Clean-Catch Urine Specimen and Urinary Tract Infection Rates Analysis at a Psychiatric Inpatient Hospital

by

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Abstract

Background: Urinary tract infections are among the most common hospital-acquired infections nationally. These infections are distinguished between catheter-associated and those that are not catheter-associated. Diagnostic tools for urinary tract infections include dipstick urine analysis and urine culture, which are collected from a clean-catch urine specimen. Urine specimen contamination is an issue in correct diagnosis of urinary tract infections. Understanding the gaps in literature, including non-catheter-associated urinary tract infections, is imperative to learn current medical practices' downfalls. This review aims to investigate the cause of clean-catch urine specimen contamination through a retrospective data analysis and survey of healthcare workers to gain their perspective.

Methods: Retrospective data mining was performed for all clean-catch urine samples during 2020. Electronic health records were investigated to analyze commonalities between patient symptoms, demographics, and charting quality. A tailored survey was administered to the Integrated Health and Aging Population unit since they had the highest counts of clean-catch urine ordered and contamination. Healthcare workers were asked about their knowledge, beliefs, perceptions, and causation of contamination to clean-catch urine samples. Results were collectively investigated for a comprehensive look at clean-catch urine specimen contamination in relation to urinary tract infection health outcomes.

Results: The 2020 retrospective data found 389 clean-catch orders were collected, with 163 (41.9%) urine samples contaminated. The Integrated Health and Aging Population Unit reported that 64 of the 140 urine samples were contaminated. Healthcare workers had knowledge, beliefs, and perceptions, which indicate the need for more education, staff training, accessibility to ready-made clean catch kits, and improved patient collection training. In addition, electronic health records support a review of current clinical definitions and guidelines for urinary tract infections to tailor to specific populations, such as the memory-impaired elderly.

Conclusion: The need for increased education and research regarding clean-catch urine in a vulnerable population such as the memory-impaired elderly needs to be addressed to increase positive public health outcomes.

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Preface

I would like to first thank my committee for taking the time to provide feedback and guidance throughout writing this essay. Without each one of your insights, this paper would not be possible. I would also especially like to thank my research mentor, Janina-Marie Tatar. She has been the person I have looked up to throughout my graduate career and took the time to expose me to the Infection Prevention realm. Also, a special thanks to Drs. Marnie Bertolet and Nancy Glynn for mentoring me professionally and academically through my graduate program. Lastly, I would like to thank my mom and dad, my "bee-hive," and my boyfriend Tim Glab for putting up with me over the last few years. We all know it has been a long, slow process. Without your continuous patience and support, this wouldn't have been possible.

1.0 Introduction

Urinary tract infections (UTIs) are one of the most common healthcare acquired infections (HAIs) in the United States.[1] UTIs are a blanket term for any kind of infection caused by bacteria entering the urinary system, which enters through the urethra, and causes an infection in either the urethra, kidney, bladder, or ureters. The most common bacteria causing agents for a UTI include gram negative bacteria such as *Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis,* and *Staphylococcus saprophyticus*.[2]

Symptoms associated with a UTI include: dysuria, increased urinary frequency, increased urinary urgency, supra pubic pain, and bloody urine. Other symptoms may include fever, chills, lower back pain, and nausea or vomiting.[3]

1.1 Catheter Associated UTIs versus Non-Catheter Associated UTIs

There are two different common types of UTIs, including catheter-associated (CAUTI) and non-catheter-associated (non-CAUTI). Subtypes include symptomatic UTIs (SUTI), and asymptomatic bacteremic urinary tract infections (ABUTI).[4] Current diagnostic criteria abide by the CDC's National Health Safety Network's (NSHN) guidelines pertaining to definitions and recommended treatment guidelines.

To be considered to have a CAUTI, the patient must have an indwelling catheter which is in place for at least two days prior to the UTI event, and the catheter must be currently placed the day the event occurs or removed the day before the event occurs. The patient must also exhibit one

of the following symptoms to be considered a symptomatic UTI (SUTI) including: fever (over 38 degrees Celsius), suprapubic tenderness, costovertebral angle pair or tenderness, increased urinary frequency, increased urinary urgency, or increased dysuria. A positive urine culture of bacterium of equal or over 10^5 CFU/ml with no more than two species of organisms must also be present, along with a positive dipstick for leukocyte esterase and/or nitrite, pyuria (urine specimen with ≥10 WBC/mm3 of unspun urine or >5 WBC/high power field of spun urine, or microorganisms seen on Gram's stain of unspun urine.[5,6]

Non-CAUTI can be categorized by symptomatology. Symptomatic non-CAUTI is defined similarly, although it is not required that the indwelling catheter was in place on the day of or day before the date of diagnosis. An infection is categorized as ABUTI if a patient exhibits no signs or symptoms consistent with SUTI. In addition to the positive urine culture, the patient must also have a blood sample with at least one of the same organisms identified from the urine culture.[7] Current research covers in great depth CAUTI cause, risk, and prevention including annual reports done by the CDC and other tracking systems, portals, and through academic research.[5,8]

In contrast with CAUTI UTIs, epidemiologic studies of non-CAUTI are sparse, with many gaps in information.[9] Non-CAUTI UTIs also do not have a standardized reporting system in the hospital setting. This in turn results in non-uniformity of reporting in the clinical and laboratory results documentation within the clinical care setting. In turn, this causes a lack of consistency in non-CAUTI reporting from the Infection Prevention department, which then results in missing a large proportion of documented cases in acute care setting. This can in turn causes data to be skewed away from the actual incidence rate for inpatient setting non-CAUTI UTIS.[9]

