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INSTRUCTIONS

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Antimicrobial stewardship in community pharmacy practice

by Matthew Swankhuizen, BSc(Pharm), CDE, PharmD



Learning objectives

After successful completion of this lesson, pharmacy technicians will be able to do the following:

1. Describe the basic mechanism of bacterial resistance and transmission.
2. Define antimicrobial stewardship and discuss its potential role and benefits within the community.
3. Discuss the role of the pharmacy team, specifically the pharmacy technician, with respect to infection control and antimicrobial stewardship.

Introduction

According to the World Health Organization (WHO), antimicrobials (see Table 1) are one of the most important health discoveries of the twentieth century, adding an estimated 20 years to our life expectancy.⁽¹⁾ The WHO also

recognizes that antimicrobial resistance is one of the most serious public health threats to the treatment of infectious diseases worldwide.⁽¹⁻³⁾ If this trend continues, we could be facing an era without effective antibiotics—a post-antibiotic era.

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Resistance to antimicrobials is persistent, has developed slowly, and is almost completely attributable to our suboptimal use of these agents.⁽⁴⁾ Overuse, coupled with the lack of development of new agents, and persistent drug shortages has resulted in the current crisis we are facing.⁽¹⁻³⁾ A post-antibiotic era will resemble a time before antibiotics; when 33% of patients died from pneumonia (compared with < 5% today), 10% died from skin and soft tissue infections (compared with < 1% today), ear infections caused deafness, and surgical procedures had much higher risks of serious infection and death.⁽²⁾

How do we know this will happen? “Superbugs” (see Table 1) are becoming more common in both hospitals and the community. They are allowing us to see the effects that untreatable organisms have on society. These effects include the 250,000 people per year in Canada who develop serious infections that are resistant to one or more antibiotics.^(3,4) These infections cost our healthcare system an extra \$1 billion annually and, despite highly specialized care, approximately 10,000 of these people die each year. In addition, patients with antibiotic-resistant organisms tend to have longer hospital stays and poorer long-term outcomes.^(1,2,4)

This lesson reviews the basic mechanism of antimicrobial resistance and factors that contribute to its development. Additionally, it suggests ways that pharmacy technicians can improve antimicrobial usage and also provides strategies to help prevent the spread of infectious diseases through collaboration with other members of the healthcare team.

Mechanism of resistance and transmission

The development of antimicrobial resistance (Figure 1) is inevitable, but it can be delayed.⁽⁴⁾ Like all living organisms, bacteria follow the basic rules of natural selection, in that mutations can take place when organisms multiply.⁽⁴⁾ In humans and animals, these mutations happen slowly over thousands of years because we do not multiply that rapidly. In contrast, bacterial cells multiply extremely rapidly, resulting in the potential for many mutations and many changes in a short amount of time. Antimicrobial medications slow the growth of or kill most

TABLE 1 - Definitions

Antimicrobials	Natural, semisynthetic or synthetic substances that destroy or inhibit the growth of micro-organisms. These include antibiotics, antifungals and antivirals.
Antimicrobial resistance	The ability of microbes to grow in the presence of a chemical (drug) that would normally kill them or limit their growth.
Broad-spectrum antibiotic	An antibiotic that kills or prevents the growth of many different species of bacteria.
<i>Clostridium difficile</i>	A bacterium that causes mild to severe diarrhea and intestinal conditions like pseudomembranous colitis (inflammation of the colon). It occurs most often in patients whom have been treated with antibiotics.
Empiric therapy	Treatment of an infection with an antimicrobial before knowing which organism is causing the disease.
Infection control	Addresses factors related to the spread of infections within the healthcare setting. This includes prevention (via hand hygiene/hand washing), monitoring or investigation of demonstrated or suspected spread of disease, and management of outbreaks.
Narrow-spectrum antibiotic	An antibiotic that kills or prevents the growth of only a few organisms. Typically targeted to those organisms usually responsible for the infection.
Suboptimal antibiotic use	Antibiotic use when not indicated, or the wrong drug, dose, or duration of therapy.
“Superbugs”	Organisms that are resistant to multiple antimicrobials, to the point where therapeutic options are very limited.

