CONCISE COMMUNICATION

Faculty and Resident Physicians' Attitudes, Perceptions, and Knowledge about Antimicrobial Use and Resistance

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We surveyed faculty and residents to assess attitudes, perceptions, and knowledge about antimicrobial use and resistance. Most respondents were concerned about resistance when prescribing antibiotics and agreed that antibiotics are overused, that inappropriate use is professionally unethical, and that others, but not themselves, overprescribe antibiotics. Antimicrobial stewardship programs should capitalize on these perceptions.

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Antimicrobial stewardship programs (ASPs) use a systematic approach to optimize antimicrobial therapy through a variety of interventions and have been proven to be cost-effective.[1,2] To curtail inappropriate use of antimicrobials, ASPs usually promote behavior changes by addressing the beliefs and motivations of target groups.[3,4] It is well recognized that physicians will not alter their management practices unless they are both aware of and in agreement with the changes that are being proposed.[5,6] Previous surveys have been conducted to assess physicians' knowledge of and attitudes about antimicrobial use and resistance.[3,4,7,8] However, little is known about the differences between faculty and resident physicians-in-training in attitudes, perceptions, and knowledge about antimicrobial use and resistance. Understanding the similarities and differences between these groups will be useful in developing effective solutions to improve antimicrobial use.

METHODS

In collaboration with the Get Smart for Healthcare program of the Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, a 68-item Web-based survey was developed for use at Jackson Memorial Hospital (JMH), a 1,500-bed university teaching hospital in Miami, Florida, affiliated with the University of Miami Miller School of Medicine (UMMSM). Demographic information included sex, whether the respondent was a foreign medical graduate (FMG) or US medical school graduate, the number of years from medical school graduation, the resident's year of training, and, for faculty, the number of years since graduation (in the area of specialty), medical specialty, and predominant practice setting (inpatient, outpatient, or both). For the series of questions regarding attitudes and perceptions about antibiotic use and resistance, we used a 5-point Likert scale with response options from "strongly agree" to "strongly disagree" or a 5-point Spector-response scale from "very useful" to "never useful." There were 10 multiple-choice knowledge questions covering basic to more advanced topics. There was only one correct answer to each knowledge question. For each survey responder, the total knowledge score was the percentage of correct answers.

Following approval of the study by the Institutional Review Boards of JMH and UMMSM, an electronic invitation letter with a link to the survey was sent to approximately 1,200 clinical faculty and residents in various specialties at JMH and UMMSM. The survey was Internet based (using http://www.surveymonkey.com) and was voluntary and anonymous. The study was open for 6 weeks between August 3 and September 14, 2009. No incentives for participation were given. During the study period, an e-mail reminder was sent every 2 weeks to all eligible participants. Data analyses were performed with Statistix software, version 9.0 (Analytical Software).

RESULTS

Of the 1,200 physicians (500 faculty and 700 residents) to whom the survey was sent, a total of 609 (329 faculty [66%] and 280 residents [40%]) completed it. Faculty respondents were 35% female and 31% FMGs, and resident respondents were 45% female and 43% FMGs. Of the 609 respondents, 17% graduated from medical school within the last 2 years, 27% within the last 3–6 years, and 57% at least 7 years previously. Ninety-one (32%) of the residents were in their first year of training, 56 (20%) in their second, 49 (18%) in their third, and 85 (30%) in their fourth or longer. Thirty-five percent of faculty members had completed residency training in their specialty within the previous 6 years, whereas 65% completed training 7 years or more before the survey. Sixty-five percent of respondents reported that they prescribe antibiotics mostly for hospitalized patients, 20% mostly for outpatients, and 15% for both.

Factors that influenced respondents' antibiotic prescribing for hospitalized patients are summarized in Table 1. Factors that most physicians felt often or always influenced antibiotic use were the risk of missing an infection and whether a patient is critically ill or immunocompromised; these factors were significantly more important for residents than for faculty physicians ($P < .001$ for both factors). Faculty were significantly more likely to be concerned about cost savings for the hospital ($P = .005$), whereas residents were significantly more likely to be reassured when using an antibiotic even if it might be the wrong one ($P = .008$). More than one-third of respondents reported that the risk of *Clostridium difficile* colitis never or rarely influenced their prescribing decisions.

