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Initiating the Loeb Criteria in Long-term Care

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Initiating the Loeb Criteria in Long-term Care

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ABSTRACT

Urinary tract infections are one of the most commonly reported infections in long-term care. Current practices often rely on non-specific symptoms, rather than specific genitourinary symptoms, to aid in the decision to obtain a urine culture. The literature does not support this practice due to the high prevalence of asymptomatic bacteriuria among long-term care patients, which does not have adverse outcomes when untreated. Antibiotics do not eradicate asymptomatic bacteriuria and place patients at risk of adverse reactions and increased risk of multi-drug resistant organisms. This clinical improvement project applied the Loeb criteria in two long-term care facilities to reduce the frequency of asymptomatic bacteriuria treated with antibiotics. The Stetler Model was chosen as the model for research utilization, providing the practitioner with a process to guide the evaluation of research findings and application to clinical practice. The Loeb criteria provide guidelines for initiation of an antibiotic for urinary tract infections; their application in the long-term care has been associated with improved recognition of asymptomatic bacteriuria and reduced inappropriate antibiotic use in this vulnerable population (Loeb et al., 2005). Nursing staff and providers were educated on the Loeb criteria, which was implemented from June 2017 through November 2017. Retrospective data collection pre- and intervention occurred over the six- month period and outcomes were compared. Both facilities experienced a notable reduction of asymptomatic bacteriuria treated with antibiotics (62.5% for facility A and 45.8% for facility B).

Challenges for the facilities included inconsistent provider adherence to the criteria and high staff turnover. Overall, benefit from implementation of the Loeb criteria was observed, but continuing evaluation after placement of protocols will provide a clearer picture of patient outcomes. Nurse practitioners can apply evidence-based criteria, such as the Loeb criteria in order to reduce unnecessary antibiotic prescribing for asymptomatic bacteriuria. Nurse practitioners can be leaders in antibiotic stewardship programs, which have been mandated by the Center for Medicare and Medicaid, in long-term care.

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LIST OF ABBREVIATIONS

ASB.....	asymptomatic bacteriuria
LTC.....	long-term care
SUTI.....	symptomatic urinary tract infection

CHAPTER 1

PROJECT DESCRIPTION

INTRODUCTION

Urinary tract infections are one of the most frequently reported infections in the long-term care (LTC) setting (Genao & Buhr, 2012). Unfortunately, in the LTC setting it is difficult to differentiate a symptomatic urinary tract infection (SUTI) from asymptomatic bacteriuria (ASB). Therefore, consensus criteria have been developed to aid the provider in identifying SUTI, though they are not widely used. The purpose of utilizing the available criteria is to reduce the frequency of urine cultures ordered unnecessarily, therefore reducing patients' exposure to antibiotics and their associated risks. The Loeb criteria were implemented in two LTC facilities in an attempt to reduce the frequency of urine cultures ordered.

A urinary tract infection is defined as the combination of significant bacteria colony counts and localized genitourinary symptoms (Genao & Buhr, 2012). The laboratory standard for diagnosis of SUTI is bacteria present in the urine at $\geq 10^5$ cfu/ml (Nicolle, 2000). Pyuria, the presence of white blood cells on the microscopic examination of urine, is present in nearly all LTC residents, therefore not a good indicator for a urinary tract infection (Genao & Buhr, 2012). Genao and Buhr (2012) report the rates of urinary tract infection in LTC settings range from 0.6%-21.8%. The wide variance of SUTI is attributable to varying surveillance definitions and differences in patient populations among facilities (Nicolle, 2000). The most common organisms associated with SUTI in long-term care are *Escherichia coli*, *Proteus mirabilis*, *Klebsiella* species, *Pseudomonas aeruginosa*, *Providencia stuartii*, *Citrobacter* species, *Enterobacter* species, *Enterococcus*, group B *Streptococcus* and coagulase-negative staphylococci (Nicolle, 2000).

The presence of bacteria in the urine without localizing genitourinary symptoms is ASB (Genao & Buhr, 2012). Asymptomatic bacteriuria is confirmed by two consecutive urine specimens with quantitative bacterial count $\geq 10^5$ cfu/mL (Nicolle, 2000). Previous randomized controlled trials, comparing non-treatment versus treatment of ASB, demonstrated no difference in morbidity and mortality between the two groups, but increased risk of adverse events and multidrug-resistant organisms (Nicolle, Mayhew, & Bryan, 1987; Nicolle, Bjornson, Harding & MacDonell, 1983), therefore best-practice guidelines recommend no treatment of ASB (Nicolle, 2001). The prevalence of ASB in non-catheterized residents is estimated to be 18-75% for women and 19-38% for men (Genao & Buhr, 2012). The prevalence of ASB increases to 100% in residents with chronic indwelling urinary catheters (Nicolle, Bentley, Garibaldi, Neuhaus, & Smith, 1996). Pyuria is present in 90% of men and women with bacteriuria (Nicolle, 2000). Pyuria is also present in 30% of LTC residents without bacteriuria and can be attributed to interstitial nephritis, prostatitis, and vaginal inflammation (Nicolle, 2000). The presence of pyuria and bacteriuria in the community population is sufficient to diagnose a urinary tract infection but is not considered sufficient in LTC due to their high prevalence (Genao & Buhr, 2012). Ordering urine cultures for ASB in the LTC setting leads to misdiagnosis of SUTI, resulting in unnecessary antibiotic prescribing.

The LTC setting presents several challenges when addressing the diagnosis of a SUTI. The definitions of urinary tract syndromes such as urethritis, cystitis, and pyelonephritis are much clearer in the community setting (Genao & Buhr, 2012). A fever and a positive urine culture in the younger, community population would be sufficient to diagnose a SUTI (Nicolle, 2000). The classic genitourinary tract symptoms associated

with an infection include new onset or increased frequency of incontinence, dysuria, hematuria, and suprapubic pain (Genao & Buhr, 2012). These acute symptoms may be difficult to identify in LTC due to impaired communication from the resident (Nicolle, 2000). Communication barriers arise in the LTC setting due to advanced dementia and stroke, which may cause impaired cognition and aphasia (Genao & Buhr, 2012). Other comorbidities such as neurogenic bladder and benign prostatic hypertrophy contribute to baseline chronic genitourinary symptoms such as incontinence (Nicolle, 2000). Also, the definition of a fever has varied over the years and throughout the studies, which contributes to the struggle in defining a SUTI in LTC (Genao & Buhr, 2012).

Orr and colleagues (1996) found, when looking at 372 episodes of fever in the LTC setting, that SUTI was associated with less than 10% of significant febrile episodes. It was also found that bacteriuria was of low predictive value when identifying a SUTI associated with fever (Orr et al., 1996). When addressing other symptoms of a urinary tract infection, Nace, Drinka, and Crnich (2014), report little data supporting an association between mental status change and SUTI.

Agata, Loeb, and Mitchell (2013) found that minimum criteria required to treat a SUTI were often missing in nursing home residents with advanced dementia. The usual symptoms reported for a urinary tract infection such as dysuria, urgency, and suprapubic pain cannot be clearly expressed in the advanced dementia resident. In the study, a change in mental status was the most commonly reported symptom associated with a SUTI, but researchers cautioned against relying on mental status change, which is non-specific to a SUTI (Agata et al., 2013). The final recommendation from the study concluded that fever and a positive urine culture in the advanced dementia nursing home

patient may be adequate to treat SUTI, given there are no other signs or symptoms indicative of a different type of infection such as a respiratory infection (Agata et al., 2013).

Due to the complexity of diagnosing a SUTI in the LTC setting and the high prevalence of ASB, it is best practice for specific criteria to be met before a urine culture is ordered. The excessive ordering of urine cultures has led to the overprescribing of antibiotics (Nace et al., 2014). Unnecessary antibiotic exposure results in increased risk of adverse events such a *Clostridium difficile* infection, and organism drug resistance (Nace et al., 2014). Resistance to third-generation cephalosporins by *Klebsiella pneumoniae* doubled in the LTC setting from 1999-2010 (Nace et al., 2014).

Overuse of antibiotics is associated with increased antimicrobial resistance, adverse side effects, length of disease, increased severity of disease and increased healthcare costs (Llor & Bjerrum, 2014). The cost of multidrug-resistant organism infections in the United States health care system are estimated to be \$21 to \$34 billion, with an additional eight million days in hospital stays as reported in previous studies (Infectious Diseases Society of America, 2011). Doron and Davidson (2011) report comprehensive antibiotic stewardship programs, which support decreased antibiotic prescribing and the choice of less expensive antibiotics when prescribing is necessary, produced annual cost savings of \$200,000 to \$900,000.

CURRENT SETTING PRACTICE

This project was implemented in two LTC facilities in North Carolina. Facility A houses short-stay rehabilitation and LTC residents with an 88-bed capacity. Facility B has 120-beds and hosts short-stay rehabilitation, assisted living and LTC residents. There

are currently no antibiotic stewardship programs in place in either facility. Both facilities run infection control reports regularly, which track the frequency of urinary tract infections, organism grown on culture and ordering of antibiotics. The infection control reports do not differentiate between STUI and ASB. Any positive urine culture, which produces an order for an antibiotic is classified as a SUTI. The medical directors do not receive unnecessary antibiotic citations from the pharmacy, nor do they promote the use of decision support tools for the ordering of urine cultures.

Nursing documentation in Facility A was reviewed for all treated urine cultures, reported as a SUTI, though some may actually be ASB, from September 1, 2015 through September 30, 2016. There were 69 SUTI documented over the given time period. The rate of SUTI was 2.17 per 1000 patient days, assuming the facility maintained a full census for the year. All of the SUTI were nosocomial except for four, which were hospital-based. Nursing staff documented symptoms, whether generalized or specific to the genitourinary tract, in 50% of diagnosed SUTI. A fever was documented in eight (11.6 %) of the 69 SUTI. Dysuria was documented in seven (10.1%) of SUTI. Antibiotics were prescribed for 98.5% of the reported SUTI. Data was collected again during the pre-intervention period, June 2016 through November 2016, for statistical comparison with intervention data (Table 1.1). There were 16 episodes of ASB after evaluating the data according to the Loeb criteria. There were no episodes of SUTI identified. A fever was documented twice and nonspecific symptoms were documented approximately 62% of the time.

Nursing documentation in Facility B was evaluated for SUTI from January 1, 2017 through May 30, 2017. The previous method for data collection in the facility made

it difficult to obtain data prior to January 2017. Data from the inflectional control log and laboratory reports were evaluated according to the Loeb criteria and classified as SUTI or ASB. There were four SUTI and 32 ASB during that period (Table 1.2). Nursing staff documented symptoms that were not specific to the genitourinary tract in approximately 50% of cases. A fever was documented in two episodes.

Direct patient care is mostly provided by medication aides and licensed practical nurses. The license practical nurse assesses the patients and calls the physician for orders. The Director of Nursing, minimum data set nurses (minimum data set coordinators) and wound care nurses are comprised of registered nurses. Each facility has one Medical Director who is present in the building once or twice a week. A nurse practitioner is also present in each facility two to three times a week. Facility B also has a physician assistant present at least once a week.

CURRENT PRACTICE GAP

The LTC setting is unique in that the provider frequently initiates treatment for a urinary tract infection without assessing the patient (Nace et al., 2014). Communication between the nursing staff and the providers occurs over the phone and therefore providers have to make a quick real-time decision to prescribe antibiotics or maintain observation (Nace et al., 2014). Providers tend to opt for antibiotic prescriptions due to fear of missing an infection, or pressure from families (Nace et al., 2014). Adopting clinical criteria in the LTC setting will offer providers confidence in their decision to order urine culture or continue close observation.

McGeer and colleagues (1991) developed definitions of infections for surveillance and benchmarking in LTC facilities. According to the McGeer criteria

(1991) a SUTI for a patient without an indwelling urinary catheter is defined as having at least 3 of the following signs and symptoms: fever (≥ 38 °C) or chills, new or increased burning pain on urination, frequency or urgency, change in character of the urine, or worsening mental status. A SUTI for a patient with an indwelling urinary catheter is defined as having at least two of the following signs or symptoms: fever (≥ 38 °C) or chills, new flank or suprapubic pain or tenderness, change in the character of the urine, or worsening mental and functional status (McGeer et al., 1991). Nace and colleagues (2014) clearly describe the McGeer criteria as surveillance criteria, to be used to compare rates of SUTI for benchmarking purposes, rather than to determine if antimicrobial therapy is indicated. In 2012, Stone and colleagues updated the McGeer criteria to include clarification on the definition of a fever and change in mental status but did not change the purpose of the criteria as a surveillance tool. The revised McGeer criteria, or Stone criteria, is closely aligned with the Loeb criteria. Both set of criteria include acute dysuria, fever and one or more genitourinary symptoms, or no fever and two or more genitourinary symptoms sufficient for identifying a SUTI (Appendix D).

In 2001 the Loeb criteria was formulated at a consensus conference held by the Society for Healthcare Epidemiology of America as a minimum criterion for the initiation of antibiotics for infection (Loeb et al., 2001). Loeb and colleagues (2005), in a randomized controlled trial, further developed the criteria into a diagnostic and treatment algorithm (Appendix E & F).

Several reviewed studies involved chart reviews to assess how well documented urinary tract infections (DUTI) in LTC aligned to criteria, whether it is Loeb or McGeer. Kistler and colleagues (2017) reviewed 260 randomly selected cases of DUTI from 31

nursing homes in North Carolina and found only 15% met the Loeb criteria. Agata and colleagues (2013), reviewed 131 DUTI in 25 nursing homes, and only 16% of the episodes met the minimum criteria for the initiation of antimicrobials (Loeb criteria). Olsho and colleagues (2013) found that 10.2% of prescriptions for DUTI met the Loeb criteria. Doernberg, Dudas, and Trivedi (2015) looked at 183 antibiotic prescriptions for DUTI in LTC; only 8% met the Loeb criteria. Juthani-Mehta and colleagues (2005) found that 14 of 22 providers were aware of the McGeer criteria for noncatheterized residents and only 12 of the 14 providers used the McGeer criteria in practice. These studies reveal how infrequently criteria are being utilized in the prescribing of antibiotics in LTC.