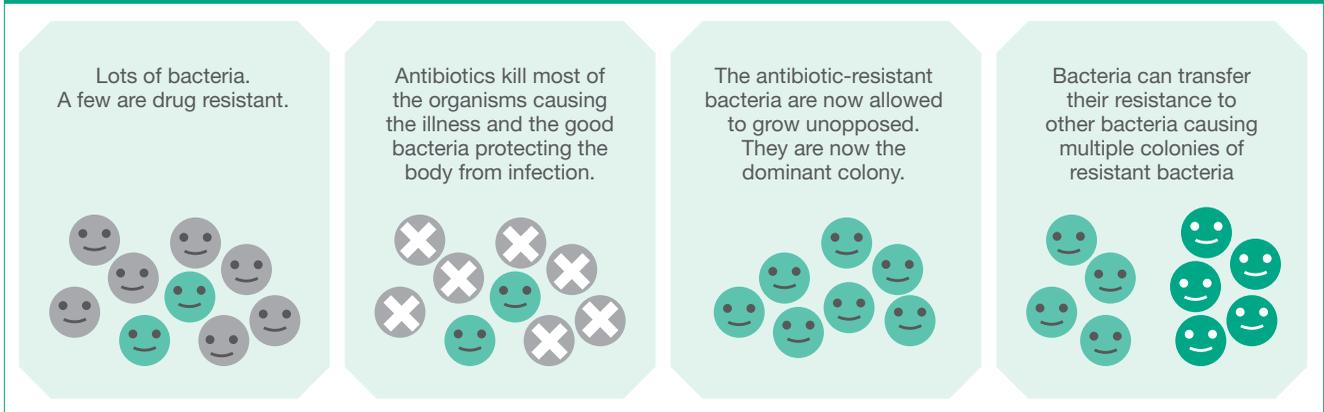


bacteria; however, some will persist if they have developed a mutation that allows them to survive the antibiotic exposure. These bacteria will then multiply unopposed and become the dominant colony. Other bacterial species colonizing the host can acquire resistance from the mutated bacteria, allowing for multiple organisms to become resistant, simply from the use of a

single antibiotic (Figure 1).

Transmission of these resistant organisms is generally facilitated by healthcare workers in the hospital and in the community.⁽¹⁻⁵⁾ A healthcare worker may touch a patient who is colonized by an antibiotic-resistant organism. They then touch a doorknob or sink before washing their hands. The healthcare worker may also

FIGURE 1 - How resistance develops



not practise proper or regular hand-washing techniques, allowing the spread of resistant organisms to many objects, including other patients. The objects or patients that were touched can become colonized; if another person touches that object or patient they can pick up the organism and transmit it, continuing the cycle.

What factors promote the development of resistance?

Antibiotic exposure is the single most important risk factor for the development of a resistant organism.^(1,3,4) Common colds, the flu (influenza), most sore throats and cases of acute bronchitis are caused by viruses; these infections will not respond to antibiotics.⁽¹⁻⁵⁾ Despite numerous public health campaigns, commercials and programs like Do Bugs Need Drugs? (www.dobugsneeddrugs.org), approximately 50% of Canadians still believe that these illnesses can be treated with antibiotics.⁽⁵⁾

In addition, despite community antimicrobial stewardship programs that are aimed at prescribers, most evidence suggests that approximately 50% of prescriptions for antibiotics are inappropriate.^(1,7,8) In one American study, antibiotics were prescribed to 73% of patients with a sore throat; this is despite the fact that 85%–95% of sore throats are caused by viruses.^(7,8) Another study found that 75% of patients with acute bronchitis were prescribed antibiotics, again despite the fact that 90% of cases of acute bronchitis are caused by a virus.^(6,8)

Other factors contributing to the development of antimicrobial resistance include the use of broad-spectrum antibiotics (Table 1) for infections that can be

treated with narrow-spectrum agents (Table 1), and the use of antibiotics with significant local resistance as empiric therapy (Table 1) for commonly encountered infections.^(4,5)

