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UPDATE

A Nurse's Guide to Antimicrobial Stewardship in Asian Hospitals

AMR&S
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Multidisciplinary antimicrobial stewardship (AMS) teams are required to implement and manage the various interventions used as part of hospital AMS programs to promote the optimal use of antibiotics.[1,2] Nurses are ideally suited to perform many important daily AMS tasks to slow the rapid development of drug-resistant pathogens through optimal infection prevention and control measures and the appropriate use of antibiotics.[3-5] Nurses should therefore play a prominent role in AMS teams.[3,5-8]

This guide describes the daily work of nurses within the AMS program, and the role of the nurse within the AMS team. The guide is intended to provide ideas and examples of ways to make best use of nurses' capabilities in AMS programs. It is not intended to be a comprehensive review of nurse AMS activities. The advice contained in the guide is consistent with recommendations for AMS programs from influential internationally recognized organizations, primarily the US Centres for Disease Control and Prevention (CDC), and the Infectious Diseases Society of America (IDSA)/Society for Healthcare Epidemiology of America (SHEA).[1,9]

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AMS refers to a set of activities designed to 'promote the selection of the optimal antibiotic drug regimen including dosing, duration of therapy, and route of administration'[1]

Tackling antimicrobial resistance with AMS

Excessive and inappropriate use of antibiotics is contributing to a high burden of antimicrobial resistance (AMR) in Asian hospitals.[10-12] When patients have serious bacterial infections, for example sepsis, the benefits of prompt broad-spectrum antibiotic therapy can outweigh potential risks. However, when patients receive antibiotics they do not need, they are put at risk of avoidable adverse effects.[13] For example, antibiotic misuse contributes to infection with *Clostridium difficile* (a diarrheal super-infection), and to the emergence of antibiotic-resistant organisms, such as vancomycin-resistant enterococci and carbapenem-resistant Enterobacteriaceae.[13]

AMS is a selection of interventions designed to encourage the right antibiotic selection, dose, route and duration of therapy, thereby optimizing clinical outcomes and minimizing the unintended effects of antibiotics, including AMR.[1] There are many potential AMS interventions, any number or combination of which can be selected for use in AMS programs (Table 1).[1,14] While nurses may not be directly involved in decision-making regarding all interventions, they must be familiar with them and participate in their implementation as appropriate.[15]

Table 1

A selection of evidence-based AMS interventions[1,2,14]

Intervention	Comments
Core interventions	One or both strategies should be included in all AMS programs
Preauthorization	• Certain antibiotics must be approved before they can be prescribed
Prospective audit and feedback	• Prescriptions for audited antibiotics are reviewed after empiric antibiotic therapy has started, with direct feedback and recommendations to continue, adjust, change or discontinue therapy • Aim to review prescriptions within 48 hours of the start of empiric therapy and again in relation to blood culture results (≥72 hours)
Additional interventions	These strategies should be a part of core interventions processes
Hospital-specific guidelines for common infectious disease syndromes	• Help to standardize prescribing practices based on local resistance patterns, evidence-based guidelines and relevant clinical factors • Use to guide and assess empiric treatment choices, de-escalation, intravenous (IV)-to-oral conversion and duration of therapy
De-escalation	• Review patients for opportunities to switch to narrower spectrum or discontinue antibiotics based on clinical criteria and culture results • Choice of antibiotics for de-escalation during empiric therapy can be based on hospital guidelines, while that for pathogen-directed therapy is based on microbiology results
IV-to-oral conversion	• Change antibiotics with good oral bioavailability from the IV to oral route as soon as possible • Relatively simple strategy applicable to many settings
Dose optimization	• Based on patient characteristics, microorganism, site of infection and pharmacodynamics/ pharmacokinetic principles of antibiotic agents (consider for broad-spectrum ß-lactams) • Individualized pharmacokinetic monitoring and adjustment for IV antibiotics help ensure adequacy of treatment (most important in critically ill patients)