Walker and colleagues (2000) completed a qualitative study addressing misconceptions of urinary tract infections by nursing staff and physicians. They found nursing staff were not aware that foul smelling urine alone is not an indication of urinary tract infection. One physician felt foul urine odor was the most common reason urine cultures were ordered, and if this criterion was no longer used as an indication, it would have an impact on the frequency urine cultures were ordered (Walker et al., 2000).

Prior to initiation of this project, facilities A and B lacked decision support tools, minimum criteria and SBAR tools for management of urinary tract infections. Urine cultures were frequently ordered for nonspecific findings such as cloudy or foul-smelling urine. These actions led to antibiotic prescribing for bacteria present in the urine, which may or may not have been a SUTI. The Loeb criteria were implemented in these facilities in order to provide best practice, minimize adverse events, and reduce healthcare cost.

The purpose of this project is to implement the use of the Loeb criteria as a decision-tool to reduce the number of urine cultures ordered in the LTC setting for ASB. It is anticipated that reduction of unnecessary antibiotic prescribing will reduce the risk of adverse events and growth of multidrug-resistant organisms.

PICOT STATEMENT

Among all residents within the LTC care facilities, does implementing the Loeb criteria (compared to usual care) result in a reduction of unnecessary urine cultures ordered, therefore reducing antibiotic prescribing for ASB, over a 6-month time period? (Table 1.3).

THEORETICAL FRAMEWORK

To guide the process of the project, the Stetler Model was chosen as the model for research utilization. The Stetler Model was originally published in 1976 and has undergone several revisions since then (Melnyk & Fineout-Overholt, 2015). The model provides the practitioner with a process, broken down into series of steps to guide the evaluation of research findings and their application to clinical practice (Melnyk & Fineout-Overholt, 2015). The model focuses on critical thinking and use of findings by the practitioner (Melnyk & Fineout-Overholt, 2015). The Stetler Model is broken down into five phases: preparation, validation, evaluation/decision making, translation/application, and evaluation (Melnyk & Fineout-Overholt, 2015). The Stetler model was chosen for this study because it considers both external evidence, obtained from research, and internal evidence, which includes locally obtained facts and information. Internal revealed the problem necessitating a review of external evidence in order to find an evidence-based solution for the problem. The fluid steps of the Stetler

are easily integrated into the practitioner's routine way of thinking, which facilitates the implementation of an evaluative process that encourages the application of evidence-based solutions in practice (Melnyk & Fineout-Overholt, 2015).

DESCRIPTION OF SEARCH STRATEGY

The volume of information for the literature review primarily came from PubMed and CINAHL research databases. Few articles relevant to urinary tract infections in LTC were available from The Joanna Briggs Institute and Cochrane Library. The following search terms were used for the literature review: urinary tract infection, UTI, LTC, nursing homes, residential care facilities, criteria, McGeer criteria, Loeb criteria, and Stone criteria. The Boolean operator, AND, was used to link the term “urinary tract infection” with terms specific to setting or criteria in order to answer the PICOT question (Melnyk & Fineout-Overholt, 2015). The Boolean operator, OR, was used to expand the search results for urinary tract infection and UTI. See Table 1.4 for a summary of results for search terms and databases.

Articles were excluded from evaluation if they did not address antibiotic prescribing for urinary tract infections in LTC by utilizing available criteria, only addressed catheter associated urinary tract infections, or prevention of urinary tract infections. There is limited research available that specifically addresses the Loeb criteria. Articles with C ratings for quality of evidence were excluded from the evidence table. Articles published prior to 2012 were included due to the limited literature available on the specific criteria. The original McGeer criteria were produced in 1991, which stimulated research to validate the criteria in the years after. The original Loeb criteria were produced in 2001, stimulating further research regarding the use of

evidence-based criteria to reduce antibiotic prescribing in LTC. Articles that focused on the settings of LTC, nursing homes and residential care facilities were included in the analysis. Article review was restricted to publications in English.

Eighteen articles were included in the final analysis. These articles provide data on the scope of the problem, barriers to implementation of evidence-base practice and recommendations for change. The final analysis included two randomized controlled trials, two systematic reviews, four consensus reviews, two qualitative case studies, four descriptive studies, one prospective cohort, one cross sectional analysis study, one prospective quasi-experimental study, and one quality improvement project (Appendix A). Evidence was critically appraised using the Johns Hopkins Nursing Evidence-Based Practice Non-Research Evidence Appraisal Tool (Appendix C) and the Johns Hopkins Nursing Evidence-Based Practice Research Evidence Appraisal Tool (Appendix B) providing a simple and concise method for evaluating the quality of the evidence. (Dearholt & Dang, 2012). Hierarchy of the evidence is explained by Melnyk and Fineout-Overholt (2015), who described systematic reviews of randomized controlled trials as evidence with the highest level of confidence, followed by individual randomized controlled trial studies. The Loeb criteria, which are supported by a cluster randomized controlled trial to reduce antibiotic prescribing in LTC, were selected for the intervention.

REVIEW OF THE LITERATURE

There have been few clinical trials aimed at the diagnostic criteria for SUTI in LTC populations, therefore, no evidence-based guidelines have been developed (Nicolle et al., 1996). Consensus criteria have been developed over time and endorsed by

infection control experts (Nace et al., 2014). The first criteria were developed in 1991 by McGeer and colleagues and then later updated by Stone and associates (2012). The original McGeer criteria have never been validated for use in management of urinary tract infections, having been developed for surveillance in the LTC setting (Stone et al., 2012). The revised McGeer criteria added a positive urine culture, which was not required in the original criteria (Stone et al., 2012). Nace et al. (2014) report that the McGeer criteria (Appendix A) and the revised McGeer criteria (Appendix D) are designed for surveillance and benchmarking. The Loeb criteria (Appendix E) were developed in 2001 and were designed to serve as the minimum criteria for the initiation of antibiotics for a urinary tract infection (Loeb et al., 2001). The criteria were used in a randomized controlled trial in 2005, which, when applied showed a significant decrease in antibiotics prescribed for urinary tract infections (Loeb et al., 2005).

Juthani-Mehta and colleagues (2007) evaluated the diagnostic accuracy of the McGeer criteria and Loeb criteria for SUTI. The goal of the study was to assess how well the criteria identified patients with an SUTI, as opposed to ASB, based on laboratory evidence, > 100,000 CFU on urine culture and > 10 WBCs on urinalysis (Juthani-Mehta et al., 2007). Participants (n= 340) were under prospective surveillance over one year for development of an SUTI (Juthani-Mehta et al., 2007). The McGeer criteria were found to have a 30% sensitivity rate and 82% specificity rate (Juthani-Mehta et al., 2007). The Loeb criteria were found to have a 19% sensitivity and 89% specificity rate (Juthani-Mehta et al., 2007). One significant limitation to the study was that patients were not tested during asymptomatic periods therefore a baseline of ASB could not be established in the cohort, which could skewed the sensitivity rate (Juthani-Mehta et al., 2007).

During the study, the determination of an SUTI was based on the judgment of a nurse or physician rather than using an established criterion to identify a SUTI (Juthani-Mehta et al., 2007). Juthani-Mehta and colleagues (2007) found antibiotic prescribing occurred for a large portion of patients who lacked laboratory evidence of an SUTI during the study.

Despite the availability of decision-making criteria, they are not widely used in practice (Nace et al., 2014). Providers consistently rely on nonspecific symptoms, such as functional decline or behavioral changes, as signs of an infection in the elderly population (Nace et al., 2014). There is no clear correlation between nonspecific symptoms and urinary tract infection in the literature (Nace et al., 2014). Therefore, there is no recommendation to utilize nonspecific symptoms solely for diagnosis of a urinary tract infection (Nace et al., 2014), except in the setting of an isolated fever or leukocytosis in the advanced dementia patient (Agata et al., 2013).

While there is little level I or II evidence supporting the use of specific criteria for antimicrobial prescribing, there is level I evidence that supports non-treatment for ASB in LTC (Loeb et al., 2005). In a randomized controlled trial, the treatment of ASB with antibiotics did not improve patient outcomes or mortality (Nicolle, Mayhew, & Bryan, 1987). However, the group who received antibiotics in the trial, had an increase in adverse drug events and antibiotic resistance when compared to the no-therapy group (Nicolle et al., 1987). Nicolle, Bjornson, Harding, and MacDonell (1983) in a randomized controlled trial, found no benefit to prescribing antibiotics for ASB.

Nicolle (2001) reported that a lack of fever and localized urinary tract symptoms, with a positive urine culture is not a definite urinary tract infection, level II evidence, quality rating A. Therefore, Nicolle (2001) recommends that standard diagnostic criteria

for long-term care should be used to diagnose SUTI, level of evidence II, quality-rating B. Finally, Nicolle and colleagues (2005) recommends that ASB not be treated with antimicrobial therapy in LTC residents, level I evidence, quality-rating A.

Loeb and colleagues (2001) in a prospective observational cohort study found 30% of antibiotics prescribed were for ASB based on the surveillance definition in the McGeer criteria. When compared to surveillance definitions, systemic antimicrobials are found to be inappropriately prescribed 25-75% of the time (Nicolle et al., 1996). Inappropriate prescribing of antibiotics places patients at risk for adverse drug events and increased risk of antibacterial resistance (Nicolle et al., 1996). Increasing antibiotic resistance has been noted in LTC. Das and colleagues (2009) found *E. coli* to be resistant to ampicillin 45% of the time, and resistant to fluoroquinolones 60% of the time.

Rotjanapan, Dosa, and Thomas (2011), assessed the appropriateness of antibiotic therapy in nursing home residents. Patients who received antibiotic therapy but did not meet the McGeer criteria were 8.5 times more likely to develop *Clostridium difficile* within three months of treatment when compared to the rest of the nursing home population. The complicated presentation of a urinary tract infection in the elderly LTC patient coupled with the known high incidence of ASB contributes to overprescribing of antimicrobials in this setting (Nicolle et al., 1996). The Centers for Medicare and Medicaid Services (CMS) (2016) addressed this problem by requiring LTC facilities to have antibiotic stewardship programs in place to monitor antibiotic prescribing.

FEASIBILITY

The feasibility of this project lies in the simplicity of the intervention, which required nursing staff and providers to follow criteria for ordering a urine culture. The

project did not require additional staff or cost for the facility to implement and held the possibility of significant cost benefits if reduction of laboratory testing and antibiotic prescribing were observed. Additional documentation outside of the nursing note was not required of the nursing staff to ensure compliance with the criteria.

Lohfeld, Loeb, and Brazil (2007) conducted a qualitative study to examine the views of nursing staff and administrators after the Loeb criteria were used in a randomized controlled trial in the facilities. Barriers identified by staff included: buy-in from staff, changing long-standing practices and ensuring new staff and part-time staff followed the procedures of the intervention (Loeb et al., 2005). Throughout the literature it is noted that providers can be reluctant to use the available criteria in their daily practice. Doernberg and colleagues (2015) implemented an antibiotic stewardship program in LTC facilities where recommendations for antibiotic prescribing for urinary tract infections were given to physicians. Recommendations for change were made in 38% of the antibiotic prescriptions, but only 10% of the recommendations were accepted by physicians (Doernberg et al., 2015). The success of implementing the criteria during this project hinges on provider buy-in and may require additional support throughout the intervention.

Another barrier to the proposed project was staff turnover, at bedside and administrative levels, which could result in inaccurate reporting of SUTI, and unfamiliarity with the Loeb criteria. Part-time or weekend staff may also be less familiar with the Loeb criteria since in-services occurred on weekdays. It was essential to collaborate with the Director of Nursing in each facility to monitor the onboarding of new staff during the intervention period.

Pharmacies and laboratory companies that are contracted with the facilities posed a barrier to information. If the facilities change contracts with laboratories or pharmacies during the intervention period it could impact the availability of data for antibiotic prescribing and the frequency of urine cultures ordered.

Additional factors that may confound results include residents who may be diagnosed and treated for a urinary tract infection at an outpatient urology office or during an emergency room visit. Outpatient offices and the emergency department are not within the borders of this project setting and may not follow the Loeb criteria in their practice. These episodes may impact the number of SUTI or ASB reported by the facilities.

METHODS

Design and setting. The project was a non-experimental quality improvement project implemented in LTC care facilities in North Carolina. Facility A is a combined short-stay rehabilitation and LTC residential facility with an 88-bed capacity. Facility B is a 120-bed combined short-stay rehabilitation, assisted living and LTC residential facility. All rehabilitation and LTC residents in both facilities were included in the project.

Institutional review board. An IRB proposal was submitted to the Office of Research and Compliance at the University of South Carolina. It was determined that the project was not subject to the Protection of Human Subject Regulations and therefore no further oversight was required (Appendix G). Approval from the administrators at each facility was obtained prior to the intervention period.

Data collection. Retrospective data collection including incidence of SUTI, ASB, type of organism, symptoms documented and antibiotic prescribed occurred over a 6-12-month period depending on availability of data. The data was obtained from the nursing documentation, infection control report, pharmacy medical records, information technology department of the laboratory, and patient orders.

Intervention. The study intervention utilized the Loeb criteria in two LTC facilities from June 2017 through November 2017. Training in-services were held for nursing staff at both sites. Providers were approached during one-on-one meetings. The nursing staff was provided with a data collection tool in order to improve communication with the provider and documentation in the patient chart. Copies of the Loeb criteria were placed at the nursing stations for easy access. The infection control report and nursing documentation was reviewed at two-week intervals, if available, to monitor for compliance with the Loeb criteria during the intervention period. One-on-one reeducation was completed with providers and nursing staff when non-compliance was identified.

Instruments. The data collection tool was derived from the Loeb criteria and included the algorithm for ordering a urine culture (Appendix H). Nursing staff were asked to document if a urinalysis and culture were ordered including any additional orders such vital sign monitoring. The tool provided the nursing staff with a documentation and communication aid for reporting a urinary tract infection to the providers.