Both of these examples select for resistance by killing off many of the bacteria that colonize our skin and respiratory and gastrointestinal tracts, allowing for more resistant organisms to become the dominant colony; these can then be spread.⁽⁴⁻⁶⁾ Commonly cited examples of unnecessary use of broad-spectrum antibiotics include using moxifloxacin for outpatient management of community-acquired pneumonia in patients who are not allergic to penicillin, clindamycin for dental infections, and amoxicillin/clavulanic acid for uncomplicated urinary tract infections.⁽⁶⁾ Using ciprofloxacin as empiric therapy for urinary tract infections is an example of empiric use of an agent with significant resistance. In some areas in Canada, about 25% of *Escherichia coli* (*E. coli*) are resistant to ciprofloxacin. Using this drug empirically may not be effective in treating the infection in up to 25% of patients, and can contribute to the development of resistance.

One contributing factor may be beyond pharmacy's immediate control, which is the use of antibiotics in food products from animals. However, many within the infectious diseases community are lobbying to limit the use of antibiotics in our food supply. In Canada, approximately 88% of antibiotic use by weight is for animals, to promote their growth and guard against disease and infection. Such use has the real potential to contribute to resistance.⁽⁴⁾ When we are in contact with meat, eggs or other animal products, transmission of antibiotic-resistant bacteria can occur. Overuse of antibiotics in

animals has been linked to the development and transmission of drug resistant *E. coli*, *Enterococcus* and *Salmonella*.^(4,9)

Antimicrobial stewardship

Antimicrobial stewardship is defined as “the optimal selection, dose and duration of an antimicrobial that results in the best clinical outcome for the treatment or prevention of infection, with minimal toxicity to the patient and minimal impact on subsequent resistance.”⁽⁴⁾ While antimicrobial stewardship programs take many forms, all use a team approach to improve the use of antibiotics through direct feedback (e.g., contacting the prescriber to advise on switching or stopping an antibiotic), education (e.g., speaking with local physicians about bacterial resistance issues) and guideline development (e.g., collaborating with local family physicians to develop pre-printed orders for commonly encountered infections).⁽¹¹⁾

These programs are already a large part of institutional practice.⁽⁴⁾ An active stewardship program must be in place as part of accreditation for all Canadian hospitals and long-term care facilities. However, despite the efforts of institutional stewardship programs, resistance is still marching forward. This may be due to the fact that hospital antibiotic use only accounts for a small proportion of overall usage. In fact, about 90% of antibiotics are prescribed in the community, making the community pharmacy the perfect place to start some form of antimicrobial stewardship program.⁽⁶⁾

The benefits of antimicrobial stewardship programs cannot be overstated. Research overwhelmingly shows that these programs



reduce the occurrence of *Clostridium difficile* infection, resistance and adverse drug reactions, and save the healthcare system a significant amount of money.⁽⁴⁾

The pharmacy technician's role

As an important part of the pharmacy team, the pharmacy technician can have a significant impact on improving antibiotic use and preventing the spread of disease.

Preventing unnecessary antibiotic use is essential in preventing resistance. Pharmacy technicians can help contribute to this goal by ensuring that patients who present to the pharmacy with what may be a self-limiting viral infection (e.g., common cold or influenza) are referred to the pharmacist for counselling and selection of optimal over-the-counter (OTC) medication. Counselling these patients on viral versus bacterial infection and suggesting both non-drug measures and potential OTC medications, can reduce the likelihood that the patient will visit a physician and be prescribed an antibiotic.

Pharmacy technicians can also play an integral role in educating patients on the nuances of colds and influenza within the pharmacy and help prevent potentially unnecessary doctor's visits and antibiotic prescriptions. They can do this by handing out pre-developed educational materials from the Do Bugs Need Drugs? or the Canadian Paediatric Society's websites during the height of the cold and influenza season to promote wise use of antibiotics and proper hand washing (see Table 2).

They can also engage patients by asking questions then referring them to the pharmacist, or by providing appropriate educational materials.

