Utility of routine urinalysis and urine culture testing in an ambulatory urology clinic: a quality improvement initiative in a Veterans healthcare facility

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RICHARDS KA, CESARIO S, LIM AH, BEST SL, DEEREN SM, BUSHMAN W, SAFDAR N. Utility of routine urinalysis and urine culture testing in an ambulatory urology clinic: a quality improvement initiative in a Veterans healthcare facility. *Can J Urol* 2017;24(1):8627-8633.

Introduction: *Urinalysis (UA) and urine culture (UCx) are commonly performed tests in the urology clinic. Many of these urine studies are performed prior to the patient visit may not always be indicated, thus contributing to unintended consequences such as antibiotic use and costs without enhancing patient care. Our objective was to perform a quality improvement initiative aimed to assess the utility of routine UA/UCx.*

Materials and methods: *The practice pattern at our site's Veteran Affairs (VA) urology clinic prior to 2014 was to obtain routine UA/UCx on most clinic visits prior to patient evaluation. Starting in 2014, we designed an intervention whereby our nurse practitioner triaged all new patient referrals and selectively ordered UA/UCx. We performed multivariable logistic regression to assess for predictors of obtaining UA or UCx.*

Results: *A total of 1308 patients were seen in January-March 2013 and 1456 in June-August 2014 and were included in this analysis. Fewer patients in 2014 received UA (59.8% versus 70.0%, $p < 0.001$) and UCx (49.6% versus 64.2%, $p < 0.001$). There was a decreased odds of obtaining UA in 2014 (OR 0.52, $p < 0.001$) as well as a decreased odds of obtaining UCx in 2014 (OR0.38, $p < 0.001$) on multivariable logistic regression. The results of UA/UCx only rarely resulted in change of management in either cohort (3%). Selective ordering resulted in an estimated cost savings of $4915.08/month in UCx costs alone.*

Conclusions: *Our quality improvement initiatives reduced rates of UA/UCx testing when providers assess patients prior to ordering these tests. The implication of this initiative is significant cost savings for the healthcare system.*

Key Words: quality control, quality improvement, urine, urine assay, urinary tract infection

Accepted for publication November 2016

Acknowledgements
This material is the result of work supported with resources and the use of facilities at the William S. Memorial Veterans Hospital. Dr. Safdar is supported by a VA funded Patient Safety Center of Inquiry and a VA MERIT award. The contents do not represent the views of the U. S. Department of Veterans Affairs or the United States Government.

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Introduction

Urinalysis (UA) and urine culture (UCx) are commonly performed tests in the ambulatory urology clinic. While investigation of the urine in patients being evaluated for medical renal disease is almost always indicated, the indications for urine studies in the urologic patient are less well defined.[1] Gerber and Brendler advocate for UA as a fundamental test that should be performed in all urologic patients;[2] however, the actual rates of UA and UCx as well as the utility of the test results in the ambulatory urology patient

population has been poorly described in the literature. Signs and symptoms of a urinary tract infection (UTI) and hematuria are common indications for UA/UCx,[3] but the utility of urine studies for other common urologic complaints such as erectile dysfunction, incidental renal mass, or prostate cancer screening is less clear and not evidence-based.

While it might be dogmatic to obtain UA in all urology patients, we questioned the clinical utility of this practice as the actual medical literature supporting this practice is limited. We also noted that practice patterns are highly variable among urology clinics. In some settings, UA and/or UCx are obtained prior to the patient being evaluated by the urologist. The advantage of up front urine studies prior to patient evaluation is that it may increase clinical efficiency. However, the potential downside of this practice pattern is that unnecessary urine studies may result in increased cost, patient inconvenience, work up of false positive results, patient anxiety, and antibiotic use. In an effort to reduce potentially unnecessary urine studies at our VA outpatient urology clinic (Madison, WI), our nurse practitioner (supported by our urologic clinic staff) championed changes in patient care process to more selectively order urine studies on our patients. As part of this quality improvement initiative, we asked the following question: is it safe and effective to use the electronic health record (EHR) to evaluate patients prior to their clinic visits and selectively order urine studies based on their clinical history.

