*Clinical Infectious Diseases*

MAJOR ARTICLE

# How Testing Drives Treatment in Asymptomatic Patients: Level of Pyuria Directly Predicts Probability of Antimicrobial Prescribing

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***Background.*** Urinalysis is a readily available test often used for screening. Pyuria is a common finding in asymptomatic patients; however, it is unknown how often identification of pyuria in the absence of confirmatory cultures leads to antimicrobial prescribing. The objective of this study was to measure the association between pyuria and antimicrobial initiation during the perioperative period and assess harms versus benefits of treatment.

***Methods.*** A retrospective cohort of preoperative patients within the national healthcare system during the period 1 October 2008–30 September 2013 who had a urinalysis performed during the 30-day preoperative period was created; patients with positive urine cultures were excluded. The primary exposure was pyuria on preoperative urinalysis. The primary outcome was antimicrobial initiation. Secondary outcomes included postoperative surgical site (SSI), urinary tract (UTI), and *Clostridioides difficile* infections. Trend and logistic regression analyses were performed.

***Results.*** Among 41 373 patients, 3617 had pyuria. 887 (24.5%) patients with pyuria received antimicrobials versus 1918 (5.1%) patients without pyuria. As the degree of pyuria increased, the odds of receiving antimicrobials also increased linearly (low, 14.7%; moderate, 24.0%; high pyuria, 37.4%). Preoperative pyuria was associated with postoperative *C. difficile* infections (aOR, 1.7; 95% CI, 1.2–2.4); risk was higher in patients who received antimicrobials (aOR, 2.4; 1.7–3.4). Pyuria was not associated with SSI but was associated with increases in UTI after orthopedic and vascular procedures; this risk was not mitigated by antimicrobial therapy.

***Conclusions.*** Urine screening during the preoperative period is a low-value intervention that increases antimicrobial exposure but does not improve postoperative outcomes.

**Keywords.** pyuria; preoperative screening; antimicrobial use; diagnostic stewardship.

Urinalysis (UA) is a commonly ordered screening test that is inexpensive, easy-to-collect, and available at the point-of-care across a wide range of inpatient and outpatient clinical settings. The ease of use of the test—and the rapid availability of the results—make it an attractive option for clinicians trying to make immediate decisions about clinical management. Thus, UA has been incorporated into many screening and diagnostic protocols in general medicine, emergency departments, and routine preoperative assessments [1]; Yin et al [2] found that UAs are collected in 62% of all admissions to the general medical service and that the vast majority were in asymptomatic patients (84%). Pyuria—potentially indicating local inflammation—is a common finding, including among patients without clinical symptoms of urinary tract infection (UTI) or systemic infection. Studies have demonstrated that pyuria is detected in patients with asymptomatic bacteriuria in 32% of women, 90% of long-term care residents, and 90% of hemodialysis patients [3]. Further, once pyuria is detected, due to the perception that inflammation is nearly always caused by an underlying infection, antibiotic use often ensues, regardless of whether the patient is symptomatic and treatment is indicated [2, 4].

Many diagnostic and testing algorithms include identification of pyuria as a reflex to the performance of a urine culture. These algorithms were developed based on the high negative-predictive value of the absence of pyuria for ruling out clinical UTI, which approaches 99% [5]. Reflex urine culture performance algorithms have led to reductions in the number of urine cultures performed [6]. While this approach has been an effective means of reducing antimicrobial use in patients without pyuria, the reliance on the UA to drive clinical decision making may drive antimicrobial prescribing in patients with pyuria [7]. The positive-predictive value of pyuria for identifying bacteriuria and clinical infections is low—equivalent to flipping a coin [5]. Due to its limited diagnostic utility, the Infectious Diseases Society of America guidelines specifically recommend against using pyuria as a criterion for the diagnosis of clinical infection

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and further state that pyuria alone does not warrant antimicrobial treatment [8]. Similarly, UA results are not included in the National Healthcare Safety Network definitions of symptomatic UTI [9].

A reduction in unnecessary antibiotic use is a central goal of the US Centers for Disease Control and Prevention, the World Health Organization, and the Veterans Health Administration [10]. However, despite these initiatives, large studies demonstrate that reducing unnecessary antibiotic use in both inpatient and outpatient settings remains a considerable stewardship challenge.