Outcomes. For the purpose of analysis, any positive urine culture, which was ordered without meeting the Loeb criteria, regardless whether treated with antibiotics will

be classified as ASB. A positive urine culture, which met Loeb criteria for ordering will be classified as a SUTI. The measurable outcome variables included number of urine cultures ordered, number of ASB, number of SUTI and number of antibiotics prescribed. These outcomes were compared to the data collected retrospectively before the intervention period.

Data analysis. Descriptive statistics included a frequency table for the categorical variables including frequency of SUTI, ASB, number of antibiotics prescribed for ASB and number of urine cultures ordered.

Table 1.1

Facility A Pre-intervention SUTI vs. ASB

	June	July	August	September	October	November	Total
UTI	0	0	0	0	0	0	0
ASB	6	1	4	0	4	1	16

Note. Data collection period June 2016 through November 2016.

Table 1.2

Facility B Pre-intervention SUTI vs. ASB

	January	February	March	April	May	Total
UTI	1	0	2	1	0	4
ASB	7	2	2	10	11	32

Note. Data collection period January 2017 through May 2017.

Table 1.3

PICOT question

Population	Intervention	Comparison	Outcome	Timing
All LTC residents within two LTC facilities	Decision-making guided by the Loeb criteria for ordering urine cultures and prescribing antibiotics.	Usual care	Reduce ordering of unnecessary urine culture and sensitivity and prescribing of antibiotics	Over a 6-month period

Table 1.4

Volume of Search Results

Search term(s)	Database	Results
McGeer criteria	CINAHL	10
	Joana Briggs Institute	1
	PubMed	80
Loeb criteria	CINAHL	3
	PubMed	231
Stone criteria	CINAHL	18
UTI AND long-term care	CINAHL	283
	PubMed	783
Urinary tract infection AND long-term care	Cochrane Library	6
UTI OR urinary tract infection AND long term care	CINAHL	9,920
Urinary tract infections AND residential care facilities	PubMed	7
Urinary tract infections AND nursing homes	PubMed	3
Bacteriuria AND long-term care	PubMed	159
Pyuria AND long-term care	PubMed	20
Loeb criteria AND urinary tract infection	CINAHL	415
	PubMed	3,362

CHAPTER 2

MANUSCRIPT: “INITIATING THE LOEB CRITERIA IN LONG-TERM
CARE”¹

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ABSTRACT

Urinary tract infections are one of the most commonly reported infections in long-term care facilities. Current practices often rely on non-specific symptoms, in place of specific genitourinary symptoms, to aid in the decision to obtain a urine culture. The high prevalence of asymptomatic bacteriuria in the long-term care population may result in unnecessary treatment with antibiotics. This clinical improvement project applied the Loeb criteria in two long-term care facilities in order to reduce the frequency of asymptomatic bacteriuria treated with antibiotics. The frequency of symptomatic urinary tract infections, asymptomatic bacteriuria, urine cultures ordered, and antibiotics prescribed were also monitored. Both facilities experienced a notable reduction of asymptomatic bacteriuria treated with antibiotics (62.5% for facility A and 45.8% for facility B). Nurse practitioners can apply evidence-based criteria in the long-term care setting where antibiotic stewardship programs have been mandated by the Center for Medicare and Medicaid

Keywords: asymptomatic bacteriuria, symptomatic urinary tract infection, long-term care, Loeb criteria

INTRODUCTION

Urinary tract infections are one of the most frequently reported infections in the long-term care (LTC) setting, with rates ranging from 0.6-21.8% (Genao & Buhr, 2012). The wide variance in reported rates is attributable to varying surveillance definitions and differences in patient populations among facilities (Nicolle, 2000). Unfortunately, in the LTC setting it is difficult to properly differentiate a symptomatic urinary tract infection (SUTI) from asymptomatic bacteriuria (ASB), defined as the presence of bacteria in the urine without localizing genitourinary symptoms (Genao & Buhr, 2012). The presence of pyuria and bacteriuria in the community population is sufficient to diagnose a urinary tract infection, but is not considered sufficient in LTC (Genao & Buhr, 2012). The prevalence of ASB in non-catheterized LTC residents is estimated to be 18-75% for women and 19-38% for men (Genao & Buhr, 2012). The prevalence of ASB increases to 100% in LTC residents with chronic indwelling urinary catheters (Nicolle, Bentley, Garibaldi, Neuhaus, & Smith, 1996). Many of the randomized controlled trials addressing the overtreatment of ASB in LTC are greater than 20 years old and have not been repeated, but their results were substantial. The randomized controlled trials, comparing non-treatment versus treatment of ASB, demonstrated no difference in morbidity and mortality between the two groups, but increased risk of adverse events and multi-drug resistant organisms (Nicolle, Bjornson, Harding & MacDonell, 1983; Nicolle, Mayhew & Bryan, 1987). Nicolle and colleagues (1998) could not demonstrate bacteriuria having a direct causative role on mortality in LTC residents. Previous studies found significant short-term risks, such as antimicrobial resistance and adverse drug reactions, and no long-term benefit of treating ASB (Nicolle, 2001). Ordering urine

cultures for ASB in the LTC setting leads to misdiagnosis of SUTI, resulting in unnecessary antibiotic prescribing (Loeb et al., 2005).

The lack of evidence-based definitions for symptoms of a urinary tract infection in the LTC resident population make diagnosis of SUTI in these settings more challenging (Genao & Buhr, 2012). Urinary tract syndromes such as urethritis, cystitis, and pyelonephritis are more easily identified in the community population (Genao & Buhr, 2012). The classic genitourinary tract symptoms associated with an infection include new onset or increased frequency of incontinence, dysuria, hematuria, and suprapubic pain (Genao & Buhr, 2012). These acute symptoms may be difficult to identify in LTC residents due to an overlap of chronic genitourinary symptoms caused by neurogenic bladder and benign prostatic hypertrophy (Nicolle, 2000). Neurogenic bladder impairs emptying of the bladder and causes ureteric reflux, which contributes to the development of bacteriuria (Walker, McGeer, Simor, Armstrong-Evans, & Loeb, 2000). Significantly lower levels of estrogen in postmenopausal women cause atrophy and decreased vaginal lubrication, resulting in dysuria, incontinence and urgency (Bremnor & Sadovsky, 2002). conditions such as advanced dementia and stroke, which may cause impaired cognition and aphasia, are common in this population, and lead to a communication barrier (Genao & Buhr, 2012). Mental status change is commonly used as a symptom of an SUTI, but Nace, Drinka, and Crnich (2014), report little data supporting an association between mental status change and SUTI. Fever is often included as a symptom, but the definition of a fever has varied over the years and throughout studies (Genao & Buhr, 2012). In an examination of 372 episodes of fever in a LTC setting, Orr and colleagues (1996) found that urinary tract infections were

associated with less than 10% of significant febrile episodes. One study concluded that fever and a positive urine culture in the advanced dementia nursing home patient may be adequate to treat SUTI, given there are no other signs or symptoms indicative of a different type of infection such as a respiratory infection (Agata, Loeb, & Mitchell, 2013).

Due to the complexity of diagnosing a SUTI in the LTC setting and the high prevalence of ASB, it is best practice for specific criteria to be met before a urine culture is ordered. The excessive ordering of urine cultures has led to the overprescribing of antibiotics (Nace et al., 2014). Overuse of antibiotics is associated with increased antimicrobial resistance, adverse side effects, increased mortality and increased length of hospital stay (Llor & Bjerrum, 2014). The cost of multidrug-resistant organism infections in the United States health care system is estimated to be \$21 to \$34 billion, with an additional eight million days in hospital stays as reported in previous studies (Infectious Diseases Society of America, 2011). Doron and Davidson (2011) reported comprehensive antibiotic stewardship programs, which support decreased antibiotic prescribing and the choice of less expensive antibiotics when prescribing is necessary, produced annual cost savings of \$200,000 to \$900,000.

There have been few clinical trials aimed at defining the diagnostic criteria for SUTI in LTC populations; therefore, no evidence-based guidelines have been developed (Nicolle et al., 1996). Consensus criteria have been developed over time and endorsed by infection control experts (Nace et al., 2014). The Loeb criteria were developed in 2001 and serve as the minimum criteria for the initiation of antibiotics for a urinary tract infection (Loeb, Bentley, et al., 2001) (Table 2.1). The criteria also included skin and

soft-tissue infections, respiratory infections and fever of unknown origin, which are not included in this project (Loeb, Simor, et al., 2001). Application of the criteria, specifically for SUTI, in a randomized controlled trial in 2005 resulted in a significant decrease in antibiotics prescribed for suspected urinary tract infections (Loeb et al., 2005). The Loeb criteria incorporate fever, acute dysuria and specific genitourinary symptoms as indications for ordering a urine culture (Loeb et al., 2005). These criteria also include a treatment algorithm, which includes a decision path for a positive urine culture ($> 10^5$ CFU/ml) or a negative urine culture (Loeb et al., 2005). The high prevalence of dementia residents in LTC often prevents providers and staff from ascertaining specific genitourinary symptoms when a SUTI is suspected. An isolated fever or leukocytosis in the advanced dementia patient may be the only time to utilize non-specific symptoms for diagnosis of an SUTI (Agata et al., 2013). Historically, providers feel that diseases in frail elderly patients present atypically, therefore increasing favor for non-specific symptoms when determining a diagnosis of SUTI (Nace et al., 2014). In the LTC setting, providers often rely on symptoms such as loss of appetite to support diagnosis (Kistler et al., 2017), or make treatment decisions for a SUTI based on nursing staff report without assessing the patient (Nace et al., 2014). Subtle changes in resident status noted during daily nursing assessments may trigger a request for a urinalysis and culture (Walker et al., 2000). Factors that impact treatment decisions include pressure from family members to treat a SUTI based on changes they have observed or pressure from staff members to treat as a precaution (Walker et al., 2000). Unfortunately, there is no clear correlation between nonspecific symptoms and an SUTI

in the literature (Nace et al., 2014). Therefore, there is no recommendation to utilize nonspecific symptoms solely for diagnosis of an SUTI (Nace et al., 2014).

METHODS

This project was a non-experimental quality improvement project implemented in two LTC facilities in North Carolina. The purpose of the project was to implement the use of the Loeb criteria as a decision-tool to reduce the number of urine cultures ordered in the LTC setting for ASB. It was anticipated that reduction of unnecessary antibiotic prescribing would reduce the risk of adverse events and growth of multidrug-resistant organisms. Facility A is an 88-bed facility comprised of rehabilitation and LTC residents. Facility B is a 120-bed facility comprised of rehabilitation, assisted living and LTC residents. All rehabilitation and LTC residents in both facilities were included in the project. Direct patient care is mostly provided by medication aides and licensed practical nurses. The license practical nurse assesses the patients and calls the provider for orders. The Director of Nursing, minimum data set nurses (minimum data set coordinators) and wound care nurses are comprised of registered nurses and help direct patient care plans. Each facility has one Medical Director who is present in the building once or twice a week. A nurse practitioner is also present in each facility two to three times a week. Facility B also has a physician assistant present at least once a week. The project was approved by facility administrators and determined by IRB to be exempt from human subjects oversight.

Retrospective data collection including incidence of SUTI, ASB, type of organism, symptoms documented and antibiotic prescribed occurred over a 6-12-month period depending on availability of data. Cases of suspected urinary tract infections were

captured from the infection control log, nursing documentation and urine culture reports from the information technology department of the laboratory. Prescribing patterns were obtained from the patients' orders and pharmacy medical records. Nursing staff was educated during in-services scheduled in the early morning and late afternoon in order to cover all shifts prior to the intervention period. Nursing staff were provided with a PowerPoint presentation and an orientation to the data collection tool, which served as both a documentation and communication tool for the staff. The data collection tool displayed the Loeb criteria diagnostic algorithm and prompted staff to document symptoms, acknowledge whether criteria was met or not, and additional orders (monitoring vital signs, increase fluid intake, laboratory testing and antibiotics). The tool provided the nursing staff with a documentation and communication aid for reporting a suspected urinary tract infection to the providers, but did not replace documentation in the nursing note, and thus its use was not mandatory. The Loeb criteria were placed at the nursing stations for easy access. The infection control report and nursing documentation were reviewed at two-week intervals, as available, to monitor for compliance with the Loeb criteria during the intervention period. Providers were educated during face-to-face visits and provided copies of the diagnostic and therapeutic algorithms.

For the purpose of this project, any positive urine culture that did not meet the Loeb criteria, whether treated with antibiotics or not, was classified as ASB. A positive urine culture treated with antibiotics that satisfied the Loeb criteria was classified as a SUTI. The measurable outcomes included frequency of SUTI and ASB, number of urine

cultures ordered, and number of antibiotics prescribed. These outcomes were compared to the data collected retrospectively before the intervention period.

Descriptive statistics included a frequency table for the categorical variables including frequency of SUTI, ASB, number of antibiotics prescribed for ASB and number of urine cultures ordered.

RESULTS

Facilities A and B were monitored for rates of SUTI, ASB, urine cultures ordered, antibiotics prescribed and nursing symptom documentation from June 2017 through November 2017. The infection control log maintained by the quality assessment nurse was reviewed to determine SUTI and ASB. Frequency of antibiotics prescribed was acquired from the medical records of the contracted pharmacy. Urine culture data was obtained from the information technology department of the contracted laboratory.

Table 2.2 shows the total number of ASB and SUTI in the pre-intervention and intervention period for both facilities. There was a 62.5% reduction in episodes of ASB treated with antibiotics in facility A, while facility B had a smaller reduction of 45.83% during the intervention period (Table 2.3). Overall, in both facilities, when a urine culture was ordered during the intervention period for a suspected UTI it was more likely to be a true SUTI rather than ASB. Urine cultures obtained for cases classified as ASB received antibiotics less frequently. During the intervention period there were more incidence of SUTI than during the pre-intervention period (Table 2.3).