Another important role for the pharmacy technician is pre-screening patients for vaccinations. As pharmacy technicians are often the first and last point of contact, they are in a perfect position to pre-screen patients for influenza and pneumococcal vaccines. Once pre-screened, the patient can be referred to the pharmacist for confirmation of eligibility and vaccination. This prevents the development of resistance directly, by preventing the primary infection, and indirectly, by preventing bacterial superinfection after a vaccine-preventable illness.

In some patients, antibiotics are prescribed for longer periods (> 14 days). These types of prescriptions should always be flagged by the pharmacy technician so that the pharmacist can investigate further. While some infections require more than 14 days of treatment, therapy that is too long can contribute to the development of resistance, specifically the development of methicillin-resistant *Staphylococcus aureus* (MRSA).^(1,4,5,10) Two examples of prescriptions that should be investigated include any long-term antibiotic for urinary tract infections (> 7 days) and daily macrolide (e.g., clarithromycin, azithromycin) therapy for prevention of chronic obstructive pulmonary disease exacerbation) with a duration of treatment greater than 10 days. While there is some evidence to suggest that daily macrolides may be effective to

prevent exacerbations, long-term use may contribute to resistance and increase the risk of cardiac arrhythmias.^(12,13) Each patient should have the risks versus benefits of treatment carefully assessed at each encounter to ensure appropriateness.

About 50% of Canadians prescribed an antibiotic do not finish the entire course. Pharmacy technicians can improve this statistic and help reduce resistance by ensuring the patient is counselled by a pharmacist.⁽⁴⁾ When handing out a prescription for an antibiotic, confirm that the patient has been counselled by a pharmacist on the reason why they are taking the antibiotic, how to take the antibiotic, the importance of completing the course even if they feel better, the importance of not reusing or sharing unused portions, and the importance of returning any unused antibiotics to the pharmacy for proper disposal.

Finally, while not specifically part of stewardship program, infection control (Table 1) enhances antimicrobial stewardship and is equally important in the war against antibiotic resistance. Because pharmacy technicians are often in contact with

TABLE 2 - Useful antimicrobial stewardship websites

- **Alliance for the Prudent use of Antibiotics**
<http://www.tufts.edu/med/apua/>
- **Canadian Paediatric Society**
<http://www.cps.ca/documents/position/antimicrobial-stewardship>
http://www.caringforkids.cps.ca/handouts/antibiotic_use_in_infections
- **Canadian Antimicrobial Resistance Alliance**
<http://www.can-r.com/>
- **Do Bugs Need Drugs?**
<http://www.dobugsneeddrugs.org/>
- **Health Canada**
<http://healthycanadians.gc.ca/drugs-products-medicaments-produits/antibiotic-resistance-antibiotique/index-eng.php>
- **University Health Network (Toronto)**
<http://www.antimicrobialstewardship.com/>

hundreds of patients every day, the importance of regular hand washing cannot be overstated. We know that the single most important mode of transmission of antibiotic-resistant microorganisms in a healthcare setting is via transiently colonized hands of healthcare workers, who acquire it from contact with colonized or infected patients or after handling contaminated material or equipment.⁽¹⁻⁵⁾ With this in mind, the most important activity that pharmacy technicians can do to reduce the development of antimicrobial resistance is to wash their hands correctly and on a regular basis. This can be easily done using an alcohol-based rub when hands are not visibly soiled, or by washing your hands with soap and warm water for approximately 20 seconds when they are soiled.⁽¹⁻⁵⁾ This simple preventive strategy is very effective in protecting you and your patients, so make sure to wash your hands frequently throughout the day.

Conclusion

The evolving role of the pharmacist and pharmacy technician provides a perfect opportunity for community pharmacy to innovate and become part of the solution in

preventing antimicrobial resistance. Resistance will continue to move forward, but we can play a valuable role in delaying resistance and preventing the spread of antibiotic-resistant organisms by implementing just a few changes within the pharmacy. Distribute appropriate patient education pamphlets (e.g., wise use of antibiotics, proper hand washing, colds versus flu) to patients, develop a regular hand-washing procedure and help the pharmacist ensure that each antibiotic is indicated, effective, safe and used for an optimal duration. While these may seem like small changes, they will help ensure that antibiotics are effective for generations to come.

