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Evidence-Based Approaches to Lowering UTI Rates in Skilled Nursing Facilities: A Review of the Literature and Application to a Local Skilled Nursing Home

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Evidence-Based Approaches to Lowering UTI Rates in Skilled Nursing Facilities: A Review of the Literature and Application to a Local Skilled Nursing Home

by

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Abstract

The purpose of this paper may be divided into two parts. The first part was a literature review that sought to determine the most common risk factors for developing a urinary tract infection in nursing homes, as well as to identify evidence-based practice interventions for decreasing UTI rates within that specific patient population. The second part consisted of a case study that sought to apply the principles gathered from the literature review to the UTI logs of a deidentified local nursing home. It was found that indwelling urinary catheters and age are the two most common precipitating risk factors for developing a UTI. In addition, prevalence of other risk factors is dependent on the specific qualities of each nursing home and their patients. Thus, initial interventions should begin with an extensive root cause analysis. Front-line staff should also be involved in the initiation and maintenance of any interventions. In terms of the case study, many of the principles identified in the literature review were found to be present in the participating nursing home. It was also found that the nursing home's rehabilitation hall had a statistically significant higher mean number of UTI cases in comparison to the long-term hall. A root cause questionnaire was designed and provided to the nursing home in order to address this trend.

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Evidence-Based Approaches to Lowering UTI Rates in Skilled Nursing Facilities: A Review

of the Literature and Application to a Local Skilled Nursing Home

The U.S. National Center for Health Statistics has reported that approximately 1.3 million American residents live in a nursing home setting (Sengupta et al., 2022, p. 44). Furthermore, it is widely accepted that urinary tract infections (UTIs), which are bacterial infections affecting any portion of the urinary tract, are the most common type of infection diagnosed in patients in nursing homes (Montoya & Mody, 2011). The high prevalence of UTIs in nursing homes suggests that a substantial risk exists for developing a UTI within this specific patient population. Therefore, it is paramount that nursing homes, regardless of acuity level, examine their own risk factors and interventions for the prevention and treatment of UTIs. Research on this topic varies and extends from the diagnosis of a UTI to risk factors for developing a UTI to prevention strategies. The first portion of this paper aims to review the current literature and ascertain common trends of UTI risk factors. Additionally, it seeks to identify evidence-based practice (EBP) prevention strategies for nursing homes. The second portion of this paper examines the UTI trends in a deidentified local nursing home in order to establish a relationship between common risk factors identified within the literary analysis and the facility's UTI logs, as well as provides a potential framework for interventions to combat those facility-specific risk factors.

UTI Pathophysiology

An uncomplicated urinary tract infection (UTI), the primary subject of this paper, is predominantly a bacterial infection of the bladder, but it can also travel to complementary structures, such as the kidneys. According to Bono et al. (2022), a UTI is the result of microorganisms, most commonly enteric coliforms, breaching the mucosal wall of the bladder and producing an inflammatory reaction known as cystitis. These microorganisms travel along

the urinary tract and may eventually ascend into the kidneys, resulting in a more severe kidney infection known as pyelonephritis. Subsequently, severe complications of pyelonephritis include sepsis, renal vein thrombosis, acute renal failure, and emphysematous pyelonephritis, which has a mortality rate of 38% (Belyayeva & Jeong, 2022). Other complications of UTIs are repeated infections, incontinence, chronic prostatitis, prostatic/renal abscess, etc. (Bono et al., 2022). Geriatrics and long-term care patients are at increased risk for developing a UTI due to weakened physiology. In a report by the United States Office of Disease Prevention and Health Promotion (ODPHP), it states:

> Many older individuals develop weakened pelvic muscles, resulting in incomplete emptying of the bladder, urinary retention, and bacterial colonization of the urinary tract. Significant morbidity is associated with these infections. In a study of blood stream infections manifesting in [nursing home/skilled nursing facility] residents, 50% were related to UTI. UTIs are a leading driver of hospitalizations, accounting for almost 30% of hospital readmissions from [nursing home/skilled nursing facility] within 30 days (ODPHP, 2013, p. 9).

Although a UTI is a common diagnosis, the potential for adverse complications, particularly in older adults admitted to nursing homes, marks it as a serious infection. Primary interventions are necessary to prevent its initial occurrence and probable reoccurrence.

Evidence-based Practice

Evidence-based practice is defined as "the conscientious and judicious use of current best evidence in conjunction with clinical expertise, patient values, and circumstances to guide health care decisions" (Lobiondo-Wood et al., 2022, p. 3). Evidence-based practice is a dynamic construct of how healthcare providers determine and improve the use of interventions and

preventative strategies for the care of patients. In relation to the study of UTIs, this paper seeks to evaluate evidence-based practice interventions, identifying successful improvements that can be applied to current practices in preventing and treating UTIs in the nursing home setting.

Review of the Literature

This literature review seeks to identify risk factors for the development of UTI in the long-term care or nursing home setting, as well as potential evidence-based practice interventions for preventing UTI. The literature obtained for the use of this review was accessed through peer-reviewed academic articles and databases. The primary databases used were the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Elsevier, and the National Library of Medicine (NIH). In order to obtain the most up-to-date information, the majority of sources accessed and reviewed were published between 2013 and 2023, with two sources being published in 2011, one source being published in 2010, and one source being published in 2007. Types of sources included literature reviews, systematic reviews, quality improvement studies, experimental studies, and evidence-based practice clinical guidelines based on systematic reviews. For the purpose of this paper, "nursing home" may refer to any of the following: long-term care, acute care or rehabilitation, geriatric unit, residential-aged care facilities, skilled nursing, and care homes. The defining characteristic of these facilities marking them relevant to this review is their purpose in caring for patients, who are generally older adults, outside of a hospital setting for extended periods of time.

