

# Best practice policy statement on urodynamic antibiotic prophylaxis in the non-index patient

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**Aims:** Antibiotic prophylaxis before urodynamic testing (UDS) is widely utilized to prevent urinary tract infection (UTI) with only limited guidance. The Society of Urodynamics, Female Pelvic Medicine, and Urogenital Reconstruction (SUFU) convened a Best Practice Policy Panel to formulate recommendations on the urodynamic antibiotic prophylaxis in the non-index patient.

**Methods:** Recommendations are based on a literature review and the Panel's expert opinion, with all recommendations graded using the Oxford grading system.

**Results:** All patients should be screened for symptoms of UTI and undergo dipstick urinalysis. If the clinician suspects a UTI, the UDS should be postponed until it has been treated. The first choice for prophylaxis is a single oral dose of trimethoprim-sulfamethoxazole before UDS, with alternative antibiotics chosen in case of allergy or intolerance. Individuals who do NOT require routine antibiotic prophylaxis include those without known relevant genitourinary anomalies, diabetics, those with prior genitourinary surgery, a history of recurrent UTI, post-menopausal women, recently hospitalized patients, patients with cardiac valvular disease, nutritional deficiencies or obesity. Identified risk factors that increase the potential for UTI following UDS and for which the panel recommends peri-procedure antibiotics include: known relevant neurogenic lower urinary tract dysfunction, elevated PVR, asymptomatic bacteriuria, immunosuppression, age over 70, and patients with any indwelling catheter, external urinary collection device, or performing intermittent catheterization. Patients with orthopedic implants have a separate risk stratification.

**Conclusions:** These recommendations can assist urodynamic providers in the appropriate use of antibiotics for UDS testing. Clinical judgment of the provider must always be considered.

## KEY WORDS

antibiotic prophylaxis, bacteriuria, infection, urodynamics, urodynamic complications, urologic interventions

## 1 | INTRODUCTION

Known risks of invasive urodynamic studies (UDS) include the development of a urinary tract infection (UTI) or bacteriuria. However, the use of prophylactic antibiotics before UDS is not without risks of adverse effects and emergence of resistant microbes. As noted in American Urological Association's Best Practice Policy (BPP) Statement on Urologic Surgery Antimicrobial Prophylaxis, prophylactic antibiotics are not routinely indicated prior to UDS for patients without UTI risk factors (also called "index" patients).<sup>1</sup> However, it is not uncommon for UDS to be performed on more complicated patients that fall outside of this definition. Furthermore, UDS testing is often performed on individuals with known or suspected abnormalities of the urinary tract. The Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction (SUFU) convened a Best Practice Policy Panel to formulate recommendations on the use of antimicrobial prophylaxis during urodynamic testing for the prevention of UTIs, with special attention given to patients that fall outside of the definition of an index patient.

The incidence of UTI after UDS is not well defined, as definition of a UTI varies considerably across studies. Bacteriuria, which is a positive urine culture without signs or symptoms of UTI, is frequently the outcome of such studies, but its clinical relevance is questionable.<sup>2</sup> Traditionally bacteriuria is defined as  $\geq 10^5$  uropathogens per mL of a voided mid-stream clean catch in the absence of any signs or symptoms of a UTI. Cystitis can be defined as  $\geq 10^3$  bacteria per mL of a mid-stream voided urine specimen with the presence of symptoms.<sup>2</sup> The Infectious Disease Society of America has issued clear guidelines and does not recommend treating asymptomatic bacteriuria unless a patient is undergoing an invasive surgical procedure.<sup>3</sup> Therefore, the occurrence of bacteriuria after UDS is not the clinical endpoint nor is it the clinical condition or outcome of this report. For example, it has been estimated that only 8% of women develop a symptomatic UTI within 1 week of a diagnosis of asymptomatic bacteriuria.<sup>4</sup> In this BPP statement, when the data were available, we attempted to discern between bacteriuria and true clinical UTI since this is the clinical outcome in question.

## 2 | MATERIALS AND METHODS

A MEDLINE search was performed using the MeSH index headings "antimicrobial prophylaxis," "urodynamic testing," "anti-bacterial agents," and the names of specific urodynamic procedures, from 1996 through 2014 for adult patients. This initial search was supplemented by scrutiny of bibliographies and additional focused searches. Publications were then selected for analysis by the Panel. These included guidelines and policies from other organizations, some of which were identified by the

Panel outside of the MEDLINE search. The Panel formulated recommendations based on review of all material and the Panel's expert opinions. Assessment of the literature suggested that insufficient information was available to derive a guideline statement on antimicrobial prophylaxis during UDS for all patient presentations based solely on literature meta-analyses. As such, the Panel was charged with developing a BPP Statement, which uses published data in concert with expert opinion, but does not employ formal meta-analysis of the literature. Levels of evidence were assigned based on the Oxford grading system and this grading used to guide final recommendations.<sup>5</sup> All recommendations were universally agreed on by the Panel members. A previously published decision analysis based on a review of the literature suggested that antibiotics can be considered beneficial only if the incidence of UTI after UDS without antibiotics was greater than 10%.<sup>6</sup> This panel concurred with this threshold and it was used to create the recommendations below. Recommendations are based on a review of the literature and the Panel's expert opinions. Justification and recommendations for antimicrobial prophylactic regimens for specific patient subgroups undergoing UDS are provided.