Perceptions of faculty and residents about antibiotic use and resistance are summarized in Table 2. Overall, most respondents agreed that antibiotics are overused nationally (94%) and locally (76%) and that inappropriate use causes

TABLE 1. Frequency Distribution of Faculty and Residents and Factors Influencing Their Antimicrobial Prescribing Practices for Hospitalized Patients

Factor	Percentage			*P*
	Never or rarely	Sometimes	Often or always	
Cost savings for the patient				.128
Faculty ($n = 325$)	22.2	35.4	42.5	
Residents ($n = 281$)	28.8	34.9	36.3	
Cost savings for the hospital				.005
Faculty ($n = 294$)	20.4	39.5	40.1	
Residents ($n = 239$)	30.1	41.8	28.0	
Risk of missing an infection				.001
Faculty ($n = 316$)	12.3	22.8	64.9	
Residents ($n = 279$)	3.9	15.4	80.6	
Patient demands and expectations for antibiotics				.655
Faculty ($n = 322$)	81.7	12.4	5.9	
Residents ($n = 280$)	79.3	15.0	5.7	
The patient is critically ill and/or immunocompromised				<.001
Faculty ($n = 323$)	8.0	13.3	78.6	
Residents ($n = 279$)	2.5	8.6	88.9	
Reassurance when using an antibiotic even if it might be the wrong one				.008
Faculty ($n = 313$)	81.2	13.7	5.1	
Residents ($n = 277$)	70.8	19.1	10.1	
Unexplained fever or leukocytosis even if culture results are negative				.051
Faculty ($n = 320$)	41.3	40.9	17.8	
Residents ($n = 279$)	34.4	40.1	25.4	
Treat colonization to prevent infection				.253
Faculty ($n = 315$)	78.4	14.9	6.7	
Residents ($n = 279$)	73.5	20.1	6.5	
Risk of developing *Clostridium difficile* colitis				.750
Faculty ($n = 309$)	35.0	34.3	30.7	
Residents ($n = 265$)	37.0	35.1	27.9	

antimicrobial resistance (97%) and can harm patients (97%). Most respondents agreed that they were concerned about antimicrobial resistance in their hospital and in society (faculty, 82%; residents, 88%; $P = .44$) when they prescribed antibiotics. Fifty-six percent of the faculty compared with 69% of the residents ($P < .001$) agreed that inappropriate use of antibiotics is professionally unethical.

While 62% of respondents agreed that other doctors overprescribe antibiotics, only 13% agreed that they themselves overprescribe antibiotics, with residents more likely to agree ($P < .01$). Most respondents agreed that they would like more education about antibiotics and feedback about their antibiotic selections.

There was a statistically significant difference regarding residents rating as most useful the following resources for continuing medical education: infectious diseases colleagues (faculty, 67%; residents, 78%; $P = .05$), UptoDate (faculty, 59%; residents, 76%; $P < .01$), the Sanford Guide (faculty, 60%; residents, 72%; $P = .03$), and ward rotations (faculty, 42%; residents, 70%; $P < .01$). Few respondents agreed that pharmaceutical representatives (faculty, 10%; residents, 20%; $P < .01$) and off-campus lectures sponsored by pharmaceutical companies were useful educational resources.

The mean score for all respondents on the knowledge questions was 67% ($\pm 30\%$). The questions and the response choices are available from the corresponding author. Knowledge scores were highest for questions on the appropriate selection of antibiotics for the management of methicillin-resistant *Staphylococcus aureus* (MRSA) bacteremia (77% $\pm$ 42%) and prevention of catheter-associated urinary tract infections (83% $\pm$ 38%). Mean scores were lowest for questions about management of anaerobic infections (51% $\pm$ 50%) and extended-spectrum β-lactamase (ESBL)–positive bacteremia (37% $\pm$ 48%). There were no differences in knowledge by sex, FMG status, or year of residency training. However, the overall mean score for residents (72% $\pm$ 27%) was significantly higher than that for faculty (64% $\pm$ 32%; $P < .001$). Residents scored higher for all questions and significantly higher for questions about management of ESBL bacteremia ($P < .001$), appropriate use of intravenous vancomycin ($P = .002$), antibiotic cost ($P < .001$), appropriate antibiotic use in hospitalized patients ($P < .001$), and surgical prophylaxis ($P = .021$).