Identified Risk Factors for Developing UTI in a Nursing Home

UTIs are the most commonly diagnosed healthcare associated infection (HAI) in the nursing home or long-term care setting. In fact, Montoya and Mody (2011) found that the incidence rate for a UTI in a nursing home was 1.87/1000 bed days. Furthermore, in their

Healthy People 2030 objectives, the United States Office of Disease Prevention and Health Promotion (ODPHP) established decreasing healthcare-associated infections (HAIs) as one of their goals for improving the overall health of U.S. citizens (ODPHP, 2013). The relationship between UTIs and nursing homes exists due to a variety of identified risk factors specific to the patient population and healthcare environment. Therefore, it is vital for nursing homes to be aware of and understand the etiology of these risk factors in order to identify necessary interventions for the mitigation of modifiable risk factors and the management of non-modifiable risk factors.

For instance, in a retrospective analysis of three cohorts, Girard et al. (2017) found that 189 nosocomial UTIs occurred in a total of 4669 patients admitted to a geriatric care unit. Researchers identified the following risk factors: being admitted to an acute/subacute or rehabilitation unit, being female, immunosuppression, and having had a previous diagnosis of a UTI. Dementia was not found to be a risk factor (Girard et al., 2017).

Similarly, Castle et al. (2017) used Minimal Data Set data (MDS) and Online Survey, Certification and Reporting (OSCAR) system data to identify all nursing home residents in the U.S. who developed a UTI within a set year. Researchers used this data to analyze factors that contribute to UTIs in nursing homes. The study examined both resident-specific factors and facility specific factors and determined indwelling catheters to be the primary cause of a UTI. A catheter-associated UTI (CAUTI) is often separately labeled and identified in comparison to a standard UTI. Despite this, Castle et al. also noted that catheterized patients only made up 6.1% of the sample size, indicating that other characteristics play a large role in determining a patient's risk factors for developing a UTI (2017). The ODPHP agrees with this statement, concluding that, "The national average for urinary catheter use in these facilities is approximately 5%,

suggesting that the majority of UTIs manifesting in long-term care are not catheter-associated" (2013, p. 202). When indwelling catheters were taken out of the equation, demographic factors were identified as primary causes for developing a UTI, particularly age. Furthermore, "Among the non-catheterized residents, falls, walking dependence, and pressure ulcers all have a large positive association with UTI incidence" (Castle et al., 2017, para 27). Interestingly, another finding among non-catheterized residents was that a lower incidence of UTI cases occurred in residents who maintained bowel control, yet a higher incidence occurred in residents who still maintained bladder control. Researchers also found "residents of facilities that have higher occupancy rates and that are a part of chains have slightly higher UTI incidence, for both the catheterized and non-catheterized populations" (Castle et al., 2017, para 29). The evidence suggests staffing levels may be a determining factor in facility UTI rates.

Identified EBP Interventions to Treat UTI

The varied assortment of risk factors for developing a UTI while being admitted to a nursing home or other healthcare facility presents caregivers with the complex problem of solving and addressing those risk factors. Additionally, it presents caregivers with the opportunity to develop unique interventions. The quantity of evidence-based interventions exhibits a dynamic growth pattern of how to prevent UTIs. Furthermore, interventions are often specific to each facility, but they may also be adaptable to other facilities. Interventions identified by the literature review process include the following: nurse-led interventions, oral rehydration, environmental interventions, CAUTI specific interventions, and staff education.

Nurse-led Interventions

In a systematic review, Wu et al. (2020) examined the effectiveness of preventing UTI rates in residential-aged care facilities through the use of nurse-led interventions. The study

focused on three subgroups of interventions, including the use of advanced nurse practitioners (ANPs), the implementation of a single UTI nursing intervention, and the implementation of a multicomponent nursing intervention. The reviewed studies that incorporated advanced nurse practitioners did not provide enough detail to determine the effectiveness of the employment of an ANP in terms of implementing interventions. Neither did it show a significance in the nurse practitioner's relationship to decreasing the UTI rates within a facility. The multicomponent nursing intervention also showed little promise by means of statistical significance. This study initiated UTI (and other adverse events) education, patient involvement, and a feedback-oriented program. The feedback-oriented program also included caregiver training sessions, 30-minute discussions, educational CD-ROMs for nurses, and an informational pamphlet for patients. Again, lack of detail inhibited the researchers' ability to determine the effectiveness of this intervention. However, despite the lack of significance from the previous studies, the study involving the implementation of a single nursing intervention, which was a hydration improvement plan where residents in an experimental group were encouraged to drink unrestricted fluids, showed a statistically significant decrease ($p<0.001$) of asymptomatic UTIs. The effectiveness of this study in comparison to the others is only mildly noted, and researchers stressed the need for further randomized and controlled experimental designs testing the use of nurse-led interventions. Wu et al. argued that the use of randomized and controlled experimental designs have a strong potential to greatly impact the development of evidence-based practices related to the prevention of UTIs (2020).

Oral Rehydration

Similar to Wu et al. (2020), MacRae et al. (2022) and Lean et al. (2019) focused on the relationship between dehydration and contracting a UTI. Nursing home residents are at risk for

poor hydration due to physical conditions, such as dysphagia, or mental deterioration, like dementia. These risk factors subsequently make nursing home residents more susceptible to poor health, which can lead to susceptibility to UTIs and other infections. On the basis that long-term care patients diagnosed with dementia are at risk for poor oral hydration because of their cognitive limitations and are, therefore, also at risk for urinary tract infections, MacRae et al. (2022) suggested the following evidence-based nursing interventions: use brightly colored cups to make fluids more visible, use double-handed cups to support physical limitations, encourage foods containing a high fluid content, such as yogurt.

Lean et al. (2019) implemented "seven structured drink rounds" in four specific care homes and tested the number of residents requiring antibiotics due to the diagnosis of a UTI in comparison to baseline data taken from Secondary Uses Service accessed by East Berkshire CCG. In conjunction with the structured drink rounds, staff and patients were supported throughout this endeavor by the provision of staff education, dehydration awareness campaigns, drink diaries for at-risk residents, and the use of "hydration champions," who were specifically trained to support staff in spreading hydration awareness. Researchers found a 58% reduction in UTIs requiring antibiotics with the implementation of their oral rehydration program. At eighteen months post intervention, the care homes' average measurement of days between UTIs increased from 9 days to 80 days. Furthermore, a 36% reduction in UTI cases requiring admission to the hospital was also seen. Ultimately, researchers attributed the study's success to the fact that it was co-designed by individuals working in the participating nursing homes (Lean et al., 2019).

