Infection Control & Hospital Epidemiology (2022), **43**, 943–962
doi:10.1017/ice.2021.126

SHEA

Letter to the Editor

Analysis of hospital antimicrobial consumption to identify targets for antimicrobial stewardship

Dawood Yusef MD[1], Wail A. Hayajneh MD[1], Stuart E. Bond PhD[2], Jade Lee-Milner NVQ, Level 4 Data analyst[2], Sayer Al-Azzam PhD[3], Ali Bani Issa MSc[4], Sara K. Jaradat MSc[3], Ian Gould FRCPath FRCPE DSc[5], Barbara R. Conway PhD[6,7], Syed Shahzad Hasan PhD[6] and Mamoon A. Aldeyab PhD[6]

[1]Department of Pediatrics, School of Medicine, Jordan University of Science and Technology, Irbid, Jordan, [2]Pharmacy Department, Pinderfields Hospital, Mid Yorkshire Hospitals NHS Trust, Wakefield, United Kingdom, [3]Clinical Pharmacy Department, Jordan University of Science and technology, Irbid, Jordan, [4]Infection Control Division, King Abdullah University Hospital, Irbid, Jordan, [5]Medical Microbiology Department, Aberdeen Royal Infirmary, Aberdeen, Scotland, United Kingdom, [6]Department of Pharmacy, School of Applied Sciences, University of Huddersfield, Huddersfield, United Kingdom and [7]Institute of Skin Integrity and Infection Prevention, University of Huddersfield, Huddersfield, United Kingdom

To the Editor—Antimicrobial resistance (AMR) poses a significant threat to health and human development worldwide.[1] Antibiotic consumption has been clearly shown to contribute to the selection and spread of drug-resistant microorganisms.[2,3] In response to the growing threat of antibiotic resistance, the World Health Assembly adopted a global action plan (GAP) on antimicrobial resistance (AMR).[4] Antimicrobial stewardship (AMS) represents a key strategy for promoting responsible antimicrobial use. Monitoring hospital antimicrobial consumption has a central role in guiding AMS activities, and it is an important step toward improving antibiotic management. The aim of the study was to explore the utility of hospital antimicrobial consumption in identifying AMS quality improvement targets.

The study was conducted at King Abdullah University Hospital (KAUH; 533 beds) in Jordan and at Pinderfields General Hospital (PGH; 770 beds) in the United Kingdom. Annual hospital antimicrobial consumption data were collected retrospectively for the year 2019 for adult wards only. Data on the annual antimicrobial consumption were converted into defined daily doses (DDD) expressed per 100 occupied bed days (OBD). The World Health organization (WHO) Access, Watch, and Reserve (AWaRe) classification was used.[5] Approval of the institutional review boards (IRB) at the Jordan University of Science and Technology and KAUH were obtained for this study (IRB no. 490-2020). The study was registered as quality improvement project at PGH.

Analysis of hospital antimicrobial consumption showed different patterns of use between KAUH and PGH (Table 1). The total antibiotic consumption at KAUH was 71.7 DDD per 100 OBD, of which 9.2 DDD per 100 OBD represent oral use (12.8%). The total antibiotic consumption in PGH was 112.9 DDD per 100 OBD, of which 63.2 DDD per 100 OBD represent oral use (56%; Table 1). At KAUH, the most frequently used antibiotics, contributing to >50% of total antibiotic use were piperacillin/tazobactam (Watch; 18.2% of total use), cefazolin (Access; 14% of total use), ceftriaxone (Watch; 10.4% of total use), and teicoplanin (Watch; 8.9% of total use). At PGH, the most frequently used antibiotics, contributing to >50% of total antibiotic use were amoxicillin/clavulanic acid (Access; 20.6% of total use), flucloxacillin (Access; 11.7% of total use), amoxicillin (Access; 11.6% of total use), and clarithromycin (Watch; 9.7% of total use). According to the WHO AWaRe classification and at KAUH, the following percentages represent hospital antimicrobial consumption: 26.4% Access group, 71% Watch group, and 2.6% Reserve group. At PGH, the following percentages represent hospital antimicrobial consumption: 65.6% Access group, 33.7% Watch group, and 0.7% Reserve group.