## 3 | RESULTS

### 3.1 | Recommendations concerning pre-procedure urine testing

#### 3.1.1 | Urinalysis should be performed on all patients prior to urodynamic study. Level of evidence: IV

Best practices recommend that all patients receive mid-stream urinalyses within 24 h of the UDS study. Dipstick urinalysis is the most widely used diagnostic tool for UTIs since it is readily available with rapid results and few equipment needs. There is no consensus definition for UTI based on urinalysis.<sup>7</sup> Leukocyte esterase is specific (94-98%) and reliably sensitive (75-96%) for detecting uropathogens equivalent to 100,000 colony-forming units per mL of urine, while nitrite positivity has sensitivity ranging from 35% to 85%, and 95% specificity.<sup>8,9</sup> The absence of four markers (blood, leukocyte esterase, nitrite, and protein) on the urine dipstick at the point of care had a 98% negative predictive value, with sensitivity of 98.3% and specificity of 19.2%.<sup>10</sup> Positive dipstick urinalysis of leukocyte esterase or nitrites each raise the high suspicion of the presence of bacteriuria or UTI. Hence, if the urinalysis is negative for both nitrites and leukocyte esterase the study should proceed and antibiotic prophylaxis only given if risk factors below are present.

Many patients, however, present on the day of procedure with a positive dipstick urinalysis. In these instances, it is important to assess the patient clinically for symptoms of a UTI. If the patient is indeed symptomatic then they should be treated

for their UTI and the procedure cancelled (see recommendation #2). It is however not a rare occurrence that a patient with lower urinary tract dysfunction has a positive dipstick in the absence of UTI symptoms; therefore, it is not considered a UTI by definition.<sup>2</sup> Given that the urine sample requires time in a laboratory to incubate, it would be unknown if the patient had bacteriuria or not at the time of the procedure. A urine microscopy could be performed to assess for the presence of bacteria, but this is not available in all clinical settings. Since the presence of bacteriuria is uncertain in this situation, the panel concludes that a urine with a positive urinalysis dipstick for nitrites or leucocyte esterase should be sent for culture and sensitivity for future reference. The UDS can be done with the patient receiving prophylactic antibiotics given the high likelihood that they have bacteriuria (See recommendation #12). A urine culture will confirm the presence or absence of bacteriuria and also provides guidance in antibiotic treatment, should the patient develop a UTI following the study.

### 3.2 | Patients with current urinary tract infection

#### 3.2.1 | In patients with a symptomatic UTI, urodynamics should be delayed until the patient completes treatment. Level of evidence: IV

There is no published data on the morbidity associated with performing a UDS during an active or symptomatic UTI, since this is an exclusion criterion in all studies. In a consecutive series of 1 246 women undergoing UDS, women with “detrusor instability” were more likely to have a UTI or significant bacteriuria than women with “genuine stress incontinence” at the time of the test.<sup>11</sup> Therefore, the presence of a UTI can also falsify cystometric findings and potentially aggravate the underlying infection; therefore, the panel recommends not performing UDS if the patient has an active UTI.

### 3.3 | Prophylactic antibiotic prescription timing, dose, route, and duration

#### 3.3.1 | Patients who require antibiotic prophylaxis should receive a single dose of antibiotics within an hour prior to urodynamics with oral trimethoprim/sulfamethoxazole as a first option. Acceptable alternatives include 1st/2nd generation cephalosporin, amoxicillin/clavulanate, or IV aminoglycoside ± ampicillin and fluoroquinolones. Level of evidence: III

The review did not find any well designed trials that compared different types of antibiotics, routes of administration or

timing of the antibiotic treatment in relation to the UDS. There were also no trials that compared different durations of antibiotic administration. One study whose population included those undergoing both UDS and cystoscopy showed no improvement in bacteriuria following the use of a 1-day prophylaxis course of nitrofurantoin.<sup>12</sup>

In reviewing the literature, the Panel found the dose, frequency, and timing of administration of the antibiotic chosen for prophylaxis differs widely, as such the available literature provides limited data for a standard approach.

The antimicrobial of choice (Table 1) is trimethoprim-sulfamethoxazole and alternative antimicrobials are 1st/2nd gen. cephalosporin, or amoxicillin/clavulanate, fluoroquinolones, and aminoglycoside ± ampicillin. The recommended duration of prophylaxis is less than 24 h, but given the nature of UDS being performed in the office setting, a single oral dose given within an hour before the procedure is sufficient and was the route chosen in nearly all reviewed studies. Fluoroquinolones are currently listed as first line prophylaxis in the current AUA Best Practice Policy<sup>1</sup> for antibiotic prophylaxis;