Environmental Interventions

Urinary tract infections are most often the result of bacteria invading the mucosal lining of the bladder (Bono et al., 2022). In a retrospective analysis study, the gram-negative microorganism *Escherichia coli* was the most commonly isolated organism in sample urinalyses, closely followed by *Klebsiella pneumoniae* (Ayhan et al., 2022). It is understood that these pathogens originate in the large intestine and perineal areas and cause UTIs when they enter the normally sterile urinary tract (Behzad et al., 2010). Dementia and incontinence of the bowel may provide pathogens with access to the urinary tract due to poor hygiene habits, resulting in inflammation of the mucosal lining and the development of a UTI. MacRae et al. (2022) discussed the importance of therapeutic touch and communication from caregivers in order to promote feelings of safety, comfort, and privacy when assisting with toileting. This ensures that caregivers can better aid with hygiene habits, decreasing the risk of pathogens entering the urinary tract via fecal matter.

Pathogens may also arise from other environmental factors. For instance, an experimental design study analyzed nursing home acquired infection rates of a 160-bed long-term care facility pre and post implementation of a pulsed-xenon ultraviolet light disinfection device (Kovach et al., 2017). Researchers found, "There were significant decreases in nursing home acquired relative to hospital-acquired infection rates for the total infections ($p = .004$), urinary tract infection rates ($p = .014$), respiratory system infection rates ($p = .017$) and for rates of infection of the skin and soft tissues ($p = .014$)" (Kovach et al., 2017, para. 3). This suggests that cleaning of high touch surfaces within a patient's environment, specifically with ultraviolet light radiation, is an effective tool in decreasing UTI rates.

Preventing CAUTI

Wu et al. (2020) identified indwelling urinary catheterization as the primary risk factor for developing a UTI in residential-aged care facilities. This specific type of UTI is known as a catheter associated urinary tract infection (CAUTI), and interventions may also be instigated specifically for preventing CAUTIs. Though CAUTIs make up only approximately 5-6% of residents in long-term care, and, therefore, only a small portion of all urinary tract infections, CAUTIs are still widely researched in terms of how to prevent them from occurring in nursing homes (ODPHP, 2013). For instance, in a retrospective observational study, Singh et al. (2021) found that the implementation of a UTI screening process for patients prior to admission reduced CAUTI rates and improved the initiation time for treatment. Furthermore, in an observational cohort quality improvement study, Fiveash et al. (2021) sought out interventions for preventing CAUTIs aside from using sterile technique during the insertion of an indwelling urinary catheter, as well as the prompt removal of such a catheter, which is a common ideology and practice amongst care providers. They argued that urinary catheters are often a necessary component for the care of long-term patients due to a variety of patient physiological circumstances, thereby making it also necessary for long-term interventions to be in place.

In order to address the long-term use of indwelling catheters, Fiveash et al. (2021) implemented staff safety huddles as their chosen intervention and remarkably saw "a near-zero CAUTI rate for over two years" (para. 1). Group huddles were employed following a CAUTI event, which was described as when a resident with an established indwelling urinary catheter tested for a positive urine culture. These huddles maintained the goal of establishing root cause analysis of the CAUTI within one week of its positive test result and utilized an analysis tool to pinpoint potential causes of the CAUTI. Sample questions from this 18-question tool include the

following, "When was the last catheter insertion? Were there possible breaks in technique following insertion? If yes, describe. What was the process for catheter maintenance?" (para. 10). Questions followed a self-reflective and facility-reflective process, allowing nurses and caregivers to identify failures that occurred within the system. This, in turn, allowed staff to change care plans, implement quality improvement education, and encourage specific behavioral modifications in both residents and staff.

Staff Education

Previous sources, including Fiveash et al. (2021); Lean et al. (2019); MacRae et al. (2022); and Wu et al. (2020), show the significance of utilizing nursing home staff as a means of decreasing UTI rates. Jones et al. (2021) completed a survey study of 58 nursing homes that opted to participate in an infection control program to reduce healthcare associated infections. Researchers distributed surveys to each of the participating nursing homes and found that the majority were aware of their UTI and CAUTI rates, but many nursing homes were simultaneously unaware of rates like staff hand hygiene or showed inconsistent staff training related to preventions of UTI. This suggests a disconnect between nursing homes' knowledge of implementing UTI interventions and the ability of those nursing homes to actually implement those interventions. In response to this, McMullen et al. aimed to improve staff education regarding UTI, as well as accountability towards infection prevention methods via "in-services, completion of competencies, and routine monitoring of perineal and catheter care" (2007, para. 8). McMullen et al. found that interventions were only impactful and able to be maintained if staff were continually educated in UTI prevention (2007).

Critical Analysis

Following the review of the current literature, a critical analysis of the reviewed articles has determined that various modifiable risk factors are likely to be the underlying cause of nursing home UTI rates. Interventions should, therefore, be based upon each facility's specific risk factors identified through a root cause analysis. Additionally, the reviewed articles, along with Lewin's theory of change, highlighted distinct trends within the identified interventions that contribute to higher success rates. The trends that were identified include the importance of involving staff throughout the change process and providing continuous auditing and staff education in order to stabilize UTI interventions. Nursing homes that adopt these principles may see improved success in lowering their facility UTI rates.

Risk Factors

Sources agree that the most common precipitating risk factor for developing a UTI is the insertion of an indwelling urinary catheter, but the percentage of catheterized residents in nursing homes is much smaller than that of non-catheterized residents. CAUTIs, therefore, only make up a partial number of overall UTI rates (Castle et al., 2017; Wu et al., 2020). Demographic factors, particularly age, are considered the next most probable underlying cause for developing a UTI (Castle et al., 2017). Most residents of nursing homes are aged 65+ (Sengupta et al., 2022). Noting that the primary risk factor for developing a UTI is increased age and that the patient population of nursing homes is primarily aged 65+, it can reasonably be interpreted that nursing homes are constantly faced with the liability of caring for UTI patients, preventing UTIs, and preventing recurrent UTI infections.