Mean scores were highest for specialists in infectious diseases (87% $\pm$ 30%), critical care (78% $\pm$ 28%), and internal medicine (75% $\pm$ 27%; Figure 1).

TABLE 2. Agreement of Faculty and Residents with Statements regarding Perceptions about Antimicrobial Use and Resistance

Perception	No. (%)		P
	Faculty	Residents	
Antibiotics are overused nationally	315 (94)	271 (95)	.925
Antibiotics are overused in my hospital	312 (79)	271 (72)	.053
Antibiotic resistance is a significant problem nationally	310 (96)	266 (95)	.689
Antibiotic resistance is a significant problem in my hospital	315 (98)	269 (95)	.091
Better use of antibiotics will reduce problems with antimicrobial resistance	313 (92)	271 (95)	.221
Strong knowledge of antibiotics is important in my medical career	315 (89)	269 (91)	.302
I am confident that I use antibiotics optimally in the ICU	290 (47)	269 (50)	.486
I am confident that I use antibiotics optimally in the non-ICU setting	307 (64)	270 (54)	.021
I overprescribe antibiotics	313 (10)	269 (17)	.010
Other doctors overprescribe antibiotics	311 (63)	266 (61)	.725
Antibiotic management programs are an obstacle to good patient care	313 (15)	269 (23)	.013
I would like more feedback on my antibiotic selections	309 (72)	271 (79)	.050
I would like more education on antibiotics	309 (77)	269 (87)	<.001
I am less likely to use restricted antibiotics if infectious disease approval is required	309 (52)	269 (61)	.027
Interactions with pharmaceutical representatives do not influence my antibiotic selections	306 (72)	266 (71)	.891
Locally developed guidelines for antibiotic treatment would be more useful than national ones	306 (75)	266 (73)	.677
I am concerned about antimicrobial resistance in the society when I prescribe antibiotics	306 (82)	266 (88)	.044
I am concerned about antimicrobial resistance in my hospital when I prescribe antibiotics	306 (88)	266 (93)	.061
New antibiotics will be developed in the future that will keep up with the problem of "resistance"	306 (20)	266 (21)	.825
Prescribing broad-spectrum antibiotics when equally effective narrower ones are available increases antimicrobial resistance	306 (88)	266 (87)	.552
Poor infection control practices by healthcare professionals causes spread of antimicrobial resistance	306 (85)	265 (88)	.291
Inappropriate use of antibiotics causes antimicrobial resistance	306 (96)	266 (97)	.552
Inappropriate use of antibiotics can harm patients	306 (97)	266 (96)	.311
Inappropriate use of antibiotics is professionally unethical	170 (56)	183 (69)	<.001

NOTE. ICU, intensive care unit.

DISCUSSION

This study shows that both faculty and resident physicians in a large public teaching hospital are highly aware of and concerned about overuse of antibiotics. Most faculty and residents agreed that antibiotics are overused nationally, but a lower proportion agreed that antibiotics are overused in their own hospital. They agreed, however, that antimicrobial resistance is a significant problem both locally and nationally, which is consistent with the findings reported in some,[3,8] but not all,[4,9] previous surveys conducted in academic medical centers.

While most respondents agreed that other doctors overprescribe antibiotics, a much smaller proportion (especially of faculty) felt that they themselves overprescribe. These results are consistent with perceptions of residents in prior surveys[8] and demonstrate that faculty and resident physicians in academic medical centers do not perceive that there is a major need for improvement in their own antibiotic prescribing patterns. Interventions to improve the use of antimicrobials must address this common misperception.

As noted in previous studies,[4,8] most physicians agreed that knowledge of antibiotics is important, that they would like more education and feedback on their antibiotic selections, that they are less likely to prescribe restricted agents requiring preapproval, and that locally developed guidelines for antimicrobial treatment are more useful than national guidelines. These perceptions suggest that guidelines promoted by ASPs are likely to meet with more success if they take into consideration local practices and patterns of resistance. Targeted interventions based on feedback to prescribers regarding their antimicrobial selection, dosing, and duration and consistency with local antibiograms are likely to be accepted by both faculty and residents. A proportion of physicians reported that the risk of *C. difficile* colitis never or rarely influenced their prescribing decisions. This is of concern given that nosocomial *C. difficile* infections have increased in incidence over the past decade—in fact, their numbers have surpassed those of MRSA infections in some community hospitals.[10] Moreover, antimicrobial exposure remains the most significant modifiable risk factor for *C. difficile* infection.[11,12]

