3. Apisarnthanarak A, Khawcharoenporn T, Mundy LM. Practices to prevent multidrug-resistant Acinetobacter baumannii and methicillin-resistant Staphylococcus aureus in Thailand: a national survey. *Am J Infect Control* 2013;41:416–421.

4. Apisarnthanarak A, Ratz D, Khawcharoenporn T, *et al.* National survey of practices to prevent methicillin-resistant Staphylococcus aureus and multi-drug-resistant Acinetobacter baumannii in Thailand. *Clin Infect Dis* 2017;64 suppl 2:S161–S166.

Antibiotic prescribing behavioral assessment of physicians involved in surgical care

Kittiya Jantarathaneewat PharmD[1], Siriththin Chansirikarnjana MD[2], Nattapong Tidwong PharmD[3], Linda M. Mundy MD, PhD[4] and Anucha Apisarnthanarak MD[2]

[1]Faculty of Pharmacy, Thammasat University, Prathum Thani, Thailand, [2]Division of Infectious Diseases, Faculty of Medicine, Thammasat University, Prathum Thani, Thailand, [3]Faculty of Pharmacy, Chiang Mai University, Chiang Mai, Thailand and [4]American Regent, Norristown, Pennsylvania

To the Editor—Appropriate antibiotic use in surgical department is associated with reduction in morbidity and mortality.[1] Challenges exist in conducting behavior-based studies of antibiotic stewardship, given the multifactorial decision-making associated with prescribing practices. Two theory-based behavioral constructs associated with sustained behavioral change are the Transtheoretical Model of Health Behavior Change (TTM) and the Theory of Planned Behavior (TPB).[2,3] These behavioral theories were recently employed in successful implementation of a hand hygiene infection prevention campaign.[4] To potentially extend the application of these theories to medication prescribing practices, we performed an exploratory study to evaluate surgical care providers, categorized by TTM and by TPB, for association with appropriate antibiotic prescribing practice.

A prospective study was conducted at Thammasat University Hospital from January 1 to January 31, 2019. Surgical care prescribers of antibiotics were enrolled; de-identified data collection included demographics, indications, the rationale for antibiotic prescriptions, and prescribed drug modifications based on Tamma et al.[5] Appropriateness of antibiotic prescriptions was defined based on the criteria of Kunin et al.[6] The source data for assessment was the hospital's drug use evaluation (DUE) form. After DUE review, an in-depth interview using a standardized data collection tool was conducted with each prescriber by either a clinical pharmacist or infectious disease physician to explore antibiotic prescribing behavior based on the TTM and TPB. The interview with each prescriber focused on 1 antibiotic for treatment or 1 antibiotic for surgical prophylaxis. In TTM and TPB assessment, questions were modeled, and each domain was assessed based on previous publications (Supplement 1 online).[2–4,7]

All analyses were performed using SPSS, version 19 software. The χ^2 or Fisher exact test was used to compare categorical variables. Independent *t* tests were used for continuous data. All *P* values were 2-tailed; $P < .05$ was considered statistically significant. To determine factors associated with appropriate antibiotic prescriptions, variables that had a significance level of $P < .20$ in univariate analysis were entered into multivariate logistic regression models. Adjusted odd ratios (aORs) and 95% confidence intervals (CIs) were calculated. Correlation between TTM and TPB behavior score were measured using Pearson correlation.

There were 92 antibiotic prescriptions assessed from 64 prescribers. Most antibiotic prescriptions (62 of 92, 67%) were for treatment of infection (Table 1); 70 prescribed antibiotics (76%) were deemed appropriate. The 3 most common reasons for inappropriate antibiotic prescriptions were (1) antibiotics choice for either treatment or surgical prophylaxis (n = 11, 50%), (2) treatment duration (n = 8, 36%), and (3) prescribed combination antibiotics (eg, a third-generation cephalosporins and metronidazole) for surgical prophylaxis (n = 3, 14%). Prolonged antibiotic use for surgical prophylaxis (>48 hours) (8 of 22, 36.3%) was common, particularly in neurosurgical procedures. Physicians who de-escalated antibiotics had higher rate of appropriate antibiotic prescriptions, with an overall trend for inappropriate antibiotic prescriptions among physicians with higher levels of training. Notably, a higher proportion of inappropriate antibiotic prescriptions were identified among physicians who had no stated rationale for antibiotic selection.