The role of pyuria without positive urine cultures in driving antimicrobial prescribing is not well established. Thus, the objective of this study was to evaluate how the presence and degree of pyuria predict antimicrobial prescribing in a national cohort of surgical patients, who primarily received UA as part of a preoperative screening protocol. A secondary goal was to assess whether antimicrobial treatment directed toward the pyuria led to improvements in postoperative outcomes.

## METHODS

### Cohort Creation

All patients with a UA collected within 2–30 days prior to surgery and who underwent manual review for preoperative and postoperative quality metrics as part of 2 previously described Veterans Affairs (VA) quality-assurance programs were potentially eligible to be included in the analysis [11, 12]. The large, retrospective multicenter cohort includes over 70 000 eligible major cardiac, orthopedic total joint replacement, vascular, and hysterectomy surgeries performed on Veteran patients at 109 different medical centers from fiscal years 2008–2013 [13]. In patients with multiple UA results recorded, the test in closest proximity to the date of surgery was used.

### Exclusions

Patients with positive urine cultures (defined as urine cultures with $\geq 10^5$ colony-forming units/mL) are previously reported and were excluded from this study [12]. Patients with antibiotics prescribed within the 7-day window prior to UA collection were also excluded.

### Definitions

The presence of pyuria was defined as the presence of more than 5 white blood cells (WBCs) or a positive leukocyte esterase detected in the UA; a low level of pyuria was defined as 6–10 WBCs per high-powered field (HPF), few or small amount, or 1 or more leukocyte esterase; moderate amount was defined as 11–20 WBCs/HPF, moderate amount, or 2 or more leukocyte esterases; and high was defined as more than 20 WBCs/HPF, large amount or too numerous to count, or 3 or more leukocyte esterases. A sample of cases with pyuria present who received antimicrobial treatment underwent manual review by a trained infectious disease clinician (J. G-S.) to determine the reason the urine was collected and treated and to assess whether lower urinary tract and/or systemic symptoms were present.

### Outcomes and Exposures

The primary exposure variable of interest was the presence and degree of pyuria; a secondary exposure variable was the presence of a urine culture that did not meet diagnostic criteria for positivity but was not negative (eg, $<10^5$ organisms identified).

The primary outcome variable was antibiotic initiation, defined as antibacterial treatment initiated on the date of the UA or between the date of the UA and the surgical date, including both inpatient and outpatient antimicrobial orders. Prescriptions for antifungals and antivirals were not included.

Secondary outcomes included 30-day incidence of surgical site infection (SSI), UTI (not available for cardiac surgery), and 90-day incidence of *Clostridioides difficile* infection. *C. difficile* testing results were based on previously described laboratory definitions [11, 12]. Surgical site infection and UTI outcomes were based on manually adjudicated review by a trained clinician as part of the VA Surgical Quality Improvement Program.

### Sensitivity Analysis

To ensure that antimicrobial use in the outpatient setting was not driven by treatment of other infections, International Classification of Diseases, Ninth Revision (ICD-9), codes for upper and lower respiratory tract infections, the most common indication for antimicrobial use outside of UTI, were extracted. Patients with these ICD-9 codes were then excluded from the cohort, and rates of antimicrobial use in patients with and without pyuria were compared.

### Statistical Analysis

Univariate analysis was completed with chi-square tests and *t* tests as appropriate. A multivariable logistic regression including covariates selected a priori (American Society of Anesthesiologists [ASA] score >2, age, smoking, diabetes [except for *C. difficile* models]) was then estimated to evaluate the association between pyuria, antimicrobial treatment of pyuria, and postoperative outcomes. The relationships between the amount of pyuria and the concentration of bacteria in urine cultures to the rate of antimicrobial prescribing were also estimated.

### Ethical Considerations

Institutional review board approval was obtained prior to data collection and analysis.

## RESULTS

### Cohort

Among 70 277 patients who underwent cardiac, orthopedic total joint, vascular, and hysterectomy procedures at a VA hospital

during the study period, n = 682 (1%) had a positive urine culture during the 1-month period prior to surgery and were excluded. A total of 42 023 (59.8%) had a UA performed during the 2- to 30-day window prior to their surgical procedure. Of these, 650 (1.5%) were receiving antimicrobials within the 7-day window prior to UA test collection and thus were excluded, leaving 41 373 eligible for inclusion (see the cohort creation diagram in Figure 1). Performance of a UA was highly variable between surgical specialties and was most common in orthopedic surgery and least common in patients who underwent hysterectomy. Baseline demographics are presented in Table 1.