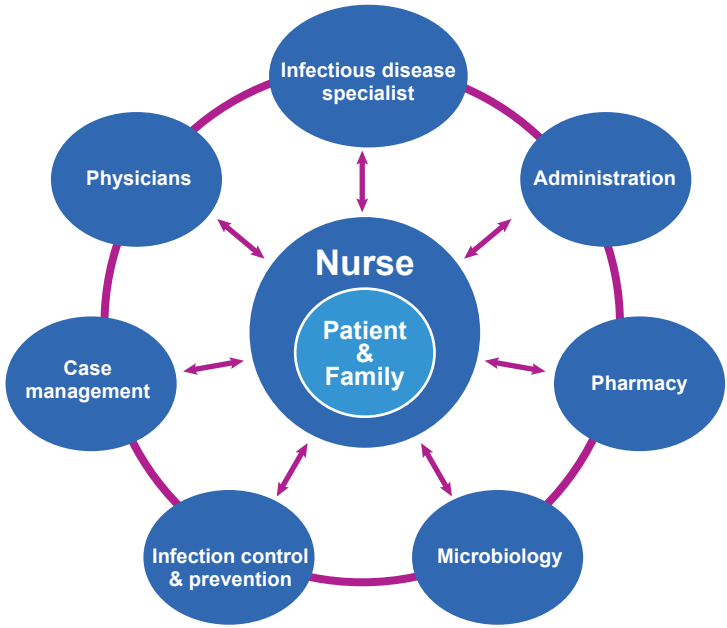
Nurses perform numerous functions that are integral to successful AMS[3]

Nurses as part of the AMS team

Nurses perform numerous functions that are integral to successful AMS, including administering antibiotics, monitoring for optimal antibiotic use, monitoring response to therapy, and ensuring optimal infection prevention and control.[3-5,7-9] Although nurses may not be direct prescribers of antibiotics, bedside nurses can be actively involved in the prescribing decision-making process.[6-8] Nurses play a central role in the communication between members of the AMS multidisciplinary team, which puts them in a perfect position to prompt discussion of appropriate antibiotic treatment and enhance the efficiency of AMS as part of their routine duties.[3,5,8,9] The unique position of the nurse with patient and family at the hub of communication between all of the team involved in antibiotic use is shown in Figure 1.

Figure 1

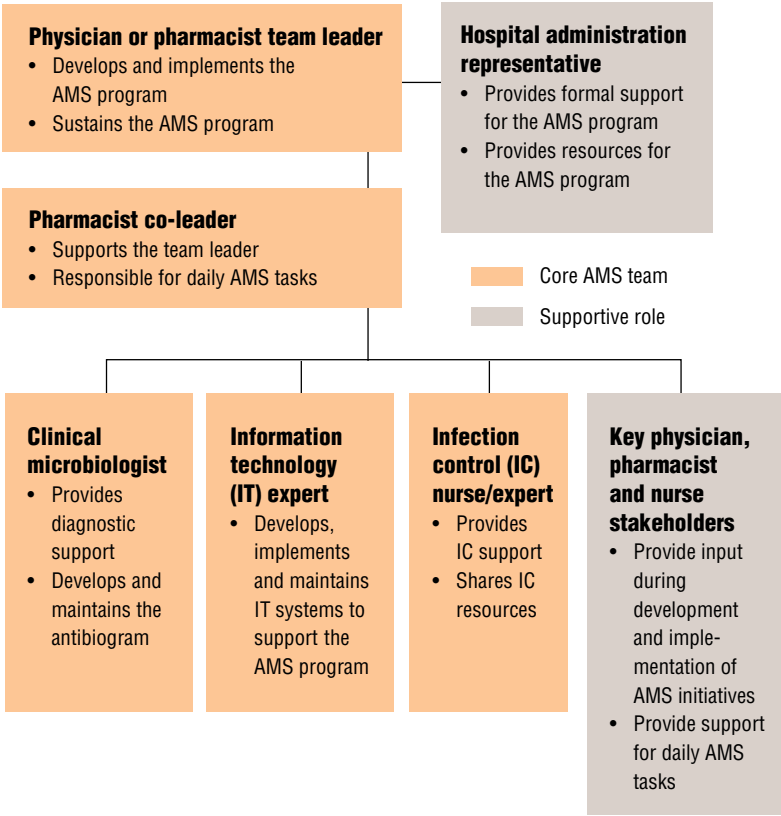
Workflow communication between the stakeholders involved in antibiotic use, demonstrating the central role of the nurse[13]



Nurses are antibiotic first responders and central communicators, and they monitor patient status, safety and response to antibiotic therapy, and co-ordinate their care 24 hours a day.[3,5,7] As part of their central role in patient care and communication, it is essential that nurses in Asian hospitals are aware of and respond to the growing problem of antimicrobial resistance through active engagement in AMS teams and activities (Figure 2).[3,4-6,13] Inclusion of staff nurses on AMS teams can help to encourage widespread acceptance of the AMS program within the hospital.[3,6]

Figure 2

Suggested hospital AMS team structure and function[2,9,14]



Adapted from Apisarnthanarak A, et al. 2018; Dellit HT, et al. 2007; and the Centers for Disease Control and Prevention 2019.