Materials and methods

Prior to initiating this intervention, we obtained approval from our Institutional Review Board in recognition of and compliance with the United States Health Insurance Portability and Accountability Act of 1996 guidelines. The protocol was also approved by our local Veterans Affairs Office of Research and we conformed to the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines for quality improvement reporting.[4] Prior to 2014, it was routine practice to obtain UA/UCx on most clinic visits prior to patient evaluation in the urology clinic at the Madison VA. This practice pattern had likely evolved for several reasons. First, the physical location of the lab is not in close proximity to the urology clinic. Hence it was felt to be more convenient for the patient to submit a urine specimen prior to their clinic appointment. Furthermore, it was also felt to be more efficient for the urology provider to have the results of the UA at the time of the clinic visit as opposed to afterwards as the results might influence counseling or treatment decisions. Lastly, the lab has limited storage capabilities decreasing its capability to hold urine specimens while awaiting confirmation from the provider about additional testing (i.e. whether or not to run the UA, urine microscopy, and/or UCx). Based on these local cultural and environmental challenges, in 2014, we set forth to reduce potentially unnecessary UA/UCx by more selective ordering of urine studies based on patient presenting complaints.

Our nurse practitioner with 29 years of urology clinical experience reviews and triages all new patient referrals. Via this triage mechanism, an intervention was planned to review all referrals and only order urine studies if the results might be helpful at the time of patient evaluation. For example, the results would be potentially helpful for a referral of a patient with recurrent UTI but may not be helpful for a referral of a patient with an incidental small renal mass. In the latter case, the urine studies would be deferred and ordered at the discretion of the provider who saw and evaluated the patient. We defined absolute indications for urine studies as referrals for UTI, hematuria, nephrolithiasis, and irritative voiding symptoms. Our nurse practitioner followed these guidelines as well as exercised professional judgment to determine which patients to order urine studies prior to provider evaluation. If there were any unusual scenarios, she conferred with a staff urologist for consensus. We hypothesized that this intervention would decrease the rates of urine studies without compromising clinic workflow.

We evaluated the intervention by designing a retrospective observational cohort study in which data was abstracted from the EHR by reviewing the chart of each individual patient. We collected data on two cohorts of patients each comprising a 3 month period of consecutive patients seen in our clinic. The first cohort was from January-March 2013 (prior to intervention) and the second cohort was from June-August 2014 (post-intervention). Our primary outcome measure was rates of urine studies between the two cohorts. We also assessed patient demographics, clinic type (new patient, return patient, or clinic procedure), and patient presenting symptoms. A UA was considered positive if it was nitrite positive and/or presence of white blood cells (≥ 5 per HPF) with bacteria. A UCx was considered positive if it grew ≥ 10^4 colony-forming units (CFU) per mL excluding diphtheroids. We reviewed the provider's clinic notes to determine if the results of the UA changed patient management. A change in management was defined as antibiotic treatment for UTI or delay in procedure. Lastly, we measured the amount of time it takes to triage patient referrals to assess its impact on workflow.

Statistical analysis was performed using Stata 12 (College Station, TX, USA). Comparison of medians was performed using the Mann-Whitney U-test. Fisher's exact and chi-squared tests were used for comparison of categorical variables. Multivariable logistic regressions were performed to identify independent predictors of obtaining UA or UCx. A two-sided p-value of < 0.05 was considered significant.

Results

From January-March 2013, 1308 patients were seen at the Madison VA urology clinic and were included in the pre-intervention cohort. From June-August 2014, 1456 patients were seen at the Madison VA urology clinic and were included in the post-intervention cohort. The 2014 cohort was slightly older (median age 68.1, IQR 64.1-74.6) than the 2013 cohort (median age 66.5, IQR 62.5-74.0, $p < 0.001$) and contained a smaller proportion of Caucasian patients (89.4% versus 93.2%, $p = 0.002$). There was no difference in type of clinic visit between cohorts and the vast majority of patients were men (97.5% in each cohort). Furthermore, as noted in Table 1, there were subtle differences in presenting complaints between groups with the 2014 cohort more likely to present with genitourinary cancer than the 2013 group (35.2% versus 31.0%, $p = 0.02$).

