comparing the Cooper Tool with the older, more recognized, Stone criteria, we hoped to gain a clear understanding of diagnostic agreement with NH residents transferred to the hospital.

METHODS

Design

For this retrospective cohort study, the medical records of NH residents who were admitted to the hospital and transferred back to the NH with a UTI diagnosis were evaluated. After reviewing the research protocol, the University's Institutional Review Board designated the study *exempt* (HUM00166265). Data were collected from hospitalizations during the period of June 2016 to June 2019.

Sample and Setting

The individuals included in this study resided at their NH facility for more than 30 days, had been transferred to one of four hospitals (for any reason) where they were diagnosed with a UTI, and subsequently transferred back to their NH. The three southeast Michigan NHs included in this study had a total of 427 beds, provided care for both long-term care and rehabilitation residents, and were owned and managed by the same corporation.

Procedures

The NH electronic medical records (EMR) were accessed to determine which residents qualified for the study. The hospital discharge documents that accompanied residents' return to the NH were reviewed using the Hospital to Nursing Home Urinary Tract Infection Data Collection Instrument and the Cooper Tool and Stone criteria (Appendix B). All hospital documents of eligible residents were reviewed to determine whether the UTI diagnoses and treatments were appropriate or inappropriate using the Cooper Tool and Stone criteria. To improve inter- and intra-rater reliability, 2 examiners independently abstracted data on the 79 identified residents with a UTI diagnosis and compared data for agreement. Any inconsistencies in data analysis were reviewed. The following hospital documents were reviewed to determine diagnosis and treatment accuracy: hospital discharge summaries, labs, medications, admission history and physical, testing/radiology results, consults, and other medical documents (eg, social work, provider, and nursing notes sent to the NH).

Measures

Appropriateness of UTI treatment were assessed using the Cooper Tool and Stone criteria. According to Cooper Tool criteria, to be appropriately diagnosed with a UTI, residents with an indwelling catheter must have at least *2* UTI signs and symptoms *plus* a positive urine culture, and residents without an indwelling catheter must have at least *3* signs and symptoms *plus* a positive urine culture. For noncatheterized residents, UTI signs and symptoms are fever; dysuria/frequency/urgency; a change in urine character; new flank, suprapubic, or testicular pain or tenderness; a change in mental status; and/or a change in functional status. For residents with an indwelling catheter, signs and symptoms are fever, chills, or new onset hypotension; new flank, suprapubic, or testicular pain or tenderness; a change in urine character or purulent discharge at the catheter insertion site; a change in mental status; and/or a change in

functional status. To be considered positive, a urine culture must have >100,000 CFU of bacteria per milliliter of urine. Antibiotic treatment was deemed appropriate when the resident met the signs and symptoms criteria, had a positive culture, and was prescribed a susceptible antibiotic (as determined by culture and sensitivity testing).

According to Stone et al., residents without a catheter may have only acute dysuria or acute pain/swelling/tenderness of the testes, epididymis, or prostate along with a positive urine culture for a UTI diagnosis. If the patient does not meet the aforementioned criteria but has a fever or leukocytosis plus at least one of the following localizing urinary tract subcriteria (acute costovertebral angle pain or tenderness, suprapubic pain, gross hematuria, new or marked increase in incontinence, new or marked increase in urgency, or new or marked increase in frequency) plus a positive urine culture, they then meet UTI diagnosis criteria. For residents without fever or leukocytosis, 2 or more of the following localizing urinary tract subcriteria must be present: suprapubic pain, gross hematuria, new or marked increase in incontinence, new or marked increase in urgency, or new or marked increase in frequency, plus a positive urine culture. Leukocytosis is defined as neutrophilia (>14,000 leukocytes/mm^3) or a left shift (>6% bands or ≥ 1500 bands/mm^3). For residents with an indwelling catheter, at least one of the following subcriteria must be present plus a positive urine culture to diagnose UTI:

1. Fever, rigors, or new-onset hypotension, with no alternate site of infection;
2. Either acute mental status change or acute functional decline with no alternate diagnosis and leukocytosis;
3. New-onset suprapubic pain or costovertebral angle pain or tenderness; and
4. Purulent discharge from around the catheter or acute pain, swelling, or tenderness of the testes, epididymis, or prostate.