There are many areas where nursing and AMS program functions already overlap[5,7,13]

Nurses' involvement in daily AMS tasks

Nurses have an important role in implementing many AMS activities (Table 2). For example, nurses do all of the following:

- *Take a detailed and accurate allergy history, especially in relation to penicillin allergy.*[3,5,7,13] Medication allergy is assessed either by the triage or admitting nurse.[3] Some patients report that they are allergic to penicillin when they have had a non-allergic adverse event, and this may result in unnecessary avoidance of the most effective narrow-spectrum antibiotic.[16] Nurses should therefore know the difference between a true allergy and non-allergic adverse reactions that would not prevent the use of certain classes of antibiotics.[3]

- *Ensure prompt antibiotic ordering and administration, and that relevant information is available at the point of care.*[3,17] After antibiotics are prescribed by a physician, staff nurses typically submit antibiotic orders to the pharmacy, receive the orders, administer the antibiotics, and record relevant antibiotic information.[3,13] If nurses have access to key information about each patient's antibiotic therapy, including indication, dosage and duration, they are well equipped to ask about changing or stopping antibiotics when appropriate.[17]

Table 2

AMS-related tasks and functions performed by nurses at different stages of inpatient care[5,7,13,15]

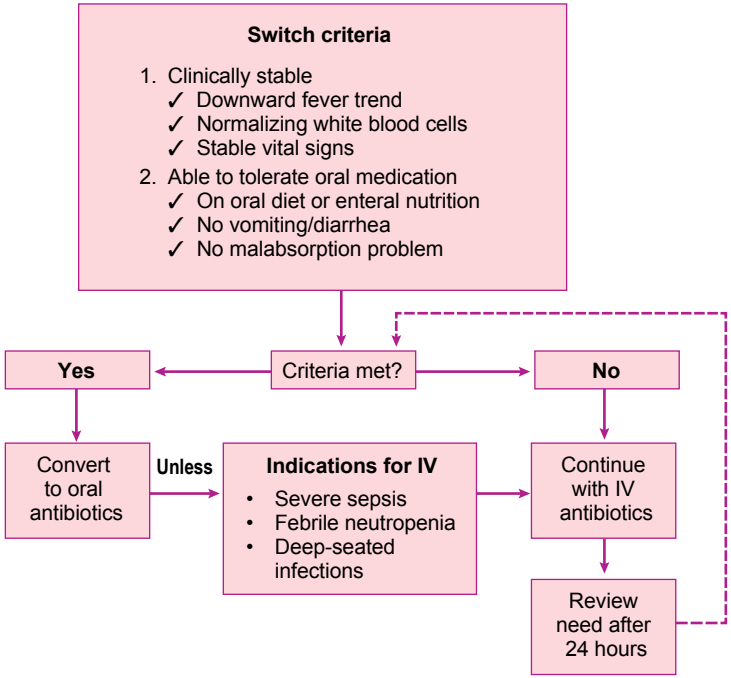
AMS-related activity or task	Nurses' role
Admission	
• Accurate antibiotic allergy history	• Take an allergy history, perform medication reconciliation and record this in the medical record
• Early and appropriate cultures	• Obtain cultures before starting antibiotics and send them to the microbiology laboratory
• Prompt initiation of antibiotics	• Receive antibiotic orders, review dose/timing of dose for accuracy, check for allergy, and administer and document antibiotic administration
Inpatient stay	
• Progress reporting	• Monitor and communicate daily patient progress, clinical status and any drug-related adverse events
• Culture and sensitivity reporting, antibiotic adjustment based on microbiology reports and clinical status	• Obtain culture results, and communicate results to the relevant physician, and participate in discussions regarding opportunities for de-escalation or discontinuation of antibiotics
• Antibiotic dosing and therapeutic drug monitoring	• Update clinical and laboratory renal function tests and drug levels, and work with pharmacists and physicians to ensure that doses are adjusted appropriately
• IV-to-oral conversion	• Monitor the patient's clinical progress and the patient's capacity to take oral medications, and work with pharmacists and physicians regarding IV-to-oral conversion
Discharge	
• Patient education	• Educate the patient on correct use of prescribed antibiotics and minimizing the risk of recurrent infection
	• Inform patients not to buy antibiotics themselves