**TABLE 1** Antimicrobial agents and doses to be administered before UDS in a patient with risk factors

Antimicrobial agents	Doses for peri-procedure use (all are single doses)
First choice	Trimethoprim-sulfamethoxazole: 1 double-strength tablet PO
Acceptable alternatives	1st generation cephalosporin
	Cephalexin: 500 mg PO
	Cephadrine: 500 mg PO
	Cefadroxil: 500 mg PO
	Cefazolin: 2 g IV <sup>a</sup>
	2nd Generation Cephalosporin
	Cefaclor: 500 mg PO
	Cefprozil: 500 mg PO
	Cefuroxime: 500 mg PO
	Cefoxitin: 1–2 g IV <sup>a</sup>
Penicillin	
	Amoxicillin/clavulanate: 875 mg PO
Fluoroquinolones	
	Levofloxacin: 500 mg PO
	Ciprofloxacin: 500 mg PO
	Ofloxacin: 400 mg PO
Aminoglycosides ± Ampicillin 1-2 g IV <sup>a</sup>	
	Gentamicin: 5 mg/kg IV <sup>a</sup>
	Tobramycin: 5 mg/kg IV <sup>a</sup>
	Amikacin: 15 mg/kg IV <sup>a</sup>

Key: g, gram; IV, intravenous; kg, kilogram; mg, milligram; PO, orally (1).

<sup>a</sup>Intravenous therapy only if no oral alternative.

however, the Food and Drug administration has recently updated the warning on this class of antibiotics recommending against its use to treat uncomplicated UTIs due to the risk of disabling tendon, muscle, or neurological complications.<sup>13</sup> Hence, it is listed as an alternative in this BPP.

The choice of prophylactic antibiotic should, however, take into consideration patient allergies, prior urine cultures, local pathogen resistance patterns, cost of the antibiotic, and availability in the urodynamic suite.

### 3.4 | Patients with presumed normal genitourinary anatomy

#### 3.4.1 | Antibiotic prophylaxis is not recommended for urodynamic studies in patients with normal genitourinary anatomy without other risk factors. The presence of an abnormality discovered during UDS, identified as a relevant risk factor for UTI, warrants consideration for antibiotic prophylaxis to be given immediately after the study. Level of evidence: I

A systematic review in 2008 included eight randomized controlled trials (RCTs) with 995 patients, most of whom were women.<sup>14</sup> The prophylactic antibiotics differed in type, dose, and duration and were compared with either placebo or no treatment. The authors noted that most of the trials had poor methodology. Most trials excluded risk factors for UTI such as recurrent UTIs or the need for catheterization. They concluded that there was a 40% reduction in the risk of bacteriuria (OR 0.39; 95%CI 0.24 to 0.61) and that one would need to give prophylactic antibiotics to 13 patients in order to prevent one significant bacteriuria of unknown clinical significance. This review assessed only the occurrence of bacteriuria and not that of symptomatic UTI; therefore, the clinical significance is unknown. It has been estimated that only 8% of women develop a symptomatic UTI within 1 week of a diagnosis of asymptomatic bacteriuria.<sup>4</sup>

On the basis of the results of a decision-analysis model that incorporated reasonable estimates of benefits and adverse events from the published literature, Lowder et al concluded that prophylactic antibiotics after UDS is not beneficial unless the occurrence rate of UTIs after UDS without prophylaxis is higher than 10%.<sup>15</sup>

A 2012 Cochrane review included nine RCT's with 973 patients between the ages of 18 and 82 years of age of which 76% were female.<sup>16</sup> Antibiotics were given as a single dose in six trials and multiple doses in three trials. When compared to no treatment, patients receiving prophylactic antibiotics had fewer UTIs (40/201, 20%) than those receiving control or placebo interventions (59/214, 28%); however, there was no statistically significant difference (RR 0.73, 95% CI 0.52 to 1.03). In regards to

bacteriuria, the administration of prophylactic antibiotics when compared to a placebo reduced the risk of significant bacteriuria (4% with antibiotics vs 12% without, RR 0.35, 95% CI 0.22 to 0.56) in both men and women. The authors concluded prophylactic antibiotics did reduce the risk of bacteriuria after UDS, but there was not enough evidence to suggest that this effect reduced symptomatic UTIs. Based upon the available data and expert opinion, the Panel concludes that antimicrobial prophylaxis is not justified for the index patient with normal genitourinary anatomy and no associated risk factors outlined in this BPP (Table 2).

However, many patients presumed to have no risk factors are diagnosed with a urinary tract anomaly such as bladder outlet obstruction, vesicoureteric reflux (VUR), neurogenic lower urinary tract dysfunction (LUTD) or incomplete bladder emptying at the time of UDS. Unfortunately, no data exists on the benefit of administering antibiotics in these instances. Hence the panel agrees that patients newly diagnosed with a functional or anatomical anomaly of the urinary tract that places them in one of the categories below (Table 2) where antibiotics are recommended should receive antibiotics at the time of diagnosis immediately following the study.