Facility B had eight known urine cultures with no growth or < 100k CFU/ml. *Escherichia coli* was the most common organism cultured; other organisms included *Enterococcus faecalis*, *Proteus mirabilis*, *Morganella morganii*, *Acinetobacter baumannii*,

Enterobacter aerogenes, *Streptococcus agalactiae* (group B), *Providencia species*, and *Citrobacter youngae*. Fourteen urine cultures were resistant to more than one antibiotic, and four urine cultures were resistant to four or more antibiotics.

Facility A had one urine culture with no growth or < 100k CFU/ml. Similar to facility B, the most common organism was *Escherichia coli*, but other organisms included *Enterococcus faecalis* and *Pseudomonas aeruginosa*. Six of the urine cultures were resistant to three or more antibiotics.

The most common antibiotics ordered to treat the urinary tract infections included fluoroquinolones, nitrofurantoin, cephalosporins, amoxicillin, and amoxicillin/clavulanate. There were no reported episodes of adverse drug reactions during the intervention period, as well as no episodes of *Clostridium difficile* related to antibiotic prescribing for urinary tract infections.

DISCUSSION

The purpose of this quality improvement project was to implement the Loeb criteria in hope of reducing unnecessary urine cultures to avoid antibiotic prescribing for ASB. Retrospective data review at facility A revealed many urine cultures were obtained for non-specific symptoms or in several cases with no documentation of symptoms. During the intervention period, there were still patients who had urine cultures obtained without meeting the Loeb criteria, but the frequency was reduced. Facility A had a 62.5% reduction in the frequency of ASB inappropriately treated with antibiotics. The reduction can be attributed to providers and nursing staff adopting the criteria more consistently than in facility B. Facility A experienced less staff turnover, and consistency in the leadership positions was maintained. Facility A is also a smaller facility than

facility B, which might have impacted the frequency of SUTI and ASB reported. The characteristics of the resident population, such as age, sex, race and co-morbidities were not analyzed. Patient characteristics could potentially affect the frequency of SUTI and ASB identified in each facility.

Factors related to providers

There were several occasions when a urinalysis and culture was ordered based on symptoms not associated with the Loeb criteria, such as mental status change or abdominal pain; therefore, the diagnostic algorithm of the criteria was not followed. On one occasion a resident who was sent to the emergency room for a mental status change received an antibiotic based on the urinalysis alone and was discharged back to the facility. As previously stated, 90% of the LTC population with bacteriuria have pyuria on urinalysis, and therefore it is of little diagnostic value to the provider (Walker et al., 2000).

Based on the data from this project, there was less frequency of ASB being treated with antibiotics, even when a culture was ordered. This can be attributed to the provider following the therapeutic algorithm of the Loeb criteria. Symptoms may have resolved, the patient remained afebrile, or additional laboratory results such as a complete blood count were negative for signs of infection during the time the urine culture was being processed. During these cases, the provider appeared to opt for observation and monitoring, which should be strongly considered as a treatment option, opposed to antibiotic prescribing, in LTC (Nace et al., 2014). Loeb and colleagues (2005) did not demonstrate a statistically significant reduction in urine cultures ordered between the study arms, though implementation of the Loeb criteria still may have had an impact on

antibiotics prescribed. This is consistent with Loeb's suggestion that the therapeutic algorithm (guides treatment) may have had a greater impact than the diagnostic algorithm (guides ordering of urine cultures) when the criteria were implemented in the LTC setting (Loeb et al., 2005).

During this project the providers did not always follow the therapeutic algorithm. For example, one provider at facility B had a pattern of ordering a follow-up urinalysis and culture when the antibiotics were completed. This resulted in a second positive urine culture on one occasion, without meeting the Loeb criteria, and therefore additional antibiotics prescribed. There is a lack of data to support ordering urine cultures as a "test of cure" and this should be avoided (Nace et al., 2014). This provider received additional education and stopped ordering repeat urine cultures towards the end of the intervention period. Ongoing reinforcement for implementation of the criteria with every case of suspected urinary tract infection will be required to change out dated practice in LTC. Collaborative buy-in can be achieved through provision of evidence-based literature and observing, over time, the long-term benefits of not prescribing for ASB, demonstrated by no change in mortality or hospitalization rates among the LTC population.

The most common symptoms reported included dysuria, urgency, frequency and incontinence. New onset burning on urination in the absence of fever meets criteria for ordering a urinalysis and culture according to the Loeb criteria. It is unclear whether the nursing staff or providers differentiated between acute, new or worsening and chronic symptoms, which may have contributed to a large number of urine cultures ordered. Providers need to continue to assess all possible causes of dysuria, whether related to estrogen deficiency or benign prostatic hypertrophy, based on the patient's medical

history and age in order to reduce unnecessary ordering of urine cultures. It will be necessary for the provide, to complete a genitourinary assessment as a part of the decision to order a urine culture. A physical assessment will provide a better understanding of the source of the patient's symptoms, for example erythematous labia and vaginal discharge would reveal a vulvovaginal candidiasis opposed to an SUTI, therefore altering treatment.

Factors related to staff

During the randomized controlled trial done by Loeb and colleagues (2005), nursing staff were required to complete a one-page log of signs and symptoms for every resident suspected of having a urinary tract infection. A data collection tool was provided to the nursing staff in order to guide their communication with the provider and also enhance their nursing documentation in the patient's chart. Nursing staff were not mandated to use the tool out of concern that it would result in less compliance with the project due to additional work burden. It is possible that the absence of a consistent prompt negatively affected staff adherence to the criteria. In retrospect, optional use also led to an inability to account for possible decisions made *not* to culture based on the Loeb criteria, which resulted in a loss of data.

This project also revealed inaccurate documentation of SUTI on the infection control log. All urine cultures treated with an antibiotic were labeled as a urinary tract infection. Many of the episodes of documented urinary tract infection did not meet the Loeb criteria. Surveillance of SUTIs should be done with existing criteria in order to accurately differentiate between SUTI and ASB. Nursing staff in charge of quality measures and infection control in LTC should receive specific training on available

criteria, adverse events of antibiotic exposure and the rise of multi-drug resistant organisms.

Factors related to setting

The setting continues to pose a difficult challenge where there are only a few providers present occasionally throughout the week. Obtaining buy-in is easier with a smaller number of providers, but lack of adherence by one could have disproportionate impact on project outcomes. In the LTC setting, licensed practical nurses are performing the majority of the assessments, but lack sufficient training in assessment and evidence-based practice compared to registered nurses, which combined with high turnover has implications for quality of care and the training approach for the Loeb criteria.

Continual staff turnover during the intervention period, especially at facility B, may have potentially affected adherence to the Loeb criteria. Cooper, Titler, Struble and Redman (2017) identified the importance of implementing “change champions”, who were elected to support the implementation process of urinary surveillance tool. This project did not have specific “change champions”, which may have impacted the adherence to the Loeb criteria. During this project, the director of nursing and the quality assessment nurse were supportive of implementing change. Facility B experienced turnover in the director of nursing position during the intervention period. The director of nursing plays an important role in encouraging nursing staff to engage and adopt new implementation and this may have impacted the results of this project.

Old standing orders to obtain a urine culture for urinary symptoms were present in all the patients’ charts prior to the intervention. No specific urinary symptoms were listed in the standing orders, which gave nursing staff free reign to obtain urine cultures

based on any symptom. The facilities are updating the standing orders to include the Loeb criteria.

The project relied on data collection obtained from outside sources including the quality assessment nurse, pharmacy medical records and information technology department for the laboratory, therefore errors in data collection may not have been recognized.

The in-services provided for the nursing staff were limited to one day, two in-services, per facility due to time constraints prior to the intervention start date, compared to the four week training period due the Loeb study (Loeb et al., 2005). Additional in-services should be provided to guarantee all staff, including part-time and weekend staff, were educated on the criteria and improve adherence.

CONCLUSION

This project demonstrated that implementation of the Loeb criteria can reduce the rate of ASB unnecessarily treated with antibiotics in a facility and thereby mitigate the risks of adverse drug events and multi-drug resistant organisms. The positive outcomes of the project were shared with the staff in both facilities. The Loeb criteria is being incorporated into their standing orders and as a part of their antibiotic stewardship program. Overall, benefit from the Loeb criteria was observed, but continuing evaluation after placement of protocols will provide a clearer picture of patient outcomes. Efforts should center around ensuring accuracy of data, comprehensive education of staff and providers, incorporation of guidelines into policy, and support of close observation as a form of treatment. Nurse practitioners can apply evidence-based criteria, such as the Loeb criteria in order to reduce unnecessary antibiotic prescribing for ASB. Nurse

practitioners can be leaders in antibiotic stewardship programs, which have been mandated by the Center for Medicare and Medicaid, in LTC.

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Table 2.1

Loeb Criteria, diagnostic algorithm

1. Fever $> 37.9^{\circ}\text{C}$ (100°F) or 1.5°C (2.4°F) increase above baseline on at least two occasions over last 12 hours and one or more of the following to order a urine culture:

- | | |
|---------------------|-------------------------|
| a. dysuria | f. frequency |
| b. urgency | g. gross hematuria |
| c. flank pain | h. urinary incontinence |
| d. shaking chills | i. suprapubic pain |
| e. urinary catheter | |

2. If no fever $> 37.9^{\circ}\text{C}$ (100°F) or 1.5°C (2.4°F) increase above baseline on at least two occasions over last 12 hours and new onset burning urination or two or more of the following to order a urine culture:

- | | |
|-------------------------|--------------------|
| a. urgency | f. gross hematuria |
| b. flank pain | g. suprapubic pain |
| c. shaking chills | |
| d. urinary incontinence | |
| e. frequency | |

3. In no fever $> 37.9^{\circ}\text{C}$ (100°F) or 1.5°C (2.4°F) increase above baseline on at least two occasions over last 12 hours, and has a urinary catheter and one or more of the following, order a urine culture:

- New costovertebral tenderness
- Rigors
- New onset delirium

4. If fever $> 37.9^{\circ}\text{C}$ (100 F) or 1.5°C (2.4°F) increase above baseline on at least two occasions over last 12 hours and two or more symptoms or signs of non-urinary tract infections: Do not order a urine culture.

Note. Adapted from “Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial”, by Loeb, M., Brazil, K., Lohfeld, L., McGeer, A., Simor, A., Stevenson, K., . . . Walter, S. D., 2005, *British Medical Journal*, 331(7518), 66

Table 2.2

Evaluating ordered urine cultures based on the Loeb criteria

Facility name	Pre- (n = 16)		Intervention (n = 13)	
	N	%	N	%
Facility A				
Symptomatic UTI	0	0	2	15.38
ASB	16	100	11	84.62
	Pre- (n = 36)		Intervention (n = 34)	
Facility B				
Symptomatic UTI	4	11.11	7	20.59
ASB	32	88.89	27	79.41

Note. The pre-intervention period for facility A was June 2016 through November 2016. The pre-intervention period for facility B was January 2017 through May 2017. The intervention period for both facilities was June 2017 through November 2017.

Table 2.3

Frequency of urine cultures, antibiotics prescribed for ASB

	Facility A		Facility B	
	Pre	Intervention	Pre	Intervention
1. Urine cultures ^a	2	13	22	36
2. ASB, antibiotic prescribed	16	6	24	13
3. ASB, antibiotic not prescribed	0	5	7	14
4. Antibiotic prescribed without urine culture	0	0	2	4
5. No bacterial growth on urine culture ^b	unknown	1	3	8

Note. The pre-intervention period for facility A was June 2016 through November 2016. The pre-intervention period for facility B was January 2017 through May 2017. The intervention period for both facilities was June 2017 through November 2017.

^a Not all urine cultures were captured as some went out to the local hospital instead of the contracted laboratory. The pre-intervention data collection for urine cultures was from March 2017-May 2017. The intervention period was from June 2017 through November 2017.

^bLack of bacterial growth does not classify as ASB.

CHAPTER 3

RESULTS

RESULTS OF IMPLEMENTING THE LOEB CRITERIA

Facilities A and B were monitored for rates of SUTI, ASB, urine cultures ordered, antibiotics prescribed and nursing symptom documentation from June 2017 through November 2017. The infection control log maintained by the quality assessment nurse was reviewed to determine SUTI and ASB. Frequency of antibiotics prescribed was acquired from the medical records of the contracted pharmacy. Urine culture data was obtained from the information technology department of the contracted laboratory.

Table 3.1 shows the total number of ASB and SUTI in the pre-intervention and intervention period for both facilities. There was a 62.5% reduction in episodes of ASB treated with antibiotics in facility A, while facility B had a smaller reduction of 45.83% during the intervention period (Table 3.2). Overall, in both facilities, when a urine culture was ordered during the intervention period for a suspected UTI it was more likely to be a true SUTI rather than ASB. Urine cultures obtained for cases classified as ASB received antibiotics less frequently. During the intervention period there were more incidences of SUTI than during the pre-intervention period (Table 3.2).

Facility B had eight known urine cultures with no growth or < 100k CFU/ml. *Escherichia coli* was the most common organism cultured; other organisms included *Enterococcus faecalis*, *Proteus mirabilis*, *Morganella morganii*, *Acinetobacter baumannii*, *Enterobacter aerogenes*, *Streptococcus agalactiae* (group B), *Providencia species*, and *Citrobacter youngae*. Fourteen urine cultures were resistant to more than one antibiotic, and four urine cultures were resistant to four or more antibiotics.

Facility A had one urine culture with no growth or < 100k CFU/ml. Similar to facility B, the most common organism was *Escherichia coli*, but other organisms

included *Enterococcus faecalis* and *Pseudomonas aeruginosa*. Six of the urine cultures were resistant to three or more antibiotics.

The most common antibiotics used for urinary tract infections included fluoroquinolones, nitrofurantoin, cephalosporins, amoxicillin, and amoxicillin/clavulanate. There were no episodes of adverse drug reactions reported during the intervention period, as well as no episodes of clostridium difficile related to antibiotic prescribing for urinary tract infections.