Data Analysis

Two measures of agreement were used to determine between-rater agreement. McNemar's test was used to determine whether the Cooper tool and Stone criteria agreed on the appropriateness of the treatment. Any situation where the overall proportion of appropriate/not appropriate designations by the two examiners was similar would result in a lack of statistically significant difference between the two tools. Cohen's kappa (κ)—a chance corrected level of agreement of 2 categorical variables between 2 observers—also was used to measure inter-rater agreement.

RESULTS

Demographics

Over the 2-year period, 621 residents transitioned back to NHs after stays in 1 of the 4 target hospitals. Of those, 80 had a hospital-documented UTI diagnosis and treatment. One of the 80 residents originally included in the study was removed due to missing documentation and the inability to determine diagnosis and treatment. Of the remaining 79 eligible residents, 72.2% were female (n = 57) and 27.8% were male (n = 22), with a mean age of 78.9 years. The residents' mean hospital length of stay was 6.2 days.

Outcomes

The document review indicated that 9 of the 79 (11.4%) residents were appropriately treated when using the Stone criteria, while 11 of the 79 (13.9%) were appropriately treated when using the Cooper Tool. Of the 9 appropriately treated UTIs per Stone, 7 (77.8%) were catheterized and 2 (22.2%) were not. Of the 11 appropriately treated UTIs per Cooper, 9 (81.8%) were catheterized and 2 (18.2%) were not. Those with catheters had a higher percentage of appropriate treatments per the Cooper Tool and Stone criteria than did those without catheters. Sixty-four of the 79 residents were noncatheterized and of those only 2 (3.1%) were treated appropriately. These 2 cases were the same residents for both the Cooper Tool and the Stone criteria (Table 1). Of the catheterized residents, 60% were treated appropriately using Cooper and 46.7% using Stone.

Table 1
Appropriateness of UTI diagnosis: cooper tool and stone criteria comparison

Total nursing home residents diagnosed with and treated for UTI (N = 79)				
	Catheterized patients		Noncatheterized patients	
	15		64	
Urine cultures	12 Positive		7 Positive	
Cooper tool	9 met	3 did not meet	2 met	5 did not meet
Stone criteria	7 met	5 did not meet	2 met	5 did not meet

All but 3 residents had at least one documented sign and symptom for UTI diagnosis. There were 132 signs and symptoms of UTI that met the Cooper tool and Stone criteria. The most frequently cited symptoms were change in mental status (75.9%), followed by change in functional status (31.6%), and fever (26.6%; Table 2). Seventy-four additional non-UTI signs and symptoms were also documented.

Seventy-nine resident medical records were reviewed to examine the appropriateness of UTI treatment based on assessment and diagnostic criteria. An exact McNemar's test determined that there was not a statistically significant difference in the proportion of those who were or were not treated appropriately when analyzed using the Cooper tool and Stone criteria, P= .687. The level of agreement between the Cooper tool and Stone criteria was κ = 0.657, indicating a moderate level of agreement (Table 3).

In the urine diagnostic testing for the 79 residents, 0 urine dipsticks, 57 urinalysis, and 19 culture and sensitivities were performed. Less than one third of the residents' charts contained urinalysis results, and in some cases no urinalysis was ordered with a UTI diagnosis and treatment.

DISCUSSION

This study aimed to understand if hospitalized NH residents were appropriately diagnosed and treated for UTIs as assessed by 2 UTI criteria. With both Cooper and Stone, the results indicated that a high

Table 2
Documented urinary tract infection signs and symptoms

Sign/symptom	Total number of NH residents exhibiting sign/symptom (N=79)*
Change in mental status	60 (75.9%)
Change in functional status/decreased ADLs	25 (31.6%)
Fever	21 (26.6%)
Hypotension	8 (10.1%)
Experienced chills	5 (6.3%)
Dysuria	4 (5.1%)
New or increased incontinence	4 (5.1%)
Leukocytosis	3 (3.8%)
Suprapubic pain	1 (1.3%)
Frequency	1 (1.3%)
Urgency	0 (0%)
Change in urine character	0 (0%)
Acute prostate, testes, or epididymis pain, swelling, or tenderness	0 (0%)
Flank pain/CVA tenderness	0 (0%)
Gross hematuria	0 (0%)

ADLs, activity of daily living; CVA, costovertebral angle; NH, nursing home.
*Percentage = number of residents experiencing the sign/symptom divided by N.