- *Ensure that appropriate cultures are collected appropriately before starting antibiotics.*[3] Although cultures are generally ordered by a physician, collection and submission of specimens for culture are usually performed by nurses, sometimes without or before the physician's evaluation of the patient.[3,7,9,18] Nurses therefore need to know how to appropriately obtain accurate and standardized specimens for culture.[3,18,19] A concise guide to collecting cultures can be found at: **www.nurseslabs.com/nurses-guide-specimen-collection-preparation-handling-procedures/**.

- *Promote IV-to-oral antibiotic conversion when appropriate.*[5,7,20] Advantages of oral therapy include ease of administration, early discharge opportunities, decreased IV-related adverse events and IV drug cost savings.[20] Nurses should regularly assess the appropriateness of IV antibiotic therapy, and discuss opportunities for conversion to oral therapy with the prescribing physician or other members of the healthcare team.[7,17] See Figure 3 for an example of an IV-to-oral conversion guideline.

Figure 3

The IV-to-oral conversion guideline used by pharmacists during prospective audit as part of the AMS program at Singapore General Hospital[21]



Adapted from Teo J, et al. 2012.

- *Ensure the timely administration of optimal therapy upon receipt of microbiology results.*[18] Nurses are often the first health professionals to be notified of microbiology results.[3,5,18] When microbiology results become available, nurses should be aware of the meaning and implications of these results, and check with the prescribing physician or other members of the healthcare team that the prescribed antibiotic is still the best choice of treatment in relation to any identified orgamisms.[13,17,18] A change to narrower spectrum antibiotic therapy may be appropriate based on culture and susceptibility results,[18,22,23] so this is a good time for the nurse to ask if the prescribed antibiotic is still appropriate and advocate for de-escalation.[17] See Table 3 for an example of de-escalation criteria.

Table 3

Criteria for the de-escalation of broad-spectrum antibiotics used by pharmacists during prospective audit and feedback as part of an AMS program at Tan Tock Seng Hospital, Singapore[22]

	Empiric therapy	**Definitive therapy**
Criteria for de-escalation via switching to narrower spectrum antibiotics	• Temperature <38°C for 24 hours • Not on inotropes • Systolic blood pressure returned to baseline or ≥100 mmHg • Not mechanically ventilated or fraction of inspired oxygen ≤0.4 • Respiratory rate <25 breaths per minute and saturation of oxygen ≥92% on room air	• De-escalation to narrower spectrum antibiotics based on culture and susceptibility results, in the absence of contraindications
Criteria for de-escalation via discontinuation	• Completed course of therapy • No indication or infectious causes identified	

Empiric versus definitive antibiotic therapy[16]

- Microbiology results are generally not available for 24 to 72 hours
- Initial antibiotic therapy is, therefore, usually empiric and guided by clinical presentation and the organisms most likely to be causing the infection at that site of infection
- When the pathogen causing the infection is identified, definitive pathogen-directed antibiotic therapy can be started

- *Evaluate the need for antibiotics during transitions of care.* Nurses should evaluate the need for antibiotic therapy during transitional periods, including when patients are transitioned between hospital care points, such as the intensive care unit to a general ward, and when patients transition from the hospital to the outpatient setting.[17] Nurses should also discuss antibiotic therapy with other nurses during each change-of-shift report.[17] When patients are discharged with a prescription for antibiotic therapy, nurses can educate patients about how to take their antibiotics correctly and minimize the risk of recurrent infection.[3,7]

- *Use hospital guidelines to ensure patients are receiving the right antibiotic, for the right duration, and by the best route.*[13] When available, hospital-specific antibiotic treatment **guidelines** should be used by nurses to assess the appropriateness of antibiotic use. If a nurse realizes that the hospital's empiric antibiotic treatment guidelines have not been followed without a valid reason in a clinically stable patient, it would be appropriate to discuss with the physician on whether broad-spectrum empiric therapy should be de-escalated in accordance with the guidelines.[22,23]