Among patients with a UA performed, 37 756 did not have pyuria; 3617 had varying degrees of pyuria detected (1584, 43.8% low; 791, 21.9% moderate; 1242, 34% high). Identification of pyuria varied by surgical specialty, and patients with pyuria were more likely to be female, have black race recorded, have diabetes, and have higher ASA scores. Pyuria also varied by surgical specialty (Table 1). A urine culture was collected and was negative or of low quantity in 13 872 patients in the cohort; 1784 of these patients (12.9%) had pyuria compared with 1833 (6.7%) of 27 501 with no urine culture performed.

Based on a manual chart review of a sample of the patients who had pyuria and who received antibiotics across multiple different surgical specialties, we found that the majority of patients with pyuria were identified as part of a preplanned, preoperative urine screening protocol (333/448, 74%). None of the 448 cases had lower urinary tract irritative symptoms, but 46 (10%) had systemic signs or symptoms of infection, such as a fever or an elevated WBC count. An additional 69 (15%) had an infection diagnosis other than UTI, such as pneumonia or bronchitis, that potentially warranted antibiotics. Seventeen (3.5%) had both a potential alternate diagnosis and acute infectious symptoms. The demographic characteristics of the patients undergoing chart review were similar to those in the cohort who had pyuria and received antibiotics but were not reviewed.

#### Antimicrobial Prescribing

Antimicrobial therapy was started during the window between the day of UA collection and the day prior to surgery in 2805 patients (6.8%). In patients with any degree of pyuria, antimicrobials were prescribed in 887 of 3617 patients (24.5%).

As the degree of pyuria increased, the odds of receiving antimicrobials also increased in a predictable fashion across all types of surgical procedures (Figure 2). Among patients with no pyuria, 5.1% (95% confidence interval [CI], 4.9–5.3%) were prescribed antimicrobials. Among patients with a low degree of pyuria, 14.7% (95% CI, 13.0–16.7%) received antimicrobial therapy versus 24.0% (95% CI, 21.1–27.2%) in patients with moderate pyuria and 37.4% (95% CI, 34.7–40.1%) in the high-degree group ($P$ for trend < .001). In a sensitivity analysis, exclusion of patients with an upper or lower respiratory infection diagnosis code did not change the dose–response relationship between pyuria level and antimicrobial prescribing.

Among patients with a confirmed negative or low colony count ($<10^5$ colony-forming units/mL) urine culture, those with pyuria were more likely to receive antimicrobials (540; 30.3%) versus 785 (6.5%) with no pyuria. Similarly, in patients with no urine culture performed, those with pyuria were more likely to receive antimicrobials (347; 18.9%) versus those