1.2 UTI Incidence, Prevalence, and Burden

Approximately 62,700 UTIs were accounted for in 2015 in an acute care hospital setting.[1] However, the overall incidence of UTIs is difficult to obtain due to the high proportion of cases that go unreported either due to the patient not seeking treatment, the patient not presenting with symptoms, or a urine culture being contaminated.[10] Currently, there is a national system, the Centers for Disease Control and Prevention (CDC) National Nosocomial Infections Surveillance System (NNIS), for 38,000 participating hospitals to report HAIs on a voluntary basis. Infections are categorized, with one type being catheter-associated urinary tract infections (CAUTI).[11] However, the NNIS is no longer hospital wide and targets only certain, at risk populations which the hospitals deem to be fit. This in turn leaves gaps in data, which in turn result in estimates that are not completely accurate. Other categories of UTIs are also not included, such as non-CAUTI classified UTIs. Even with this hole in data, it can be concluded that UTIs are one of the most frequent and financially burdensome HAIs.[12] As of 2020, UTIs are found to cost approximately $2.8 million US dollars per year and is predicted to increase. This can partially be attributed to increased antibiotic resistance due to patients being repeatedly treated with antibiotics for infections such as a UTI.[13] Approximately 40% of women will experience a recurrent UTI within 6 to 12 months of their initial infection.[14] On average antibiotic treatment costs from $10 for oral trimethoprim-sulfamethoxazole to upwards of $3970 for intravenous Ertapenem.[15] The choice of drug depends on the innate level of antibiotic resistance of the patient. The more the patient is treated with antibiotics, the more likely they will require an antibiotic which is less commonly available and in turn cost more money. Other added costs for recurrent UTIs include bladder imaging, routine maintenance visits, and specialty care to prevent future UTI infections.[15] On

average, as of 2011 for a hospitalized patient with a primary diagnosis of a UTI the total hospitalization stay cost around $6,424.[16]

1.3 Clinical Surveillance Methods

1.3.1 Urine Collection Techniques

There are multiple ways that a patient can have their urine sampled to test for a UTI. Some of these include a straight catheter, suprapubic aspiration, or a clean-catch procedure. Straight catheters and suprapubic aspiration are the most reliable to not have contamination due to obtaining the urine straight from the bladder. However, there is a chance that bacteria can be introduced through the tube used to perform this procedure and in turn introduce bacteria which can result in infection. Both of these can also cause discomfort to the patient. These two procedures are also costly, and required trained professionals to perform.[17]

When compared to other techniques, urinalysis of clean-catch collected urine presents many advantages as the procedure is non-invasive, inexpensive, has no chance of introducing bacteria into the bladder during collection, and can be performed by the patient without assistance. Urinalysis determines the presence of bacteria and white blood cells among a urine sample obtained from a patient after urination into a collection cup. If either are present, there can be an indication that the patient currently has an infection. The exact bacterium can be identified through a urine culture, a technique which identifies the number and type of bacteria grown in a medium.[18] However, the likelihood of the specimen getting contaminated is higher since the urine has to be expelled out of the bladder and through the urethra. In order to lower the likelihood of this, clean-

catch collection is preferred since there are steps involved to remove external bacteria from the urethral opening and surrounding genitalia, including using materials such as sanitary wipes. This procedure, however, can be difficult since it is laid out in a step by step process which has to be executed correctly in order to not allow any bacterium to enter the sample. Certain populations, including the elderly or those with physical or mental impairments, have the highest risk of collecting a contaminated sample. For this reason, proper instruction and assistance for individuals is imperative to ensure that the likelihood of contamination is reduced.

1.3.2 Urine Specimen Testing

Testing methods for a UTI most commonly start with a urinalysis being ordered by the caring physician. This procedure instructs the patient to urinate in a collection cup which is sent to a laboratory for analysis to confirm bacterial growth in the urine. A UTI diagnosis is made if the urine contains at or over 100,000 colony forming units per mL. There must be no more than 2 types of species in order for this the specimen to be considered non-contaminated.[7] If the specimen is found to be contaminated, laboratories usually write in their results that there is mixed-flora or probable contamination.

1.3.3 Clinical Surveillance Guidelines

In an effort to standardize the classification of HAIs and reduce subjectivity, the National Healthcare Safety Network (NHSN) has established guidelines in order to classify an infection which was acquired in a hospital facility. In order to be classified as a HAI, the infection must be present on or after the third day post admission to the hospital. The condition or symptoms must

not be present upon admission to the hospital or acute care setting. Once a HAI is identified, the infection is classified amongst one of the fourteen categories of the grouping of diseases defined by the CDC (including UTI), and diagnosis and treatment specific guidelines are followed.[6] When analyzing the HAI, the infection window is taken into account for surveillance and containment purposes. The NHSN states that, from the first clinically definitive symptoms or positive test, the infection window is considered to be seven days including three days prior, day of test, and three days post of that date.

1.3.4 Clinical Surveillance versus Clinical Judgement

A current potential challenge is competing treatment guidelines and recommendations from the Infection Prevention team and the clinicians. Clinical surveillance guidelines from NHSN are very uniform and strict in order to decrease the chance for subjectivity. However, clinical diagnosis takes into account all tests or related information to that specific patient such as additional laboratory tests, patient diagnoses, or epidemiological data.[19] Additional symptoms such as confusion in elderly patients have been found to be linked to UTIs, but have not been officially added to the NHSN guidelines and therefore are not considered to be a part of Infection Prevention's definition of clinical surveillance.[20] Because the Infection Prevention team follows the NHSN guidelines for clinical surveillance, but clinicians use an additional set of standards for patient diagnosis and treatment, the clinician's judgement may disagree with that of the Infection Prevention Department. Therefore the patient may or may not be treated for the UTI with antibiotics, depending on whether or not the clinician follows the Infection Preventionist's recommendations.[19] These competing criteria can lead to inconsistencies with treatment.

Clinically, this may result in under- or over-treatment of the patient, and competing surveillance and clinical criteria may result in misclassification of healthcare acquired UTI.