- *Use medication chart review to prompt discussions about antibiotic treatment, indication and duration.*[6,9,13,24] As the healthcare worker primarily responsible for administration of antibiotics, review of medication charts and monitoring response to antibiotic therapy, nurses are well placed to contribute to antibiotic decision-making on general wards or AMS rounds.[6,24] As discussed in preceding points, this may include review of antibiotic therapy, discussions about the appropriateness of de-escalation in relation to clinical status and microbiology results after 2 to 3 days of treatment, and questioning the route of antibiotic administration.[5-7,17]

- *Consistently practice effective infection prevention and control.*[25,26] On its own, AMS is not sufficient to prevent and manage AMR in the hospital.[25,26] Infection control measures, including hand hygiene, contact precaution, environmental cleaning and disinfection, are critical for controlling drug-resistant pathogens, such as multidrug-resistant *Acinetobacter baumannii*, in hospitals.[26] Practices to prevent common healthcare-associated infections, such as central line-associated blood stream infection, catheter-associated urinary tract infection and ventilator-associated pneumonia, are also important.[27,28] All hospital healthcare staff should contribute to infection prevention and control, but nurses have a pivotal role in preventing the transmission of drug-resistant pathogens and may be responsible for educating other staff members on infection control protocols.[25,26] Infection control education resources for nurses can be found at: **www.nursingworld.org/practice-policy/work-environment/health-safety/infection-prevention/**

Successful AMS depends on nurses' ongoing vigilance[15]

Case examples

The following case examples are fictional patients, but the scenarios represent a combination of events based on real-life experiences that show how daily nursing activities contribute to AMS in the hospital setting.

Inpatient admission[15]:

A 32-year-old male paraplegic with a permanent indwelling suprapubic catheter and several prior admissions for urinary tract infections was admitted to the emergency department with rigor, confusion, a rectal temperature of 38.9°C, and a blood pressure of 80/50 mmHg. Blood and urine cultures were collected and he was started on IV fluids, cefepime and gentamicin. The admitting nurse reviewed the patient's records and discovered he had previously been on contact precautions. His urine microbiology culture results from his last hospitalization, 2 months prior, had grown extended-spectrum-ß-lactamase (ESBL)-positive *Klebsiella pneumoniae*, resistant to both cefepime and gentamicin. The nurse called in the infectious diseases physician (who was not scheduled to see the patient until the following morning) and a stat order of ertapenem was prescribed. The following day, both urine and blood cultures grew multidrug-resistant ESBL-positive *K. pneumoniae*.

Take-home point: In the hectic setting of the emergency department, the previous microbiology report was overlooked due to human error. While the patient was treated with an initial protocol that would be appropriate for most patients with sepsis and a suprapubic catheter, it was the wrong choice for him. The nurse's action of taking the initiative to investigate why the patient had previously been on contact precautions led to an intervention that prevented worsening of sepsis and possible death. In addition, her actions prevented the transmission of this resistant organism to other patients.

Inpatient stay[15]:

A 45-year-old woman with severe osteoporosis underwent an uneventful hip nailing after sustaining a left hip fracture from falling. After 3 days, she was transferred to a rehabilitation facility, but during the following week developed methicillin-resistant *Staphylococcus aureus* (MRSA) wound and bloodstream infections and was transferred back to the hospital and to the care of her orthopedic surgeon. After telephone consultation with an infectious disease physician, her surgeon ordered 'vancomycin by pharmacy', an electronic order set developed to ensure optimal dosing and monitoring of IV vancomycin. The woman's wound was drained that evening in the operating room. During the ward round the following morning, the surgeon and infectious disease physician noted the 'vancomycin by pharmacy' protocol flag in her medication administration record and assumed it had been administered. However, it had not been administered due to the fact that per protocol, all preoperative medication orders are automatically discontinued by the physician order entry software and require renewal following surgery. The surgeon and infectious disease physician both assumed the drug had been reordered postoperatively, while the pharmacist thought that the surgeon had deliberately cancelled the agent. A new graduate nurse who was concerned for the patient, knew the patient had been transferred back to hospital specifically due to an MRSA infection and that it had been 24 hours since her last vancomycin dose. While the pharmacy told her that the vancomycin had been discontinued, she had been told at the last shift change that the patient was still receiving 'vancomycin by pharmacy' dosing. The nurse phoned the infectious disease physician who ordered a stat single dose of vancomycin until the problem was resolved.