It should further be noted that age is a non-modifiable risk factor, meaning it cannot be changed. This necessitates nursing homes to look beyond the main risk factor when determining

preventative measures. Fortunately, modifiable risk factors have also been identified, including being admitted to an acute/subacute or rehabilitation unit, (Girard et al., 2017), staffing levels (Castle et al., 2017), hydration status of nursing home residents (Lean et al., 2019; MacRae et al., 2022; Wu et al., 2020), environmental pathogenic factors (Kovach et al., 2017), and staff education (Jones et al., 2021; McMullen et al., 2007). This wide array of risk factors showcases the need for an individualistic approach to be taken in order to prevent UTI cases. To elaborate, the identification of modifiable risk factors within a specific facility and a focus on intervention strategies related to those risk factors, may be of greater assistance to nursing homes in combating UTIs, as opposed to seeking out a single "most common" risk factor relevant to all nursing homes, such as CAUTI rates and age.

EBP Interventions

Various success rates were seen in individual sources regarding their chosen forms of UTI interventions. Perhaps the most successful quality improvement study was Fiveash et al. (2021) and their implementation of CAUTI specific safety huddles, which resulted in a near zero rate of CAUTIs in participating facilities. Although CAUTIs should be addressed as a prominent issue in nursing homes and as a necessary focus for nursing home staff, a more significant percentage of UTI cases are not related to indwelling catheters. Accordingly, these separate urinary tract infections require different prevention techniques. Nevertheless, principles of action can still be ascertained from the success story of the safety huddle. For instance, the primary goal of the safety huddle was to perform a root cause analysis, which is defined as "a structured method used to understand sources of system variation that lead to errors or mistakes, including sentinel events, with the goal of learning from mistakes and mitigating hazards that arise as a characteristic of the system design" (Lobiondo et al., 2019, p. 173). Root cause analysis is both a

reactive and proactive procedure, requiring staff to identify where the initial flaw in the system occurred and how it contributed to the incidence of the UTI. Furthermore, it encourages staff to invoke reactive measures to more effectively treat the UTI, and additionally to generate proactive preventative measures to inhibit the recurrence of the initial flaw. Subsequently, this prevents further UTIs in the originally infected resident, as well as other residents.

Root cause analysis also addresses the unique nature of each nursing home. The set-up, environment, management, staff, and patients of each nursing home makes every facility different from the next. As a result, primary UTI interventions must also be uniquely adjusted to fit the distinct needs of each facility. In some nursing homes, root cause analysis may determine that an oral rehydration program is required. Likewise, how the oral rehydration program is set up also varies between facilities. For instance, Lean et al. (2019) and Wu et al. (2020) concentrated on dehydration as a risk factor, and both studies saw success in their interventions. However, the methods behind their oral rehydration programs were dissimilar in their framework and structure. Lean et al. (2019) instituted a very strict routine of seven structured drink rounds, whereas Wu et al. (2020) had staff encourage and remind residents to drink unrestricted fluids without a structural routine. The success of these unique interventions demonstrates that, more important than the intervention itself, principles of change must accompany both the initial root cause analysis and the ensuing intervention.

According to Lewin's theory of change, a commonly recognized model for implementing evidence-based practices in healthcare, there are three phases of change that leaders need to address in order to facilitate and enforce a new practice in an already established workflow (Huber & Joseph, 2022, p. 35). For example, the first phase of Lewin's model is known as "unfreezing," or bringing awareness to the issue, and it is perhaps most applicable to the huddle

process developed by Fiveash et al. (2021). The idea of the safety huddle is versatile and can be implemented across nursing homes, and even more promising is the fact that it actively involves frontline staff in the brainstorming and promotion of UTI interventions. Fiveash et al. (2021) accomplished unfreezing by including frontline nursing staff in the huddle process and encouraging them to participate and provide their own feedback in response to the root cause analysis questionnaire tool. This resulted in staff growing more aware of each flaw in the system that potentially led to their facility's CAUTI cases. It also gave staff a personal connection to both the root cause of the issue and the preventative solution.

Principles of action derived from Lewin's change theory can be obtained from other studies as well. For instance, Lewin's second phase, known as "moving," demonstrates the initial process of implementing the change. Each study saw a varied amount of success within this stage. However, the fundamental theory behind the third and final stage, known as "refreezing" or the stabilization of the chosen implementation, was argued by McMullen et al. (2007) to be essential in maintaining a long-lasting intervention. An important aspect of refreezing is behavioral reinforcement, which provides positive feedback and encouragement to staff. McMullen et al. (2007) demonstrated this by requiring staff to complete competency trainings, as well as by performing routine auditing of perineal care.

Overall, a variety of best practice suggestions are available for nursing homes to implement in order to decrease UTI rates. However, various success rates were seen across studies depending on the risk factors, thoroughness of the study, and staff compliance. It is, therefore, suggested that root cause analyses and principles from Lewin's change theory may better assist nursing home staff as they seek to lower UTI rates within their facilities. Different risk factors may appear to be more prominent in each nursing home, thus requiring nursing home

staff to implement unique changes. Instead of relying on a single or "most common" risk factor as the driving force for determining a framework of interventions for lowering UTI rates, it is more important for each nursing home to first conduct a root cause analysis and determine what risk factors their facility is currently susceptible to. Furthermore, the actual interventions should uniquely address the situation of the nursing home and actively involve staff in the unfreezing, moving, and stabilization phases of those chosen interventions. Due to the patient population of nursing homes, urinary tract infections will continue to remain a notable issue. However, adherence to these principles may successfully aid in a significant decrease of UTIs.

Case Study: Application to a Local Skilled Nursing Home

The second portion of this paper seeks to put to practice the principles interpreted from the literature review by applying them to a local nursing home. The local nursing home, which has been deidentified for privacy and HIPAA purposes, agreed to provide its UTI logs to the research team, which then analyzed the logs for trends related to the onset of a urinary tract infection. The nursing home may be described as a 52-bed skilled nursing facility and contains two halls of both rehabilitation and long-term care residents. While these halls are separated based on patient characteristics, strict adherence to these categories was not observed within the facility, meaning that long-term patients may be present in the rehabilitation hall and vice versa. Moreover, staff members may be scheduled to work on separate or both halls. This project was reviewed by the Utah State University Institutional Review Board and granted a waiver of HIPAA alteration on the basis that all patient data were deidentified prior to retrieval by the research team, thereby maintaining patient privacy. Patient charts were not accessed, and UTI data was limited to relevant information.

