

**A Systematic Review of Common Symptoms Associated with Urinary Tract Infections in
the Elderly**

An EBP Capstone Project submitted to the St. David's School of Nursing at Texas State
University in partial fulfillment of the requirements for the degree of Master of Science in
Nursing

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NURS 5391: Translational Science

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November 27, 2022

Abstract

Introduction: Urinary tract infections (UTIs) are a common infection seen in primary care.

There are many key predictive factors including age, gender, comorbidities, and symptom presentation that can be used to quickly identify UTIs for rapid treatment to be implemented.

Methods: This systematic review of literature was guided by Dorothea Orem's Self Care Deficit Theory, and by using databases including CINAHL, PubMed, and Medline to gather and evaluate articles for relevance and guidance. A Rapid Critical Appraisal Tool was used to further screen these articles for relevance and validity through a screening process with inclusion criteria to include or exclude articles for the review. The articles reviewed were used to answer the clinical PICOT question presented and the articles were presented in the form of an evidence synthesis table to give a side-by-side comparison of the research.

Results: Six cohort studies were ultimately included and used based on relevance, to show strong evidence that there are many key predictive factors of UTI in the elderly population that a provider can assess for in their practice to identify and quickly treat before complications occur. All six studies were able to support the clinical question presented.

Discussion: Based on the studies reviewed, there is evidence that improvements can be made in identification and rapid treatment of UTIs in the elderly with further quality improvement projects, more research into the signs and symptoms noted in a larger population with the key focus on identification prior to having positive confirmation of urinary tract infection.

Introduction

Urinary tract infections (UTIs) are extremely common, affecting 150 million people each year worldwide (Rodriguez-Mañas, 2020). UTI's are the second-most common infection in elderly women living in the community, and the most common cause of infection in hospitalized elderly women or residents in long-term care (Rodriguez-Mañas, 2020). In the elderly, UTI's are often associated with a range of comorbidities such as incontinence, immobility, and cognitive impairment, and place patients at high risk for confusion, falls, acute kidney injury and hospital admissions (Zeng, et al., 2020). The importance of rapid identification and treatment of UTIs is crucial to the overall outcomes of this population (Rodriguez-Mañas, 2020). This systematic review examines the importance of identifying key factors related to unconfirmed urinary tract infections in the elderly population.

UTI's and the subsequent development of urinary sepsis has been a significant cause of morbidity and mortality in the elderly. UTI is commonly defined as a common infection that occurs when bacteria enter the urethra and infect the urinary tract (Zeng, et al., 2020). Bladder infection (cystitis) is the most common, but a kidney infection can also occur (pyelonephritis) (Zeng, et al., 2020). Studies have shown the elderly are vulnerable to dehydration due to age-related physiologic changes and impaired physical and cognitive functioning (Zeng, et al., 2020). Accurate diagnosis of UTI is challenging in the elderly population, as they often lack typical signs and symptoms, but rather present with a very wide variation of non-specific symptoms such as malaise, lethargy, or generalized weakness (Rodriguez-Mañas, 2020).

Urinary tract infection was the condition with the highest rate of emergency department visits in the last several years, and dehydration has been highlighted as a common cause of UTIs and hospital admissions among the elderly and assisted living residents (Lean, et al., 2019).

Older adults often forget to hydrate properly, and this can increase the risk of dehydration and UTIs which can lead to confusion, falls, acute kidney injury, and unnecessary hospitalizations (Lean, et al., 2019). In assisted living facilities, inadequate staffing, including high turnover and understaffed care homes, increases the risk of dehydration in residents from lack of staff to provide proper reminders or assistance with hydration (Lean, et al., 2019).

The presence of alternate co-morbidities that are taken into effect as well. Diabetes mellitus, stroke, cancer, incontinence of feces and/or urine, indwelling urinary catheter, and benign prostatic hyperplasia were found to also be present and contribute to urinary tract infections in this population, along with dehydration (Chu & Lowder, 2018). Inpatient admission should be considered for acute UTI for elderly patients and patients who have diabetes, who are immunocompromised, or who show signs of toxicity such as dehydration, hyperpyrexia, rigors, or inability to tolerate oral fluids or medications, as clinical decline related to UTI in these populations is highly likely (Chu & Lowder, 2018).