Rates of UA were lower for the 2014 cohort (59.8%) versus the 2013 cohort (70.0%, $p < 0.001$). Similarly, rates of UCx were lower for the 2014 cohort (49.6%) versus the 2013 cohort (64.2%, $p < 0.001$). There was no difference in rates of positive UA/UCx or UCx organisms between the two cohorts, Table 2. There were decreased odds of obtaining a UA in the 2014 cohort (OR 0.52, 95% CI 0.43-0.63, $p < 0.001$) in our multivariable logistic regression analysis assessing for independent predictors of obtaining UA while controlling for age, race, presenting complaint, and type of clinic visit, Table 3. Likewise, there was a decreased odds of obtaining a UCx in the 2014 cohort (OR 0.38, 95% CI 0.28-0.53, $p < 0.001$) in our multivariable logistic regression analysis assessing for independent predictors of obtaining UCx while controlling for age, race, presenting complaints, and the results of the UA, Table 4.

Through our detailed chart review, we assessed if the results of the UA/UCx had an impact on patient management. The results of the UA/UCx only rarely resulted in change of management in either cohort (2013: 3.1 % versus 2014: 3.0%, $p = 0.87$) with no treatment for asymptomatic bacteriuria. The change in management was almost exclusively for treatment of UTI as only two patients from the 2014 cohort had a procedure delayed due to the results of their UA. Post-intervention, the average amount of time spent reviewing and triaging new referrals was 15 minutes per day. The total cost (not including manpower) estimated for a single UCx at our facility is $22.14. While a comprehensive cost-analysis is beyond the

TABLE 1. **Baseline cohort characteristics stratified by year of clinic visit**

	2013	**2014**	**p value**
Patients, n	1308	1456	
Age, median (IQR)	66.5 (62.5-74.0)	68.1 (64.1-74.6)	< 0.001
Caucasian, n (%)	1219 (93.2)	1301 (89.4)	0.002
Type of clinic visit, n (%)			0.99
New visit	301 (23.0)	332 (22.8)	
Return visit	751 (57.4)	839 (57.6)	
Procedure clinic	256 (19.6)	285 (19.6)	
Male, n (%)	1275 (97.5)	1420 (97.5)	0.93
Presenting complaint, n (%)			0.02
Retention/BPH/LUTS	338 (25.9)	384 (26.3)	
Genitourinary cancer	406 (31.0)	512 (35.2)	
Kidney stones	92 (7.0)	89 (6.1)	
Hematuria	116 (8.9)	151 (10.4)	
Elevated PSA	196 (15.0)	183 (12.6)	
Other	160 (12.2)	137 (9.4)	

TABLE 2. **Urinalysis and urine culture characteristics stratified by year of clinic visit**

	2013	2014	p value
Urinalysis sent, n (%)	915 (70.0)	870 (59.8)	< 0.001
Positive urinalysis, n (%)	141 (15.4)	114 (13.1)	0.16
Urine culture sent, n (%)	840 (64.2)	722 (49.6)	< 0.001
Positive urine culture, n (%)	145 (17.3)	117 (16.2)	0.58
Positive urine culture organism, n (%)			0.26
Alpha streptococcus	27 (18.6)	13 (11.1)	
Candida albicans	4 (2.8)	0	
Escherichia coli	13 (9.0)	11 (9.4)	
Enterococcus faecalis	14 (9.7)	8 (6.8)	
Pseudomonas aeruginosa	3 (2.0)	4 (3.4)	
Staphylococcus species	43 (29.6)	46 (39.3)	
Streptococcus species	11 (7.6)	13 (11.1)	
Klebsiella pneumoniae	10 (6.9)	10 (8.6)	
Other	20 (13.8)	12 (10.3)	

scope of this quality improvement initiative, we estimated that selective ordering of UCx (i.e. only ordering UCx if UA is positive) would result in an estimated cost savings of $4915.08/month in UCx costs alone for our clinic.