Objective

The overall objective of this project was to analyze trends within UTI logs in order to provide the participating nursing home with a potential framework for quality improvement practices related to UTIs that are based on the facility's associated root causes.

Methods

The data obtained were the monthly UTI logs from January 2020 to January 2023. These logs were categorized into the following groups: type of hall in which UTI was present (rehabilitation versus long-term), month/year of acquired UTI, UTI present or not present upon admission, if not present, when was infection acquired, acute or recurring, medication interventions, antibiotic start date, antibiotic stop date, does or does not meet McGreer's criteria, and the name of the isolated pathogen. UTI cases acquired in a different setting than that of the participating nursing home, meaning they were already present prior to admission, were ultimately excluded from the analysis. Recurrent infections in the facility were still included.

In terms of analysis, an independent samples *t*-test was performed to assess the statistical difference of mean UTI cases between the rehabilitation and long-term halls within the three-year sample period. Incidence rates of UTIs were also calculated and compared per month, per year, and per season, ultimately seeking to identify increasing or decreasing trends within those time periods. Furthermore, the types of pathogens isolated in urinalyses were also briefly addressed.

Hypotheses

Based on the UTI risk factors gathered from the previous literature review, it was hypothesized that summer months (June, July, and August) would exhibit spikes in number of UTIs as a result of increased risk for dehydration related to warmer temperatures (Lean et al.,

2019; MacRae et al., 2022; Wu et al., 2020). Due to the findings of Girard et al. (2017), it was also hypothesized that more UTIs would be present on the rehabilitation hall versus the long-term hall. Furthermore, based on the understanding that *Escherichia coli* is the most common isolated pathogen in urinalysis cultures, it was expected that the provided data would follow this trend and that *E. coli* would make up the highest percentage of pathogens (Ayhan et al., 2022).

Results

When comparing the number of UTI cases per month, no clear seasonal trend was observed. However, most recently a markedly steady increase between July 2022 and January 2023 was discovered, with cases increasing from one UTI in July 2022 to six in January 2023. Notably, January 2023 and July 2020 marked the highest number of UTI cases logged per month. However, it should be noted that data was not provided for December 2022, October 2022, May 2022, or September 2021. When these months were taken out of the equation for their respective years, 2021 was seen to have the highest incidence of UTI cases, totaling 28, compared to 26 cases in 2020, and 25 cases in 2022. In 2023, a total of six cases were identified in January. Winter months (defined as January-February) saw an average incidence of 3.22 UTI cases; summer months (June-August) saw an average of 3.13 cases; autumn (September-November) saw an average of 2.57 cases; and spring (March-May) saw an average of 3.25 cases. Based on these averages, autumn ostensibly saw the lowest UTI rates, whereas spring saw the highest. Again, it should be noted that data was not provided for December 2022, October 2022, May 2022, or September 2021 and, therefore, were not included in these calculations, potentially skewing the averages.

Figure 1

Total UTIs/Month Vs. Rehabilitation Hall UTIs/Month Vs. Long-Term Hall UTIs/Month
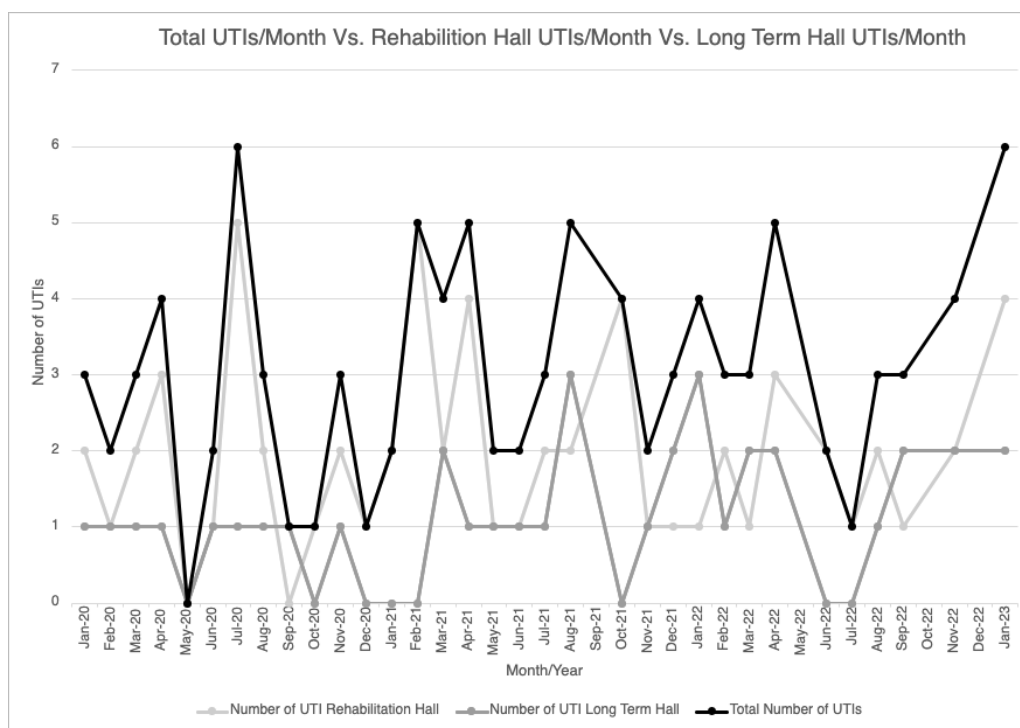
Table 1

Seasonal Variation of UTI Cases

Winter Months	Number of UTI Rehabilitation Hall	Number of UTI Long-Term Hall	Total Number of UTIs
Jan-23	4	2	6
Feb-22	2	1	3
Jan-22	1	3	4
Dec-21	1	2	3
Feb-21	5	0	5
Jan-21	2	0	2
Dec-20	1	0	1
Feb-20	1	1	2