1.4 Significance of Appropriate Treatment

One vital factor to decrease the chance of a patient developing antibiotic resistance is through having them receive proper treatment. Each year, there are reported to be more than 2.8 million antibiotic resistant infections in the United States.[4] This is often due to over prescribing antibiotics to patients when it is not necessary, because of clinical judgement or incorrect test results. Tests such as the dipstick uranalysis are not always accurate and cannot distinguish between symptomatic and asymptomatic UTIs. Therefore, results based on this testing method are imprecise, especially in certain age groups and populations such as older women. As individuals age, the amount of natural bacteria which is found within the urinary tract increases. This is especially true for older women due to female urinary anatomy, as the anus and urethral opening are closer in proximity. For this reason, not all bacteria found in the urinary tract warrant treatment.[21] Proper collection technique for a urine sample is also vital, as many asymptomatic UTI patients show false positives on their urine analysis clean-catch sample due to contamination.[22] This presents difficulties, as patients are often over prescribed antibiotics which are unnecessary, and many patients do not adhere to the prescribed antibiotic treatment regimen as recommended. There are situations where a urine culture will have a positive result with bacteria being present, but will not warrant treatment.[18] Around 5% of women that are pre-menopausal, and around 40% of elderly women are found positive for asymptomatic bacteriuria without the need for medical treatment.[21] This holds true especially for individuals with incontinence, where

pyuria is often found via microscopic testing but the patient does not have current symptoms. Positive pyuria does not always indicate that treatment is necessary, as elderly women who have incontinence are especially susceptible to over treatment with antibiotics.[21]

The need to avoid improper UTI diagnosis and unnecessary antibiotic treatment should be balanced with appropriate and early treatment of true UTIs to avoid the progression to serious complications including pyelonephritis and sepsis, especially in certain demographics such as the elderly.[23,24] Current clinical perceptions are also changing, as a shift towards decreasing prescribing unnecessary antibiotics and therefore using antibiotics as a backup treatment method is increasing amongst practitioners.[25] Therefore, it is crucial to treat individuals who truly have a symptomatic UTI confirmed with a positive, non-contaminated laboratory culture.

1.5 Demographic Considerations and Rates of UTIs

1.5.1 Risk Factors

There are differences on the rates and risk for UTIs. Sex, having co-morbidities, and the presence of immunosuppressive diseases all pose risk factors for having a UTI. Individuals who are women, possess co-morbidities such as diabetes, possess immunosuppressive diseases, have spinal cord injuries, or who require a urinary catheter are at a higher risk of having a UTI.[9,22,10] Women have a significantly higher risk for UTIs. Around half of women report having a UTI which required medical treatment in their lifetime. Of these, around a third reported having a UTI by the age of 24.[10] This can be partly explained by anatomy, as female urinary tracts are shorter in length than male tracts.[22] Further, bacterial colonization in the vagina is very common, due to

changes in bacteria through microbiota in response to hormonal fluctuation and sexual intercourse.[26] Women also have an increased risk of incorrect bladder voiding by not having the bladder be completely emptied due to events such as prolapse or urinary retention.[21]

Increased age is another factor which increases the chance of developing a UTI. Elderly patients are at high risk for UTIs, with approximately 20% of women and 10% of men over the age of 65 reporting to have bacteriuria at least once.[27] Elderly patients are also likely to contaminate self-collected urine samples due to improper clean-catch urine collection because of decreased physical and cognitive ability.[22] Also, some urinalysis tests are more sensitive to certain populations than others such as the dipstick test since elderly patients' urine samples are more sensitive to nitrite urinalysis testing due to natural increase bacteria being present in the urine. This can cause the test result to produce a false positive and prompt the patient to be treated unnecessarily.[21] Elderly patients are subjected to routine testing including upon admission, leading to enhanced UTI diagnosis in this age group. However, several studies have shown that these tests were deemed unnecessary as most elderly individuals did not show symptoms and were inappropriately treated with antibiotics, therefore putting this demographic at increased risk of recurrent complicated UTIs.[28]

1.5.2 Inpatient Settings

1.5.2.1 Short, acute-care settings

UTIs are known to be a common infection diagnosed in inpatient settings. These include acute care settings such as hospitals, skilled nursing facilities, personal care facilities, and communal living for both short and long term. Approximately 9.5% of infections in a hospital

were reported to be UTIs.[1] Almost all of these are due to having a catheter. Each day that a patient has a catheter placed, their risk of acquiring a UTI increases by 3% to 7%.[1]

1.5.2.2 Long-term care settings

Long-term care is defined to be a service where a person is carried for at some capacity over a long duration of time. This service can be provided either in the patient's home, which as known as personal care, or in a facility setting. Facility settings are often nursing homes or skilled nursing facilities.[29]

Long-term care facilities also have a large burden of UTIs as well as antibiotic over-prescription, resulting in increased likelihood of developing antibiotic resistance and other adverse drug events.[30] Currently the incidence rate is high, estimated to be between 0.3 and 0.8 cases of 1,000 patient care days. UTI are ranked as the second highest cause of infection in the long-term care setting, behind respiratory disease. Of those antibiotics distributed in the long-term care facility, around 40% of the antibiotic supply used for patient care is for treating UTIs.[30] Reasons for this include the elderly having decreased immune function, leaving them at risk for infection, and the high rate of catheter use in this patient population.[31]

1.6 Previous Quality Improvement Project Findings

The University of Pittsburgh Medical Center (UPMC) Western Psychiatric Hospital (WPH) performs ongoing quality improvement projects to increase positive health outcomes. One project centered their goal on investigating the facility's urine analysis cultures and analyzed the healthcare workers charting and appropriateness of ordering antibiotics. Data from March 2019

through March 2020 were retroactively analyzed by the Infection Prevention and Quality Improvement WPH team. Antibiotic treatment was categorized as likely appropriate, potentially inappropriate, or likely inappropriate. Results of this study showed that 26% of the orders were potentially inappropriate and 27% were likely inappropriate, indicating that the majority of antibiotic administration was deemed inappropriate. One of the main factors considered for potentially inappropriate use was urine specimen contamination. This resulted in the patient having to be retested, and treatment was delayed for true positives. From these results, it was noted that further investigation of charting quality and development of an intervention for patient facing healthcare workers should be explored.

1.7 Study Objectives

The objectives of this current study are:1) To investigate rates and percentage by unit of clean-catch urine orders and contamination rates; 2) To investigate knowledge and perceptions of healthcare workers; and 3) To describe common barriers and perceptions of healthcare workers of the unit with the highest contamination burden.