Discussion

We designed and implemented a quality improvement study in our local urology clinic with the goal of reducing potentially unnecessary urine studies. We

TABLE 3. **Multivariable logistic regression assessing for independent predictors of obtaining urinalysis**

	Odds ratio	95% CI	p value
Year of clinic visit			
2013	Ref.	Ref.	
2014	0.52	0.43-0.63	< 0.001
Age	1.00	0.99-1.01	0.29
Race			
Caucasian	Ref.	Ref.	
African-American	0.78	0.46-1.33	0.37
Asian	2.37	0.31-18.4	0.41
Other	1.20	0.80-1.79	0.38
Presenting complaint			
Retention/BPH/LUTS	Ref.	Ref.	
Genitourinary cancer	3.26	2.59-4.10	< 0.001
Kidney stones	7.78	5.07-11.9	< 0.001
Hematuria	7.23	4.37-12.0	< 0.001
Elevated PSA	6.37	4.33-9.37	< 0.001
Other	0.84	0.62-1.15	0.28
Type of clinic visit			
Procedure clinic	Ref.	Ref.	
Return visit	0.09	0.07-0.13	< 0.001
New visit	0.58	0.39-0.87	0.01

TABLE 4. **Multivariable logistic regression assessing for independent predictors of obtaining urine culture**

	Odds ratio	95% CI	p value
Year of clinic visit			
2013	Ref.	Ref.	
2014	0.38	0.28-0.53	< 0.001
Age	0.98	0.96-0.99	0.01
Race			
Caucasian	Ref.	Ref.	
African-American	1.05	0.40-2.75	0.92
Asian	0.05	0.01-0.91	0.04
Other	4.29	1.52-12.13	0.01
Presenting complaint			
Retention/BPH/LUTS	Ref.	Ref.	
Genitourinary cancer	0.16	0.10-0.26	< 0.001
Kidney stones	0.64	0.29-1.41	0.27
Hematuria	2.18	0.90-5.30	0.09
Elevated PSA	1.39	0.67-2.89	0.38
Other	0.87	0.36-2.06	0.74
Urinalysis results			
Negative	Ref.	Ref.	
Positive	0.93	0.60-1.43	0.73

believed that by performing this initiative, we would improve the healthcare value for our patients by maintaining quality yet reducing costs. We believe we were able to accomplish this through a simple intervention as our nurse practitioner triaged patient referrals to clinically determine the appropriateness of urine studies prior to the urology provider seeing the patient. This strategy was feasible in effectively reducing some of the potentially unnecessary urine studies that may have not been indicated without greatly impacting workflow. We also believe that this strategy was safe as our comprehensive chart review revealed that the results of the urine studies (whether obtained for an indication or per routine) rarely resulted in any change in clinical management. The strengths of this study include the uniform implementation of the intervention as well as the detailed data collected from the chart abstraction. When extrapolated to urology clinics across the country, the implications for cost savings could be immense without a huge disruption in workflow.

What are indications for UA and/or UCx? Expert opinion suggests that all urologic or nephrologic patients should have a UA.[1,2] However, as noted in this study, the results of the urine studies rarely changed or altered clinical management of our urology clinic patients. The exact incidence or rate of urine studies performed in the ambulatory urology clinic is unknown but our study reveals the rate to be in the 50%-70% range in our clinic. The rates are likely to vary in other clinics based on patient population, provider biases, local lab environment, etc. Professional societies have developed guidelines and consensus statements with appropriateness criteria for obtaining a urine culture.[5-10] In patients with an indwelling catheter, condom catheter, or intermittent straight catheterization, a UCx is recommended for new onset fever, rigors, altered mental status, suprapubic pain/tenderness, hematuria, costovertebral pain/tenderness, or increases spasticity or autonomic dysreflexia (in patients with spinal cord injury). For patients that had a urinary catheter removed < 48 hours prior, a UCx is recommended for any of the above criteria and/or irritative voiding symptoms (urgency, frequency, dysuria). Lastly, in patients without any urinary catheter history, UCx is recommended for fever, irritative voiding symptoms, costovertebral pain/tenderness, suprapubic pain, hematuria, and/or new or worsening incontinence. These recommendations are largely based on clinical expertise, descriptive studies, or reports from expert committees. In a study of 208 patients that had a UCx sent during their hospital admission, Hartley and colleagues noted that 57.7% of patients did not meet these guideline-based criteria for UCx and that there