Analysis of data showed that KAUH using more from the Watch group (71%) compared with the Access group (26.4%). In part, this antimicrobial consumption could be due to the requirement to use specific antibiotics, classified within the Watch group, to respond to the high prevalence rates of specific pathogens. Such uses include carbapenems against extended-spectrum β-lactamase–producing organisms, glycopeptides against methicillin-resistant *Staphylococcus aureus*, or piperacillin-tazobactam or carbapenems in combination regimens (usually with colistin) against multidrug-resistant *Acinetobacter baumannii* or multidrug-resistant *Pseudomonas aeruginosa*. This finding is supported by others who reported that in high-resistance settings, increased use of Watch and Reserve antibiotics might be appropriate.[5] This finding is also consistent with other reports that rates of resistance can affect the choice of drug; thus, targets for consumption should take local resistance rates into consideration.[6] The increased use of ceftriaxone is probably because it is considered the first-line treatment for common infections such as pneumonia and urinary tract infections.[7,8] The need to treat high prevalence rates of pathogens was also reflected in the higher use of parenteral antibiotics compared with oral antibiotics in KAUH. For example, >45% of the total hospital antimicrobial consumption was attributable to piperacillin/tazobactam, glycopeptides (vancomycin and teicoplanin), and carbapenems, all of which require parenteral administration. The potential to increase the use of Access group antibiotics, optimize the use of third-generation cephalosporins, along with increasing the IV-to-oral switch, should be considered for quality improvement and AMS activities.

At PGH, the use of antibiotics from the Access group (65.6%) was higher than from the Watch group (33.7%). This finding is in line with national AMS initiatives in England. At PGH,

Author for correspondence: Dr Mamoon Aldeyab, E-mail: m.aldeyab@hud.ac.uk
Cite this article: Yusef D, *et al.* (2022). Analysis of hospital antimicrobial consumption to identify targets for antimicrobial stewardship. *Infection Control & Hospital Epidemiology*, 43: 943–945, https://doi.org/10.1017/ice.2021.126

Table 1. Hospital Antimicrobial Consumption, Expressed in DDD per 100 OBD Per Antimicrobial Class, for King Abdullah University Hospital and Pinderfields General Hospital, 2019

ATC Level	Antimicrobial Class	King Abdullah University Hospital (Jordan)					Pinderfields General Hospital (UK)				
		Oral	Parenteral	Total	Class %	Oral %	Oral	Parenteral	Total	Class %	Oral %
J01AA	Tetracyclines	1.04	0.06	1.10	1.54	94.24	9.05	0.07	9.12	8.08	99.23
J01BA	Amphenicols	0.00	0.00	0.00	0.00	NA	0.00	0.01	0.01	0.00	0.00
J01CA	Penicillins with extended spectrum	0.09	0.29	0.38	0.53	24.46	8.19	5.32	13.52	11.97	60.61
J01CE	β-lactamase sensitive penicillins	0.00	0.00	0.00	NA	NA	0.39	0.98	1.38	1.22	28.50
J01CF	β-lactamase resistant penicillins	0.00	0.00	0.00	NA	NA	6.60	6.63	13.23	11.72	49.87
J01CR	Combinations of penicillins, including β-lactamase inhibitors	0.90	13.03	13.93	19.42	6.43	16.88	11.47	28.36	25.12	59.54
J01DB	First-generation cephalosporins	0.01	10.08	10.08	14.06	0.08	0.36	0.00	0.36	0.31	100.00
J01DC	Second-generation cephalosporins	1.28	0.51	1.79	2.49	71.66	0.00	0.46	0.46	0.41	0.00
J01DD	Third-generation cephalosporins	0.02	7.49	7.51	10.47	0.26	0.04	1.74	1.78	1.58	2.41
J01DF	Monobactams	0.00	0.00	0.00	NA	NA	0.00	0.37	0.37	0.33	0.00
J01DH	Carbapenems	0.00	10.15	10.15	14.15	0.00	0.00	2.54	2.54	2.25	0.00
J01DI	Other cephalosporins and penems	0.00	0.03	0.03	0.04	0.00	0.00	0.00	0.00	0.00	NA
J01EA	Trimethoprim and derivatives	0.00	0.00	0.00	NA	NA	1.64	0.00	1.64	1.46	100.00
J01EE	Combinations of sulfonamides and trimethoprim, incl. derivatives	0.76	0.00	0.76	1.06	100.00	1.43	0.05	1.48	1.31	96.48
J01FA	Macrolides	1.56	0.00	1.56	2.17	100.00	10.12	1.56	11.68	10.35	86.65
J01FF	Lincosamides	0.06	0.00	0.06	0.09	100.00	0.96	1.76	2.72	2.41	35.44
J01GA	Streptomycins	0.00	0.00	0.00	NA	NA	0.00	0.00	0.00	0.00	0.00
J01GB	Other aminoglycosides	0.00	1.64	1.64	2.28	0.00	0.00	4.88	4.88	4.32	0.00
J01MA	Fluoroquinolones	3.44	3.61	7.04	9.82	48.79	5.75	2.41	8.17	7.23	70.45
J01XA	Glycopeptide antibacterials	0.00	9.84	9.84	13.73	0.00	0.00	7.80	7.80	6.91	0.00
J01XB	Polymyxins	0.00	1.37	1.37	1.90	0.00	0.00	0.01	0.01	0.01	0.00
J01XC	Steroid antibacterials	0.00	0.00	0.00	NA	NA	0.02	0.00	0.02	0.02	100.00
J01XD	Imidazole derivatives	0.00	4.08	4.08	5.68	0.00	0.00	1.40	1.40	1.24	0.00
J01XE	Nitrofuran derivatives	0.02	0.00	0.02	0.02	100.00	1.59	0.00	1.59	1.41	100.00
J01XX	Other antibacterials	0.00	0.39	0.39	0.55	0.00	0.18	0.19	0.37	0.33	49.03
	Total	9.17	62.56	71.73	100.00	12.79	63.22	49.65	112.88	100.00	56.01

