

CONCISE COMMUNICATION

Resident Physician Knowledge of Urine Testing and Treatment Over Four Years

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We surveyed resident physicians at 2 academic medical centers regarding urinary testing and treatment as they progressed through training. Demographics and self-reported confidence were compared to overall knowledge using clinical vignette-based questions. Overall knowledge was 40% in 2011 and increased to 48%, 55%, and 63% in subsequent years ($P < .001$).

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Infectious Diseases Society of America (IDSA) guidelines recommend against treating asymptomatic bacteriuria (ABU), except during pregnancy and before urologic surgery expected to cause mucosal bleeding.¹ Despite this, ABU is commonly treated, which contributes to increased medication costs,² *Clostridium difficile* infection,³ and multidrug-resistant organisms.⁴

Prescriber characteristics are associated with overtreatment of ABU, potentially allowing targeting of interventions to improve management. In one study, patients admitted to internal and family medicine services received unnecessary antimicrobials more often than those admitted to surgery or obstetrics/gynecology services.⁴ Prescriber-level barriers to appropriate ABU management include inappropriate urine testing, poor knowledge of guidelines, and fear of causing harm.⁵ We hypothesized that progression through residency, clinical experience, or educational interventions would improve resident's knowledge regarding urinary testing and treatment.

METHODS

Participants

Participants were recruited from Jackson Memorial Hospital/University of Miami Miller School of Medicine and the University of Minnesota Medical School. Each first-year resident physician in internal medicine or medicine-pediatrics ($n = 63$) as of July 1, 2011, received an e-mail invitation to participate. Surveys were sent to the same resident physicians in the summers of 2012, 2013, and 2014. Institutional review boards at both institutions approved the study.

Survey Instrument

A 19-question Internet-based survey was developed as published previously⁶ and used annually (supplemental material).

Briefly, respondents reported demographics (age, sex, residency-type, and training site), ABU-related education (ie, awareness/reading of IDSA ABU guidelines, or participation in an infectious disease rotation during the prior 12 months), and clinical experience (how many patients with UTI the resident physician had personally managed in the prior 3 months).

Respondents answered 10 multiple-choice questions based on scenarios commonly encountered by resident physicians in internal medicine and medicine-pediatrics programs. Overall, 6 vignettes described nonsurgical scenarios and 4 described surgical scenarios. Furthermore, 6 board-certified infectious disease physicians pilot tested the vignettes and questions. For one question, 3 physicians indicated that either of 2 answers could be considered correct, whereas the other 3 chose 1 of those same 2 answers. For another question, 2 reviewers disagreed with the other 4 reviewers as to the correct answer; consequently, this question was excluded from analysis. Thus, 9 questions remained, of which 8 had a single correct answer and 1 had 2 correct answers. Overall knowledge was defined as the percentage correct among the 9 validated vignette-based questions. Correct answers were not provided after survey completion.

Finally, respondents assessed their ability to differentiate ABU from UTI, to determine whether a urine culture requires treatment, and to use antimicrobials in general. Knowledge self-assessment was measured using a 5-point Likert scale: 5 = very confident, 4 = confident, 3 = neutral, 2 = not confident, and 1 = not confident at all. Because few respondents reported being "very confident" or "not confident at all," these responses were combined with "confident" and "not confident," respectively.

Statistical Methods

Demographics, education, experience, and self-assessed knowledge were assessed for associations with knowledge on overall, surgical, and nonsurgical questions. Between-group comparisons of overall knowledge were performed using the Student t test, 1-way analysis of variance (ANOVA), and the χ^2 test for linear trends, as appropriate. Parametric tests were used after verifying that the data were normally distributed. Results of nonparametric tests, conducted in parallel, were similar and are not reported. Because of the anonymous nature of the survey, the annual surveys could not be linked to individuals, and their results were treated as if they were independent results. A Bonferroni correction was used to adjust ANOVA results for multiple between-group comparisons. Analyses were performed using SPSS (IBM, Armonk, NY) or R (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Results from 2011 were published previously⁶; here we present results from the entire study period. Of 296 surveys, 125 (42.2%)

were returned (33 annually, except 26 in 2012). Male and female respondents were balanced, with a median age of 28 years. More respondents categorized themselves as internal medicine residents than medicine-pediatric residents. Over time, a greater percentage of respondents were from the University of Minnesota.