UTI was the second most common infection that providers initially overlooked due to not recognizing symptoms that could indicate infection, mainly due to challenges encountered with history taking in this population of patients, and a presentation that was often thought to be the product of a different disease process (Rodriguez-Mañas, 2020). According to the article, *urinary tract infections in the elderly: a review of disease characteristics and current treatment options*, the article describes patient who were elderly female patients, who presented to their provider with symptoms described as delirium, increased lethargy, blunted fever response, new-onset incontinence, and anorexia and had a delay in treatment because UTI was not always the initial differential diagnosis (Rodriguez-Mañas, 2020).

Urinary tract infection is one of the most common community-acquired infections among women of all ages, especially of post-menopausal women, affecting an estimated 11.3 million women in the United States annually, at a cost of \$1.6 billion (Jackson, et al., 2018). This statistic alone highlights the need for rapid identification, and for providers to be proactive in identifying the key predictive factors to provide necessary treatment.

A literature review was done to evaluate key predictive factors present in elderly patients who have unconfirmed urinary tract infections. In reviewing the literature, several studies were relevant and provided good insight to key data that provided insight into the key predictive factors of UTI in the elderly population. The articles used for this review include Alpay, et al., 2018; Linhares, et al., 2013; Calijouw, et al., 2011; Butler, et al., 2017; Jackson, et al., 2004; and Jorgensen, et al., 2018. These articles all describe in detail the specific and general key indicators that are present in UTI in the elderly.

One of the articles, *Predictors of Urinary Tract Infection after Menopause: A Prospective Study*, the design of the study was a prospective cohort study. The sample of this study was 1017 postmenopausal women, 55 to 75 years-of-age, who were enrolled in a Health Maintenance Organization and followed for 2 years. The purpose of this study was to describe the incidence of and risk factors for acute UTI among nondiabetic and diabetic elderly women. The interventions and key findings include that 138 symptomatic UTIs occurred per person-year, and independent predictors of urine infection included diabetes and a lifetime history of UTI (Jackson, et al., 2018).

A second specific study reviewed, *Predictive factors of urinary tract infections among the oldest old in the general population. a population-based prospective follow-up study*, the

design and sample study were a population-based prospective follow-up study and 479 patients (157 men and 322 women aged 86 years-of-age) with predictive factors of a history of UTI between with cognitive impairment and mini-mental exam (MMSE) score of < 19 , positive depressive symptoms, a decline in independent activities of daily living, and diabetes co-morbidity (Calijouw, et al., 2011). The purpose of this study was to examine the incidence and predictive factors of UTI among the elderly in the general population (Calijouw, et al., 2011). The interventions and key findings of this study were that the incidence of UTI from age 86 through 90 years was 11.2, per 100 persons at risk, and analysis showed history of UTI between 85 and 86 years with impaired cognitive function disability in daily living (77%), and urine incontinence (82%), were independent predictors of an increased incidence of UTI from age 86 onwards (Calijouw, et al., 2011).

A third study reviewed, *Urinary tract infections in the geriatric patients*, had a design and sample setting that was a Retrospective observational research study, and included 140 hospitalized patients with UTIs who were evaluated within three years between January 2011-January 2015 at the Eskisehir Yunus, Turkey (Alpay, et al., 2018). The purpose of this study was to investigate clinical findings, diagnostic approaches, complicating factors, prognosis, causative factors, and antimicrobial susceptibility in the over sixty-five population who were diagnosed with a UTI (Alpay, et al., 2018). Interventions and key findings of this study include that during a five-year period, 558 patients were evaluated who were over sixty-five years-of-age, 140 were hospitalized with a positive UTI (Alpay, et al., 2018). Among the positive results, this age group had symptoms that included dysuria (74%), polyuria (36%), and urgency (61%) (Alpay, et al., 2018).