Recommendations for special population subgroups:

### 3.5 | Patients with neurogenic lower urinary tract dysfunction

#### 3.5.1 | Antibiotic prophylaxis is recommended for urodynamic studies in patients with relevant neurogenic lower urinary tract dysfunction. Level of evidence: IV

Nearly all of the literature involving neurogenic lower urinary tract dysfunction (LUTD), also referred to as neurogenic bladder, and UTI post UDS have involved spinal cord injury patients. It is widely accepted that spinal cord injury (SCI) patients with a neurogenic LUTD have an increased risk for UTI, due to various risk factors such as elevated intravesical storage pressure, incomplete voiding, asymptomatic bacteriuria, and use of catheterization. Bacteriuria is very common in this population, occurring at a rate of 2.72/100 person days in a daily cultured study population.<sup>17</sup> Eventually almost all of spinal cord-injured patients will become bacteriuric, particularly those with indwelling catheters, with rates of 98% after 38 months.<sup>17</sup> Reports regarding SCI patients without prophylactic antibiotics document a post-UDS UTI rate of 9.7% to 15.8%.<sup>18,19</sup> In a descriptive-observational study of 133 SCI patients undergoing UDS without antibiotic prophylaxis, Bothig et al showed a difference in UTI rates based upon bladder management method. SCI patients with triggered reflex voiding revealed a high post-UDS UTI rate of 14.28% compared to intermittent catheterization patients at 7.59%.<sup>19</sup>

**TABLE 2** Risk factors and recommendations for antibiotics before urodynamic studies

Recommendation number	Risk factor	Antibiotics	Level of evidence
1	Recommendations concerning pre-procedure urine testing <i>Urinalysis should be performed on all patients prior to urodynamic study</i>	All patients need UA. If positive and no UTI, need prophylaxis.	IV
2	Patients with current urinary tract infection <i>In patients with a symptomatic UTI UDS should be delayed until the patient completes treatment</i>	Cancel UDS until UTI treated	IV
4	Patients with presumed normal genitourinary anatomy <i>Antibiotic prophylaxis is not recommended for urodynamic studies in patients with normal genitourinary anatomy without other risk factors. The presence of an abnormality discovered during UDS, identified as a relevant risk factor for UTI, warrants consideration for antibiotic prophylaxis to be given immediately after the study.</i>	No	I
5	Patients with relevant neurogenic lower urinary tract dysfunction <i>Antibiotic prophylaxis is recommended for urodynamic studies in patients with neurogenic lower urinary tract dysfunction.</i>	Yes	IV
6	Patients with bladder outlet obstruction and/or elevated post void residual <i>Antibiotic prophylaxis is recommended for urodynamic studies in patients with clinically important elevated PVR, regardless of the cause.</i>	Yes	IV
7	Advanced age (older than 70 years) <i>Antibiotic prophylaxis is recommended for urodynamic studies in patients older than 70 years.</i>	Yes	II
8	Diabetes mellitus <i>Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of diabetes.</i>	No	IV
9	Recent prolonged hospitalization <i>Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of a recent prolonged hospitalization in the absence of other risk factors.</i>	No	IV
10	Diet and nutrition <i>Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of dietary or nutritional deficiencies, including obesity.</i>	No	IV
11	Menopausal status <i>Antibiotic prophylaxis is not recommended for urodynamic studies based on menopausal status.</i>	No	II
12	Asymptomatic bacteriuria <i>Antibiotic prophylaxis is recommended for urodynamic studies in patients with asymptomatic bacteriuria.</i>	Yes	IV
13	History of Recurrent urinary tract infections <i>Antibiotic prophylaxis is not recommended for urodynamic studies in patients with a history of recurrent urinary tract infections.</i>	No	IV
14	Gender <i>Antibiotic prophylaxis is not recommended for urodynamic studies based on gender.</i>	No	IV
15	Immunosuppression, corticosteroids and inherent immune deficiency <i>Antibiotic prophylaxis is recommended for urodynamic studies in patients with immunosuppression from immunosuppressants, chronic steroids or innate immunosuppression, particularly those who have had renal transplant.</i>	Yes	IV
16	Patients with chronic catheters <i>Antibiotic prophylaxis is recommended for urodynamic studies in patients with indwelling urinary catheters, either urethral or suprapubic, external condom catheters or those performing CIC.</i>	Yes	IV
17	Prior urologic surgery <i>Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of a history of prior urologic surgery.</i>	No	IV
18	Cardiac valvular disease <i>Antibiotic prophylaxis should not routinely be administered for urodynamic studies in the presence of cardiac valvular disease.</i>	No	III
19	Orthopedic implant <i>Antibiotic prophylaxis is recommended for patients undergoing UDS who have had total joint implant that are at increased risk of developing joint infection from bacteremia or have an increased risk of actually developing bacteremia (list in).</i>	Yes	III

There is only one small (40 patient) RCT trial that evaluated antibiotic prophylaxis in spinal cord injury patients.<sup>20</sup> Darouiche et al used oral 500 mg ciprofloxacin for 3 days and demonstrated an advantage of prophylactic antibiotic treatment in preventing post-procedure UTI (0.0% UTI in treatment group vs 13.6% placebo group). Unfortunately, the sample size was too small to reach statistical significance.