Knowledge was low overall, especially for nonsurgical vignettes. However, there was a significant increase over the 4-year study period, which is reflected in the mean percentage of correct answers by year, both overall (40%, 48%, 55%, and 63%; $P < .001$) and separately for surgical (56%, 64%, 71%, 74%; $P = .049$) and nonsurgical vignettes (28%, 37%, 46%, 53%; $P = .001$).

Educational and clinical experiences are described in Table 1. Respondent self-knowledge is detailed in Table 2. Increasing confidence with training was documented in all domains but was only significant for "ability to correctly use antimicrobials,"

TABLE 1. Respondent Reported Education and Clinical Experience, Assessed 2011 Through 2014

Education or experience category, % responding affirmatively	Year surveyed (No. of Respondents)			
	2011 (n = 33)	2012 (n = 26)	2013 (n = 33)	2014 (n = 33)
Know of IDSA guidelines regarding ABU	39	38	73	73
Read some of IDSA ABU guidelines	12	15	18	24
Read all IDSA ABU guidelines	3	4	9	15
Infectious diseases rotation ^a	12	12	36	39
No. of patients with UTI managed in prior 3 mo				
0	3	0	9	3
1	30	35	56	21
2	45	31	15	42
3	12	15	12	18

NOTE. IDSA, Infectious Diseases Society of America; ABU, asymptomatic bacteriuria; UTI, urinary tract infection.

^aAt least 2 weeks on infectious diseases service in the last 12 months.

for which the percentage of respondents reporting being confident or very confident rose from 9% to 58%.

Univariate and multivariate analyses were conducted to identify predictor variables (ie, demographics, experience, and self-assessed knowledge) associated with knowledge overall and separately in nonsurgical and surgical cases. Although there were sporadic weak associations, none were significant in more than a single year's survey (data not shown).

DISCUSSION

Overall knowledge of urine testing and treatment increased during residency but remained suboptimal (63% at the end of training). This finding suggests that education and experience have some effect on resident knowledge; however, current training is insufficient to effectively teach management of urinary testing and treatment. None of the assessed variables had a consistent association with knowledge, which makes targeting future interventions difficult.

Several aspects of our study limit the generalizability of our findings. First, our response rate of 42% is low but consistent with other resident surveys.^{6,7} Second, responses from different years were deidentified prior to analysis and could not be individually linked over time; they were analyzed as if each survey was independent from those of prior and subsequent years. Third, our survey could not capture all possible respondent exposures prior to or during the study, including new curricula, different attending physicians, and quality improvement interventions. Finally, the preponderance of responses from 1 study site in the later years of the survey is unexplained, although not statistically significant.

Interestingly, whereas measured overall knowledge showed an absolute increase of 23% (from 40% to 63%), respondent's self-reported ability to correctly use antimicrobials in general showed a much larger increase of 49% (from 9% to 58%). These findings may reflect differences between resident's confidence with antimicrobials in general versus in specific urinary cases. Alternatively, knowledge deficits may be more obvious when assessed in specific cases than in general.

TABLE 2. Self-Assessed Ability to Perform Specific Clinical Tasks, Assessed 2011 Through 2014

Clinical Task	Self-Assessed Ability, Column %	Year of Survey (No. of Respondents)				P Value
		2011 (n = 33)	2012 (n = 26)	2013 (n = 33)	2014 (n = 33)	
Ability to differentiate ABU and UTI	Not confident	18	12	3	3	.24
	Neutral	27	19	24	12	
	Confident	46	50	64	67	
Ability to determine whether urine culture result requires treatment	Not confident	27	4	3	12	.08
	Neutral	42	35	36	30	
	Confident	21	43	52	42	
Ability to correctly use antimicrobials	Not confident	30	4	0	6	<.001
	Neutral	49	54	33	21	
	Confident	9	23	58	58	

NOTE. ABU, asymptomatic bacteriuria; UTI, urinary tract infection.

Residents across disciplines report desiring more education and feedback on their use and prescribing of antimicrobials.⁸ Numerous studies and meta-analyses show that multifactorial educational interventions improve overall knowledge on surveys, inappropriate ordering of urine cultures, treatment of ABU, and costs.^{2,5,8} Multifactorial interventions are necessary to change antimicrobial prescriptions, including one-on-one discussions with another health professional, local versions of guidelines, active small-group sessions, individualized feedback (audit and feedback), and computer assistance.^{9,10}

In summary, overall knowledge of urine testing and treatment increased during residency but remained low and was not associated with variables previously thought to influence knowledge.

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SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit <https://doi.org/10.1017/ice.2018.34>.

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