Of the six total studies reviewed, none had a disagreeing point of view, and all were able to address and support the clinical question of concern through evidence-based practice and are all peer reviewed for accuracy. There are no current clinical practice guidelines identified for identification of key predictive factors for UTIs in the elderly population.

Purpose and Clinical Question

UTIs are a significant and common problem in the elderly population, and present providers with a difficult decision as to whether to treat immediately with antibiotics or to wait for definitive laboratory results. The purpose of this systematic review of the literature was to evaluate studies that would support data to answer *the question guiding this review which is: In older-aged, frail adults, what are the predictive key factors to consider when planning treatment for suspected but unconfirmed urinary tract infection?*

Conceptual Frameworks

Dorothea Orem's Self-Care Deficit Theory guided this systematic review. Orem's theory describes self-care as the act of assisting others in the maintenance and management of self-care to maintain or improve functioning at the average level of effectiveness (Orem, et al., 1995). It focuses on the ability of the patient to perform self-care, and the ability to identify issues when something is not right with their body (Hartweg, 2015; Orem, et al., 1995). I believe this is important to this literature review because with the patient's inability to identify and treat the problem, the provider then can treat symptoms they identify on contact with the patient (Hartweg, 2015). This identification can occur quickly, allow for rapid treatment, and the patient to remain in their home and increase independence and possibly avoid an emergency department visit or an acute care hospitalization (Hartweg, 2015).

Methods

This systematic review of the literature was guided by Dorothea Orem's Self-Care Deficit Nursing Theory, and The Integrated Model of Community Health Nursing. This project was created to educate providers on the key predictive factors in undiagnosed UTI in the elderly client. (Gbinigie, et al., 2018). It is important to allow the patient to remain at their normal level of functioning in their community setting, if possible, to promote the highest level of personal health to avoid in-patient stays.

Terms I used to conduct the search for articles were “elderly”, “frail”, “urinary tract infection”, “UTI”, “hospitalization”, “ER visits”. Databases searched were PubMed, CINAHL, and Medline. The types of articles I searched for were primary research studies published in 2016 or later. The JBI Critical Appraisal Questions for Cohort Studies (see table 2), for each level of evidence is the quality appraisal tool used as the indicator for strength and quality of evidence.

Articles screened, Alpay, et al., 2018; Linhares, et al., 2013; Calijouw, et al., 2011; Butler, et al., 2017; Jackson, et al., 2004; and Jorgensen, et al., 2018, were done so using the listed inclusion criteria. This was done specifically by first evaluating the title of the study, then the abstract, then by reading the full text, I then used the quality appraisal tool to evaluate the quality of the article. I then used the flow diagram (see Figure 1) to show the number of studies reviewed and screened for inclusion in this review. The flow diagram was able to narrow down the number of articles from seven hundred and three articles and studies to evaluate for inclusion, down to the six I used for inclusion.

With the included studies, I was able to pull data from the text to use as evidence in my research. The evidence synthesis table I used had nine columns containing information found regarding the study author's purpose, framework, design, sample/setting, methods, findings, quality appraisal limitations, and conclusions/applications. There were seven rows containing the six studies and a row set aside for the abbreviation's legend. With the evidence synthesis table complete, I was able to evaluate the studies for common themes to answer the research question using the levels of evidence identified.

Results

The CINAHL and PUBMED databases were searched using the keywords in various combinations. After duplications and unrelated articles were removed, three hundred twenty-nine articles were further screened. Further filters were applied to narrow the search to articles meeting the publication date inclusion criteria. Further review of full text for inclusion criteria and quality appraisal left six studies selected for inclusion in this systematic review. A flow diagram was used to show the literature search process (see Figure 1).