2.0 Methods

This study was performed in a two-step approach. First, retrospective clean-catch urine culture results were obtained and analyzed by the Infection Prevention team at WPH. This consisted of all patients who were admitted during the year of 2020 at WPH. Based on findings, a tailored survey was developed to capture the healthcare workers' knowledge, perceptions, and beliefs regarding clean-catch urine contamination and the impact of contamination on patient health outcomes.

2.1 Retrospective Urine Collection Analysis

Retrospective data from January 1, 2020 through December 31, 2020 of patients admitted to UPMC Western Psychiatric Hospital (WPH) were obtained through the electronic health record (EHR) system. General numbers of total testing by unit and contamination rates were calculated. All analyses were performed internally within the Infection Prevention team. Data mining through EHR for patients were recorded in Microsoft Excel, and analyzed using SAS 9.4. The unit with the highest contamination plus positive case count rate was further analyzed via data mining through reading EHRs using the Lippincott's definition for the diagnostic window of two days before and three days after the urinalysis was performed. Information including admission date, symptoms, completeness of charting, and basic demographic information was obtained.

2.2 Healthcare Workers Survey

From the data mining information, a survey was developed to obtain the knowledge, perceptions, and beliefs of all patient facing healthcare workers on the unit with the highest rate of positive and contamination rates compared to the other units. The survey population of the Integrated Health and Aging Population (IHAP) floor included 63 staff members including: 1 unit director, 3 clinicians who were registered nurses, 29 psychiatric nurses, 14 patient care technicians, 1 physician assistant, 8 student behavioral assistants, and 7 milieu therapists. All workers on this unit were eligible to participate in taking the survey. However, the main targets were those with the role to order, instruct, and assist with the clean-catch urine collection process.

This survey included fifteen questions. Six questions assessed knowledge for when and how to assist a patient in collecting a clean-catch urine sample, six questions asked of beliefs and perceptions of the clean-catch procedure, and three questions captured experience and job history, including length of time working in the healthcare field and length of time working in this facility. Lastly, healthcare workers were asked to rank possible solutions from 1 through 7, with 1 being the most important and 7 being the least. The surveys were developed in Microsoft Word and imported to Qualtrics XM to allow for the healthcare workers to fill out the survey via paper or online. A QR code was also available on the paper version to take them to the online survey.

3.0 Results

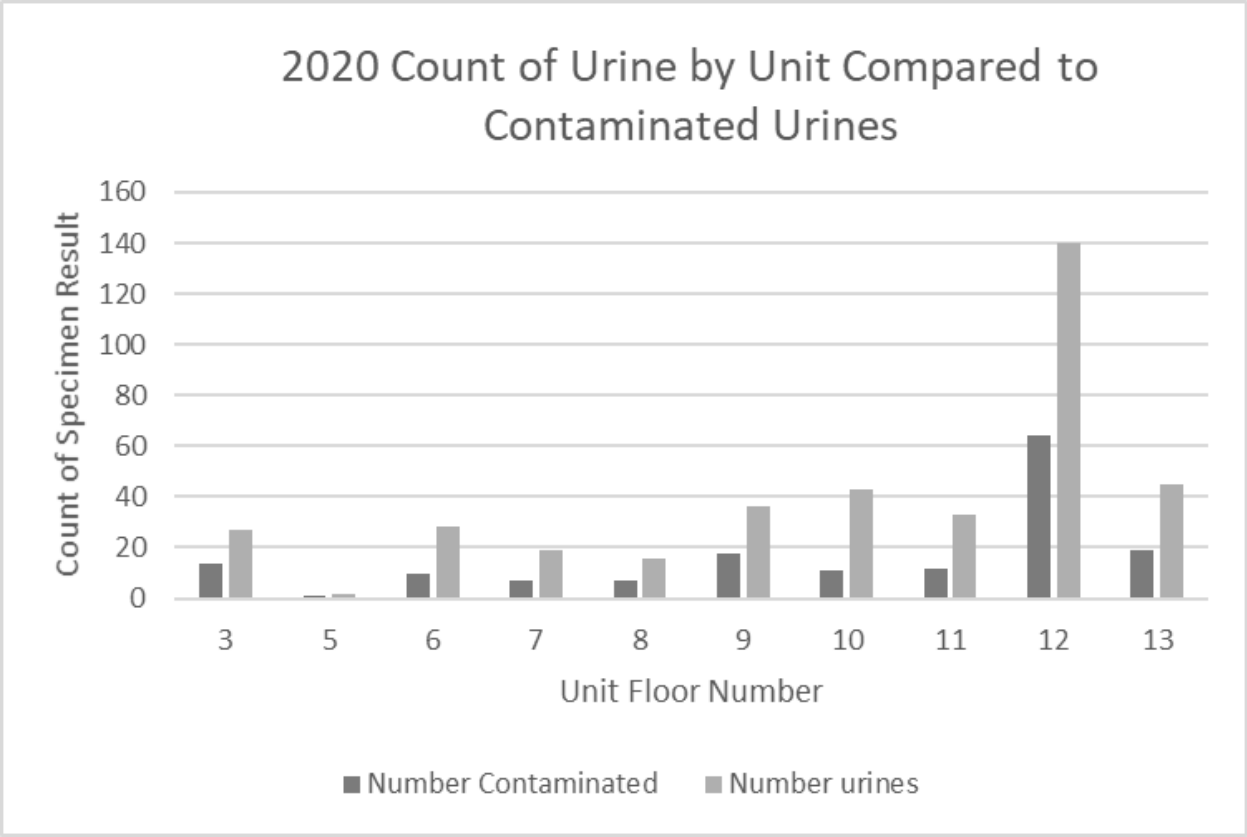
3.1 Using 2020 Retrospective Data

From all of the 389 clean-catch orders collected at WPH from January 1st- December 31st 2020, 163 (41.9%) urine samples were classified as contaminated due to having more than 2 bacterial organisms with levels over 10^5 CFU/ml identified in the urine sample. Contaminated samples were investigated further to see which unit had the highest of clean-samples obtained and the percentage which were classified as contaminated. The percentage of orders contaminated ranged from 25.58% to 51.85%. The floor with the highest number of orders, positive tests, and contaminations was the 12th floor, which is the Integrated Health and Aging Population (IHAP). Floors 3, 5, and 9 were found to have the highest contamination rates. These floors were considered for intervention of this study; however, due to the difficulty of using the emergency room (floor 5), and the sensitive nature of floor 3 and 9 being children and adolescents and individuals with active schizophrenia, it was determined to pilot this study on a population which had a more direct benefit and had significant case cost burden. For this study, the goal was to target the floor with the highest number of urines ordered where the positive and contamination with the highest contamination rates. Therefore, the IHAP unit was chosen to target for intervention development and implementation.