Take-home point: This mistake was due to an error in the electronic health record. The observation and common sense of the bedside staff nurse allowed this error to be discovered and corrected. This case demonstrates how nurses can protect patients from the errors that can arise from computerized systems.

Inpatient discharge[15]:

A 65-year-old man with a history of penicillin allergy (rash) was admitted to hospital with a collapsed L2 vertebra and increased bone marrow signal intensity on MRI. A vertebral biopsy revealed osteomyelitis due to oxacillin-susceptible *S. aureus*. The hospitalist ordered IV vancomycin because of a history of penicillin allergy (rash) and the man's pain gradually improved. Three days prior to scheduled transfer to the spinal rehabilitation unit, he developed a bullous skin rash, presumed to be an allergic reaction to vancomycin. His prescription was changed to IV daptomycin. Unfortunately, the rehabilitation unit cancelled his transfer as they did not supply daptomycin. The patient's nurse reassessed the situation and recognized that histories of penicillin allergy are often inaccurate. She consulted with the infectious disease physician who ordered a test dose of ceftriaxone under careful nursing monitoring. The man did not develop any allergic reactions to the agent and he was subsequently treated with ceftriaxone and transferred to the rehabilitation unit. He then received IV therapy at home and returned to work.

Take-home point: It is well known that penicillin allergy history is unreliable and a poor predictor of true allergic reactions. The nurse identified this as a potential issue and organized testing of the patient, with a positive outcome.

These case examples may include information about non-approved uses of certain pharmaceutical products for the purpose of scientific information exchange, which does not represent the opinion of any specific pharmaceutical company. Full prescribing information and primary references should be consulted for complete safety and efficacy information relating to the locally approved use of pharmaceutical products.

AMS education and training for nurses

Nurses are not typically prescribers of antibiotics, so they often do not view their activities as contributing to AMS.[3,7,13,15] AMS education is therefore important to make sure nurses feel confident about their ability to contribute to AMS.[3,6,7,24] Practical educational topics for nurses include the following:

- How best to obtain cultures and interpret the results[13]
- The role of treatment guidelines[3]
- Differences between infection and colonization[3,13]
- Differences between antibiotic-related adverse events and true antibiotic allergies[3,13]
- Considerations for IV-to-oral conversion, and good antibiotic candidates for conversion (eg, fluoroquinolones)[3,13]
- Training to engage in discussions with pharmacists and physicians regarding antibiotic treatment[13]

Nurses can make individual efforts to improve their knowledge of infectious disease- and AMS-related issues by making use of online educational resources and courses:

- The US Centers for Disease Control and Prevention (CDC) **Antibiotic Prescribing and Use** website is a comprehensive educational resource (**www.cdc.gov/antibiotic-use/healthcare/index.html**)
- A free online AMS course for healthcare professionals is available at **www.futurelearn.com/courses/antimicrobial-stewardship**

Summary

Nurses already make meaningful contributions to AMS programs as part of their routine daily activities, and should be formally integrated into AMS teams in Asian hospitals. Nurses are the most consistent providers of patient care, and as such AMS programs rely on nurses to:

- Follow infection prevention and control protocols
- Correctly administer antibiotics at the right time
- Monitor the effects of antibiotic treatment and any adverse events
- Obtain appropriate culture specimens, submit specimens to the microbiology laboratory, and update physicians on the latest microbiology report once available
- Actively discuss opportunities for IV-to-oral conversion and de-escalation of antibiotic therapy with pharmacists and prescribing physicians
- Provide patients with education about antibiotics and their appropriate use