All six studies of the studies reviewed (Alpay, et al., 2018; Butler, et al., 2017; Calijouw, et al., 2011; Jackson, et al., 2004; Jorgensen, et al., 2018; and Linhares, et al., 2013) used a retrospective cohort design to evaluate outcomes regarding identification of UTIs in the elderly population. All studies focused on key symptoms used to identify urinary tract infections in the elderly. Sample sizes ranged from 140 (Alpay, et al., 2018) to 155,597 (Linhares, et al., 2013) with a total sample size across all studies equaling 158,380. The general characteristics of participants included in the studies ranged in age from 39-92 years of age, residing in nursing homes or the general community, or who were hospitalized or seen in emergency department settings. Study settings included Turkey (Alpay, et al., 2018), Europe (Linhares, et al., 2013;

Calijouw, et al., 2011; Butler, et al., 2017), and the United States (Jorgensen, et al., 2018; Jackson, et al., 2004). An evidence synthesis table (see Table 1) was utilized to organize and synthesize reference article information.

All studies in this review examined key factors to consider when diagnosing and planning treatment for suspected UTI in the elderly. Across studies, two overall themes were identified: Theme 1: *Physical Findings*: four articles found that women made up a large percentage of the elderly population who were diagnosed with UTI (Linhares, et al., 2013; Calijouw, et al., 2011; Butler, et al., 2017; Jackson, et al., 2004). All articles except Linhares, et al., 2013 and Jackson, et al., 2004, determined that fever, nausea and vomiting, dysuria, hematuria, urgency, frequency, altered mental status, and decline in mobility were all common symptoms displayed in elderly patients diagnosed with UTI. Breakdown of common key symptoms identified are listed in table 3 (see table 3).

Theme 2: *Historical/Comorbidity Factors*: personal history of diabetes is described in many of the articles as being an important co-existing condition in most cases (Alpay, et al., 2018; Jorgensen et al., 2018; Jackson, et al., 2004). One article focused on co-morbidities present in most suspected UTI cases as diabetes at 67% of positive urinary tract infection cases, history of recurrent UTIs at 24%, and history of renal calculi at 9% (Jackson, et al., 2004). There was also a noted increase in the average number of samples positive for urinary tract infection from nursing home settings (64% of the positive tests), versus community settings (36% of positive tests), who presented to the emergency room (Jorgenson, et al., 2018).

Discussion/Implications/Recommendations

The studies included in this review focused on predictive key factors of confirmed UTI in the elderly population. In order to answer the question “*In older-aged, frail adults, what are the predictive key factors to consider when planning treatment for suspected but unconfirmed urinary tract infection?*”, there is a focus on rapid identification of UTIs in nursing home settings, community settings, ED, and inpatient settings by quickly identifying common signs and symptoms as noted from the participants in the studies who were determined to actually have a UTI. (Jorgensen, et al., 2018; Juthani-Mehta, et al., 2009; Alpay, et al., 2018; Butler, et al., 2018; Jackson, et al., 2004; Calijouw, et al., 2011). There is also a focus on gender and comorbidities identified in identification of risk and need for treatment early versus delayed. Dorothea Orem’s Self Care Deficit Theory plays an important role in the interpretation of the study results because the elderly population are less likely to recognize or self-identify key symptoms of suspected UTI until the infection is identified through a urinalysis or in the later stages of the process when the patient could possibly experience complications related to UTI.

According to the studies reviewed, key predictive factors for UTI in the elderly population include being female, presenting with a comorbidity of diabetes, history of UTI, history of renal calculi, and physical symptoms of acute fever, dysuria, abdominal pain, hematuria, urinary frequency, altered mental status, and a recent decline in mobility or independent functioning. Although these findings do not specify how many of these symptoms or which combination of symptoms is most diagnostic, they do offer providers an evidence-based list of symptoms from which to gauge the next step more easily in diagnosis or treatment. However, in the presence of any of these factors in this population, especially when more than one is present, UTI should be suspected and urinalysis with reflex to microscopic urine culture

should be ordered and antimicrobial treatment should be started as soon as a positive urine culture is noted (Fagan, et al., 2015). Empirical treatment for uncomplicated UTI or for those who are not at high risk for side effects related to use of antibiotics can be done at the provider's and patient's discretion (Gharbi, et al., 2019). Identifying these common signs and symptoms may be helpful when making this decision.