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QUESTIONS

Please select the best answer for each question and answer online at www.CanadianHealthcareNetwork.ca for instant results.

1. Before the development and mass production of antibiotics, approximately what percentage of patients died from pneumonia?
 - a) 50%
 - b) 28%
 - c) 3%
 - d) 33%
2. As a healthcare provider, what is the most important thing you can do to prevent the spread of antibiotic-resistant organisms?
 - a) Start an antimicrobial stewardship program in your pharmacy to ensure the judicious use of antibiotics
 - b) Determine a patient's eligibility for vaccination and encourage them to keep their vaccines up to date
 - c) Ensure you wash your hands regularly with hand sanitizer and, if soiled, use soap and water
 - d) Triage patients to the pharmacist when they have questions with respect to common infections that are viral in nature
3. The development of which "superbug" is directly related to the duration of antibiotic use?
 - a) Extended spectrum beta-lactamase producing-Enterobacteriaceae
 - b) Methicillin-resistant *Staphylococcus aureus* (MRSA)
 - c) Vancomycin-resistant *Staphylococcus aureus* (VISA)
 - d) *Clostridium difficile*
4. Approximately how many people die each year in Canada due to antibiotic-resistant organisms?
 - a) 23,000
 - b) 2,000,000
 - b) 18,000
 - d) 10,000
5. Which of the following has contributed to the worry of a post-antibiotic era?
 - a) Patients are more sick and require antibiotics more frequently for infections
 - b) Overuse of antibiotics for the treatment of viral illnesses
 - c) Antibiotics being inappropriately used for bacterial infections
 - d) All of the above
6. Which of the following prescriptions for antibiotics should be referred to a pharmacist for follow-up?
 - a) Daily azithromycin for 1 year for a patient with chronic obstructive pulmonary disease
 - b) Ciprofloxacin daily for 7 days for an uncomplicated urinary tract infection
 - c) Moxifloxacin daily for 7 days for a patient with acute bronchitis
 - d) All of the above

7. What does an antimicrobial stewardship program consist of?
- Ensuring the optimal drug, dose and duration of use of an antibiotic to maximize clinical benefit and minimize resistance
 - Ensuring proper hand washing
 - Preventing the use of both appropriate and inappropriate antibiotic use
 - Promoting a healthy diet and exercise regimen to prevent infection
8. Which of the following strategies can be implemented in a community pharmacy to prevent the development and spread of antimicrobial-resistant organisms?
- Providing influenza and pneumococcal vaccines to eligible patients
 - Develop a stewardship program within your pharmacy that uses resources provided by resources such as Do Bugs Need Drugs?
 - Develop a standardized hand washing procedure for pharmacy staff
 - All of the above
9. How many antibiotic prescriptions are inappropriate?
- 50%
 - 73%
 - 75%
 - 30%
10. Studies suggest that half of patients do not finish their full course of antibiotics. What would be the most important concern with this?
- An increased risk of an antibiotic-resistant organism
 - There is no concern with not finishing the course
 - The patient would remain ill and require a second course of antibiotics
 - The antibiotics might be saved and may be taken in future without a valid diagnosis of a bacterial infection
11. What biological theory explains the mechanism behind bacterial resistance?
- Natural selection
 - Exponential growth
 - Transfer of resistance between species
 - A and C
12. How long should you wash your hands with soap and water for?
- 20 sec
 - 30 sec
 - 1 minute
 - 5 sec
13. What is the preferred method for washing your hands when they are visibly soiled?
- Alcohol rub
 - Soap and water
 - It doesn't matter as long you wash them
 - Soap and water then alcohol rub
14. Which of the following infections should be treated with antibiotics?
- Influenza
 - The common cold
 - Acute bronchitis
 - Community-acquired pneumonia
15. What are the benefits of antimicrobial stewardship programs?
- A reduction in antibiotic-resistant organisms
 - Reduced risk of *C. difficile* infection
 - Reduced costs to the healthcare system
 - All of the above

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