DISCUSSION

The purpose of this quality improvement project was to implement the Loeb criteria in hope of reducing unnecessary urine cultures to avoid antibiotic prescribing for ASB. Retrospective data review at facility A revealed many urine cultures were obtained for non-specific symptoms or in several cases with no documentation of symptoms. During the intervention period, there were still patients who had urine cultures obtained without meeting the Loeb criteria, but the frequency was reduced. Facility A had a 62.5% reduction in the frequency of ASB inappropriately treated with antibiotics. The reduction can be attributed to providers and nursing staff adopting the criteria more consistently than in facility B. Facility A experienced less staff turnover, and consistency in the leadership positions was maintained. Facility A is also a smaller facility than facility B, which might have impacted the frequency of SUTI and ASB reported. The characteristics of the resident population, such as age, sex, race and co-morbidities were not analyzed. Patient characteristics could potentially affect the frequency of SUTI and ASB identified in each facility.

Factors related to providers

There were several occasions when a urinalysis and culture was ordered based on symptoms not associated with the Loeb criteria, such as mental status change or abdominal pain; therefore, the diagnostic algorithm of the criteria was not followed. On one occasion a resident who was sent to the emergency room for a mental status change received an antibiotic based on the urinalysis alone and was discharged back to the facility. As previously stated, 90% of the LTC population with bacteriuria have pyuria on urinalysis, and therefore it is of little diagnostic value to the provider (Walker et al., 2000).

Based on the data from this project, there was less frequency of ASB being treated with antibiotics, even when a culture was ordered. This can be attributed to the provider following the therapeutic algorithm of the Loeb criteria. Symptoms may have resolved, the patient remained afebrile, or additional laboratory results such as a complete blood count were negative for signs of infection during the time the urine culture was being processed. During these cases, the provider appeared to opt for observation and monitoring, which should be strongly considered as a treatment option, opposed to antibiotic prescribing, in LTC (Nace et al., 2014). Loeb and colleagues (2005) found a similar phenomenon in their randomized controlled study where there was no significant reduction in the number of urine cultures ordered, but a change in treatment response with a reduction in antibiotics prescribed to treat ASB and concluded the providers were more receptive to the therapeutic algorithm than the diagnostic algorithm.

However, during this project the providers did not always follow the therapeutic algorithm. For example, one provider at facility B had a pattern of ordering a follow-up urinalysis and culture when the antibiotics were completed. This resulted in a second

positive urine culture on one occasion, without meeting the Loeb criteria, and therefore additional antibiotics prescribed, which is problematic since there is a lack of data to support ordering urine cultures as a “test of cure” and this should be avoided (Nace et al., 2014). This provider received additional education and stopped ordering repeat urine cultures towards the end of the intervention period. Ongoing reinforcement for implementation of the criteria with every case of suspected urinary tract infection will be required to change out dated practice in LTC. Collaborative buy-in can be achieved through provision of evidence-based literature and observing, over time, the long-term benefits of not prescribing for ASB, demonstrated by no change in mortality or hospitalization rates among the LTC population.

The most common symptoms reported included dysuria, urgency, frequency and incontinence. New onset burning on urination in the absence of fever meets criteria for ordering a urinalysis and culture according to the Loeb criteria. It is unclear whether the nursing staff or providers differentiated between acute, new or worsening and chronic symptoms, which may have contributed to a large number of urine cultures ordered. Providers need to continue to assess all possible causes of dysuria, whether related to estrogen deficiency or benign prostatic hypertrophy, based on the patient’s medical history and age in order to reduce unnecessary ordering of urine cultures. It will be necessary for the provider to complete a genitourinary assessment as a part of the decision to order a urine culture. A physical assessment will provide a better understanding of the source of the patient’s symptoms; for example, erythematous labia and vaginal discharge would reveal a vulvovaginal candidiasis opposed to an SUTI, therefore altering treatment.

Factors related to staff

During the randomized controlled trial done by Loeb and colleagues (2005), nursing staff were required to complete a one-page log of signs and symptoms for every resident suspected of having a urinary tract infection. In this project, a data collection tool was provided to the nursing staff in order to guide their communication with the provider and also enhance their nursing documentation in the patient's chart. Nursing staff were not mandated to use the tool out of concern that it would result in less compliance with the project due to additional work burden. It is possible that the absence of a consistent prompt negatively affected staff adherence to the criteria. In retrospect, optional use also led to an inability to account for possible decisions made *not* to culture based on the Loeb criteria, which resulted in a loss of data.

This project also revealed inaccurate documentation of SUTI on the infection control log. All urine cultures treated with an antibiotic were labeled as a urinary tract infection. Many of the episodes of DUTI did not meet the Loeb criteria. Surveillance of SUTIs should be done with existing criteria in order to accurately differentiate between SUTI and ASB. Nursing staff in charge of quality measures and infection control in LTC should receive specific training on available criteria, adverse events of antibiotic exposure and the rise of multi-drug resistant organisms.

Factors related to setting

The setting continues to pose a difficult challenge where there are only a few providers present occasionally throughout the week. Obtaining buy-in is easier with a smaller number of providers, but lack of adherence by one could have a disproportionate impact on project outcomes. In the LTC setting, licensed practical nurses are performing

the majority of the assessments, but lack sufficient training in assessment and evidence-based practice compared to registered nurses, which combined with high turnover has implications for quality of care and the training approach for the Loeb criteria.

Continual staff turnover during the intervention period, especially at facility B, may have potentially affected adherence to the Loeb criteria. Cooper, Titler, Struble and Redman (2017) identified the importance of implementing “change champions”, who are elected to support the implementation process for utilizing the urinary surveillance tool. This project did not have specific “change champions”, which may have impacted the adherence to the Loeb criteria. During this project, the director of nursing and the quality assessment nurse were supportive of implementing change. Facility B experienced turnover in the director of nursing position during the intervention period. The director of nursing plays an important role in encouraging nursing staff to engage and adopt new implementation and this may have impacted the results of this project.

The project relied on data collection obtained from outside sources including the quality assessment nurse, pharmacy medical records and information technology department for the laboratory, therefore errors in data collection may not have been recognized.

The in-services provided for the nursing staff were limited to one day, two in-services, per facility due to time constraints prior to the intervention start date, compared to the four week training period utilized in the Loeb study (Loeb et al., 2005). Additional in-services should be provided to guarantee all staff, including part-time and weekend staff, are educated on the criteria to improve adherence.

IMPLICATIONS FOR NURSING PRACTICE AND POLICY

Antibiotic stewardship programs are becoming a requirement in LTC. This project was the first implementation of criteria for ordering a urine culture in either facility. It revealed patterns of ordering urine cultures, and antibiotic prescribing, which did not follow consensus guidelines. In order to be effective, antibiotic stewardship programs will require implementation of existing criteria such as the Loeb, McGeer, or revised McGeer when addressing antibiotic prescribing or ordering diagnostic tests to rule out infections. The environment of the LTC facility is unique in that it is primarily staffed by licensed practical nurses. Primary care providers, whether physicians, nurse practitioners or physician assistants, are only present intermittently. The strength of an antibiotic stewardship program relies on the skill of the nursing staff to identify changes in the condition of the patient, appropriately communicate changes and thoroughly document in the patient's chart. Frequent nursing staff turnover requires ongoing educational interventions to ensure staff are up to date on quality improvement measures. Facility policies and available criteria, such as the Loeb criteria, should be included in the orientation process. The positive outcomes of the project were shared with the staff in both facilities. The Loeb criteria are being incorporated into their standing orders and a part of their antibiotic stewardship programs.

Old standing orders to obtain a urine culture for urinary symptoms were present in all the patients' charts prior to the intervention. No specific urinary symptoms were listed in the standing orders, which gave nursing staff free reign to obtain urine cultures based on any symptom. The facilities are updating the standing orders to include the Loeb criteria.

This project also revealed inaccurate documentation of SUTI on the infection control log. All urine cultures treated with an antibiotic were labeled as a urinary tract infection. Many of the episodes of documented urinary tract infection did not meet the Loeb criteria. Surveillance of SUTIs should be done with existing criteria in order to accurately differentiate between SUTI and ASB. Nursing staff in charge of quality measures and infection control in LTC should receive specific training on available criteria, adverse events related to antibiotic exposure and the risks associated with the rise of multi-drug resistant organisms. Programs such as The Statewide Program for Infection Control and Epidemiology by the University of North Carolina, Chapel Hill, provide education and consultation to LTC staff for prevention and control of infections.

FUTURE PROJECTS

Overall, benefit from the Loeb criteria was observed, but continuing evaluation after placement of protocols will provide a clearer picture of patient outcomes. Efforts should center around ensuring accuracy of data, comprehensive education of staff and providers, incorporation of guidelines into policy, and support of close observation as a form of treatment. As interprofessional team members, nurse practitioners are uniquely positioned to influence patient outcomes directly through clinical practice and indirectly by facilitating quality-focused system changes.

DISSEMINATION PLAN

This project highlights the ongoing complications of differentiating SUTI from ASB in the LTC setting. A manuscript was created for submission to the journal, *Geriatric Nursing*, which strives to contribute relevant information for caregivers working directly or indirectly with the elderly in community, acute care and LTC

settings. An abstract for a poster presentation was submitted to the Gerontological Advanced Practice Nurses Association (GAPNA), which holds an annual conference in the fall of 2018 (Appendix I). GAPNA aims to enhance the knowledge of the advanced practice nurse and improve the care of elderly individuals.

CONCLUSION

This project demonstrated that implementation of the Loeb criteria can reduce the rate of ASB unnecessarily treated with antibiotics in a facility and thereby mitigate the risks of adverse drug events and multi-drug resistant organisms. The positive outcomes of the project were shared with the staff in both facilities. The Loeb criteria is being incorporated into their standing orders and as a part of their antibiotic stewardship program. Nurse practitioners can apply evidence-based criteria, such as the Loeb criteria in order to reduce unnecessary antibiotic prescribing for ASB. Nurse practitioners can be leaders in antibiotic stewardship programs, which have been mandated by the Center for Medicare and Medicaid, in LTC care. It is imperative for advanced practice nurse leaders to identify nurse practitioner-sensitive outcomes, utilize data to demonstrate effectiveness of practice initiatives, and disseminate findings that improve quality and safety in LTC setting.

Table 3.1

Evaluating ordered urine cultures based on the Loeb criteria

Facility name	Pre- (n = 16)		Intervention (n = 13)	
	N	%	N	%
Facility A				
Symptomatic UTI	0	0	2	15.38
ASB	16	100	11	84.62
	Pre- (n = 36)		Intervention (n = 34)	
Facility B				
Symptomatic UTI	4	11.11	7	20.59
ASB	32	88.89	27	79.41

Note. The pre-intervention period for facility A was June 2016 through November 2016. The pre-intervention period for facility B was January 2017 through May 2017. The intervention period for both facilities was June 2017 through November 2017.

Table 3.2

Frequency of urine cultures, antibiotics prescribed for ASB

	Facility A		Facility B	
	Pre	Intervention	Pre	Intervention
1. Urine cultures ^a	2	13	22	36
2. ASB, antibiotic prescribed	16	6	24	13
3. ASB, antibiotic not prescribed	0	5	7	14
4. Antibiotic prescribed without urine culture	0	0	2	4
5. No bacterial growth on urine culture ^b	unknown	1	3	8

Note. The pre-intervention period for facility A was June 2016 through November 2016. The pre-intervention period for facility B was January 2017 through May 2017. The intervention period for both facilities was June 2017 through November 2017.

^a Not all urine cultures were captured as some went out to the local hospital instead of the contracted laboratory. The pre-intervention data collection for urine cultures was from March 2017-May 2017. The intervention period was from June 2017 through November 2017.

^bLack of bacterial growth does not classify as ASB.

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APPENDIX A
EVIDENCE TABLE

Evidence Table for PICOT question: Among all residents within the LTC care facilities, does implementing the Loeb criteria (compared to usual care) result in a reduction of unnecessary urine cultures ordered, therefore reducing antibiotic prescribing for ASB, over a 6-month time period?