In another study of spinal cord injury patients who all had confirmed sterile urine prior to the study, 9.7% developed UTI after UDS, indicating that this population is at high risk of UTI following UDS even in the absence of bacteriuria.<sup>18</sup>

Neurogenic LUTD is present in many neurological conditions, and is often diagnosed with UDS. Hence, it is often unknown before the UDS testing if the patient indeed does carry this diagnosis. There is no literature available to give recommendations on antibiotic prophylaxis in this situation nor is there literature specifically including less severe forms of neurogenic LUTD where voiding is still possible. The Panel, therefore, agrees that in patients with relevant neurological conditions with a high suspicion of neurogenic LUTD (multiple sclerosis, spina bifida, stroke, cauda equina, transverse myelitis, and many other less common neurological diseases) that antibiotic prophylaxis should be administered prior to UDS as the benefits outweigh the risk.

Given the high rate of bacteriuria in the neurogenic LUTD population and the high rate of UTI after UDS even with sterile urine, based upon the available data and expert opinion, the Panel concludes that all patients with neurogenic LUTD or suspected neurogenic LUTD (based on the presence of relevant neurological conditions) should receive prophylactic antibiotics prior to UDS.

### **3.6 | Patients with bladder outlet obstruction and/or elevated post void residual**

#### **3.6.1 | Antibiotic prophylaxis is recommended for urodynamic studies in patients with clinically important elevated post void residual regardless of the cause. Level of evidence: IV**

Several studies of patients undergoing pressure-flow studies did not identify any statistically significant correlation between significant bacteriuria and bladder outlet obstruction or post void residual.<sup>21,22,23</sup> In patients with benign prostatic hyperplasia, antibiotic administration prior to UDS has; however, been shown to decrease the rates of UTI, most markedly in patients with diabetes mellitus or with a residual urine volume of more than 50 mL.<sup>24</sup> In a cohort of patients of both genders undergoing UDS, bacteriuria after the study correlated with a post void residual more than 100 mL.<sup>25</sup>

Considering there is very limited evidence combined with the Panel's universal consensus on the need for antibiotics in this clinical scenario, the Panel concludes that patients with elevated post void residual would benefit from antibiotics prior to UDS.

### **3.7 | Advanced age (older than 70 years)**

#### **3.7.1 | Antibiotic prophylaxis is recommended for urodynamic studies in patients older than 70 years. Level of evidence: II**

There is no RCT trial that specifically evaluated the need for antibiotic prophylaxis for UDS in elderly patients. Observational studies have shown that advancing age is a predictive factor for UTI.<sup>26,27</sup> These findings could be accounted for by several age related changes including detrusor underactivity with incomplete bladder emptying, decline in cell-mediated immunity and higher risk of catheter associated bacteriuria.<sup>27,28</sup> The prevalence of bacteriuria in the elderly increases with age and population surveys have demonstrated 21-22% of men and 23-50% of women older than 80 years have bacteriuria.<sup>29</sup> In addition, with the onset of chronic debilitating illness and institutionalization, the rate of UTI increases in both sexes with frequencies between 25% and 50% reported.<sup>27,28</sup> Numerical age, unfortunately, is likely not the best predictor of risk of UTI and frailty is probably a better indicator. However, there exists no literature assessing frailty in the UDS population hence age was used as a surrogate. Advanced age appears to be an important factor in predicting UTI after UDS, therefore, the panel recommends antibiotic prophylaxis for all UDS in patients over the age of 70 years.<sup>1</sup>

### **3.8 | Diabetes mellitus**

#### **3.8.1 | Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of diabetes mellitus. Level of evidence: IV**

An increased incidence of bacteriuria and symptomatic UTIs appears to occur in women with diabetes mellitus, but there are no RCT trials that evaluated antibiotic prophylaxis and the risk of post-UDS UTI in diabetic patients. In a sub-set of their 225 patient series without antibiotic prophylaxis, Choe et al reported on 13 diabetic women with urodynamic stress urinary incontinence and noted no difference in post procedure bacteriuria rates (5.9% without diabetes vs 7.1% with diabetes).<sup>30</sup> Based upon the limited evidence and expert opinion, the Panel concludes that diabetes in the absence of other risk factors such as elevated residual urine where there is an increased risk of UTI after UDS with diabetes discussed in this document does not warrant antibiotic prophylaxis for UDS.<sup>24</sup>

### 3.9 | Recent prolonged hospitalization

#### 3.9.1 | Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of a recent prolonged hospitalization in the absence of other risk factors. Level of evidence: IV

There was no literature that addressed the benefits of antibiotic prophylaxis for UDS in patients who have been recently hospitalized for a prolonged time. Nor could any literature be found that alluded to the infection risk in this population. Though such patients may be colonized with resistant bacteria, the panel concluded that in the absence of any of the risk factors mentioned in this recommendation, there is not sufficient evidence to recommend antibiotic prophylaxis solely due to a recent hospitalization.

### 3.10 | Diet and nutrition

#### 3.10.1 | Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of dietary or nutritional deficiencies or obesity. Level of evidence: IV

Optimal nutrition status is accepted as having a positive impact on health and well-being; conversely, poor diet and malnutrition can have a negative impact. These factors have not been specifically looked at in any study regarding infectious complication after UDS. Poor nutritional status; however, may be a surrogate for poor health from other comorbid conditions. Given the lack of UDS specific data, the clinician should use judgment about a patient's nutrition status as it relates to overall health in consideration of antibiotics use.