Treatment for uncomplicated UTI in older adults is similar to treatment recommended for the younger female population (Rowe & Juthani-Mehta, 2013). The International Clinical Practice Guideline for Acute Uncomplicated Cystitis and Pyelonephritis in Women: A 2010 update by the Infectious Disease Society of America and the European Society for Microbiology and Infectious Diseases, recommends treatment with nitrofurantoin monohydrate macrocrystals 100 mg twice daily for 5 days, or trimethoprim/sulfamethoxazole 160/800 mg twice daily for 3 days if local resistance rates do not exceed 20% (Rowe & Juthani-Mehta, 2013; Gupta et al., 2011).

There were several limitations identified in the studies included in the review. Two of the studies had limitations related to reliance on accurate coding (Jorgensen, et al., 2018 & Linhares, et al., 2013). Two of the studies had limitations including data entry errors possible and lack of proper reporting parameters for symptoms (Alpay, et al., 2018 & Jackson, et al., 2018). One study listed their limitation as only including symptoms from those who are 86 years of age (Calijouw, et al., 2011). One article described being the only known research study in Europe of its kind and had lack of comparable data (Butler, et al., 2017). One article described having a population sample of those of all ages and not just inclusive of those over 65 years of age (Jorgensen, et al., 2018).

There were also limitations of this systematic review, including the lack of recent studies performed in the United States. This presents limitations in this review, because the population in the United States have BMI, culture and lifestyle differences that could affect the review (Linhares, et al., 2013). Additionally, all the studies found were retrospective reviews, so none were gold standard randomized control studies, so the level of evidence presented was not high. In several studies, the age range of the participants varied quite a bit from 24-92 years of age and could affect the validity of the findings. Finally, I was only able to find 6 studies, so there are few studies addressing this question of what key predictive factors are noted in undiagnosed UTI in the elderly, and more research is needed.

In the elderly, it is important to quickly identify those who are presenting with key predictive factors for a urinary tract infection to properly treat this patient in a timely manner to avoid complications. The elderly are highly susceptible to the complications related to untreated urinary tract infections (Chu & Lowder, 2018). It is important to recognize females with a personal history of diabetes, renal calculi, or history of UTI, and have acute fever, altered mental status, dysuria, hematuria, or abdominal pain, to consider this specific identification as having the predictive key factors of possible UTI (Mody & Juthani-Mehta, 2014). In the elderly, especially women, with suspected UTI, it is important to promptly obtain a urinalysis with microscopy and either empirically treat, or prepare for treatment as appropriate (Ahmed, et al., 2018).

Implications for further research would be to better identify and treat urinary tract infections as quickly as possible to avoid serious complications or illness, including debility or death to this population. The symptoms most identified in this population as being the most

common were history of diabetes, previous history of UTI, altered mental status, physical limitations, and being female.

Conclusion

I believe improvements can be made in identification and treatment of UTIs in the elderly with further quality improvement projects, more research into the signs and symptoms noted in a larger population with the key focus on identification prior to having positive confirmation of urinary tract infection. There is evidence to support the identification of key predictive factors of UTIs in the elderly population. There is strong evidence to support the importance of rapid identification and treatment to prevent significant complications of UTI, including physical and mental complications and even death.