Table 1. 2020 Urine Cultures Test Results

Floor	Number Positive Culture	Number Orders Contaminated	Number Total Orders	Contamination Rate Percentage (Contamination # / Total #) x 100	Percentage Positive + contaminated / total
3	3	14	27	51.85	62.96
5	1	1	2	50	100
6	7	10	28	35.71	60.71
7	4	7	19	36.84	57.89
8	2	7	16	43.75	56.25
9	2	18	36	50	55.56
10	10	11	43	25.58	48.83
11	5	12	33	36.36	51.51
12	31	64	140	45.71	67.85
13	8	19	45	42.22	60

Figure 1. Clean-Catch Urine Contamination Counts versus Total Collected Specimen



Of the specimen collected, the Integrated Health and Aging Population Unit (IHAP) or floor 12, was found to have the highest clean-catch urine specimen collection rate (35.99%) and had the highest number of contaminated urines (45.71%). From this, the IHAP floor was chosen to be the target population for investigating the 64 contaminated urine specimens collected on this unit during 2020.

Table 2. Demographic Breakdown for the IHAP Unit

Demographics	Count (%)
Sex	
Male	15 (23.44)
Female	49 (76.56)
Race	
Refused/Unknown	1 (1.56)
African American/Black	9 (14.06)
American Indian	3 (4.69)
Other/Pacific Islander	2 (3.13)
White	49 (76.56)
Age	
46-55	3 (4.69)
56-65	22 (34.38)
66-75	15 (23.44)
76-85	20 (31.25)
86+	4 (6.25)
Total	64

Demographics of the patients, symptoms, and completeness of charting were obtained and mined using the Cerner software. Of the patients analyzed, 49 (76.56%) were female and 15 (23.44%) were male. The sample included 49 (76.56%) reported as white, making up the majority of the sample. Age was calculated as the how old they were from the date of admission and was categorized into ten-year groups. The majority of the population was found to be between 56 through 85 years old with the average age being 70.64 years old, with ages ranging from 49 through 90 years old.

Table 3. Symptom Breakdown for IHAP Unit (n=64)

Symptom	Yes Count (%)	No Count (%)	Unknown Count (%)
Incontinence	39 (60.94)	25 (39.06)	0 (0)
Diarrhea	5 (7.81)	59 (92.19)	0 (0)
Elevated WBC	6 (9.38)	58 (90.62)	0 (0)
Fever	4 (6.25)	59 (92.18)	1 (1.56)
Dysuria	9 (14.06)	55 (85.93)	0 (0)
Increased Frequency	10 (15.62)	54 (84.38)	0 (0)
Increased Urgency	5 (7.81)	59 (92.19)	0 (0)
Supra pubic Pain	2 (3.13)	62 (96.87)	0 (0)
Increased Urinary Retention	9 (14.06)	55 (85.94)	0 (0)
Delirium	11 (17.19)	53 (82.81)	0 (0)

Symptoms were collected from mining data on the Cerner system of the hospital. Symptoms were chosen through the Lippincott's definition, with additional symptoms included through literature review of additional symptoms associated with UTIs the target's population and common patterns in the clinical notes. The symptoms were collected within the defined 5-day window, where information was collected from 2 days before the test date through 3 days after the test date. Incontinence was reported to be the most commonly charted symptom, with 60.93% of patients. One measurement of fever was not noted in the chart during the symptom window, therefore was considered missing. Other symptoms found to be reported to accompany the textbook definition such as elevated WBC (9.37%), increased urinary retention (14.06%), delirium (17.18%) and diarrhea (7.81%).

3.2 Healthcare Worker Survey

Data collection took place over a three-day period, where all healthcare workers on shift were rotated off the unit to take the survey. Attendance was recorded by UPMC. However, all identifiers were removed before analysis began, ensuring anonymous collection of data. The respondents included 8 psychiatric nurses, 2 patient care technicians, and 1 milieu therapist. Experience in their occupations included 4 with less than a year experience, 1 with 1 to 2 years of experience, and 6 with more than 5 years of experience. Even though the majority of the respondents were in their profession for over 5 years, most individuals who responded had worked for WPH for less than a year (7), 2 individuals had been at the facility for 1 to 2 years, and 2 were there for over 5 years.

Knowledge varied, with only 20% of individuals correctly reporting symptoms that must be exhibited for determination of a suspected UTI. Almost all knew the correct clean catch procedure order for someone with a vagina (Table 2).