There is limited data regarding the impact of obesity on risk of bacteriuria and UTI after UDS.<sup>6</sup> Patients with Body Mass Index  $>30$  kg/m<sup>2</sup> were noted in a multivariate analysis of a single prospective cohort study to be only slightly at higher risk for bacteriuria and UTI compared to other patients (OR 1.10; 95% CI 1.01-1.20,  $P = 0.025$ ) as well as UTI after UDS (OR 1.16; 95% CI 1.01-1.32;  $P = 0.02$ ).<sup>31</sup> The panel concluded that in the absence of any of the risk factors mentioned in this recommendation, there is not sufficient evidence to recommend antibiotic prophylaxis solely due obesity or poor nutritional status.

### 3.11 | Menopausal status

#### 3.11.1 | Antibiotic prophylaxis is not recommended for urodynamic studies based on menopausal status. Level of evidence: II

One RCT of 262 postmenopausal females compared the incidence of UTI after UDS with either a placebo or a single

400 mg dose of norfloxacin antibiotic prophylaxis.<sup>32</sup> There were no significant differences in the rate of UTI with 18.4% women developing a UTI in the antibiotic arm, compared to 22.7% in placebo. In non-randomized trials, Tsai et al and Bombieri et al noted that menopausal status was not associated with bacteriuria and hormone replacement therapy was not protective for bacteria or UTI after UDS.<sup>27,33</sup> Based upon the limited evidence and expert opinion, the Panel concludes that post-menopausal status is not an independent risk factor to warrant antibiotic prophylaxis for UDS.

### 3.12 | Asymptomatic Bacteriuria

#### 3.12.1 | Antibiotic prophylaxis is recommended for urodynamic studies in patients with asymptomatic bacteriuria. Level of evidence: IV

No studies have addressed the specific question of the risk of performing UDS on patients with bacteriuria. In most studies that included such patients, the testing physician was unaware of the bacteriuria until culture results were obtained several days later. Two studies have reported their rates of UTI after UDS in those patients with and without bacteriuria. Asymptomatic bacteriuria was found in 12 out of 88 samples from women prior to UDS. These women were randomized to cotrimoxazole or placebo. This study did not show any benefit of antibiotic treatment in the overall group, but was not powered to focus on asymptomatic bacteriuria.<sup>34</sup>

In a group of 55 patients, both men and women, two patients were found to have a positive culture from urine taken at the time of UDS. Both of these patients developed bacteremia after the study along with four other patients with negative urine culture at the time of UDS.<sup>35</sup> In another study, out of 123 male patients, thirteen (11%) had significant bacteriuria at the time of UDS. Three of them had transient bacteriuria not present after UDS, while the remainder received antibiotics after the procedure. The overall risk of infection after the study was 4.2%.<sup>23</sup> In a population of spinal cord injured patients, those individuals with unsuspected significant bacteriuria prior to UDS were significantly more likely to develop UTI (32.5%) than the group of patients with sterile urine prior UDS (8.6%).<sup>18,19</sup> There is also concern that bacteriuria may alter the results of the study. In a small series, 8 of 15 patients with significant bacteriuria at the time of cystometry had "detrusor instability."<sup>36</sup> The incidence decreased by 50% after treatment. Thus, given the risk of UTI and the more serious bacteremia, the Panel concludes that a single dose antibiotic prophylaxis is warranted in patients with asymptomatic bacteriuria.

### 3.13 | History of Recurrent urinary tract infections

#### 3.13.1 | Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of a history of recurrent urinary tract infections. Level of evidence: IV

Patients are usually considered to have recurrent UTIs if they have three or more UTIs in a 12-month period.<sup>37</sup> Others will consider a patient with two or more infections in a 6-month period as having recurrent UTIs.<sup>38</sup>

Many studies on UTI after UDS have regrettably excluded patients with recurrent UTIs.<sup>32</sup> There are no RCT trials that evaluated antibiotic prophylaxis for UDS in patients with recurrent UTIs. Three studies have noted that having had a UTI before UDS is a predictor for UTI after investigation, even with confirmation of normal analysis of mid-stream urine. However, this does not meet the definition of recurrent UTI.<sup>26,33,39</sup> Yip et al studied 822 incontinent women with UDS without antibiotic prophylaxis and noted a UTI before UDS was an independent risk factor for post procedure UTI (odds ratio, 3.13; 95% CI, 1.43-6.83).<sup>39</sup> Tsai et al followed 261 female patients and noted a history of UTI was associated with increased risk of UTI after examination with an odds ratio of 5.49 (95% CI = 1.74-17.29,  $P = 0.004$ ).<sup>33</sup> In a study aiming to identify high-risk subjects that would benefit from antibiotic prophylaxis, only 7% of the 232 women studied had a history of recurrent UTIs. The rates of bacteriuria were similar among women with and without recurrent UTIs (7.8% vs 7.4%,  $P = 0.942$ ) and there were no cases of symptomatic UTI in the recurrent UTI group. Given the small number of events and small number of recurrent UTI patients (only 18), conclusions in the recurrent UTI population may be somewhat limited. In a group of 225 women with SUI and negative urine cultures pre-UDS, 6.2% developed bacteriuria and none received antibiotic prophylaxis.<sup>30</sup> On multivariate logistic regression of multiple risk factors, a past history of recurrent UTI was the only significant independent risk factor for bacteriuria (OR = 28.5, 95% CI = 4.309-188.488,  $P = 0.009$ ). Thus given the very limited and conflicting data the panel could not find sufficient evidence to warrant antibiotics in this population. Many patients with recurrent UTIs are very concerned about instrumentation causing a UTI and it is always a joint decision between patient and provider on the benefits in this situation. However, if a patient currently has a symptomatic UTI, the procedure should be cancelled and if the patient has any of the other risk factors, they should receive prophylaxis.