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Figure 1

Flow Diagram

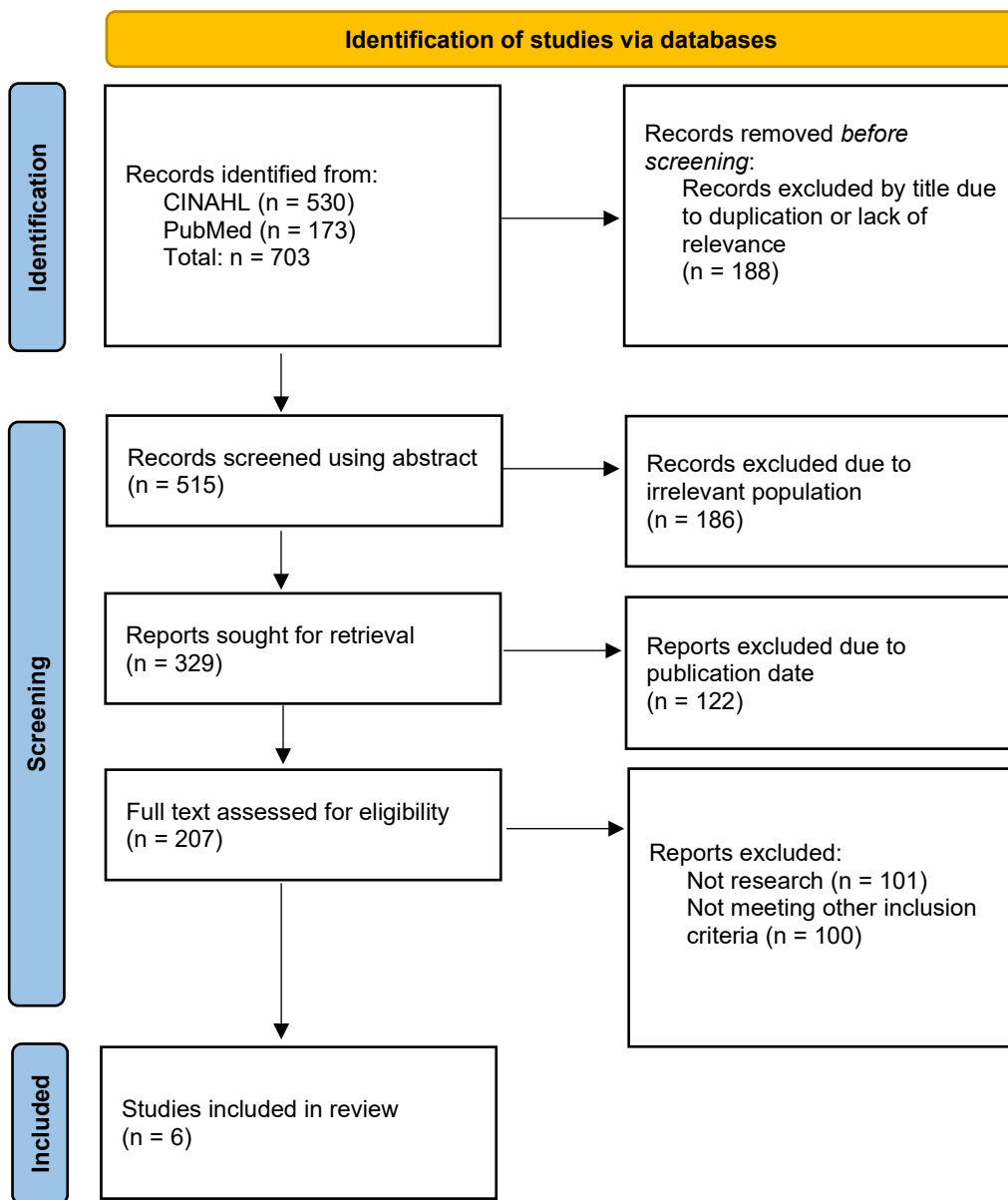


Table 1

Evidence Synthesis Table

Author	Purpose	Frame- work	Design	Sample/ Setting	Methods	Findings	Quality Appraisal/ Limitations	Conclusions/ Application
Alpay, et al., 2018	Investigate clinical findings, diagnostic approaches, complicating factors, prognosis, causative microorganisms and antimicrob. suscep. in >65 diag with UTI.	None stated	Retrospective observational research study	140 hospitalized patients with UTIs were evaluated within three years between January 2011-January 2015 at the Eskisehir Yunus	UTIs diagnosed at the hospital were diagnosed as systemic with S&S and a positive UD and UC.	5 yr period: 558 patients eval: > 65 years: 140 hospitalized UTI +. UTI rates according to age groups were 32.9% 65-75 years, 48.6% 76-85 years, and 18.6% for > 85 years. Of the symptoms, 74% had dysuria, 36% had polyuria, and 61% had urgency	QA: 8/10 limitations include reporting parameters and errors in data entry	Typical findings for UTI, such as dysuria, polyuria and urgency, are sometimes obscured in the elderly. However, N/V, abd pain, incontinence, resp distress & AMS may be symptoms. fever, dysuria, pollakiuria, hematuria and abd pain in the elderly with UTI showed that fever and dysuria were the most common symptoms
Butler, et al., 2017	To compare and examine possible differences in outcomes related to early symptom management of suspected UTI in the elderly	None stated	Prospective observational study	study of 797 females with symps of uncomp UTI in primary care networks in England, Wales, the Netherlands, and Spain.	Clinicians recorded history, symptom severity, mgmt, and urine culture obtained. Participants recorded symptom severity daily for 14 days. Time to recovery was compared between patient characteristics and between countries using two-level Cox proportional hazards models	726 of 797 females for whom there was a result were urine culture positive for UTI. No meaningful differences at a country network level before and after controlling for severity, prior UTIs, and antibiotic prescribing. Need info on presenting sx's of those who actually had UTI.	QA: 9/10 limitations include this being the first prospective study known to describe the presentation and mgmt of uncomplicated UTI in primary care settings in Europe, and to explore the association with patient recovery, taking microbiological findings and case mix into account	little difference in GP-rated symptom severity at presentation, pathogens, and their sensitivity to antibiotics. However, considerable differences were found in UTI with + culture, abx given, subsequent abx prescriptions, f/u with MD. Abx prescribing was associated with successful recovery.