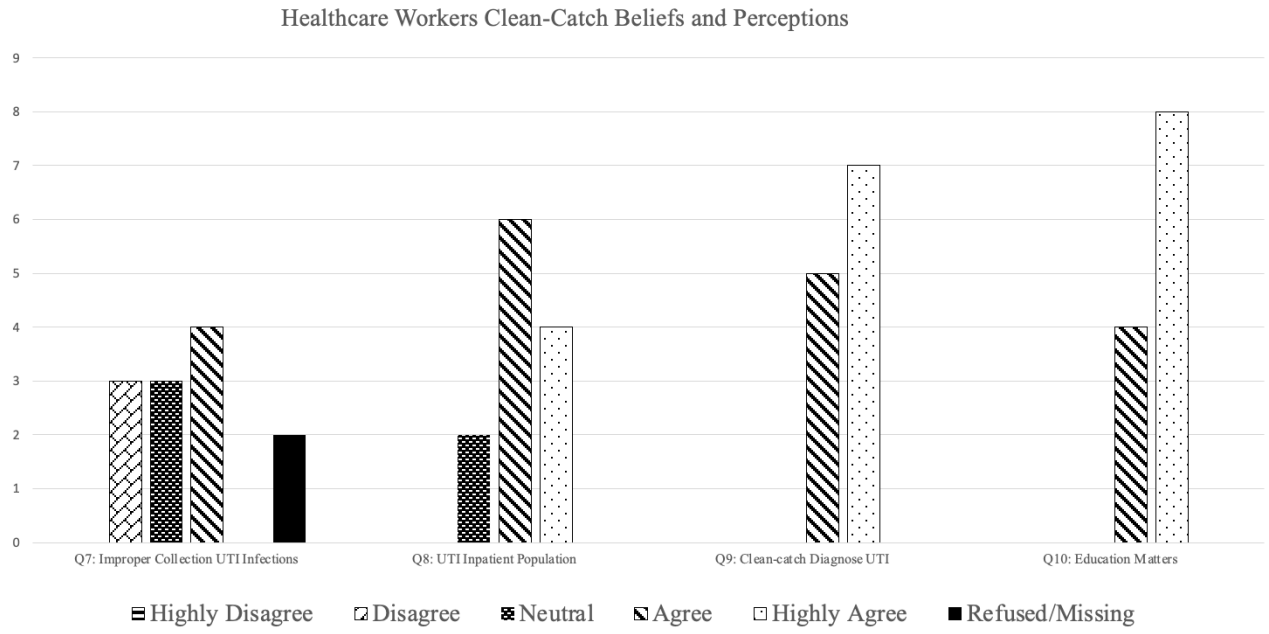
Table 4. Healthcare Worker Survey Results Questions 1-5 (n=12)

	Which of the following symptoms must be exhibited to be considered a UTI? (Click all that apply)	Which urine tests require a clean catch urine sample?	What supplies are needed to complete a clean catch (applicable to all persons)? Select all that apply.	What is the purpose of a clean catch?	What is the correct clean catch procedure order for someone with a vagina?	What is the correct clean catch procedure order for someone with a penis?
# correct	2	5	7	6	10	6
# incorrect	10	7	3	5	2	4
# missing	0	0	2	1	0	2
% Correct	20%	41.66%	58.33%	50%	83.33%	50%

Questions 7 through 10 accessed the healthcare workers' beliefs and perceptions. There were evenly mixed opinions from question seven on whether improperly collected urine could

result in subsequent additional infections. Question eight's results indicated that most individuals thought that UTIs are an increased problem in the dementia population at WPH, although two healthcare workers were neutral on the topic. All individuals thought that having a properly collected clean catch sample is important to correctly diagnose UTIs in patients and that their role in educating patients can influence patient's proper urine collection. These results came from questions nine and ten of the healthcare worker survey.

Figure 2. Clean-Catch Perceptions and Beliefs of IHAP Healthcare Workers



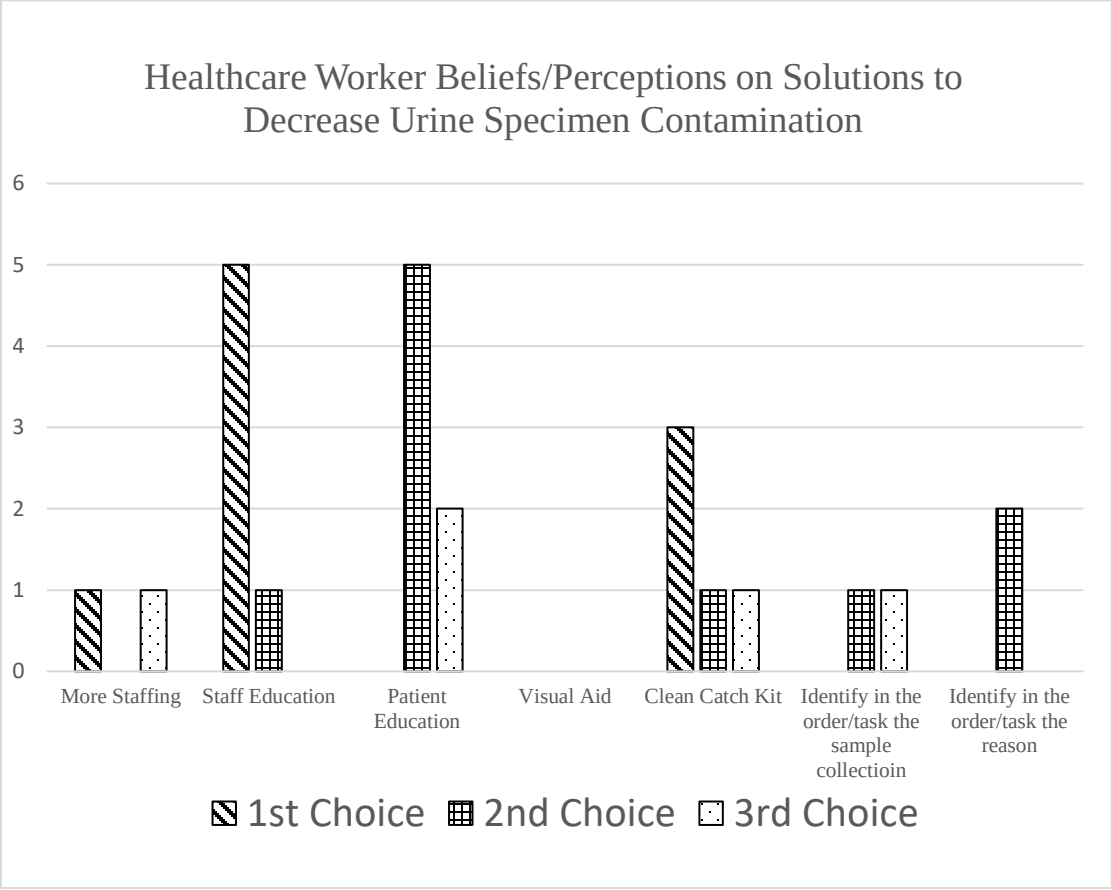
Question 7: Improperly collected urine can result in other infections.