A majority of faculty (56%) and residents (69%; $P < .001$) agreed that inappropriate use of antibiotics is professionally unethical. We did not ask our respondents what they considered to be inappropriate use of antibiotics, and, thus, we do not know what prescribing scenarios might be considered unethical by the respondents. Nevertheless, we are not aware of any previous study that has evaluated physicians' attitudes about the ethics of inappropriate antibiotic use. The value of framing inappropriate antibiotic use as an ethical issue in a comprehensive program to improve antimicrobial

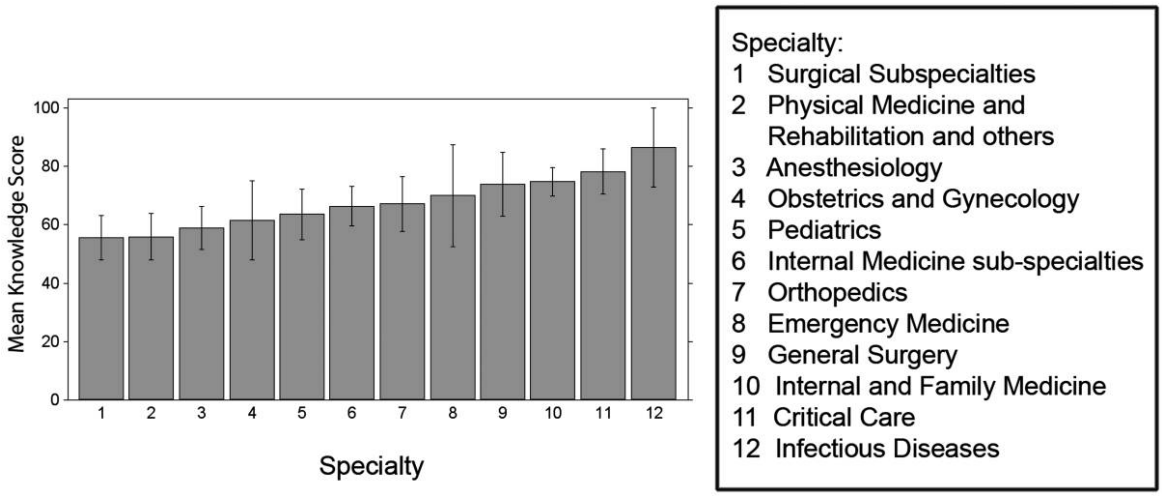

FIGURE 1. Mean knowledge scores and 95% confidence intervals (*vertical lines*) by specialty. The score for each respondent was defined as the proportion (%) of correct answers to 10 knowledge questions.

prescribing under the principle *primum non nocere* warrants further study.

Faculty respondents scored lower than residents on the antibiotic knowledge questions for each of the 10 questions. It appears that both faculty and residents have important gaps in knowledge regarding the appropriate use of antibiotics, and this represents an opportunity for improvement. Higher knowledge scores for residents are likely the result of frequent exposure of residents to continuing medical education about antimicrobials and resistance during their training and the responsibility of residents to prescribe antimicrobials in an academic setting. A proposed solution to address these gaps in knowledge between faculty and residents is the incorporation of antimicrobial education as a requirement for individual revalidation and accreditation.[13] Educational efforts should also be interlaced with prescriber feedback regarding their antimicrobial use and local patterns of resistance.

Potential limitations of our study are that our questionnaire was self-reported, has not been externally validated, and was evaluated in a single institution.

In a world facing globalization of antimicrobial resistance and with a limited antibiotic pipeline, ASPs must develop effective education and intervention programs to prevent further development and spread of antimicrobial resistance. Programs should be tailored on the basis of attitudes, perceptions, and knowledge. This study has demonstrated several areas where antimicrobial stewardship education and intervention activities could be targeted, including some areas where it may be reasonable to emphasize different concepts among faculty and resident physicians. ASPs should consider physicians' common perception that they do not personally overprescribe antibiotics and should also capitalize on the common perception that there are real and dangerous unintended consequences to antimicrobial use.

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