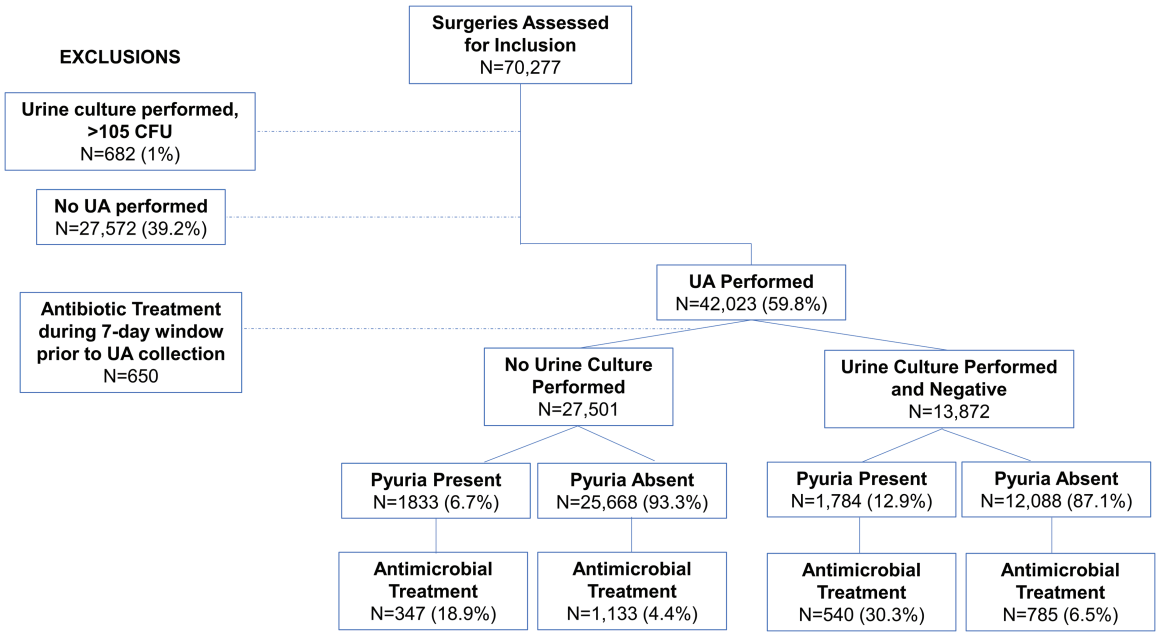


**Figure 1.** Cohort creation diagram. Abbreviatons: CFU, colony-forming units; UA, urinalysis.

**Table 1. Baseline Characteristics of Cohort**

| | UA Not Performed | No Pyuria | Pyuria | *P* |
|---|---|---|---|---|
| n | 27 572 | 37 756 | 3617 | |
| Mean (SD) age, years | 64.02 (9.94) | 63.84 (9.46) | 65.36 (11.09) | n/a |
| Male sex, n (%) | 25 735 (93.3) | 35 851 (95.0) | 2901 (80.2) | <.001 |
| Race, n (%) | | | | <.001 |
| White | 21 647 (78.5) | 29 510 (78.2) | 2653 (73.3) | |
| Black | 3671 (13.3) | 5258 (13.9) | 675 (18.7) | |
| Other and unknown | 2237 (8.1) | 2988 (7.9) | 289 (8.0) | |
| Smoking, n (%) | 8876 (32.2) | 10 124 (26.8) | 1001 (27.7) | .273 |
| Diabetes, n (%) | 7672 (27.8) | 9743 (25.8) | 1000 (27.6) | .017 |
| Specialty, n (%) | | | | <.001 |
| Cardiac | 9489 (34.4) | 10 486 (27.8) | 947 (26.2) | |
| Hysterectomy | 1028 (3.7) | 737 (2.0) | 204 (5.6) | |
| Orthopedics | 12 081 (43.8) | 23 789 (63.0) | 2127 (58.8) | |
| Vascular | 4974 (18.0) | 2744 (7.3) | 339 (9.4) | |
| ASA category, n (%) | | | | .003 |
| 1–2 | 3938 (14.3) | 7069 (18.7) | 596 (16.5) | |
| 3–5 | 23 633 (85.7) | 30 683 (81.3) | 3021 (83.5) | |
| Unknown | 1 (0) | 4 (0.0) | 0 (0.0) | |

Abbreviations: ASA, American Society of Anesthesiologists score; SD, standard deviation; UA, urinalysis.

without pyuria (1133; 4.4%). Regardless of whether a urine culture was performed, the odds of antimicrobial receipt increased approximately 4-fold if pyuria was present versus if it was absent (odds ratio [OR] of no urine culture performed, 4.3; OR of urine culture performed and negative, 4.7). There was also a dose–response relationship between degree of urine culture abnormality and odds of antimicrobial therapy, with low-quantity urine culture results (ie, cultures with colony counts $<10^5$) associated with increased odds of receiving antimicrobials when compared with patients with negative urine cultures or who did not have urine cultures performed (Figure 3).

### Postoperative Outcomes

*Clostridioides difficile* infections during the 90-day postoperative period were higher among patients identified as having pyuria than among patients without (OR 2.1; 95% CI 1.5–2.9). However, this finding was highly confounded by receipt of antimicrobial therapy in patients with pyuria; when the model was adjusted for receipt of antibiotic treatment, there was an independent and higher-magnitude association between antibiotic exposure and C. *difficile* infection (adjusted OR [aOR], 2.4; 95% CI 1.7–3.4) than between pyuria and C. *difficile* infection (aOR, 1.7; 95% CI 1.2–2.4). The results were similar when stratified by surgery type (Table 2).

Although pyuria was a strong predictor of antimicrobial exposure and *C. difficile* infections, it was not associated with increased risk of SSI in cardiac, vascular, orthopedic, or hysterectomy procedures. Further, receipt of antimicrobial treatment directed at the pyuria did not change SSI risk (1.7% in patients with pyuria, 1.6% in patients without pyuria, and 1.8% in patients with treatment for pyuria) (Table 2). The degree of pyuria was also not associated with SSI risk.