Question 8: UTIs are a problem amongst the dementia (confused) Western Psychiatric Hospital (WPH) inpatient population.

Question 9: Having a proper clean catch is important to correctly diagnose UTIs in patients.

Question 10: My role in educating patients will influence patient proper urine collection.

Figure 3. Possible Solutions to Decrease Urine Contamination from Healthcare Worker Survey



Question 11 asked for the healthcare workers to rank from 1 to 7 possible solutions in order of 1 being the most helpful and 7 being the least, which is displayed in Figure 3. The results show that staff education was prioritized as the most important option with 5 individuals ranking it with a 1. Clean catch kits were also seen as important with 3 individuals ranking it as 1, and patient education in third with 5 respondents ranking it was number 2. In the last question of the survey, and from hearing anecdotally from the healthcare workers, it was stated that the healthcare workers felt they lacked proper education and training when they were onboarded to the facility on clean-catch urine and the importance in relation to UTIs. The respondents also voiced concern over not having clean-catch kits available and therefore having to search for all of the necessary supplies.

Other barriers addressed included lack of staffing, and the difficulty of educating this specific population that is memory impaired.

4.0 Discussion

4.1 Elderly Patients

The results of this cross-sectional study demonstrate lack of knowledge regarding UTI diagnosis and urine clean-catch procedures among the healthcare workers on the IHAP unit. In the retrospective data mined from 2020, it was often common for patients to present incontinence when being tested for a UTI. This suggests that in this study population there is a need for interventions to improve staff and patient education for clean-catch procedures and to make clean-catch kits available for the healthcare workers to utilize. Misconceptions of clean-catch symptoms were identified, with incontinence being one symptom which the healthcare workers deemed as indicative of a UTI.

Elderly patients are amongst the populations which are most susceptible to urinary incontinence, especially those with cognitive impairments. In the retrospective data mined from 2020, it was common for patients to present incontinence when being tested for a UTI. This can be attributed to physical factors such as weakened urinary tract muscles and incorrect or inhibited brain signaling to properly store and void the bladder.[32] Although incontinence is not a direct symptom of a UTI, it is often associated with lower urinary tract infections.[33] Dementia patients are known to have a higher risk of asymptomatic UTIs.[34] According to the current Lippincott's definition, which is the current golden standard to diagnose and treat UTIs, a patient must exhibit symptoms to be classified and treated for a UTI. This presents a problem, as many dementia patients lack the typical symptoms which the general population presents. General guidelines to help aid clinicians for this population have been published. However, a standardized definition

for clinicians and infection preventionists to follow has yet to be established.[34] Therefore, the 2020 data on clean-catch urine confirm that it is common for physicians to order a clean-catch urine specimen even in the absence of typical UTI symptoms to test for elevated white blood cells (WBC) counts, as high WBC levels are indicative of patient infection.[34] In our retrospective data mining analysis, we demonstrated that a raised white blood cell count test result frequently resulted in UTI testing and diagnosis. This could suggest that clinicians rationalize testing this patient population as a way to rule out UTIs, due to the variability in presentation of symptoms for this study population. Delirium and mood changes were also found in the data from 2020 to be common amongst those tested for a UTI. A meta-analysis that investigated 29 studies which looked for the association between delirium and UTIs, showed a highly significant relationship between the two factors (OR 2.67; 95% CI 2.12–3.36; $p < 0.001$).[35] Other research literature supports this connection, however, there are limited studies directly investigating this relationship. Because of limited research and lack of universal guidelines for care of elderly populations, it is challenging for providers to implement guidelines for diagnosis and treat a UTI.[33,34]

4.2 Clean-Catch Urine Contamination

As shown in the results, contamination rates for the facility ranged from 25.58% to 51.85%, with the IHAP floor being amongst the highest offenders. From a study looking at healthy adult clean-catch contamination rates, the percentage of sample contamination ranged from 22.2% to 34.8%.[36] This supports the notion that patients who have mental impairments may be at an increased likelihood to produce contaminated clean-catch urine specimen. Due to limited research on this specific demographic, further investigation and research needs to be obtained.

4.3 Staff Surveys

From the surveys administered to the IHAP floor, there was a consensus that there is a need for onboarding education and refresher courses for healthcare workers. Other results from the survey support the need for increased patient education and enhanced provision of clean-catch kits for the staff to readily access. Education of patients in the impacted unit is challenging, as individuals on the IHAP floor are memory impaired. Therefore, a tailored intervention utilizing multiple teaching methods and timepoints would be crucial to increase the rate of successful outcomes. Such interventions would need enhanced healthcare worker assistance due to physical and cognitive limitations. Clean-catch kits were also identified as a prioritized need by healthcare workers. Multiple staff members mentioned that current unit supplies are difficult to find, and therefore following protocols that include all of the needed supplies is very challenging. Providing a full clean-catch kit would address this issue by conveniently allowing healthcare workers to access a single whole set of supplies at the onset of the procedure. The IHAP floor presents many challenges, so a tailored intervention would be necessary to take into consideration both the healthcare workers' and patients' needs.

4.4 Strengths and Limitations

There is currently limited literature on contaminated clean-catch urine causes, specifically through the eyes of the healthcare worker and focused on an at risk memory impaired population. For this reason, this novel study was one of the first to explore this field. Access to all EHR records allowed for a comprehensive listing of patients, and all were able to be identified in the system.

The approach of looking at the patient records and healthcare workers attitudes, perceptions, and beliefs allow for a comprehensive look at clean-catch urine in order to diagnose possible sources of the cause for contamination in the urine collection.

Despite the above strengths, this study had limitations of note. While data-mining through the EHR records, there were many patient records with limited or incomplete charting from the clinician and nurses. The response rate was also low for the survey, with only 12 of 60 healthcare workers (20%) answering the survey. This in part could be due to the impact of COVID-19 restrictions of maintaining a staff to patient ratio, while also having limited staffing.