Brief Reference, Type of Study, Quality Rating	Methods	Threats to Validity/Reliability	Study Findings	Conclusions
<p>Loeb, M., Brazil, K., Lohfeld, L., McGeer, A., Simor, A., Stevenson, K . . . Walter, S. D. (2005). Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial. <i>BMJ</i>, 331(7518), 669. doi:10.1136/bmj.38602.586343.55</p> <p>Level of evidence: I Quality rating: B. Nursing staff was not blind to the study, and study may not be generalizable to the entire long-term care population. Statistically significant different between control and intervention. There is clinical significance, not statistical, with regards to ordering</p>	<p>-cluster randomized controlled trial -setting of 24 nursing homes in Ontario, Canada and Idaho, US. -12 allocated to the intervention arm, 12 allocated to usual care -4,217 residents included in the study -all residents in the facilities were eligible for the study -in the intervention arm, data was collected by inflectional control staff using a standardized collection form</p>	<p>-nursing staff not blinded to the intervention -P-value not mentioned when discussing significant results -study may not be generalizable to facilities with < 100 residents -2 facilities dropped out, therefore their paired facility dropped as well-20 facilities used for data collection in the end -the difference between the two groups decreased towards the end of the study, though not statistically significant and may be related fatigue with the intervention</p>	<p>-a significant difference in antimicrobial prescribing for suspected UTI between the two study arms: 28% antimicrobial use for suspected UTI in the intervention arm compared to the usual care arm (39%). weighted mean difference -9.6%, -16.9-2.4% -However, no statistically significant difference in overall total antibiotic use between the two arms -one explanation may have been relabeling of the indication for which the antibiotic was prescribed -1402 urine cultures sent was lower in the intervention arm, than usual care (1737), the difference was not significant (weighted mean difference -0.51, -1.38 to 0.35).</p>	<p>- Implementing a multifaceted intervention in the nursing home setting can help reduce antimicrobial prescribing for suspected UTIs in the nursing home setting</p>

of urine cultures.				
<p>2. Stone, N. D., Ashraf, M. S., Calder, J., Crnich, C. J., Crossley, K., Drinka, P. J., . . . Stevenson, K. B. (2012). Surveillance Definitions of Infections in Long-Term Care Facilities: Revisiting the McGeer Criteria. <i>Infection Control & Hospital Epidemiology</i>, 33(10), 965-977. doi:10.1086/667743</p> <p>Level of evidence: IV</p> <p>Quality of evidence: A, keywords, databases and inclusion/exclusion criteria explained. Rigorous appraisal method of literature not included. Internationally recognized criteria-accepted by Association for Professional in Infection Control and Society for Health Epidemiology of America, also by CMS as the standard for surveillance</p>	<p>-systematic review of infection surveillance definitions for long-term care facilities</p> <p>-review of definitions searched via Medline, National Guideline Clearing house, Cochrane Health Technology Assessment, National Institutes of Health Consensus Development and USPSTF.</p> <p>-definitions reviewed and approved by a team of Society of Healthcare Epidemiology of America (SHEA) Long-term care special interest group (LTCSIG) and a panel of outside viewers selected by the SHEA Board of Directors.</p>	<p>- new definitions need to be further validated by research</p>	<p>-Criteria for UTI were made more specific- UTI should be diagnosed when there are localized GU symptoms and a positive urine culture (addition of urine culture results new to criteria)</p> <p>-clinical criterion for residents with indwelling catheters were derived from Loeb et. al's criteria (2005).</p> <p>-definition of fever changed to single T > 37.8°, or two repeated oral T > 37.2° or single T > 1.1° above baseline</p>	<p>-McGeer criteria for infection surveillance was developed 20 years ago.</p> <p>-The new definitions serve as an updated national standard for infection surveillance in long-term care facilities.</p>
<p>3. McGeer, A., Campbell, B., Emori, T. G., Hierholzer, W. J., Jackson, M. M., Nicolle, L. E., . . . Wang, E. E. L. Definitions of infection for surveillance in long-term care facilities (1991). <i>American Journal of Infection</i></p>	<p>-consensus review</p> <p>-It was noted that the definitions of infections in the acute care setting did not apply to long-term care</p> <p>-a set of definitions for long-term care is required for surveillance and for measuring</p>	<p>-noted in article that there is no reliability or validity to definitions at the time they were developed</p>	<p>-definitions for upper respiratory infection, urinary tract infection, ENT infections, GI infections, skin infections and systemic infections were developed</p> <p>-for UTI, urine culture results are not included in the criteria</p> <p>-Fever defined as a single temp of 38° or higher</p>	<p>- Definitions were defined to provide a basis for further development of standardized definitions and encourage further research into infection control for long-term care facilities</p>

<p><i>Control</i>, 19(1), 1-7. doi:10.1016/0196-6553(91)90154-5</p> <p>Level of evidence: IV</p> <p>Quality of evidence: B. The original McGeer criteria, which had not been tested for sensitivity, specificity, validity (at the time), but paved the way for more research with regards to managing infections in long-term care. Systematic search not explained. Also accepted by CMS as surveillance tool</p>	<p>outcomes -consensus review based on definitions developed at Yale, revised by the Co-operative Infection Control Committee, and detailed review of definitions written by a collection of 62 infectious disease physicians, geriatricians, infection control practitioners from LTC and authors of research in the field.</p>			
<p>4. Nicolle, L.E., Bradley, S., Colgan, R., Rice, J. C., Schaeffer, A., & Hooton, T. M. (2005). Infectious Diseases Society of America Guidelines for the Diagnosis and Treatment of Asymptomatic Bacteriuria in Adults. <i>Clinical Infectious Diseases</i>, 40(5), 643-654. doi:10.1086/42507 Level of evidence: IV Quality of evidence: A.</p>	<p>Recommendation guidelines based on systematic review - recommendation given for the management of asymptomatic bacteriuria in adult. Each recommendation was tagged with a code regarding quality of evidence and strength of recommendation -inclusion criteria for studies reviewed included only those published in English -exclusion criteria- study</p>	<p>-recommendations must be further validated</p>	<p>-with regards to outcomes specifically looking at long-term care residents; screening for and treatment of asymptomatic bacteriuria in elderly residents in long-term care is not recommended. This is an A-I recommendation meaning good evidence to support recommendation and evidence is obtained from at least one or more RTC</p>	<p>- pyuria (WBC on urinalysis) associated with asymptomatic bacteriuria (ASB) is not an indication for antibiotics (recommendation A-II- good evidence to support, and based on > 1 well designed clinical trial without randomization)</p>

<p>Many Recommendations supported by high level of evidence, but not RCT or quasi-experimental only, inclusion/exclusion criteria included, explained databases used.</p>	<p>population could not provide generalizability, evidence of bias to limit credibility, insufficient number of patients in study to ensure statistical validity - PubMed database reviewed, and then references of relevant papers - experts were asked to include any relevant trials not included in the review</p>			
<p>5. Lohfeld, L., Loeb, M., & Brazil, K. (2007). Evidence-based clinical pathways to manage urinary tract infections in long-term care facilities: a qualitative case study describing administrator and nursing staff views. <i>Journal of the American Medical Association</i>, 8(7), 477-484.</p> <p>Level of evidence: III</p> <p>Quality of evidence: B. Discussed attempts to reduce interviewer bias, small sample size</p>	<p>descriptive study- qualitative case study - exploratory single case study - data from interviews with administrators and nurses from the 10 facilities where intervention was implemented during a larger RCT - interview topics- importance of UTIs, UTI symptoms and their management, benefits and barriers to the intervention and recommendations for improvement of the intervention (Loeb criteria) interviews</p>	<p>- interviewer bias reduced by consistently using the same interviewers, but still present - sample size limited by number of administrators and nursing staff in facilities may not be generalizable because some frustration with the algorithm discussed in this study was because presented in a larger RCT. Facilities and staff might have experienced the burden of being enrolled in study</p>	<p>- participants thought the intervention/algorithm was well developed and easy to use - pressure from physicians made it difficult for some nurses to follow the algorithm - barriers to using algorithm: initial buy-in from staff, ensuring part-time or PRN staff followed the algorithm, difficulties getting physicians to follow/accept new protocol - many nurses liked using the algorithm- it gave them more objective signs and symptoms to present to physician, but they felt the algorithm should find a way to incorporate practitioner</p>	<p>- In general, once administration and nursing staff are familiar with the algorithm, they generally support its use in the long-term care setting. variation in staffing, facility culture may explain differences in facilities adopting evidence-based research</p>

	throughout the study conducted by an experienced qualitative researcher and 2 interviewers		judgment	
6. Juthani Mehta M., Drickamer, M. A., Towle, V., Zhang, Y., Tinetti, M. E., & Quagliarello, V. J. (2005). Nursing home Practitioner survey of diagnostic criteria for urinary tract infections. <i>Journal of the American Geriatrics Society</i> , 53(11), 1986-1990. doi:10.1111/j.132-5415.2005.0040.x Level of evidence: III Quality rating: B. Survey had 83% response rate, limitations described, identifies inconsistencies in practitioner diagnosis of UTI	-descriptive study -self administered survey -completed in 3 nursing homes in New Haven, CT. - n = 25 physicians, n = 3 Pas, n= 8 DON/ADON, n = 37 charge nurses, n = 3 infection control practitioners. -only 63 of the surveys were completed, 83% (19 MD, 3 PA, 41 nurses). - open and closed ended questions	-Results not generalizable to all providers due to this study being done in a small area -possibility for recall bias on survey	-identified inconsistencies in diagnosis of UTI -64 % of MD/PA heard of McGeer Criteria and 55% used it in practice	- identified difference between consensus recommendations and provider practice -a call for more empirical prospective data needed to identify symptoms associated with UTI, develop of evidence-based definition of UTI
7. Juthani Mehta, M., Tinetti, M., Perrelli, E. Towle, V., Van Ness, P. H., & Quagliarello, V. (2007). Diagnostic accuracy of criteria for	-prospective cohort study -3 New Haven nursing homes -340 residents enrolled, age 65+ and without indwelling catheters or on long-term antibiotics.	-may not be generalizable to a larger population -for a cohort study-population was small and follow-up was only over a year -the study was completed in 3 nursing homes in	- McGeer criteria: 30% sensitivity (95% CI= 17-44%), 82% specificity (95% CI = 73-92%) -Loeb criteria: 19% sensitivity (95% CI= 7-30%), 89% specificity (95% CI= 82-97%) -revised Loeb	consensus-based criteria have similar characteristics should be improved upon to improve diagnostic accuracy. -McGeer, Loeb or revised Loeb

<p>urinary tract infection in a cohort of nursing home residents. <i>Journal of the American Geriatrics Society</i>, 55(7), 1072-1077. doi:10.1111/j.1325-2914.2007.01277.x</p> <p>Level of evidence: III</p> <p>Quality of evidence: B. Body of evidence was small for a cohort study and follow-up was only for a year.</p>	<p>-Data was collected from May 2005-April 2006. -100 suspected UTI episodes documented -the 100 episodes were compared to the McGeer criteria, Loeb criteria and revised Loeb criteria to assess ability of the criteria to detect UTI -for this study the definition of a UTI was based on the MD or nurse in the facility</p>	<p>the same area, which may not result in diverse practice culture with regards to management of UTI -rates of ASB not determined before study -laboratory evidence of UTI based on bacteriuria and pyuria (previously stated not diagnostic for UTI in long-term care)</p>	<p>criteria: 30% sensitivity (95% CI= 17-44%), 79% specificity (95% CI = 68-90%) -antibiotics were prescribed to 37% of residents without laboratory evidence of UTI i.e. prescribed for nonspecific symptoms</p>	<p>used alone may not be sufficient for clinical decision-making with regards to prescribing antibiotics</p>
<p>8. Olsho, L. E. W., Bertrand, R. M., Edwards, A. S., Hadden, L. S., Morefield, G. B., Hurd, D., . . . Zimmerman, S. (2013). Does Adherence to the Loeb Minimum Criteria Reduce Antibiotic Prescribing Rates in Nursing Homes? <i>Journal of the American Medical Association</i>, 309(4), 309.e301-309.e307.</p> <p>Level of evidence: III</p> <p>Quality of evidence:</p>	<p>-cross-sectional analysis of 12 NC nursing homes between March-May 2011 -data collected by reviewing medical records -Estimated multivariate models adjusting for nursing home characteristics via multilevel Poisson regression, with strong standards of error to consider antibiotic prescription clustering among residents in nursing homes outcome measured was count of</p>	<p>- data relied on medical documentation of staff , which may not be reliable</p>	<p>-only 12.7 % prescriptions were classified as adherent to Loeb criteria no significant relationship between adherence to Loeb criteria and prescribing rates for UTIs (or other infections such as respiratory, skin soft tissue infections when addressed alone) no significant difference between adhering Loeb criteria and overall prescribing rates</p>	<p>-little evidence to suggest prescribers adhere to Loeb criteria evidence-based guidelines for antibiotic prescribing in long-term care need to be adopted before a significant decline in antibiotic prescribing will be seen</p>

<p>B. Data was pulled from documentation of medical staff, which may include bias.</p>	<p>prescriptions per resident per day</p>			
<p>9. Walker, S., McGeer, A., Simor, A. E., Armstrong Evans, M., & Loeb, M. (2000). Why are Antibiotics prescribed for asymptomatic bacteriuria in institutionalized elderly people? A qualitative study of physicians' and nurses' perceptions. <i>CMAJ: Canadian Medical Association Journal = Journal De L'association Medicale Canadienne</i>, 163(3), 273-277. Level of evidence: III Quality of evidence: B. It is not generalizable due to small sample size and voluntary nature of participants. It does reveal misinterpretation of the definition of UTI by nursing staff.</p>	<p>a qualitative study, focus groups -17 physicians and 16 nurses participated in focus groups in long-term care facilities. They were tape recorded -focus groups were held over a one month period -tape recordings were analyzed relevant themes and issues in the discussions</p>	<p>- participants were voluntary, and from two nursing homes in Ontario therefore results may not be generalizable</p>	<p>-nurses thought foul odor urine was an indication of UTI -misconceptions about the definition of UTI symptoms identified - nurses and physicians identified that it is nursing staff who trigger ordering of urine cultures -physicians had different opinions about treatment of positive urine cultures -study participants thought that education at many levels was necessary</p>	<p>-education on the topic is a priority for nurses and physicians</p>
<p>10. Doernberg, S. B., Dudas, V., & Trivedi, K. K. (2015). Implementation of an antimicrobial stewardship program targeting</p>	<p>-prospective quasi-experimental study using time-series analysis, targeting prescriptions for UTI -setting = 3</p>	<p>-low acceptance rates of recommendations show bias -study power lower than expected</p>	<p>-04 antibiotic prescriptions reviewed by pharmacist of the 183 total antibiotic prescriptions for UTI -only 8% met Loeb criteria -recommendations for change made in</p>	<p>antibiotic stewardship program (ASP) has the potential to be effective in long-term care -further studies needed to the most efficient design for an</p>