For the behavioral assessments of prescribing practice, higher stages of TTM strongly correlated with appropriate antibiotic use. In contrast, there was no correlation between the total TPB score and appropriate antibiotic prescriptions (Supplement 1 online). Characteristics, antibiotic prescribing patterns, rationale for prescribing empirical antibiotics and modifying antibiotics, and behavior of prescribers are summarized in Table 1.

By multivariate analysis, TTM prescribers in Action plus Maintenance (aOR, 7.95; 95% CI, 2.08–30.30) and prescribers considering patients as first priority (aOR, 4.02; 95% CI, 1.05–15.32) were associated with appropriate antibiotic prescriptions. Neurosurgical procedures (aOR, 0.13; 95% CI, 0.02–0.89) and antibiotic prescriptions for surgical prophylaxis (aOR, 0.15; 95% CI, 0.004–0.53) were associated with inappropriate antibiotic prescriptions. Prescribers staged in TTM Action plus Maintenance were also associated with appropriate antibiotic prescriptions for treatment and for surgical prophylaxis.

The major finding of this study is the identification of the strong correlation between the TTM stages of surgical care prescribers and appropriate antibiotic prescriptions. To our knowledge, this is the first study to evaluate TTM stages with medication selection. Based on the TTM framework, early-stage prescribers (precontemplation, contemplation, and preparation) have the potential

Author for correspondence: Anucha Apisarnthanarak, E-mail: anapisarn@yahoo.com

Cite this article: Jantarathaneewat K, *et al.* (2019). Antibiotic prescribing behavioral assessment of physicians involved in surgical care. *Infection Control & Hospital Epidemiology*, 40: 1079–1081, https://doi.org/10.1017/ice.2019.167

Table 1. Baseline Characteristics Among 92 Prescriptions in Perioperative Care Who Were Prescribed Antibiotics for Treatment or Prophylaxis

	Overall (n = 92)			Treatment (n = 62)			Surgical Prophylaxis (n = 30)		
Variable	Appropriate (n = 70)	Inappropriate (n = 22)	*P* Value	Appropriate (n = 54)	Inappropriate (n = 8)	*P* Value	Appropriate (n = 16)	Inappropriate (n = 14)	*P* Value
Age (mean ± SD)	27.10 ± 2.16	30.23 ± 8.76	.007	27.50 ± 2.27	31.63 ± 10.21	.01	25.75 ± .86	29.43 ± 8.12	.08
Sex (male)	42 (60)	14 (63.6)	.81	32 (59.3)	4 (50)	.71	6 (37.5)	4 (28.6)	.71
Level of training			.04			.07			.26
Extern and Intern	27 (38.6)	10 (45.5)		17 (31.5)	4 (50)		10 (62.5)	6 (42.9)	
Residency	41 (58.6)	8 (36.4)		35 (64.8)	2 (25)		6 (37.5)	6 (42.9)	
Fellow and staff	2 (2.9)	4 (18.2)		2 (3.7)	2 (25)		0 (0)	2 (14.3)	
Antibiotic for treatment	54 (77.1)	8 (36.4)	.001	. . .	. . .	. . .	. . .	. . .	. . .
Urinary tract infection	10 (18.5)	2 (25)	.65	10 (18.5)	2 (25)	.65	. . .	. . .	. . .
Intraabdominal infection	9 (16.7)	2 (25)	.62	9 (16.7)	2 (25)	.62	. . .	. . .	. . .
Pneumonia	16 (29.2)	2 (25)	1.00	16 (29.2)	2 (25)	1.000	. . .	. . .	. . .
Other[a]	15 (27.8)	2 (25)	1.00	15 (27.8)	2 (25)	1.000	. . .	. . .	. . .
Antibiotic for surgical prophylaxis	16 (22.9)	14 (63.6)	.001	N/A	N/A	N/A	16 (22.9)	14 (63.6)	.001
Patterns of antibiotic use									
First-generation cephalosporins	13 (18.6)	7 (31.8)	.24	. . .	. . .	. . .	13 (81.3)	7 (50)	.12
Third-generation cephalosporins	16 (22.9)	4 (18.2)	.77	14 (25.9)	2 (25)	1.0	2 (12.5)	2 (12.5)	1.00
BLBIs	20 (28.6)	1 (4.5)	.02	20 (37)	1 (12.5)	.25	. . .	. . .	. . .
Carbapenems	6 (8.6)	4 (18.2)	.23	6 (11.1)	3 (37.5)	.08	0 (0)	1 (7.1)	.47
Vancomycin	2 (2.9)	0 (0)	1.00	1 (1.9)	0 (0)	1.00	1 (6.3)	0 (0)	1.00
Combination antibiotics[b]	8 (11.4)	3 (13.6)	.72	8 (14.8)	0 (0)	.58	0 (0)	3 (21.4)	.09
Other[c]	5 (7.1)	3 (13.6)	.39	5 (9.3)	2 (25)	.22	0 (0)	1 (7.1)	.47
Antibiotic de-escalation	46 (85.2)	4 (50)	.04	46 (85.2)	4 (50)	.039	. . .	. . .	. . .
Total TPB score (mean ± SD)	41.34 ± 5.84	42 ± 3.30	.62	40.83 ± 6.02	42.25 ± 2.87	.52	43.06 ± 5.01	41.86 ± 3.61	.46
Attitude	13.57 ± 1.55	12.71 ± 1.54	.37	13.65 ± 1.64	12.50 ± 1.51	.07	13.31 ± 1.20	13.64 ± 1.45	.50
Subjective norm	21.17 ± 4.02	21.14 ± 2.64	.97	20.93 ± 4.15	21.88 ± 3.09	.54	22 ± 3.56	20.71 ± 2.37	.26
Perceived behavioral control	6.60 ± 2.43	7.64 ± 1.39	.06	6.26 ± 2.52	7.88 ± 1.36	.08	7.75 ± 1.69	7.50 ±1.35	.66
TTM stage of change			.001			.002			.17
Precontemplation	4 (5.7)	8 (36.4)	.001	2 (3.7)	4 (50)	.002	2 (12.5)	4 (28.6)	.38
Contemplation	2 (2.9)	2 (9.1)	.24	2 (3.7)	0 (0)	1.00	0 (0)	2 (14.3)	.21
Preparation	1 (1.4)	1 (4.5)	.42	1 (1.9)	0 (0)	1.00	0 (0)	1 (7.1)	.47
Action	5 (7.1)	0 (0)	.33	4 (7.4)	0 (0)	1.00	1 (6.3)	0 (0)	1.00
Maintenance	58 (82.9)	11 (50)	.004	45 (83.3)	4 (50)	.05	13 (81.3)	7 (50)	.12
Consider patients as first priority	593 (75.7)	12 (54.5)	.006	39 (72.2)	4 (50)	.24	14 (87.5)	8 (57.1)	.10
Lack of rationale[d]	4 (5.7)	5 (22.7)	.03	3 (5.6)	2 (25)	.12	1 (6.3)	3 (21.4)	.32
Recovery	69 (98.6)	20 (90.9)	.14	53 (98.1)	6 (75)	.04	16 (100)	14 (100)	. . .