### 3.14 | Gender

#### 3.14.1 | Antibiotic prophylaxis is not recommended for urodynamic studies based on gender. Level of evidence: IV

There is no RCT trial evaluating antibiotic prophylaxis and the risk of UTI post-UDS comparing the different genders. In a small series, Klinger et al noted a slightly higher post-UDS UTI rate of 6.2% in men with prostatic obstruction compared to 1.8% in women using oral antibiotic prophylaxis.<sup>22</sup> Payne et al studied 66 women and 22 men after standard UDS and noted the frequencies of bacteriuria after UDS were much higher in men (36%) compared with the women studied (15%), but the rate of symptomatic UTI was not reported.<sup>40</sup> Based upon the limited evidence and expert opinion, the Panel concludes that gender alone is not a risk factor to warrant prophylactic antibiotics.

### 3.15 | Immunosuppression, corticosteroids, and inherent immune deficiency

#### 3.15.1 | Antibiotic prophylaxis is recommended for urodynamic studies in patients with immunosuppression from immunosuppressants, chronic steroids, or innate immunosuppression, particularly those who have had renal transplant. Level of evidence: IV

There is no published data on the risk of UTI after UDS in patients on chronic immunosuppression. The majority of patients on immunosuppression who require UDS are patients post renal transplantation. Patients who have had a renal transplant overall are at high risk of UTI compared to the general population.<sup>41,42</sup> Also, since many of these patients have VUR into their transplant, they are at increased risk of pyelonephritis with over 20% of UTIs in this population being febrile pyelonephritis.<sup>43</sup> There are no reported series on the risk of UTI after UDS in patients on chronic corticosteroids or other immune deficiencies. Patients on chronic corticosteroids are at slightly elevated risk of UTI compared to the general population.<sup>44,45</sup> Similarly, men with HIV have a higher risk of UTI and the severity of an infection is greater in the presence of immunosuppression.<sup>46</sup> Therefore, given the risk of a potentially more severe infection, the Panel concludes that antibiotic prophylaxis is recommended routinely prior to UDS to prevent UTI in immunosuppressed patients due to immunosuppressants, chronic corticosteroids, or innate/acquired immunosuppression.



### 3.16 | Patient with Chronic Catheters

#### 3.16.1 | Antibiotic prophylaxis is recommended for urodynamic studies in patients with indwelling urinary catheters either urethral or suprapubic, external condom catheters or those performing CIC. Level of evidence IV

All patients with neurogenic LUTD are at high risk of UTI after UDS regardless of bladder management method.<sup>17</sup> In the small amount of published data, there was little to no difference in the UTI rate after UDS between those patients who reflexively void and those who perform CIC or have catheterization by a caregiver.<sup>18,19</sup> Patients with indwelling catheters were excluded from all studies due to their high risk of UTI.

Since no bladder management method in this population is protective from UTI after UDS, patients with permanent catheter regardless of the specific bladder management method require antibiotic prophylaxis. A pre-procedure urine culture in this population would be of great value since the rate of colonization is very high and would allow for culture directed prophylaxis.

### 3.17 | Prior urologic surgery

#### 3.17.1 | Antibiotic prophylaxis is not recommended for urodynamic studies in the presence of a history of prior urologic surgery. Level of evidence: IV

There is conflicting data regarding the risk of UTI in patients who have had prior urologic surgery (examples: strictures, ureteroscopy for stones, continence surgery).<sup>30,47</sup> None of the studies evaluated symptomatic UTI, rather solely the development of bacteriuria in patients with previously sterile urine. Combining two studies addressing this issue, the absolute risk of bacteriuria after UDS in patients who have had prior surgery is 17.1% (12/70) and 0.7% (4/566) in those who have not. However, bacteriuria is not a pathological condition requiring treatment. Therefore, the panel concludes that in patients with prior urologic surgery in the absence of other risk factors, antibiotic prophylaxis is not typically needed prior to UDS since it only prevents bacteriuria.

### 3.18 | Cardiac valvular disease

#### 3.18.1 | Antibiotic prophylaxis should not routinely be administered for urodynamic studies in the presence of cardiac valvular disease. Level of evidence III

Regarding patients with cardiac valvular disease, the American Heart Association (AHA) does not recommend the administration of antibiotic prophylaxis for GU procedures solely to prevent endocarditis.<sup>48</sup> The AHA panel indicated that their

recommendations were intended to serve as a guideline, not as an established standard of care. For patients with active UTI or colonization, antibiotic therapy to eradicate enterococci from the urine before the procedure may be reasonable.