<p>residents with urinary tract infections in three community long-term care facilities: a quasi experimental study using time-series analysis. <i>Antimicrob Resist Infect Control</i>, 4, 54. doi:10.1186/s1756-015-0095-y</p> <p>Level of evidence: II</p> <p>Quality of evidence: B. Study power lower than expected. Bias towards intervention may have altered outcomes.</p>	<p>community long-term care facilities in Northern California -7 months pre-intervention, April 2011-Oct 2012 (baseline information obtained- antimicrobial utilization), 7 months during the intervention (Nov 2012-May 2012) Interventions- antibiotics prescribed were reviewed by ID pharmacist and ID physician for adherence to Loeb criteria and recommendations provided to the prescribing physician -consent not required from residents because it was viewed as a quality improvement study -analyzed using segmented regression and a Poisson distribution to account for clustering of antibiotic prescriptions in a facility -significance defined as $P < 0.05$ antibiotic use was measured as antibiotic starts per 1000 resident days</p>		<p>38% of antibiotic prescriptions and 10% were accepted by prescribing physician -E. coli was the most common organism -Fluoroquinolones most commonly prescribed upon intervention, 26% decrease in antibiotic prescribing for UTI was observed</p>	<p>ASP intervention -it is important to include an education component for staff to the ASP program</p>
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<p>11. Lim, C. J., McLellan, S. C., Cheng, A. C., Culton, J. M., Parikh, S. N., Peleg, A. Y., & Kong, D. C. (2012). Surveillance of infection burden in residential aged care facilities. <i>Medical Journal of Australia</i>, 196(5), 327-332.</p> <p>Level of evidence: III</p> <p>Quality of evidence: B. Results may not be generalizable because they were in 4 residential care facilities on the same campus, data clearly presented in tables</p>	<p>-descriptive study, retrospective analysis of data Jan '06-Dec '10 in Melbourne, Australia.</p> <p>-Reviewed data in 4 residential aged care facilities, total 150 beds</p> <p>-outcomes measured: antibiotic use, incidence of health care associated infections, does prescribing of antibiotics meet McGeer criteria guidelines</p> <p>-rates of antimicrobial prescribing only available from '09-'10</p>	<p>data may not be generalizable</p>	<p>'09-'10: 662 episodes of suspected infection noted, antimicrobial prescribed in 659 episodes, 247 of these episodes (37%) did not fulfill McGeer criteria</p> <p>-specifically looking at UTI, McGeer criteria was not met in 141/288 of the episodes</p> <p>-with UTIs- 28 episodes were prescribed antimicrobials for ASB</p> <p>- most common antibiotic for UTI- Cephalexin, Trimethoprim, Augmentin, Amoxicillin, Norfloxacin (11%) were broad spectrum</p> <p>-indwelling catheter contributed to 20% UTI episodes of the 659 episodes receiving antibiotics, a clinical specimen was obtained in only 36% of them.</p>	<p>-McGeer criteria may not be specific/sensitive for microbiologically confirming infection</p> <p>Development of antimicrobial stewardship programs are imperative</p>
<p>12. Nicolle, L. E. (2001). SHEA position paper. Urinary tract infections in long-term-care facilities. <i>Infection Control & Hospital Epidemiology</i>, 22(3), 167-175.</p> <p>Level of evidence: IV</p> <p>Quality of evidence: A.</p> <p>No description of search strategy for literature or appraisal method of studies included. Material is</p>	<p>- SHEA position paper- expert consensus based on literature</p> <p>-clarifies classification of strength of evidence: A, good evidence to support, B moderate evidence to support recommendation , C, poor evidence to support. I: evidence from at least one properly RCT, II: evidence</p>	<p>this is a position paper that needs to be further validated</p>	<p>Recommendations (specifically looking at those that pertain to PICOT):</p> <ul style="list-style-type: none"> - Standard diagnostic criteria should be used for diagnose symptomatic UTI (BII) - routine screening for UTI by urinalysis or urine culture is not recommended for LTCF residents (AI) - a diagnosis of symptomatic UTI should not be made given stable and chronic GU 	<p>Recommendations for prevention, diagnosis, treatment in long-term care facilities provided</p>

officially sponsored by SHEA, strength and quality of recommendations provided	from at least one well-designed clinical trial, III: evidence from opinions- based on clinical experience, descriptive studies, reports of expert committees		symptoms (B III) - In resident's who have deteriorated clinically, lack fever and GU symptoms, a positive urine culture is not definite for diagnosis of UTI (AII) ASB should not be treated with antimicrobial therapy in LTC residents (AI)	
13. Loeb, M., Bentley, D. W., Bradley, S., Crossley, K., Garibaldi, R., Gantz, N., . . . Strausbaugh, L. (2001). Topics on long-term care. Development of Minimum criteria for the initiation of antibiotics in residents of long-term-care facilities: results of a consensus conference. <i>Infection Control & Hospital Epidemiology</i> , 22(2), 120-124. Level of evidence: IV Quality of evidence: B. The criteria is endorsed by the Society of Healthcare Epidemiology of America	-consensus paper -individual signs and symptoms were ranked with respect to importance of initiating antibiotics by the attendants of the consensus conference -modified Delphi approach used to achieve consensus on weighted variables	-newly developed criteria therefore not validated yet	-little data exists to establish validity of clinical features, which serve as the triggers for initiation of antibiotics, therefore the criteria is developed from indirect observational studies or expert opinion	- minimum criteria for the initiation of antibiotics in long-term care for soft tissue infections, UTI, respiratory infections and fever where the focus of infection is unknown
14. Agata, E. D., Loeb, M. B., & Mitchell, S. L. (2013). Challenges in Assessing	-prospective 12-month study, descriptive -looked at nursing home patients with	-may not be generalizable to the rest of the population due to the sample coming from the same	-72 residents experienced 131 suspected UTI episodes, only 16% of the episodes met the minimum criteria	-UTI commonly suspected in dementia patients residing in LTC, but symptoms reported most

<p>Nursing Home Residents with Advanced Dementia for Suspected Urinary Tract Infections. <i>Journal of the American Geriatrics Society</i>, 61(1), 62-66. doi:10.1111/jgs.12070</p> <p>Level of evidence: III Quality of evidence: B. The study relied on nursing documentation in the charts, the 25 nursing homes were in the same area</p>	<p>dementia and treatment of UTI with regards to adhering to the minimum criteria -25 nursing homes in Massachusetts, 266 patients</p>	<p>local area</p>	<p>to initiate antimicrobial therapy -79% of urinalysis and cultures were positive -of the episodes that lacked the minimum criteria, 74.5% received antimicrobial therapy -most common presenting sign and symptom was fever</p>	<p>likely do not represent a true UTI -call for more research to optimize criteria in order to decrease antibiotic use</p>
<p>15. Kistler, C. E., Zimmerman, S., Scales, K., Ward, K., Weber, D., Reed, D., . . . Sloane, P. D. (2017). The Antibiotic Prescribing Pathway for Presumed Urinary Tract Infections in Nursing Home Residents. <i>J Am Geriatr Soc</i>. doi:10.1111/jgs.14857</p> <p>Level of evidence: III Quality of evidence: B. The study was a chart review which relied on infection control logs and if not kept up accurately, could alter results</p>	<p>-chart review -260 randomly selected cases from 247 nursing home residents in 31 nursing homes in NC -prescribing pathway examined</p>	<p>-may not be generalizable due to all nursing homes being in the same location -relied on nursing documentation and management of the infection control log, which may not accurately reflect true rate of infections</p>	<p>-60% of UTI events had signs/symptoms documented, only 15% met the Loeb criteria -acute change in mental status was the most commonly documented sign/symptoms -75% of urine cultures grew at least one organism and 12% grew multi-drug resistant organisms</p>	<p>- non-specific signs and symptoms appear to influence prescribing of antibiotics more than specific UTI symptoms</p>
<p>16. Nicolle, L. E., Bentley, D., Garibaldi, R., Neuhaus, E., & Smith, P.</p>	<p>-SHEA position paper -addresses concerns about adverse</p>	<p>- no level I or II for recommendations</p>	<p>-Infection control programs should be optimized- BIII -A review program should monitor</p>	<p>-programs should be put into place in long-term care facilities which assess</p>

<p>(1996). Antimicrobial use in long term-care facilities. <i>Infection Control & Hospital Epidemiology</i>, 17(2), 119-128.</p> <p>Level of evidence: IV Quality of evidence: B. Quality standards and level of evidence explained, not use of I or II level of evidence</p>	<p>consequences of inappropriate antimicrobial prescribing</p> <ul style="list-style-type: none"> - recommendation s to promote appropriate use of antimicrobials 		<p>antimicrobial prescribing- BIII</p> <ul style="list-style-type: none"> -Programs promoting appropriate antibiotic use should be implemented- BIII -guidelines should be developed for use of antimicrobials in patients who are only comfort care- BIII 	<p>antimicrobial prescribing practices, evaluate appropriateness, burden and cost of care</p>
<p>17. Nicolle, L. E., Mayhew, W. J., & Bryan, L. (1987). Prospective randomized comparison of therapy and no therapy for asymptomatic bacteriuria in institutionalized elderly women. <i>The American Journal Of Medicine</i>, 83(1), 27-33.</p> <p>Level of evidence: I Quality of evidence: B. Small sample size for type of study, 50 subjects. Not blinded to physicians and nurses.</p>	<ul style="list-style-type: none"> -randomized controlled trial looking at treatment of asymptomatic bacteriuria versus no treatment in female residents in long-term care in Canada -Inclusion criteria- women with 2 consecutive urine cultures were enrolled after consent from patient or family obtained -subjects were followed for a year 	<ul style="list-style-type: none"> -difficult to obtain reliable urine specimens may alter data -study was not blinded to physicians and nurses therefore there may have been observer bias for observing adverse drug events 	<ul style="list-style-type: none"> -residents assigned to the therapy group had more adverse drug events -no change in genitourinary morbidity and mortality between the two study arms therefore no benefit to prescribing antibiotics for asymptomatic bacteriuria 	<ul style="list-style-type: none"> -No antibiotic prescribing for asymptomatic bacteriuria due to offering no benefits and may increase harm.

<p>18. Cooper, D.L., Titler, M., Struble, L., & Redman, R. (2017). A multifaceted, evidence-based program to reduce inappropriate antibiotic treatment of suspected urinary tract infections. <i>Annals of Long Term Care: Clinical Care and Aging</i>, 25(2): 36-43.</p> <p>Level of evidence: III Quality of evidence: B. Small sample size. Tool not generalizable to all long-term care facilities.</p>	<p>-quality improvement project in 151 bed facility in Michigan. -Used the newly developed Cooper Urinary Surveillance Tool -multifaceted evidence-based program included tool, staff education, change champions -3 month retrospective data review before implementation</p>	<p>-not generalizable to all long-term care facilities because the algorithm requires a urine dip stick to be performed, many facilities do not do that anymore -it also has been previously stated that pyuria is present in approximately 90% of long-term care residents. -the algorithm also includes non-specific symptoms -the short 3 month intervention period may have improved compliance</p>	<p>-statistically significant reductions in incidence of overall UTI diagnoses and inappropriate diagnoses. -the algorithm was used in 86% of the cases where residents were being monitored for a UTI -There were 35 UA tests done pre-intervention and 18 total tests post-implementation</p>	<p>- the best approach for the reduction of UTI in long-term care involves implementing a decision support tool (such as the Cooper Urinary Surveillance Tool) as well as staff education and “change champions”, which encourage adherence to using the tool.</p>
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APPENDIX B

JOHNS HOPKINS EVIDENCE-BASED PRACTICE: RESEARCH

EVIDENCE APPRAISAL TOOL

Level of Evidence: I	There is manipulation of an independent variable, there is an independent variable, study participants were randomly assigned to intervention and control groups	RCT, experimental study, for systematic review- all studies are RCT
Level of Evidence: II	There is manipulation of an independent variable, there is or is not a control group, there is no randomly assigned participants	Quasi-experimental study, for systematic review- combination of RCT and quasi-experimental
Level of Evidence: III	No manipulation of independent variable, no control group, participants not randomly assigned	descriptive, correlational, comparative. For systematic review- combination of RCT, quasi-experimental, and non-experimental, or are any or all studies qualitative?
Quality of Evidence: A, High quality	Consistent, generalizable results, sufficient sample size, adequate control. Definitive conclusions, consistent recommendations	
Quality of Evidence: B, Good quality	Reasonably consistent results, sufficient sample size, some control, fairly definitive conclusions	
Quality of Evidence: C, Low quality or major flaws	Little evidence with inconsistent results, insufficient sample size for study design, conclusions cannot be drawn	

(Dearholt and Dang, 2012).

APPENDIX C

JOHNS HOPKINS EVIDENCE-BASED PRACTICE: NON-RESEARCH
EVIDENCE APPRAISAL TOOL

Level of Evidence	IV: Clinical Practice Guidelines, Consensus of Position Statement	V: Organizational Experience- quality improvement, financial evaluation, program evaluation	V: Literature review, expert opinion, community standard, clinical experience, consumer preference
Quality rating: A, High quality	Officially sponsored by a professional, public or private organization, criteria-based evaluation, national expertise clearly evident, developed and revised within last 5 years	Clear aims and objectives, consistent results, formal quality improvement or financial evaluation with methods used, definitive conclusions, consistent recommendations, thorough reference to scientific evidence	Expertise is clearly evident, draws definitive conclusions, provides scientific rationale, though leader in the field
Quality rating: B, Good quality	Material officially sponsored by professional, public or private organization. Reasonably thorough and appropriate systematic literature search strategy, evaluation of strength and limitations, national expertise clearly evident, produced within the last 5 years	Clear aims and objectives, formal quality improvement or financial evaluation methods used, consistent results in a single setting, reasonably consistent recommendations, some reference to scientific evidence	Expertise appears to be credible, draws fairly definitive conclusions, provides logical argument for opinions
Quality rating: C, Low quality or major flaws	Not sponsored by an official organization, limited search strategy, insufficient evidence, inconsistent results, conclusions cannot be drawn, not revised within last 5 years.	Unclear	Expertise is not discernable or is dubious; conclusions cannot be drawn

(Dearholt and Dang, 2012)

APPENDIX D
THE REVISED MCGEER CRITERIA

A. For residents without an indwelling catheter (both criteria 1 and 2 must be present):

1. At least 1 of the following signs of symptom sub-criteria
 - a. Acute dysuria or acute pain, swelling or tenderness of the testes, epididymis, or prostate
 - b. Fever or leukocytosis and at least 1 of the following localizing urinary tract infection sub-criteria
 - i. Acute costovertebral angle pain or tenderness
 - ii. Suprapubic pain
 - iii. Gross hematuria
 - iv. New or marked increase in incontinence
 - v. New or marked increase in urgency
 - vi. New or marked increase in frequency
 - c. In the absence of fever or leukocytosis, then 2 or more of the following localizing urinary tract sub-criteria
 - i. Suprapubic pain
 - ii. Gross hematuria
 - iii. New or marked increase in incontinence
 - iv. New or marked increase urgency
 - v. New or marked increase in frequency
2. One of the following microbiologic sub-criteria
 - a. At least 10^5 CFU/ml of no more than 2 species of microorganisms in a voided urine sample
 - b. At least 10^2 CFU/ml of any number of organisms in a specimen collected by in-and-out catheter

B. For residents with an indwelling catheter (both criteria 1 and 2 must be present)

1. At least 1 of the following signs of symptom sub-criteria
 - a. Fever, rigors, or new-onset hypotension, with no alternate site of infection
 - b. Either acute change in mental status or acute functional decline, with no alternate diagnosis and leukocytosis
 - c. New-onset suprapubic pain or costovertebral angle pain or tenderness
 - d. Purulent discharge from a round the catheter or acute pain, swelling or tenderness of the testes, epididymis, or prostate
2. Urinary catheter specimen culture with at least 10^5 CFU/ml of any organism(s)

Note. Adapted from “Surveillance Definitions of Infections in Long-Term Care Facilities: Revisiting the McGeer Criteria,” by Stone, N. D., Ashraf, M. S., Calder, J., Crnich, C. J., Crossley, K., Drinka, P. J., . . . Stevenson, K. B., 2012, *Infection Control & Hospital Epidemiology*, 33(10), p. 965-977.