Table 3
Tool comparison-appropriateness of UTI treatments

		Cooper tool		
		Not appropriate	Appropriate	Total N = 79
Stone Criteria	Not Appropriate	66	4	70
	Appropriate	2	7	9
Total N = 79		68	11	79

Comparison of tools (Stone and Cooper) for appropriateness of urinary tract infection (UTI) diagnosis and treatment in nursing home residents transferred to the hospital and back to the nursing home.

percentage of UTIs were not appropriately diagnosed or treated. Statistically, both Cooper and Stone showed a moderate level of agreement and no statistical difference in the assessment of appropriateness of treatment. In fact, even with differing criteria, Cooper and Stone agreed 100% of the time in appropriate treatments of noncatheterized residents. However, the benefit of the Cooper tool over Stone is ease of understanding and use, which is likely to increase implementation into practice by clinicians. Appropriate treatments were seen more frequently with catheterized residents with both Cooper and Stone, a finding that could be related to the fact that such residents require fewer signs and symptoms to meet the diagnostic criteria. For example, of those with a catheter, only mental status change, functional status change or fever are required by Stone to meet sign and symptom criteria. These 3 signs and symptoms were the most documented in this study.

Several of the diagnosed and treated UTIs were missing UTI-specific signs and symptoms (instead having non-UTI signs and symptoms documented in the patient EMR), and lacking urine culture to confirm diagnosis. Non-UTI signs and symptoms included descriptors such as abdominal pain, distension, nausea/vomiting, dehydration, dizziness, headache, anxiety, back pain, sleepiness, agitation, and several other nonspecific symptoms. In order to diagnose a UTI, specific terminology must be used. Nonspecific symptoms (eg, abdominal pain) could have been a UTI symptom (ie, suprapubic pain), but were not documented as such. In addition, only 72% of those treated for UTI had a documented urinalysis and only 24% had documentation of a culture and sensitivity, even while the literature supports the need for these in UTI diagnosis.[4,14,17,19] Using a standardized guideline or tool in the hospital with NH residents may promote more specific documentation. It is not known whether hospitals use NH specific guidelines when assessing NH residents. Specific UTI sign and symptom language also may not be used by all clinicians when diagnosing UTI. It is unknown what tools or standardized language was used in hospitals to identify symptoms reported by patients with a suspected UTI. While guidelines are not meant to replace clinical judgment, nurse and provider adherence to UTI guidelines has been low,[18,20,21] possibly due to the complexity of some of the diagnostic processes.

While Stone et al. identifies localized genitourinary signs and symptoms (eg, dysuria, frequency, urgency, incontinence, and suprapubic/testicular/flank pain) as the most predictive of UTI, they were among the least cited in this study (7.6%; Table 2).[19] This study found change in mental status as the most commonly documented sign of UTI (75.9%). While confusion has long been considered a UTI variable by clinicians caring for elderly individuals, the literature generally states that mental status changes alone should not be used to determine a UTI diagnosis.[22] With UTI remaining a leading nosocomial diagnosis for hospitalized NH residents and the potential for antibiotic resistance and adverse events with antibiotic treatments, this topic warrants further investigation.[23,24]

Several limitations could have impacted the study's findings, including the retrospective nature of the study and the small sample size. Additionally, the study relied on discharge documents that the hospital shared with NHs, rather than obtaining information directly from the hospital EMR. For the several charts missing urine cultures, we were unable to confirm whether the test was not done or if the data was not shared. The data needed to determine UTI diagnosis accuracy might have been more easily obtained from the hospital EMRs, which may have included more information about the patient's care. While the Stone criteria and Cooper tool had similar results, the complexity of the Stone criteria might be a barrier to its use. Finally, further study might be warranted to compare the time it takes to use the tools, the ease in which the tool is used, and nursing preference.

CONCLUSION

Antibiotic resistance and adverse events in NHs highlight the need to address the problem of inappropriate antibiotic treatments for UTIs and mandate a close stewardship of these patients, both of which depend on careful medical documentation. True antibiotic stewardship cannot be achieved without the appropriate assessment and diagnosis of infectious disease using published guidelines and processes, such as the Cooper Tool and Stone criteria. A variety of guidelines are used with NH residents and hospitalized patients for many common diagnoses and treatments. However, data on hospital use of guidelines specifically designed for NH residents is lacking.

Efforts are needed to improve education and promotion of UTI diagnosis and treatment guidelines in the hospital setting when caring for elderly NH residents. This study validates that inappropriate UTI treatments for NH residents also exist in these hospitals, however larger scale research is needed to extrapolate these findings to areas beyond southeast Michigan. Dissemination of research will improve awareness of this issue for healthcare providers for future antibiotic stewardship initiatives.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.ajic.2021.04.001.

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