Note. DDD, defined daily dose; OBD, occupied bed days; ATC, Anatomical Therapeutic Chemical.

prevalence estimates of specific pathogens were much lower than at KAUH. This finding was also reflected their higher use of the oral route of administration. For example, >50% of the total hospital antimicrobial consumption at PGH was due to amoxicillin/clavulanic acid, flucloxacillin, amoxicillin, and clarithromycin. All of these antibiotics are available to be administered via oral and parenteral routes. The relatively higher use of Access group antibiotics, compared with those in the Watch group, and the balance between parenteral and oral administration, reflects good clinical practices. However, amoxicillin/clavulanic acid, classified as within the Access group and representing 20.6% of total use at PGH, has been linked with the development of AMR in several studies.[2,3] Therefore, the high use of amoxicillin/clavulanic acid, and in general the higher total use of antibiotics, warrant further work to reduce unnecessary use, for example, long oral courses following IV-to-oral switch.

In conclusion, hospital antimicrobial consumption data facilitate deeper understanding of our antibiotic use, and they can help in identifying targets for quality improvement and antimicrobial stewardship. In addition, the availability of hospital antimicrobial consumption allows hospitals to compare their consumption with others, with the aim of adopting the best healthcare practices.[9,10]

Acknowledgments.

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

Conflicts of interest. All authors report no conflicts of interest relevant to this article.

References

1. Aldeyab M, López-Lozano JM, Gould IM. Global antibiotics use and resistance. In Z-U-D Babar, editor, *Global Pharmaceutical Policy*. New York: Palgrave Macmillan; 2020:331–344.
2. Jirjees FJ, Al-Obaidi HJ, Sartaj M, *et al.* Antibiotic use and resistance in hospitals: time-series analysis strategy for determining and prioritising interventions. *Hosp Pharma Eur* 2020;95:13–19.

3. Conlon-Bingham GM, Aldeyab M, Scott M, *et al.* Effects of antibiotic cycling policy on incidence of healthcare-associated MRSA and *Clostridioides difficile* infection in secondary healthcare settings. *Emerg Infect Dis* 2019;25:52–62.
4. Resolution WHA 68-7. Global action plan on antimicrobial resistance. In: *Sixty-eighth World Health Assembly,* Geneva, *26 May* 2015. *Annex 3.* Geneva: WHO; 2015.
5. Sharland M, Gandra S, Huttner B, *et al.* Encouraging AWaRe-ness and discouraging inappropriate antibiotic use—the new 2019 Essential Medicines List becomes a global antibiotic stewardship tool. *Lancet Infect Dis* 2019;19:1278–1280.
6. Klein EY, Milkowska-Shibata M, Tseng KK, *et al.* Assessment of WHO antibiotic consumption and access targets in 76 countries, 2000-15: an analysis of pharmaceutical sales data. Lancet Infect Dis 2020. doi: 10.1016/S1473-3099(20)30332-7.
7. Gupta K, Hooton TM, Naber KG, *et al.* International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: a 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clin Infect Dis* 2011;52(5):e103–e120.
8. Metlay JP, Waterer GW, Long AC, *et al.* Diagnosis and treatment of adults with community-acquired pneumonia—an official clinical practice guideline of the American Thoracic Society and Infectious Diseases Society of America. *Am J Respir Crit Care Med* 2019;200(7):e45–e67.
9. *GLASS Guide for National Surveillance Systems for Monitoring Antimicrobial Consumption in Hospitals.* Geneva: World Health Organization; 2020.
10. Aldeyab MA, McElnay JC, Scott MG, *et al.* A modified method for measuring antibiotic use in healthcare settings: implications for antibiotic stewardship and benchmarking. *J Antimicrob Chemother* 2014;69:1132–1141.