APPENDIX E
DIAGNOSTIC ALGORITHM

1. Fever > 37.9C (100 F) or 1.5 C (2.4 F) increase above baseline on at least two occasions over last 12 hours and one or more of the following to order a urine culture:

- | | |
|---------------------|-------------------------|
| a. dysuria | f. frequency |
| b. urgency | g. gross hematuria |
| c. flank pain | h. urinary incontinence |
| d. shaking chills | i. suprapubic pain |
| e. urinary catheter | |

2. If no fever > 37.9C (100 F) or 1.5 C (2.4 F) increase above baseline on at least two occasions over last 12 hours and new onset burning urination or two or more of the following to order a urine culture:

- | | |
|-------------------------|--------------------|
| a. urgency | e. frequency |
| b. flank pain | f. gross hematuria |
| c. shaking chills | g. suprapubic pain |
| d. urinary incontinence | |

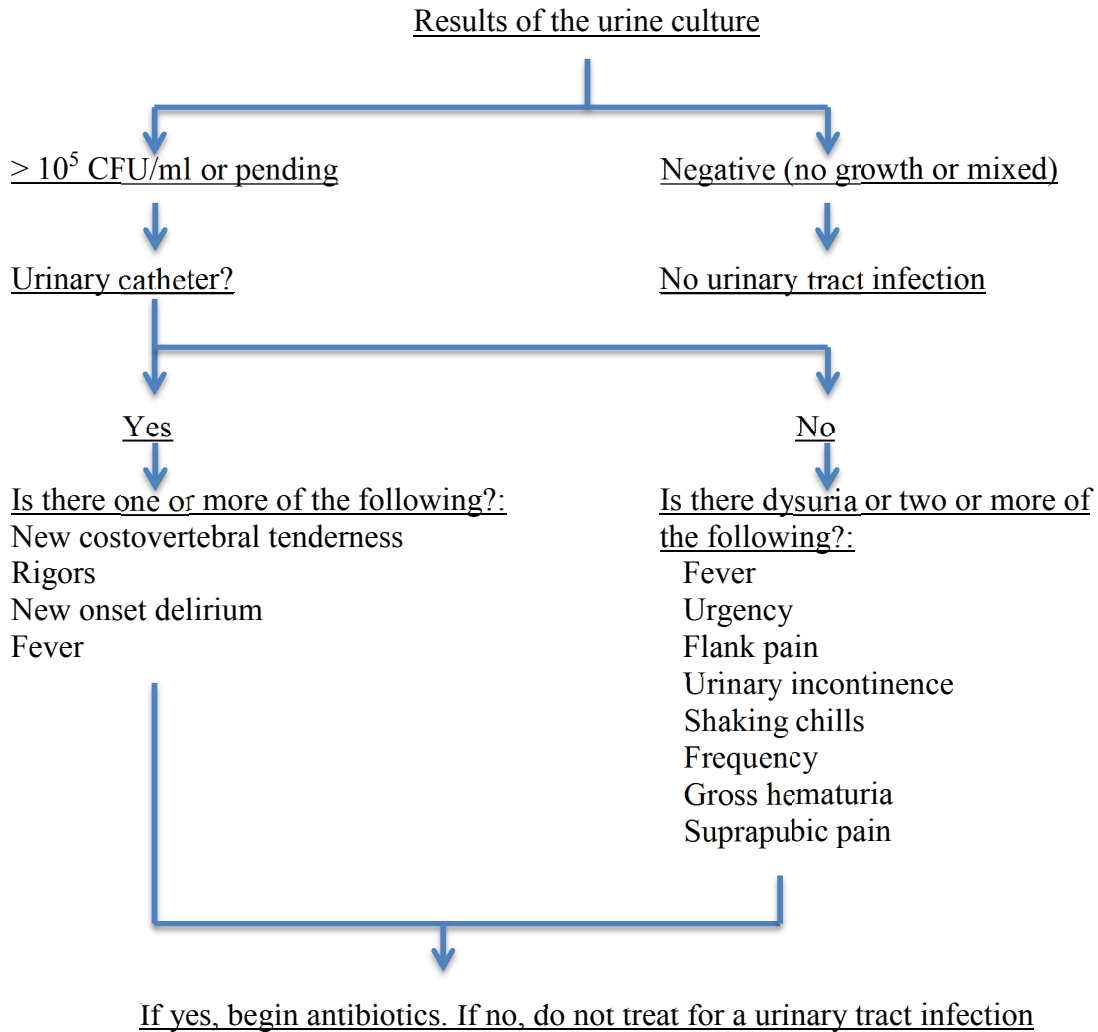
3. If no fever > 37.9C (100 F) or 1.5 C (2.4 F) increase above baseline on at least two occasions over last 12 hours, and has a urinary catheter and one or more of the following, order a urine culture:

- a. New costovertebral tenderness
- b. Rigors
- c. New onset delirium

4. If fever > 37.9C (100 F) or 1.5 C (2.4 F) increase above baseline on at least two occasions over last 12 hours and two or more symptoms or signs of non-urinary tract infections: Do not order a urine culture.

Note. Adapted from “Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial”, by Loeb, M., Brazil, K., Lohfeld, L., McGeer, A., Simor, A., Stevenson, K., . . . Walter, S. D., 2005, *British Medical Journal*, 331(7518), 669.

APPENDIX F
TREATMENT ALGORITHM



Note. Adapted from “Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial”, by Loeb, M., Brazil, K., Lohfeld, L., McGeer, A., Simor, A., Stevenson, K., . . . Walter, S. D., 2005, *British Medical Journal*, 331(7518), 669.

APPENDIX G
IRB APPROVAL LETTER



OFFICE OF RESEARCH COMPLIANCE

**INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH
DECLARATION of NOT RESEARCH**

Janice Khauslender
College of Nursing
1601 Greene Street
Columbia, SC 29208

Re: **Pro00067236**

This is to certify that research study entitled, "*Initiating the Loeb criteria in long-term care,*" was reviewed on **6/1/2017**, by the Office of Research Compliance, which is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). The Office of Research Compliance, on behalf of the Institutional Review Board, has determined that the referenced research study is not subject to the Protection of Human Subject Regulations in accordance with the Code of Federal Regulations 45 CFR 46 et. seq.

No further oversight by the USC IRB is required. However, the investigator should inform the Office of Research Compliance prior to making any substantive changes in the research methods, as this may alter the status of the project and require another review.

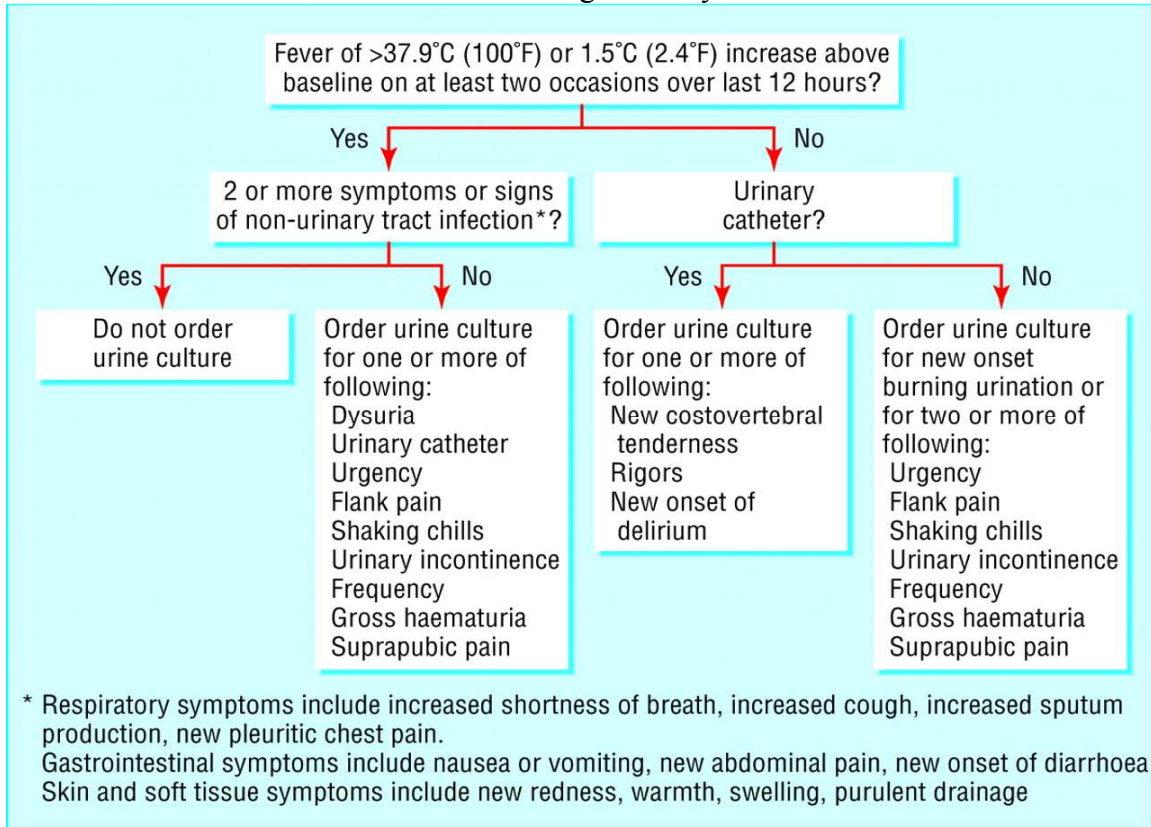
If you have questions, contact Arlene McWhorter at arlenem@sc.edu or (803) 777-709
Sincerely,

Lisa M. Johnson
IRB Assistant Director

APPENDIX H
DATA COLLECTION TOOL

DON'T FORGET TO USE THE LOEB CRITERIA WHEN ASSESSING A PATIENT FOR A URINARY TRACT INFECTION

Loeb Criteria for ordering a urinalysis and culture



Symptoms reported: _____

Does the resident meet the criteria? Yes No

Was a urinalysis and culture ordered? Yes No

What orders were put in place (if any)?

Monitor VS

Increase fluid intake

Laboratory testing

Antibiotics

Note. Adapted from “Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents of nursing homes: cluster randomised controlled trial”, by Loeb, M., Brazil, K., Lohfeld, L., McGeer, A., Simor, A., Stevenson, K., . . . Walter, S. D., 2005, *British Medical Journal*, 331(7518), 669

APPENDIX I
ABSTRACT FOR POSTER PRESENTATION

Initiating the Loeb Criteria in Long-term Care

Purpose: This clinical improvement project applied the Loeb criteria in two long-term care facilities to reduce the frequency of asymptomatic bacteriuria treated with antibiotics.

Rationale: Urinary tract infections are one of the most commonly reported infections in long-term care. Current practices often rely on non-specific symptoms, rather than specific genitourinary symptoms, to aid in the decision to obtain a urine culture. The literature does not support this practice due to the high prevalence of asymptomatic bacteriuria among long-term care patients, which does not have adverse outcomes when untreated. Antibiotics do not eradicate asymptomatic bacteriuria and place patients at risk of adverse reactions and increased risk of multi-drug resistant organisms.

Theoretical Framework/Supporting Literature: The Stetler Model was chosen as the model for research utilization, providing the practitioner with a process to guide the evaluation of research findings and application to clinical practice. The Loeb criteria provide guidelines for initiation of an antibiotic for urinary tract infections; their application in the long-term care has been associated with improved recognition of asymptomatic bacteriuria and reduced inappropriate antibiotic use in this vulnerable population (Loeb et al., 2005).

Method/Interventions: The project was a quasi-experimental clinical improvement project implemented in two long-term care facilities. Nursing staff and providers were educated on the Loeb criteria, which was implemented from June 2017 through November 2017. Retrospective data collection pre- and intervention occurred over the six-month period and outcomes were compared.

Outcomes: Both facilities experienced a notable reduction of asymptomatic bacteriuria treated with antibiotics (62.5% for facility A and 45.8% for facility B). Challenges for the facilities included inconsistent provider adherence to the criteria and high staff turnover. Overall, benefit from implementation of the Loeb criteria was observed, but continuing evaluation after placement of protocols will provide a clearer picture of patient outcomes.

Applicability to APN Practice: Nurse practitioners can apply evidence-based criteria, such as the Loeb criteria in order to reduce unnecessary antibiotic prescribing for

asymptomatic bacteriuria. Nurse practitioners can be leaders in antibiotic stewardship programs, which have been mandated by the Center for Medicare and Medicaid, in long-term care.