Postoperative UTI was diagnosed at a higher rate among vascular and orthopedic patients with preoperative pyuria than those without preoperative pyuria (aOR orthopedics, 1.5; 1.1–2.1; aOR vascular, 2.5; 1.4–4.5). However, antimicrobial therapy concurrent with the preoperative pyuria result did not significantly change this association; pyuria was still associated with postoperative UTI in both specialties after adjusting for antimicrobial treatment (aOR orthopedics, 1.5; 1.1–2.1; aOR vascular, 2.3; 1.2–4.2).

There was no significant association between pyuria and postoperative UTI in patients who underwent hysterectomy (aOR pyuria, 1.8; 0.71–4.4), and this remained nonsignificant after accounting for treatment (aOR, 1.8; 0.72–4.5). A combined analysis including all surgery types (not available for cardiac surgery) demonstrated similarly that pyuria was associated with postoperative UTI diagnosis (aOR, 1.8; 1.4–2.4) but that the increased risk was not changed with antibiotic treatment (aOR, 1.8; 1.4–2.3). The degree of pyuria was associated with increasing risk of a postoperative UTI diagnosis, but again, antibiotic treatment was not associated with a reduction in risk.

## DISCUSSION

Once pyuria is identified, antimicrobials are often prescribed unnecessarily, even if the patient is asymptomatic and the urine culture is found to be negative or with low colony counts. The probability of antimicrobial prescribing is predictable based on the degree of pyuria and the level of the colony count identified in culture; as the level of pyuria increases, so does the proportion of patients who receive unnecessary antimicrobial exposure (Figure 2). These data highlight the principle that "less