Infection prevention versus antimicrobial stewardship: Does nasal povidone-iodine interfere with methicillin-resistant *Staphylococcus aureus* (MRSA) screening?

Cecelia Harrison MPH[1], Robie Zent BSN, RN, CCRC[2], Elyse Schneck BS (MT) ASCP[3], Cynthia E. Flynn MD[4] and Marci Drees MD, MS[2,5,6]

[1]ChristianaCare, Value Institute, Newark, Delaware, [2]Department of Medicine, ChristianaCare, Newark, Delaware, [3]Department of Microbiology, ChristianaCare, Newark, Delaware, [4]Department of Pathology and Laboratory Medicine, ChristianaCare, Newark, Delaware, [5]Department of Quality and Patient Safety and Department of Medicine, ChristianaCare, Newark Delaware and [6]Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania

To the Editor—When healthcare-associated pneumonia (HAP) is suspected, broad-spectrum antibiotics, often including vancomycin, are recommended to include coverage for methicillin-resistant *Staphylococcus aureus* (MRSA).[1] However, a primary goal of antimicrobial stewardship is to rapidly de-escalate these broad-spectrum antibiotics, based on culture results or other clinical data.[2] A causative organism can be identified in some HAP cases and the antibiotics can be appropriately tailored, but in many cases no pathogen is identified, making de-escalation more challenging. To combat this situation, intranasal MRSA screening has been suggested as a stewardship tool because the absence of MRSA in the nares has been found to have a high negative predictive value for MRSA pneumonia.[3]

Universal decolonization by applying chlorhexidine gluconate (CHG) to skin and mupirocin to the nares has been shown in large multicenter studies to reduce MRSA and other bloodstream infections.[4] Due to concerns that widespread use of mupirocin may lead to increasing resistance, many institutions have elected instead to use the antiseptic povidone-iodine (P-I) due to its antistaphylococcal properties and similar outcomes.[5–7]

Although sensitivity of culture-based MRSA screening may decline in the setting of antimicrobial or antiseptic use, PCR can also detect nonviable bacteria.[8] However, after our institution adopted universal nasal decolonization in addition to CHG bathing in our intensive care units (ICUs), staff raised concerns that MRSA nasal screening would no longer be accurate, and data were unable to be identified on this topic in the literature. The goal of this study was to determine whether nasal decolonization with P-I diminishes the utility of polymerase chain reaction (PCR)–based nasal MRSA screening.

Methods

We conducted a prospective cohort proof-of-concept study at our 1,200-bed community-based academic healthcare system from February to July 2019, with an enrollment goal of 20 participants for a convenience sample. Participants were eligible if they were aged ≥18 years, had been admitted to a medical ICU or stepdown unit, and had undergone baseline MRSA nasal screening by PCR (GeneXpert, Cepheid, Sunnyvale, CA) as ordered by their provider that was positive for MRSA. We excluded patients whose expected ICU or stepdown unit length of stay was <48 hours, those whose initial MRSA screen was performed after ≥2 doses of nasal P-I, and those who did not have nasal P-I decolonization performed for any reason (eg, allergy, patient refusal). Participants could only be enrolled once in the study. Verbal informed consent was obtained from each participant.

Intranasal P-I (Aplicare, 7.5%) was applied twice daily for 5 days or until ICU discharge, according to the protocol. Due to availability, Medline P-I (10%) was used from June 2019 until the end of the study. All positive PCR results underwent confirmatory testing via nonquantitative culture using MRSA-specific media (CHROMagar). All baseline PCR-positive results were

Author for correspondence: Cecelia Harrison, E-mail: Cecelia.K.Harrison@Christianacare.org

PREVIOUS PRESENTATION: These data were presented at IDWeek 2020 on October 22–26, 2020, during a virtual poster session.

Cite this article: Harrison C, *et al.* (2022). Infection prevention versus antimicrobial stewardship: Does nasal povidone-iodine interfere with methicillin-resistant *Staphylococcus aureus* (MRSA) screening?. *Infection Control & Hospital Epidemiology*, 43: 945–947, https://doi.org/10.1017/ice.2021.152