Author	Purpose	Frame-work	Design	Sample/ Setting	Methods	Findings	Quality Appraisal/ Limitations	Conclusions/ Application
Calijouw, et al., 2011	Examines incidence and predictive factors of UTI among the elderly in the general population.	None stated	population-based prospective follow-up study	479 patients. 157 men and 322 women aged 86 yrs predictive factors were hx of UTI between 85 and 86 yrs, with cognitive impairment MMSE < 19, + depressive symptoms GDS > 4, decline in ADLs, & co-morbidities	study of 86-yr-old subjects in Leiden, The Netherlands. Info on the dx of UTI obtained annually during 4 yrs of f/u from the medical records and interviews of treating MDs.	The incidence of UTI from age 86 through 90 years was 11.2, 95% CI per 100 person-yrs at risk. Analysis showed hx of UTI between 85 and 86 years with impaired cognitive function disability in daily living (77%), and urine incontinence (82%), were independent predictors of an increased incidence of UTI from age 86 onwards	QA: 9/10 only 86-year-olds could be considered a limitation of this study.	A history of UTI between the age of 85 and 86 years, cognitive impairment, ADL disability and urine incontinence are independent predictors of developing UTI. These predictive factors could be used to target preventive measures to the oldest old at high risk of UTI.
Jackson et al., 2004	To describe the incidence of and risk factors for acute UTI among nondiabetic and diabetic elderly women	None stated	prospective cohort study	1017 postmenopausal women, 55 to 75 yrs, who were enrolled in a HMO and followed for 2 years	A wide range of behavioral and physiologic exposures were assessed at baseline interview and follow-up clinic visits; the main outcome measure was UA confirmed acute symptomatic cystitis. Follow-up was 87% at 12 months and 81% at 24 months	138 symptomatic UTIs occurred per person-year. Indep predictors of infection included diabetes and a lifetime history of UTI.	QA: 9/10 relied on accuracy of records that were not as well maintained as they could be	DM is an important risk factor for UTI, and with its increasing prevalence, diabetes-associated UTIs are likely to become more common. Lifetime history of UTI was the strongest predictor. Use of oral or vaginal estrogen was not protective, and a wide range of behavioral and physiologic factors was not associated with acute cystitis