Jan-20	2	1	3
AVERAGE	2.111111111	1.111111111	3.222222222
Summer Months	**Number of UTI Rehabilitation Hall**	**Number of UTI Long-Term Hall**	**Total Number of UTIs**
Aug-22	2	1	3
Jul-22	1	0	1
Jun-22	2	0	2
Aug-21	2	3	5
Jul-21	2	1	3
Jun-21	1	1	2
Aug-20	2	1	3
Jul-20	5	1	6
AVERAGE	2.125	1	3.125
Autumn Months	**Number of UTI Rehabilitation Hall**	**Number of UTI Long-Term Hall**	**Total Number of UTIs**
Nov-22	2	2	4
Sep-22	1	2	3
Nov-21	1	1	2
Oct-21	4	0	4
Nov-20	2	1	3
Oct-20	1	0	1
Sep-20	0	1	1
AVERAGE	1.571428571	1	2.571428571
Spring Months	**Number of UTI Rehabilitation Hall**	**Number of UTI Long-Term Hall**	**Total Number of UTIs**
Apr-22	3	2	5
Mar-22	1	2	3
May-21	1	1	2
Apr-21	4	1	5

Mar-21	2	2	4
May-20	0	0	0
Apr-20	3	1	4
Mar-20	2	1	3
AVERAGE	2	1.25	3.25

Overall, the average number of UTI cases was 3.03/month with a standard deviation of 1.49. Average number of UTI cases in the rehabilitation hall was 1.94/month with a standard deviation of 1.294 and a standard error of the mean of 0.229, compared to an average of only 1.09/month and a standard deviation of 0.856 and standard error of the mean of 0.151 in the long-term hall. With the assistance of Dr. Sara Harper, an independent samples t-test was performed under the following null hypothesis (H0): mean number of UTI/month in the rehabilitation hall = mean number of UTI/month in the long-term hall (H0: $\mu1 - \mu2 = 0$); and the following alternative hypothesis (Ha): mean number of UTI/month in the rehabilitation hall $\neq$ mean number of UTI/month in the long-term hall (Ha: $\mu1 - \mu2 \neq 0$).

Table 2

Descriptive Statistics Comparing UTI Rates of Both Halls

Group Statistics				
Group	N	Mean	Std. Deviation	Std. Error Mean
Rehabilitation Hall	32	1.94	1.294	.229
Long-Term Hall	32	1.09	.856	.151

The t-test indicated a statistically significant difference between the two means calculated in relation to the different halls. The rehabilitation hall had more UTIs (1.94 ± 1.29) than long-

term care (1.09 ± 0.86), showing a mean difference of .84. Furthermore, using a 95% confidence

interval, the p-value was calculated to be: p = 0.003 (Dr. Sara Harper, personal communication,

April 11, 2023). Thus, the rehabilitation hall acquired more urinary tract infections amongst its

residents in comparison to the long-term hall, suggesting a greater need for UTI interventions in

the rehabilitation hall than in its neighboring hall. This finding also agreed with Girard et al.

(2017), who found that subacute/rehabilitation halls have higher rates of UTIs.

Table 3

Independent Samples t-test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
UTIs	Equal variances assumed	2.890	.094	3.077	62	.003	.844	.274	.296	1.392
	Equal variances not assumed			3.077	53.783	.003	.844	.274	.294	1.394

Note. More UTIs were reported in rehabilitation versus long-term care.

Escherichia coli was found to be isolated in 22 urinalyses, followed by *Klebsiella* in nine

urinalyses. Unfortunately, 73 UTI cases remained unspecified in reference to their disease-

causing agent, indicating incomplete reports and a potential need for better log keeping by staff.

Figure 2

Pie Chart of Pathogens Isolated and Identified in Urinalysis Cultures
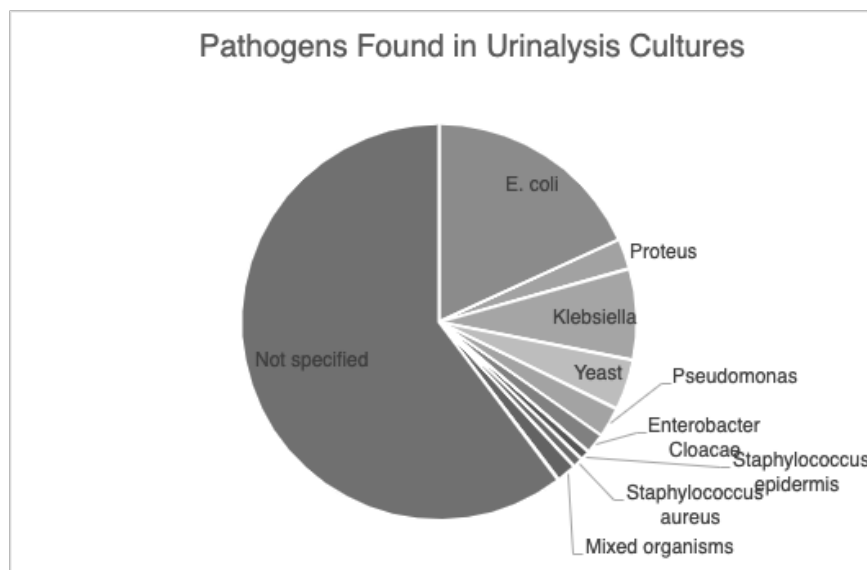
Note. More than half of the reported UTI cases remained unidentified in terms of specific pathogens responsible for infection.

Limitations

Due to the nature of this project, several limitations exist. The UTI logs were specific to a single local nursing home and are not representative of any other nursing home, nor to any other patient population. Data was provided by the nursing home itself and exhibited few categorizations beyond the presence of a UTI, hall distinction, dates of infection, antibiotics prescribed, etc. Limited information was also an ongoing issue due to incomplete logs and small sample sizes. However, suggestions for change can still be garnered from both the lack of available data, as well as from the information that was present and able to be analyzed.