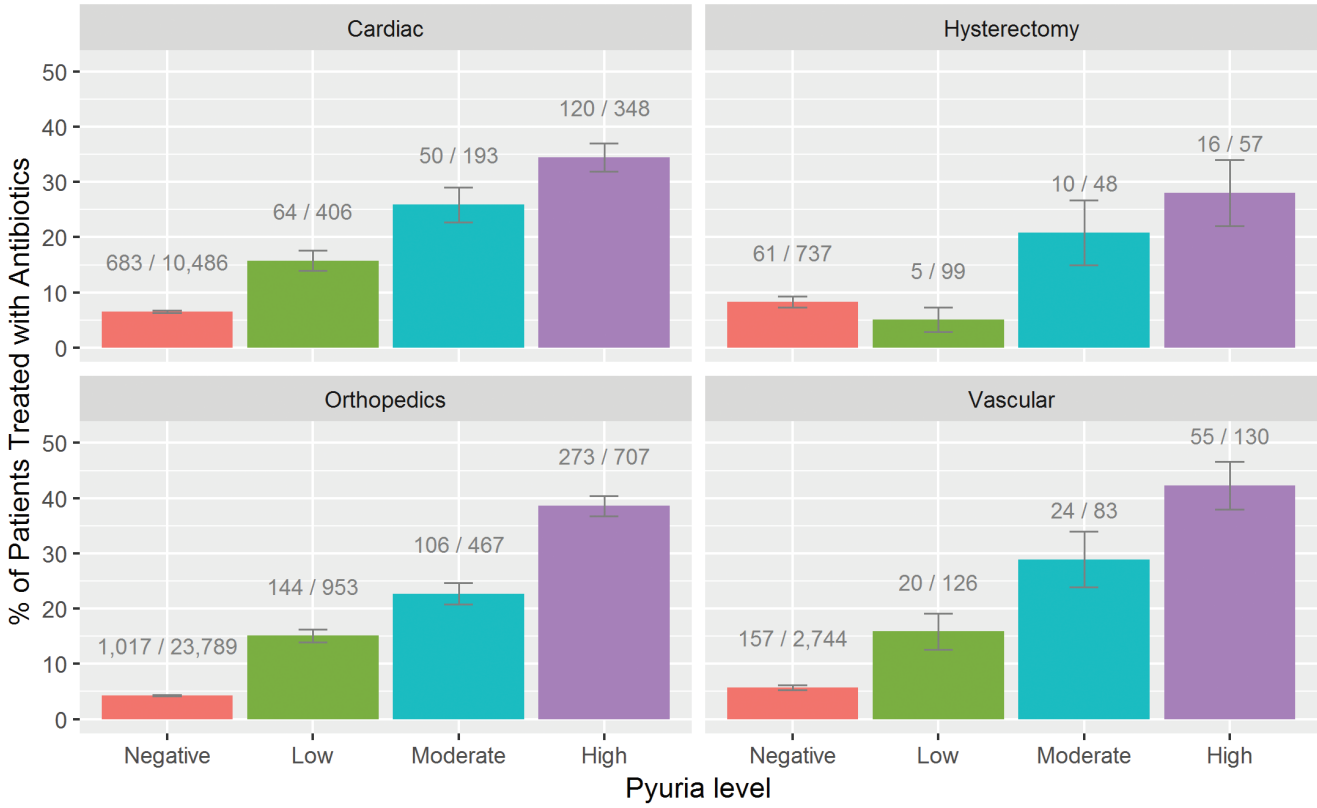


**Figure 2.** Association between degree of pyuria and probability of antimicrobial receipt in a national Veterans Affairs surgical cohort.

is more" and the importance of "choosing wisely," not just for medications but also for diagnostic testing, as highlighted in the Society for Healthcare Epidemiology recommendations [14, 15]. Our findings demonstrate the critical need for more focused efforts not only in the realm of antimicrobial stewardship once laboratory results are available but also in regard to diagnostic stewardship to prevent unnecessary testing before it happens [15–17]. Once a result is available—and not entirely negative—clinicians have a difficult time disregarding it, despite national campaigns promoting judicious use of testing and treatment [15].

In addition to identifying pyuria and low-quantity urine culture results as drivers of antimicrobial prescribing in a predictable fashion based on the degree of abnormal result, we also found that antimicrobial prescribing directed toward patients without symptoms and without confirmatory urine cultures did not improve clinical outcomes but did increase harm through unnecessary antimicrobial exposure. This evaluation of the association between pyuria and clinical outcomes, independent of urine culture results, is novel and expands upon our prior work, which found that treatment of asymptomatic bacteriuria during the preoperative period did not improve outcomes, including among patients with implantation procedures [12]. Patients who received treatment directed toward their pyuria were more likely to develop *C. difficile* infections than patients who did not, in keeping with studies that have found that every day of antimicrobial exposure in uninfected patients leads to unnecessary patient harm [18]. While risk of harm was increased with treatment directed toward the pyuria, we did not find any suggestion that other outcomes were improved with increased antimicrobial exposure. Surgical site infection and UTI risk were not impacted by antimicrobial therapy directed at pyuria. In line with other studies, this suggests that the presence of pyuria is a risk marker of comorbid illnesses but not an independent risk factor or driver of adverse outcomes. Because pyuria is a risk marker—and not an independent risk factor—and treatment of asymptomatic patients with pyuria and bacteriuria does not improve outcomes [12] there is no indication for either urine screening or treatment of asymptomatic patients in most clinical settings.

Although these data are from a surgical population, protocolized screening in asymptomatic patients is common in other areas of medicine. For example, UAs are a common test obtained in the emergency room as part of medical clearance prior to psychiatric admissions; a survey found that more than 50% of psychiatrists request urine screening prior to admission from the psychiatric ward, regardless of whether the patient had symptoms of UTI [1, 19, 20]. In this population, the rate of abnormal test results was low