Author	Purpose	Frame- work	Design	Sample/ Setting	Methods	Findings	Quality Appraisal/ Limitations	Conclusions/ Application
Jorgensen et al., 2018	identify risk factors for return visits in ED elderly patients treated for UTI.	None stated	Retrospective cohort research study	350 adult ED patients with UTI Pasadena, CA	Relevant data was extracted from medical charts and compared between elderly patients with and without ED return visits within 30 days	Approx. 87% of pts dx'd with UTI were female; 45% of those not initially dx'd were 65 or older; 40% of return visit pts had only non-specific sx's and 40% of all pts had only non-specific sx's; 31% of all pts had n/v and 35.3 of return visit pts had n/v; 25% of all pts had a healthcare exposure within 6 mos, and 15% overall had a psych disorder or diabetes	QA: 9/10 Not all of those evaluated were >65; reliant of ICD coding d/t retrospective research; patients not in a "closed healthcare" system	BSI in UTI patients may be minimized by using ED-source specific antibiogram data to guide empiric treatment decisions and by targeting at-risk patients for post- discharge follow-up
Linhares, et al., 2013	Assess empirical ABX treatment, the pre and the resist patterns in UTIs in >65 yrs	None	Retrospective cohort research study	155597 samples analyzed in Portugal	During 2000–2009 UAs with > 105 CFU/mL bacteria were considered + and, for these samples, the bacteria were identified, and the profile of ABX susceptibility was characterized	Of the samples analyzed, 18797 (12.1%) were + for BI. UTI in women 78.5%, and the elderly 38.6%	QA: 9/10 Limitations exist in coding errors and inaccurate labeling of samples	The differences in sex and age must be accounted for at the moment of empirical prescription of ABX as women made up a large majority of this population

Abbreviations: ABX = antibiotics; ADLs = activities of daily living; AMS = altered mental status; AR = antibiotic resistance; ASB = asymptomatic bacteriuria; BC = British Columbia; BI = bacterial infection; BSI = blood stream infection; CA = community-acquired; CI = Confidence Interval; CPRD = Clinical Practice Research Datalink; CRP = C-reactive protein; d/t = due to; DM = diabetes mellitus; ED = emergency department; GDS = Geriatric Depression Scale, GP = general practitioner; HA = hospital-acquired; HMO = health maintenance organization; HR = hazard ratio, LOE = Level of Evidence; MDRO = multi-drug resistant organisms; MMSE = mini-mental state exam NH = nursing home; N/V = nausea and vomiting; PC = primary care; QA = quality appraisal; S&S = signs and symptoms; UC = urine culture; UD = urine dipstick; UK = United Kingdom; US = United States; UTI = Urinary tract infection

Table 2*JBI Critical Appraisal Questions for Cohort Studies*

Reviewer _____	Date _____				
Author _____	Year _____	Record Number _____			
		Yes	No	Unclear	N/A
1. Were the two groups similar and recruited from the same population?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the exposure measured in a valid and reliable way?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were confounding factors identified?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were strategies to deal with confounding factors stated?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes measured in a valid and reliable way?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Were strategies to address incomplete follow up utilized?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Was appropriate statistical analysis used?		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall appraisal: Include <input type="checkbox"/> Exclude <input type="checkbox"/> Seek further info <input type="checkbox"/>					
Comments (Including reason for exclusion) _____					

Table source: Melynck, B.M. & Fineout-Overholt, E. (2019). *Evidence-based practice in nursing and healthcare* (4th ed.). Philadelphia, PA: Wolters Kluwer.

Table 3**Common Key Symptoms of UTI Identified in the Elderly Population**

	Clijouw et al., 2011	Butler et al., 2017	Alpay et al., 2018	Jorgensen et al., 2018
Fever	52%	45%	None stated	None stated
Nausea and Vomiting	Not stated	22%	None stated	18%
Dysuria	20%	18%	33%	43%
Hematuria	60%	44%	60%	51%
Urgency or Frequency	67%	58%	55%	59%
Altered Mental Status	81%	79%	71%	75%
Decline in Mobility	84%	80%	88%	79%