Discussion

Contrary to the initial hypothesis, summer months did not have the highest average of UTI cases. Instead, spring saw the most cases (3.25). However, incomplete data may have

skewed these numbers, making it difficult to draw conclusions regarding seasonal trends and further affecting the ability to determine root causes for the development of UTIs within the nursing home. Similarly, identified pathogens accounted for less than half of the UTI cases, whereas the rest of the cases were listed as an "unspecified" pathogen due to the UTI logs being incompletely filled out. The combination of these findings suggests that improvements in the nursing home can be made simply by maintaining the UTI logs in a more consistent manner and providing a complete set of the required information. If information is unavailable, notes could be included to explain why it is lacking.

Despite the frustrating lack of data available to draw many substantial conclusions, a more recent upwards trend in UTI cases was noted, as well as a difference in the means of UTI cases per resident hall, which was identified to be statistically significant. This indicates a potential direction for the nursing home to further investigate. Although it is unlikely that an accurate conclusion as to why the rehabilitation hall tends to have more UTIs can be confirmed through the data used in this study alone, potential hypotheses can be inferred based upon risk factors identified through the prior literature review and include the following:

1. Rehabilitation patients are more likely to have had an indwelling catheter (the number one risk factor for developing a UTI) from a recent surgery (Wu et al., 2020).

2. The rehabilitation hall may have a higher census of residents, on average, compared to the long-term hall, causing it to be at higher risk for staffing shortages, which can decrease quality of care (Castle et al., 2017).

3. Rehabilitation patients may retain better control over their bladder in comparison to long-term care residents, causing rehabilitation patients to present with fewer incontinence issues, thereby receiving less assistance from staff with proper perineal care.

Ultimately, these hypotheses remain solely as suggestions for the nursing home to potentially pursue as future research questions. Another root cause analysis is needed to further identify specific sources for higher UTI rates on the rehabilitation hall. To assist with this, a framework for a retrospective patient chart review and root cause analysis quality improvement study was designed based on the success of the huddle process developed by Fiveash et al. (2021). This framework was organized into a similar huddle tool, but questions were created to specifically address the trends in the rehabilitation hall. The resulting questionnaire was shared in a meeting with the director of nursing for the participating nursing home and may be implemented per the nursing home's desires. It was suggested that the huddle team be made up of the facility's director of nursing, the infection control officer, and self-volunteered front-line workers, including registered nurses, licensed practical nurses, and certified nursing assistants.

Table 4

UTI Root Cause Analysis Huddle Tool

Patient Name: _____

Date of Infection: _____

1. In which hall did the resident acquire a UTI? Is this a recurrent infection?

2. What is the resident's activity status and level of independence (full staff support, extensive assist, limited assist, supervision, or independent/no staff support)?

3. Is the resident continent of bowel and/or bladder?

4. Does the resident currently, or have they recently (within the last 7 days) had an indwelling urinary catheter? If yes, when/at what facility was the catheter placed? If the catheter was placed in-house, who performed the initial insertion, and can infection

protocols be verified? How often was catheter care performed, including flushing, cleaning, and emptying of the catheter?

5. Were there holes in staffing (nurses and certified nursing assistants) during the week prior to the positive urinalysis?

6. Did the patient receive showers and/or bed baths per the shower schedule in the week leading up to the UTI? Was perineal care performed during the resident's showers?

7. Were the scheduled water pass rounds completed during the week leading up to the UTI?

8. What is the resident's biological sex?

9. Are all scheduled staff up to date on UTI prevention trainings?

10. Are there any other observations made by staff that may have contributed to the UTI?

Note. This questionnaire does not represent the data within the current study.

The purpose of this questionnaire is to help identify whether patient specific factors, such as gender and level of independence, versus facility specific factors, such as staffing and/or training, are the root causes for developing more UTIs in the rehabilitation hall, as well as for tracking trends in the facility as a whole. Answers to the questionnaire should be tracked in some form of spreadsheet, allowing for easy analysis of trends. It was suggested that the questionnaire be used retrospectively for all previous UTIs, as well as prospectively for each future UTI that occurs. Furthermore, following the analysis of trends, evidence-based interventions rooted in the dominant trends should be put into place, and future UTI cases acquired during the intervention period should be compared to the analysis of the number of cases prior to the interventions.

Conclusion

The overall aim of this paper and project was to identify the most likely risk factors for developing a UTI in a nursing home and the relevant evidence-based practice interventions for

decreasing UTIs based on those common risk factors. Additionally, it sought to apply this information to a local nursing home in the form of a case study via an analysis of the nursing home's UTI logs, which further aimed to produce a framework of interventions most applicable to the nursing home's needs. In the initial literature review, it was found that indwelling urinary catheters were the number one risk factor for developing a UTI, but catheters make up relatively few residents in nursing homes (Castle et al., 2021; ODPHP, 2013). Aside from catheters, age was the next most common risk factor, however age is non-modifiable and difficult to base interventions on (Castle et al. 2021). With this information in mind, it was concluded that best-practice interventions should center on change theory and root cause analysis. For instance, maintaining staff involvement was key in the success rates of various studies and interventions (Fiveash et al., 2021; Lean et al., 2019; MacRae et al., 2022; and Wu et al., 2020).

Determining the relevant risk factors and evidence-based interventions for urinary tract infections in a single nursing home proved to be no small feat. Ultimately, it turned into a multi-step process that, in the future, may or may not be fully implemented due to a dependence on the nursing home's preferences. However, significance lies in the fact that a plan for decreasing UTI rates was initiated. UTIs are rampant in nursing homes and will remain so unless each individual nursing home agrees to take action. Notably, Jones et al. (2021) remarked on how many nursing homes were aware of their own CAUTI and UTI rates, but little was done beyond the gathering of this data. The participating nursing home in this study was a case in point example of this particular phenomenon. In fact, the evidence gathered from the UTI logs showed that rather than focusing on reducing a single risk factor, the most beneficial intervention to reducing future UTI rates within the nursing home would be to implement a more in-depth root cause analysis tool, similar to the huddle process developed by Fiveash et al. (2021). Again, this may be further

investigated through the root cause analysis questionnaire that was developed specifically for the participating nursing home.