### 3.19 | Orthopedic implant

#### 3.19.1 | Antibiotic prophylaxis is recommended for patients undergoing UDS who have had total joint implant that are at increased risk of developing joint infection from bacteremia or have an increased risk of actually developing bacteremia (list in Table 3). Level of Evidence III

There are limited studies looking directly at the risk of infection from UDS on patients with an orthopedic implant. This issue of past prophylaxis should be discussed with patients undergoing UDS and deferral should be to their implanting surgeon's preference prior to any genitourinary (GU) manipulation.<sup>1</sup> The American Academy of Orthopedic Surgery has issued their own guidelines and deference to the orthopedic surgeon seems prudent.

In general, for orthopedic patients, antibiotic prophylaxis is not indicated for urologic procedures on the basis of pins, plates, and screws.<sup>49</sup> In patients who have undergone total joint implants, bacteremia can theoretically cause hematogenous seeding of the implant.<sup>50</sup> The presence of bacteriuria dramatically increases the risk of developing bacteremia. The greatest risk and most critical period are in the first two years after joint replacement, based on one study determining that the risk of joint infection between the first 2 years and three to 10 years was 5.9 versus 2.3, respectively, per 1000 joint-years.<sup>51</sup> Although bacteremia can develop with certain urologic procedures, there is little direct evidence to support an increased incidence of artificial joint infections in most patients undergoing genitourinary procedures. Therefore, antibiotic prophylaxis for patients with artificial joint replacements undergoing genitourinary procedures is only recommended for patients who specifically are at an increased risk for bacteremia (Table 3). It should be emphasized that the routine use of antibiotic prophylaxis in all patients with joint replacements remains controversial.<sup>49</sup>

It should also be noted that some previous randomized controlled studies have not demonstrated a reduction in infections rates with antibiotic use associated with UDS.<sup>12,34</sup> Thus, justification for the use of antibiotic prophylaxis in general should be limited to patients with risk factors (Table 3). In addition, as detailed earlier, antibiotic prophylaxis should be administered to patients undergoing UDS with recent orthopedic implant if this recommendation has been made in the past for other procedures or if their surgeon implanter recommends it.<sup>1</sup> Future studies looking at specific patient populations with implanted hardware will better allow

**TABLE 3** Patients with prosthetic joints are at increased risk of bacteremia associated with urologic procedures

Increased Risk of Joint Infection or Bacteremia:	
Inflammatory Arthropathies	Example: rheumatoid arthritis, systemic lupus erythematosus
Drug-Induced Immunosuppression	
Radiation-Induced Immunosuppression	
Patients with Co-Morbidities:	
Previous prosthetic joint infections	
Orthopedic joint implant surgery less than 2 years ago	
Malnourishment	
Hemophilia	
HIV infection	
Diabetes	
Malignancy	
Patient-Related Factors Affecting Host Response to Surgical Infections:	
Advanced age	
Anatomic anomalies of the urinary tract	
Poor nutritional status	
Smoking	
Chronic corticosteroid use	
Immunodeficiency	
Externalized catheters	
Colonized endogenous/exogenous material	
Distant coexistent infection	
Prolonged hospitalization	

determination of who should receive antibiotic coverage prior to UDS. Until such information is available, however, it appears that safety should be the paramount objective and antibiotic coverage should be considered prior to UDS. While risks of antibiotics, such as rash and colitis, do exist, these are generally less significant than an infection of a periprosthetic joint.

## 4 | CONCLUSION

UTIs are the most common post-procedure risks for patients undergoing UDS. For patients without risk factors as outlined in this BPP, antibiotic prophylaxis is not recommended given the potential morbidity of antibiotic administration. However, for the subgroup populations identified in this review as being at increased risk for UTI after UDS, antimicrobial prophylaxis is an important preventative measure to reduce post-procedural UTIs.

The decision to use antimicrobial prophylaxis in UDS, and the selection of agent and dosing, can start with guidelines presented in this document. The appropriate use of antimicrobial

prophylaxis in an individual patient requires consideration of not only these guidelines, but a comprehensive evaluation of the patient's specific circumstances and the provider's clinical judgment. Finally, the Panel encourages additional well-conducted clinical studies to augment the data on infection risk associated with UDS in the non-index patient population.

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## APPENDIX

### Need for Peri-Procedure Antibiotics for Urodynamics

Yes	No
Neurogenic lower urinary tract dysfunction	Male or female patients without genitourinary anomalies
Elevated post void residual	Diabetes
Asymptomatic bacteriuria	Prior genitourinary surgery
Immunosuppression	Recently hospitalized patients
External urine collection device (condom catheter)	History of recurrent UTI (not current)
Any form of indwelling catheter	Post-menopausal women
Intermittent or catheterization	Nutritional deficiencies/obesity
Age over 70	Cardiac valvular disease
Total joint w risk factor or <2 y	Pins, plates, or screws