Note. N/A, not applicable; BLBIs, β-lactam-β-lactamase inhibitors; TPB, theory of planned behavior; TTM, transtheoretical model of health behavior

[a]Other: surgical site infection, CNS infection, sepsis, osteomyelitis, prosthetic/ implant infection, ventilator associated pneumonia, ventilator associated tracheobronchitis, *Clostridium difficile* associated diarrhea, febrile neutropenia.

[b]Combination antibiotics: carbapenem plus vancomycin, third generation cephalosporins plus metronidazole, third generation cephalosporins plus azithromycin, third generation cephalosporins plus clindamycin.

[c]Other; dicloxacillin, penicillin G, TMP/SMX, fluconazole, ciprofloxacin.

[d]Rationale including antibiotic prescribing for empirical and modification according to Tamma et al.[6]

https://doi.org/10.1017/ice.2019.167 Published online by Cambridge University Press

opportunity to adopt appropriate antibiotic prescribing behaviors.[7] In contrast, the summary TPB scores did not correlate with antibiotic prescribing behavior. This finding contrasts with a systematic review of TPB domain scores reporting an association with antibiotic prescription behaviors.[8] It is plausible that the weight of the individual TPB determinants requires future refinement.[8] A second study finding was the key predictor of "considering patients as first priority" as a key predictor of appropriate antibiotic use. This finding suggests a patient safety and quality-improvement opportunity, while additional efforts may exist to minimize unnecessary antibiotic combinations for surgical prophylaxis and to shorten postoperative antibiotic duration.

The limitations of this study include acknowledgment of reported findings which may not be generalizable to other study populations, given the exploratory study design, small sample size, and single institutional study site. Additionally, despite structured interviews, inherent bias may have occurred in the TTM and TPB assessments, and have influenced the unweighted, cumulative TPB scores. Future work is planned for assessment of TTM stage–based prescriber interventions associated with antibiotic prescribing practices along with further characterization of the TPB intrapersonal behavior theory.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2019.167.