was no documented reason for ordering the UCx in 37.5% of the patients.[11] While it might seem innocuous to obtain urine studies, the results of these studies may have a negative impact on patients secondary to false positives, patient anxiety, additional work-up, and unnecessary treatment of asymptomatic bacteriuria (ASB).

The treatment of ASB is a significant contributor to antibiotic overuse in hospitalized and nursing home patients especially those with urinary catheters.[5,12] This lack of antibiotic stewardship has resulted in an estimated $1.1 billion spent annually on unnecessary antibiotics in the United States, fostered the emergence of drug-resistant pathogens, and overall undermines patient safety.[13] Studies estimate that 20% to 83% of patients with ASB are treated inappropriately with antibiotics.[14,15] Therefore, novel interventions have been developed such as "The Kicking CAUTI: The No Knee-Jerk Antibiotics Campaign" focused on reducing UCx ordering as the results of urine studies can be a powerful stimuli for antibiotic use and/or additional testing.[16,17] The key features of "The Kicking CAUTI" intervention are case-based audit and feedback and an actionable algorithm.[18] Using this intervention in a patient population with urinary catheters on acute medicine wards and long-term care units, the overall rate of UCx ordering decreased significantly during the intervention period (from 41.2 to 23.3 per 1000 bed-days, $p < 0.001$).[19] The implication is that interventions directed at reducing unnecessary urine testing are feasible and are emerging domains for reducing waste in medicine as well as antibiotic stewardship. Most of the literature has focused on excess urine studies in hospitalized patients; however, our study brings to light the potential excess in an outpatient setting as well.

The limitations of this study deserve specific mention as they may impact external and internal validity. With regards to external validity, the results of this study may not be generalizable to every ambulatory clinic given the specific specialty clinic, culture, and environment that the study was performed in. However, for any clinic that routinely obtains tests on a majority of patients prior to provider evaluation, designing a triage intervention with brief review of the EHR may be an effective and safe strategy that could be implemented and analyzed in other clinical settings as well. With regards to internal validity, the retrospective nature of data collection may have biased study outcomes and limited the ability to measure more subjective outcomes (i.e. patient satisfaction). Additionally, it was challenging to assess retrospectively whether the results of the urine studies impacted management decisions (outside of treatment for UTI) and this end point would be better evaluated prospectively. However, the primary outcome measures were objective and easily measurable in a retrospective fashion, thus limiting the impact on internal validity. Lastly, it is unknown if this intervention is safe from the viewpoint that significant pathology may have been missed from omission of urine tests. Future directions include additional study on the sustainability of our intervention, the impact of reduced urine testing on provider satisfaction, the impact of reduced urine testing on antibiotic stewardship, and the impact of reduced urine testing on patient safety with regards to the potential for missed pathology. Additionally, cost is an important consideration and further studies will need to address the issues of costs of the test, cost of additional work up, costs of side-effects from treatment, costs of additional treatment, and the time/cost spent on our intervention.

Conclusions

Quality improvement interventions within ambulatory urology clinics reduce rates of UA/UCx when providers assess patients prior to routine ordering of tests. The implication from this initiative is significant cost savings for the healthcare system as well as ongoing antibiotic stewardship directed at interventions designed to reduce routine ordering of urine studies. □

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