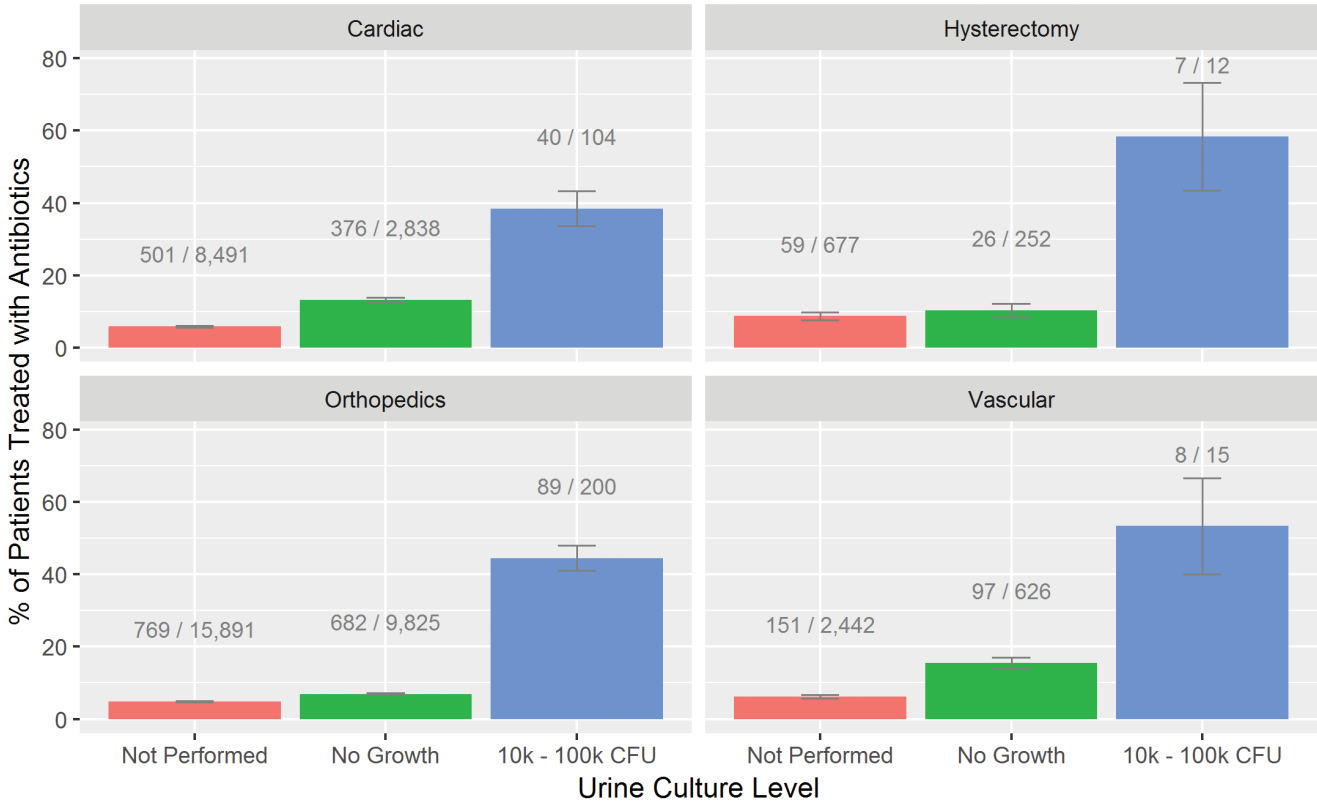


**Figure 3.** Association between level of urine culture result and probability of antimicrobial receipt in a national Veterans Affairs surgical cohort. Abbreviation: CFU, colony-forming units.

(3.2%), demonstrating the poor clinical yield of protocolized screening in asymptomatic patients and the need to limit unnecessary testing in patients who do not have UTI symptoms. Thus, although our findings are based on protocolized care in the surgical population, lessons about diagnostic stewardship and the treatment cascade that results from unnecessary testing are generalizable throughout the spectrum of clinical care.

**Table 2. Postoperative Outcomes Associated With Pyuria, Stratified by Surgical Specialty**

| | Pyuria,[a] aOR (95% CI) | Pyuria Adjusted for Antibiotic Initiation,[a] aOR (95% CI) | Antibiotic Initiation,[b] aOR (95% CI) |
|---|---|---|---|
| Cardiac surgery | | | |
| SSI | 1.23 (.72–2.11) | 1.22 (.70–2.12) | 1.05 (.58–1.88) |
| *C. difficile* | **1.76 (1.02–3.05)** | 1.40 (.79–2.48) | **2.56 (1.56–4.21)** |
| Orthopedic total joint replacements | | | |
| SSI | 0.95 (.62–1.45) | 0.87 (.56–1.34) | 1.46 (.95–2.24) |
| UTI | **1.50 (1.10 – 2.05)** | **1.50 (1.09–2.07)** | 1.00 (.65–1.54) |
| *C. difficile* | **2.33 (1.36–4.01)** | **1.93 (1.08–3.43)** | **2.09 (1.12–3.91)** |
| Vascular surgery | | | |
| SSI | 0.74 (.47–1.15) | 0.77 (.48–1.21) | 0.85 (.51–1.40) |
| UTI | **2.48 (1.38–4.45)** | **2.25 (1.22–4.16)** | 1.53 (.74–3.19) |
| *C. difficile* | **2.65 (1.24–5.65)** | **2.33 (1.04–5.26)** | 1.59 (.62–4.11) |
| Hysterectomy | | | |
| SSI | 0.83 (.31–2.24) | 0.80 (.30–2.17) | 1.57 (.53–4.70) |
| UTI | 1.77 (.71–4.43) | 1.80 (.72–4.52) | 0.83 (.19–3.65) |

The pyuria model did not include antimicrobial therapy as an adjustment variable. SSI and UTI models adjusted for age, diabetes, and smoking. *Clostridium difficile* models adjusted for pyuria and treatment only. *C. difficile* results were not available for the hysterectomy cohort because the model failed to converge. UTI outcome was not collected by the VA Surgical Quality Improvement Program for cardiac surgery, and this outcome is not available. Bold values in the table indicate statistically significant.