   Altogether, these conclusions provided an important first step towards addressing UTI rates within the local nursing home's residential population. They have also placed an emphasis on the importance of putting effort towards seeking out root causes behind the development of UTI cases, as well as the need to involve front-line staff in the making and implementation of those interventions. Each nursing home is unique by nature, and each UTI intervention should match the facility's needs. By applying these principles, staff will be better equipped to fully evaluate their UTI cases and prevent future cases from occurring. Furthermore, staff will grow increasingly aware of both their care deficits and proficiencies, connecting them to the root cause issues, as well as to their patients. Urinary tract infections can be prevented, but it will take hard work and dedication in order to obtain this goal.

Reflection

Having finally gotten to the portion of this project where I can write a reflection, I'm a little bit in awe of everything I've accomplished. The field of nursing isn't generally known for its involvement in research, and although nurse researchers exist, they're just not as common as bedside nursing. That being said, even as students, nurses are encouraged to stay up to date on research topics by actively seeking out quality improvement studies and suggestions based on current evidence-based practice recommendations. This capstone project has been the culmination of my entire academic experience at USU because it has given me the opportunity to take those principles of research relating back to nurses, whether they work bedside or not, and apply them to a real life setting in my community. Essentially, I was able to experience what it is like for a nurse to seek out quality improvements in an actual work setting. Furthermore, I was able to stretch myself in terms of research (something I'm not used to), by designing my own interventions through critical thinking (something I worried I wouldn't be able to do), and by strengthening and developing relationships (with my mentor, my community, and other disciplines).

My capstone project involved two types of research: a literature review and a data analysis. I've had some experience with smaller literature reviews, so for this project I was able to stretch myself by delving deeper into the research in an attempt to draw applicable conclusions for a real case study. This was a lot harder than I initially expected, and I ultimately had to conclude that there was no "right" answer or "specific" intervention like I wanted there to be. However, I was also forced to critically think beyond the studies by analyzing characteristics of interventions, particularly what did or didn't make them successful. Eventually, I landed on this idea of root cause analysis, which led to me designing my own root cause questionnaire

specifically for the nursing home in the case study. One of my proudest moments in this whole project was being asked by the director of nursing if I could send her a copy of the questionnaire so she could implement it into the facility's infection protocols.

The data analysis also turned out to be trickier than I expected. Because I was accessing patient data, even though it was deidentified, I knew I would need to get IRB approval. Unfortunately, I didn't realize the number of steps it would take to get this approval, which ended up being a process that took weeks to be completed. In fact, the whole process was an exercise in patience and precision. I don't know if I ever want to go through that whole thing again, but if I choose to go to graduate school, I'm glad I have a basic understanding of what could be in store for me. I also feel more confident in the idea of pursuing research of that caliber, especially if it needs the approval of a review board.

I also had this crazy idea that I could re-educate myself on statistics after having not used it since my AP statistics class in high school, which tells you all you need to know about how that went. Thank goodness Dr. Sara Harper happened to pop her head into my mentor's office when we were discussing my struggles, because her expertise in a discipline outside of my own was essential in helping me analyze the nursing home's UTI logs. I'm so grateful for her kindness. In fact, if I could give one piece of advice to future Honors students, it would be to seek advice and assistance from other disciplines. It might feel a little nerve-wracking to step outside of the discipline you've spent 3-4 years studying in depth and insert yourself into a discipline where you know next to nothing, but it will only serve to make your capstone project stronger. Furthermore, it's more than okay for you to admit that you don't know how to do something, because it provides you with the opportunity to make new connections and learn.

Who knows, it might even direct your current project and spark future interests for you to explore!

Speaking of connections, my mentor, Jeanette Harris, was instrumental in keeping this project going. If I didn't have somebody to report to, I honestly don't know if I would have finished my capstone. I was trying to do it all in a short amount of time, didn't really know what I was doing, and got hit with a bad case of "senioritis" right when the spring semester started. I don't know if Jeanette knew how badly I was struggling with motivation, but her encouragement kept me going. Things that would have stressed me out if I were on my own, like calling the IRB office for guidance when submitting our protocol, were able to be completed because of her. Jeanette has also become a mentor outside of my capstone. At one point, I found myself absolutely stressed with everything I had on my plate, including school, both my Honors and nursing capstones, job interviews, and personal matters. To help me prepare for a job interview, I asked Jeanette if she would run through a practice interview with me, but to my embarrassment, I broke down crying toward the end of it. Jeanette sat with me and reassured me of my ability to meet my goals. She took on the role of both a mentor and a friend in that moment, and I'm sincerely grateful that I was able to develop such a relationship with her because of my capstone.

I'll be the first to admit that I was terrified of completing an Honors capstone, but looking back on everything I have accomplished, I can now safely say that this project has had an impact on not only my experience as an Honors student but also on my experience as a nursing student. I have been pushed to think critically, seek out problems within my community, and step outside my comfort zone in order to address those issues and challenge myself. I have grown closer with the faculty in my department and have overcome personal challenges, showing myself that I do have what it takes to design and complete a project of this size, even when my motivation wants

to make a run for it. More importantly, the various aspects of this project have shown me what it takes to be a nurse who involves themselves in patient care beyond the basic skills and concepts that I've been learning as a nursing student. I feel prepared to enter my profession with a growth mindset, as well as with the necessary research and critical thinking skills required to recognize areas for improvement and potential interventions. I didn't always believe I could do it, but I'm so glad I stuck with the Honors program because I have been able to watch myself struggle and grow, and I know I will be a better nurse because of it.

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Author Biography

Hailey Griffin will graduate with Honors on May 05, 2023 from Utah State University with both her Bachelor of Science in Nursing and a minor in Music Studies. She is a high performing student and was designated a Lawson Fellow Scholar in 2022. At the start of her sophomore year at USU, Hailey started working as a certified nursing assistant in a skilled nursing facility, where she developed a strong love for geriatrics and patient care. During the Spring 2023 semester, she began a nursing preceptorship on the Level II Newborn ICU at Layton Hospital, where she also developed a strong love for the NICU. Following graduation, she is excited to have the opportunity to take what she has learned from both of these experiences to the Level IV Newborn ICU at Primary Children's Hospital, where she has been offered a full-time nursing position.