4.5 Future Implications

Future steps for this research include developing a program which is tailored to the IHAP unit. This will include a multiple facet approach to create a healthcare worker educational presentation to teach the workers of how to assist their patients to obtain a clean-catch urine sample, when it is appropriate to order the sample, and what supplies are needed. This would serve as both an initial training and as an ongoing refresher for the staff. Visual aids will also be developed to have in the restrooms for the patients to have as a reference of the steps of the clean-catch procedure, and also as a teaching visual for the healthcare workers to use to instruct the patients. A post-survey will be administered to the same population after a set duration of time to assess if they retained the knowledge, and EHR records will be explored to see if the percentage of contaminated urines has decreased.

Other areas to explore include further research into how different signs and symptoms present in elderly, memory-impaired populations. Current literature has supported that memory-

impaired individuals tend to present both delirium and incontinence.[20] However, the current definition used by hospitals does not have a definition specific to this population. Further investigation into the validity of these differing symptoms is needed to solidify a more appropriate standard definition for this demographic.

Increasing proper clean-catch sample collections will lead to the likelihood of faster, more accurate diagnosis which will lead to better health outcomes. This study supports that there is a gap in knowledge for the healthcare workers pertaining to clean-catch urine procedures, and patients have specific barriers associated with their demographic. Multifaceted interventions at both the staff and patient level are needed to optimize short- and long-term public health outcomes among the hospitalized memory-impaired elderly population.

Appendix

Figure 4. Healthcare Worker Survey Administered at Baseline

Staff Knowledge, Attitudes, Perceptions of Urinary Tract Infections (UTI), Incontinence, and Clean Catch Urine Samples

Thank you for your interest in our quality improvement project. The purpose of this survey is to assess healthcare worker knowledge, attitudes, and perceptions of urinary tract infections (UTI), incontinence, and clean catch urine collection to better improve patient outcomes. This survey will take no longer than 15 minutes to complete. The following survey is entirely anonymous and will not be identifiable in any way. The following survey can be done on either paper or scan the QR code below.

If any questions come up, contact Mikaela Kluver via email at kluvermw@upmc.edu.

1. Which of the following symptoms must be exhibited to be considered a UTI? (Circle all that apply)
    a. Dysuria (burning while urination)
    b. Costovertebral angle pain or tenderness
    c. Increased urine frequency
    d. Incontinence
    e. All the above
2. Which urine tests require a clean catch urine sample? (Click all that apply)
    a. C&S
    b. Urinalysis
    c. Urine drug screen
    d. Urine pregnancy
    e. All the above

3. What supplies are needed to complete a clean catch (applicable to all persons)? Circle all that apply.

a. Clean Catch Kit

c. Alcohol prep pad

e. Specimen collector pan

b. Specimen cup

d. Castile wipes or soap and water

f. Foley bag

4. What is the purpose of a clean catch?
    a. To prevent infecting the patient
    b. To prevent bacteria from getting into the sample
    c. To keep the urine cup clean
    d. All the above
    e. None of the above

5. What is the correct clean catch procedure order for someone with a vagina? (Select one).
    a. Sit on toilet with legs spread apart, wipe inner fold of labia, spread open labia, use same wipe to clean over opening where urine comes out, urinate in clean cup.
    b. Sit on toilet with legs spread apart, use two fingers to spread open labia, use first wipe to clean the inner folds of labia, wipe front to back, use second wipe to clean opening of urethra, urinate small amount into toilet, urinate in cup until halfway full, finish urinating in the bowl.
    c. Sit on toilet with legs spread apart, use two fingers to spread open labia, use first wipe to clean the inner folds of labia, wipe front to back, use second wipe to clean opening of urethra, urinate in cup until halfway full, finish urinating in the bowl.
    d. Sit on toilet, urinate into cup until halfway full, finish urinating in the bowl.

6. What is the correct clean catch procedure order for someone with a penis? (Select one).
    a. Urinate a small amount in toilet bowl, urinate in cup until half full, finish urinating in bowl.

b. Clean the head of the penis with a sterile wipe (if not circumcised, pull back foreskin), urinate a small amount in toilet bowl, urinate in cup until half full, finish urinating in bowl.
c. Clean the head of the penis with a sterile wipe (if not circumcised, pull back foreskin), urinate a small amount in toilet bowl, urinate in cup until half full, finish urinating in bowl, use second wipe to clean the outside of the cup before giving to nurse.
d. Clean the head of the penis with a sterile wipe (if not circumcised, pull back foreskin), urinate in cup until half full, wipe head of penis again, finish urinating in bowl.

7. Improperly collected urine can result in other infections. (Select one).
    a. Highly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Highly agree

8. UTIs are a problem amongst the dementia (confused) Western Psychiatric Hospital (WPH) inpatient population. (Select one).
    a. Highly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Highly agree

9. Having a proper clean catch is important to correctly diagnose UTIs in patients. (Select one).
    a. Highly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Highly agree

10. My role in educating patients will influence patient proper urine collection. (Select one).
    a. Highly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Highly agree

11. Which of the following do you think would be the solution to decreasing improperly clean catch? (Rank from 1 being most important to 7 being the least important)
    - ____ More staffing
    - ____ Better education for staff
    - ____ Better education for patients
    - ____ Having a visual aid in bathrooms for patients
    - ____ Having a clean catch kit available (i.e., supplies with information sheet)
    - ____ Identifying in the order/task that sample collection should be clean catch
    - ____ Identifying in the order/task the reason for collecting the sample

12. What is your current occupation at WPH?
    a. Milieu Therapist (MT)
    b. Patient care tech (PCT)
    c. Registered Nurse (RN)
    d. Student behavioral associate (SBA)
    e. Other: _____

13. How many years of experience do you have in your current occupation?
    a. Less than a year
    b. 1 to 2 years
    c. More than 2 and less than 5 years
    d. More than 5 years

14. How many years have you worked at WPH?
    a. Less than a year
    b. 1 to 2 years
    c. More than 2 and less than 5 years
    d. More than 5 years

15. What do you feel would best influence an improved clean catch collection by a patient?

_____

_____

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