References

1. Barlam TF, et al. Implementing an antibiotic stewardship program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis* 2016;62:e51-e77.
2. Apisarnthanarak A, et al. Antimicrobial stewardship for acute-care hospitals: An Asian perspective. *Infect Control Hosp Epidemiol* 2018;39:1237-1245.
3. Olans RN, et al. The critical role of the staff nurse in antimicrobial stewardship – Unrecognised, but nearly there. *Clin Infect Dis* 2016;62:84-89.
4. Alividza V. Reducing drug resistance through antimicrobial stewardship strategies. *Nursing Times* 2017;113:22-25.
5. Olans RD, et al. Nurses and antimicrobial stewardship: Past, present, and future. *Infect Dis Clin North Am* 2020;34:67-82.
6. Ha DR, et al. A multidisciplinary approach to incorporate bedside nurses into antimicrobial stewardship and infection prevention. *Jt Comm J Qual Patient Saf* 2019;45:600-605.
7. van Gulik N, et al. Perceived roles and barriers to nurses' engagement in antimicrobial stewardship: A Thai qualitative case study. *Infect Dis Health* 2021;26:218-227.
8. Wong LH, et al. Empowerment of nurses in antibiotic stewardship: a social ecological qualitative analysis. *J Hosp Infect* 2020;106:473-482.
9. Centers for Disease Control and Prevention. Core elements of hospital antibiotic stewardship programs. Available at: www.cdc.gov/antibiotic-use/core-elements/hospital.html. Accessed July 2022.
10. Hsu LY, et al. Carbapenem-Resistant *Acinetobacter baumannii* and Enterobacteriaceae in South and Southeast Asia. *Clin Microbiol Rev* 2017;30:1-22.

11. Lai CC, et al. High burden of antimicrobial drug resistance in Asia. *Int J Antimicrob Agents* 2014;37:291-295.

12. Suwantarat N, Carroll KC. Epidemiology and molecular characterization of multidrug-resistant Gram-negative bacteria in Southeast Asia. *Antimicrob Resist Infect Control* 2016;5:15.

13. American Nurses Association/Centers for Disease Control and Prevention (ANA/CDC). White Paper: Redefining the antibiotic stewardship team: Recommendations from the American Nurses Association/Centers for Disease Control and Prevention workgroup on the role of registered nurses in hospital antibiotic stewardship practices. 2017. Available at: www.cdc.gov/antibiotic-use/healthcare/pdfs/ana-cdc-whitepaper.pdf. Accessed July 2022.

14. Dellit HT, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis* 2007;44:159-177.

15. Olans RD, et al. Good nursing is good antimicrobial stewardship. *Am J Nurs* 2017;117:58-63.

16. Leekha S, et al. General Principles of Antimicrobial Therapy. *Mayo Clin Proc* 2011;86:156-167.

17. Manning ML. Antibiotic stewardship for staff nurses. American Nurse Today 2016. Vol 11(5). Available at: www.americannursetoday.com/antibiotic-stewardship-staff-nurses. Accessed January 2022.

18. Morency-Potvin P, et al. Antimicrobial stewardship: How the microbiology laboratory can right the ship. *Clin Microbiol Rev* 2016;30:381-407.

19. Shepherd E. Specimen collection 1: general principles and procedure for obtaining a midstream urine specimen. *Nursing Times* [online];113:7, 45-47.

20. Gillespie E, et al. Improving antibiotic stewardship by involving nurses. *Am J Infect Control* 2013;41:365-367.

21. Teo J, et al. The effect of a whole-system approach in an antimicrobial stewardship programme at the Singapore General Hospital. *Eur J Clin Microbiol Infect Dis* 2012;31:947-955.

22. Lew KY, et al. Safety and clinical outcomes of carbapenem de-escalation as part of an antimicrobial stewardship programme in an ESBL-endemic setting. *J Antimicrob Chemoth* 2015;70:1219-1225.

23. Liew YX, et al. Prospective audit and feedback in antimicrobial stewardship: Is there value in early reviewing within 48 h of antibiotic prescription? *Int J Antimicrob Agents* 2015;45:168-173.

24. Edwards R, et al. Covering more territory to fight resistance: Considering nurses' role in antimicrobial stewardship. *J Infect Prev* 2011;12:6-10.

25. Levy Hara G, et al. Ten key points for the appropriate use of antibiotics in hospitalised patients: A consensus from the Antimicrobial Stewardship and Resistance Working Groups of the International Society of Chemotherapy. *Int J Antimicrob Agents* 2016;48:239-246.

26. Cheon S, et al. Controlling endemic multidrug-resistant *Acinetobacter baumannii* in Intensive Care Units using antimicrobial stewardship and infection control. *Korean J Intern Med* 2016;31:367-374.

27. Apisarnthanarak A, et al. National survey of practices to prevent health care-associated infections in Thailand: The role of prevention bundles. *Am J Infect Control* 2017;45:805-810.

28. Nagel JL, et al. Antimicrobial Stewardship for the Infection Control Practitioner. *Infect Dis Clin North Am* 2016;30:771-784.

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