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; SSI, surgical site infection; UTI, urinary tract infection.

[a]The risk of the outcome associated with pyuria after adjustment for antimicrobial exposure.

[b]The risk of the outcome associated with antibiotic treatment after pyuria detection.

Other work has demonstrated the negative impact that overtesting of urine samples can play on antimicrobial use. Leis et al [4] evaluated the prevalence of symptoms within 24 hours of a urine culture order among an inpatient population and found that 68% of urine cultures were ordered without a clinical indication; among patients with no clinical indication for testing and a positive urine culture, 57% received antimicrobial treatment to treat the positive culture. In another study, increasing the colony count threshold from $10^4$ to $10^5$ to report a "positive" urine culture was associated with large reductions in antimicrobial use in asymptomatic patients [21]. These studies highlight the challenges in avoiding treatment in patients with abnormal test results and the importance of intervention early on in the treatment cascade to de-implement antimicrobial use that is directed toward laboratory results rather than clinical symptoms.

Prior work demonstrates no benefit to screening and treating asymptomatic bacteriuria during the preoperative period for nonurologic procedures [12]. This study expands upon this finding to demonstrate that identification of pyuria in asymptomatic patients does not improve clinical outcomes but does lead to increases in antimicrobial exposure and the potential for antimicrobial-associated harms, such as acute kidney injury, *C. difficile* infection, and future antimicrobial resistance [22]. These data strongly suggest that the practice of routine preoperative screening is a low-value intervention that increases costs without improving outcomes and thus should be specifically avoided.

Our data also highlight the principle that once an abnormality is identified, clinicians often act upon it, regardless of clinical evidence supporting no intervention. Asymptomatic bacteriuria guidelines clearly recommend against treatment of asymptomatic patients except in very limited circumstances, yet de-implementation of treatment for these patients remains challenging [8]; some studies suggest that half of patients with asymptomatic bacteriuria receive antimicrobial therapy [4]. Thus, the best strategy to avoid unnecessary antimicrobial exposure is diagnostic stewardship.

This study is limited by its retrospective nature and the predominantly male VA population; findings in other settings with a larger proportion of female patients may be different. In addition, some antimicrobial therapy could have been for other infections. Our manual chart review of a representative sample demonstrates that at least 75% of antibiotic use was not for another clear indication and only 3.5% of patients had systemic symptoms and a potential alternate diagnosis. The persistence of a dose–response relationship between pyuria and antimicrobial therapy in our sensitivity analysis excluding patients with respiratory infection diagnoses is also reassuring. These limitations are weighed against the strengths of the study, which include manually validated exposure and outcomes data and near-complete longitudinal follow-up of patients.

### Conclusions

In this large VA study, we found that identification of pyuria—even in the absence of a confirmatory urine culture—is a strong driver of antimicrobial prescribing and that the degree of the pyuria predicts the probability of receiving treatment. These findings underscore the need to avoid testing in asymptomatic patients to reduce unnecessary and excessive antimicrobial treatment in patients who will not benefit from the intervention. Once something is seen in clinical medicine, it cannot be unseen; thus, the best strategy is to not perform tests that do not have a clinical indication. This study highlights the importance of future research into diagnostic stewardship interventions to reduce inappropriate testing and potentially harmful treatment in asymptomatic patients. "Don't test and don't treat" asymptomatic patients [15].

## Notes

***Author contributions.*** All authors contributed significantly to the work presented.

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***Potential conflicts of interest.*** K. G. is a consultant for Paratek, Rebiotix, Tetraphase, Shionogi, Iterum, Ocean Spray, Nabriva, and First Light Diagnostics; an author for UpToDate; and a co-investigator on a research grant to the institution from Pfizer and has received deferred honoraria from Harrison's Textbook. W. B-E. is an expert witness for DLA Piper, LLC, on topics unrelated to urinary tract infections and pyuria. All other authors report no potential conflicts. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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