Author ORCIDs. Anucha Apisarnthanarak 0000-0001-6390-9519

Financial support. No financial support was provided relevant to this article.

Conflicts of interest. Linda M. Mundy is a full-time employee at American Regent, Inc. and this work was conducted without compensation and independently of this employment. All other authors report no conflict of interest relevant to this article.

References

1. Sartelli M, Kluger Y, Ansaloni L, *et al.* A global declaration on appropriate use of antimicrobial agents across the surgical pathway. *Surg Infect (Larchmt)* 2017;18:846–853.
2. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. *Am J Health Promot* 1997;12:38–48.
3. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process* 1991;50:179–211.
4. Apisarnthanarak A, Eiamsitrakoon T, Mundy LM. Behavior-based interventions to improve hand hygiene adherence among intensive care unit healthcare workers in Thailand. *Infect Control Hosp Epidemiol* 2015;36:517–521.
5. Tamma PD, Miller MA, Cosgrove SE. Rethinking how antibiotics are prescribed: incorporating the 4 moments of antibiotic decision making into clinical practice. *JAMA* 2019;321:139–140.
6. Kunin CM, Tupasi T, Craig WA. Use of antibiotics. A brief exposition of the problem and some tentative solutions. *Intern Med* 1973;79:555–560.
7. Charani E, Edwards R, Sevdalis N, *et al.* Behavior change strategies to influence antimicrobial prescribing in acute care: a systematic review. *Clin Infect Dis* 2011;53:651–662.
8. Warreman EB, Lambregts MMC, Wouters RHP, *et al.* Determinants of in-hospital antibiotic prescription behaviour: a systematic review and formation of a comprehensive framework. *Clin Microbiol Infect* 2019;25:538–545.

Dentists' perceptions of antimicrobial use for dental procedures

Yasuhiro Kano MD[1], Yasuaki Tagashira MD[1,2], Daisuke Kobayashi DDS, PhD[3] and Hitoshi Honda MD, PhD[1]

[1]Division of Infectious Diseases, Tokyo Metropolitan Tama Medical Center, Tokyo, Japan, [2]Department of Microbiology, Juntendo University Graduate School of Medicine, Tokyo, Japan and [3]Department of Dentistry and Oral Maxillofacial Surgery, Tokyo Metropolitan Tama Medical Center, Tokyo, Japan

To the Editor—The importance of promoting antimicrobial stewardship in dentistry is being increasingly recognized; up to 10% of all antimicrobials are prescribed by dentists in high-income countries,[1,2] and a previous study revealed that only 8.2% of antimicrobial prophylaxes for dental procedures were appropriate.[3] Although professional societies widely recommend antimicrobial prophylaxis against infective endocarditis (IE) among high-risk populations,[4,5] no recommendations exist for antimicrobial prophylaxis against local infections or complications following invasive dental procedures, including tooth extraction and dental implant placement. Recent systematic reviews have revealed that antimicrobial prophylaxis can prevent local infections and other complications due to these procedures.[6,7]

Although understanding dentists' perceptions of antimicrobial use and prescribing patterns is essential to promoting antimicrobial stewardship in the discipline, these perceptions are still poorly understood. The aim of the study was to investigate dentists' perception of antimicrobial use to promote antimicrobial stewardship in the field.

Material and Methods

An online questionnaire on antimicrobial use before and after a dental procedure was administered to regional dental conference attendees (Japanese Society of Oral and Maxillofacial Surgeons, JSOMS) in December 2018. In total, 54 close-ended survey questions were used to collect data, including current patterns of antimicrobial prophylaxis against IE, infections and complications following tooth extraction or dental implant surgery, and dentists' perceptions of antimicrobial use.

Results

Of the 231 dentists attending the session, 111 (48.1%) responded to the questionnaire. Moreover, 70% of respondents were male, with the median age of 36 years (range, 24–64 years) and median postgraduate duration of 11 years (range, 1–44 years). University hospitals were the most common place of employment (n = 49, 44.1%) (Appendix 1 online).

Author for correspondence: Liling Tang MB, Yijishan Hospital of Wannan Medical College, 2 West Zheshan Rd, 241001, Anhui Province, China. Email: yjsygk2017@sina.com

Cite this article: Zhang P and Tang L. (2019). Current status of infection control professionals in a Chinese city. *Infection Control & Hospital Epidemiology*, 40: 1081–1083, https://doi.org/10.1017/ice.2019.186