

Antimicrobial resistance, the ability of microbes to become resistant to known antimicrobial medications, is a growing and serious global health concern. There are growing numbers of publications about efforts to educate nurses about antimicrobial resistance, and efforts to involve nurses in antimicrobial stewardship in acute and long-term care settings; however, this has not been the case in home care. Home care organizations are required to address infection control and surveillance, including patient, family, and staff education. Home care nurses play an important role in identifying infections, performing cultures, and teaching patients and families. This article provides an overview of antimicrobial resistance and antimicrobial stewardship and provides antimicrobial stewardship actions for home care nurses and agencies. In the interest of public health, home care agencies and nurses can, and should, educate themselves and patients about antimicrobial resistance and employ antimicrobial stewardship strategies.

Antimicrobial Resistance and Antimicrobial Stewardship in Home Healthcare

Antimicrobial resistance (AMR) occurs when microorganisms evolve and develop the ability to protect themselves from the effects of antimicrobial medications. Antimicrobial resistance is a serious public health concern that is multifaceted and threatens human health, the global economy, as well as national and international security (White & Hughes, 2019). Globally, AMR is increasing exponentially (Klein et al., 2018), and if enough is not done, there could be as many as 10 million annual AMR-related deaths from an array of infections by 2050 (Review on Antimicrobial Resistance, 2016). The World Health Organization (WHO) has placed AMR in the top 10 threats to global health in 2019 (WHO, 2019). In the United States, an estimated 2.8 million AMR-related infections occur annually, accounting for 8 million extra hospital days, 35,000 deaths, and 20 billion in direct healthcare costs (Centers for Dis-

ease Control and Prevention [CDC], 2019a; Hughes, 2011). In the United States, at least 47 million antibiotic prescriptions each year are unnecessary and this represents about 30% of all prescribed antibiotics (CDC, 2019b).

Any antibiotic use, whether in people, animals, or crops, can lead to resistance. (Figure). Two recent examples highlight the threat of emergence and geographic spread of antibiotic resistance genes beyond the borders of countries and healthcare settings. New Delhi metallo-beta-lactamase (NDM-1), an enzyme that confers resistance to a wide range of commonly used antibiotics, emerged in the Indian subcontinent and spread to the United Kingdom as a result of medical tourism after first being detected in 2008 (Yong et al., 2009). Interestingly, the NDM-1 was subsequently detected in surface and tap water samples in India in 2010 and in the environment in Bangladesh,

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indicating the likelihood of environmental origin and worldwide spread of this gene and its variants (Islam et al., 2017; Khan et al., 2017; Walsh et al., 2011). Furthermore, the NDM-1 gene was recently detected in the soil in a remote Norwegian region, raising the possibility of spread by feces from migratory birds (McCann et al., 2019). In another example, the mobilized colistin resistance-1 gene, a plasmid-borne gene related to colistin resistance, was detected in pigs in China in 2014 and has subsequently spread in other countries (Marston et al., 2016; Wang et al., 2018).

Reducing AMR

Although efforts to reduce AMR exist in acute, outpatient, and long-term care facilities, to our knowledge, there is less focus on reducing AMR in patients served by home care organizations. The WHO (2018) identified AMR competencies for nurses which are relevant to home care nurses:

- Assessing the source of infection and identifying appropriate measures
- Obtaining allergy history, medication reconciliation
- Educating patients/families/the public on the importance of infection prevention
- Administering/monitoring antimicrobial medication use
- Updating clinical/laboratory results
- Monitoring for adverse events of antimicrobial treatment
- Understanding the role of the nurse in “antimicrobial stewardship”

Home care organizations in the United States are required to address infection control and surveillance including education to staff, patients, and caregivers as required under the Conditions for Participation for Home Health Agencies (Centers for Medicare and Medicaid, 2017). This article specifically focuses on strategies for the development and implementation of antimicrobial stewardship (AS) actions in the home care setting. Although this article is primarily aimed at home care nurses, it is recognized that other home care clinicians, such as therapy staff, apply principles of infection prevention and educate patients about medications.

Antimicrobial stewardship, also commonly referred to as antibiotic stewardship, is defined as a coordinated program that promotes the appropriate use of antimicrobials (including antibiotics),

improves patient outcomes, reduces microbial resistance, and decreases the spread of infections caused by multidrug-resistant organisms (Association for Professionals in Infection Control and Prevention, n.d.). Although efforts to educate and involve nurses in AS are growing in acute care and long-term care settings, this has not been the case in home care. Yet, home care nurses can play a critical role in AS. They work independently, assessing patients, identifying signs of infection, communicating with providers about treatment, providing patient education, and assessing/ensuring that patients take medications as prescribed. Therefore, home care nurses must understand the broader issue of AMR, inappropriate/overuse of antimicrobial medications, the concepts of AS, and evaluate their role in appropriate patient/family education about proper use of antimicrobial medications and treatment of infection.

Prevalence of Infections Beyond the Hospital Setting

Infections are common among patients receiving home care services and likely underestimated as a problem (Shang et al., 2018). Based upon United States data from the Outcome and Assessment Information Set (OASIS), 17% of unplanned hospitalizations were due to infection, most commonly respiratory, wound, and urinary infections (Shang et al., 2015). Yet, what is less well documented in the literature is the prevalence and appropriateness of antimicrobial treatment of infections occurring during the course of home care and not resulting in hospitalizations. The most common category of adverse events in a retrospective medical record review of home care patients in Sweden was infection with most adverse events considered preventable (Schildmeijer et al., 2018). Urinary tract infections (UTI) are common across the world and among home care patients. In England, approximately 90,000 patients in the community use long-term urinary catheters resulting in high rates of emergency department usage and catheter-associated UTIs (Ansell & Harari, 2017; Gage et al., 2017). In a home care study out of Taiwan, 47% of patients had at least one UTI with an indwelling urinary catheter being the most important risk factor (Shih et al., 2019).

Data are more available for long-term care settings (e.g., skilled nursing facilities) substantiating a high prevalence of infections and antimicrobial use. Antibiotics are frequently prescribed in these settings with up to 70% of residents receiving one

Table 1. Antimicrobial Stewardship (AS) Functions for Home Care Clinicians

| AS ACTIVITY | HOME CARE NURSE ROLE IN AS |
|--|---|
| Prevent infections | <ul style="list-style-type: none">• Hand hygiene and consistent application of standard precautions and transmission-based precautions when warranted• Handling of supplies/equipment from home to home (“bag technique”)• Adherence to Aseptic Non-Touch Technique with invasive procedures; education and competency assessment (Gorski et al., 2021)• Patient education regarding infection prevention (e.g., hand hygiene, handling of food, disinfection procedures)• Ensure patient/caregiver competency with ANTT when providing self-care procedures such as urinary catheter care, wound care, and infusion administration |
| Identify infections | <ul style="list-style-type: none">• Accurate assessment of s/s of infection• Use accepted definitions; consider use of specific tools/forms to support/substantiate s/s of infection; incorporate into electronic health record |
| Address patient/family beliefs/barriers to appropriate use of antibiotics | <ul style="list-style-type: none">• Recognize that home care patients may request an antibiotic and may even call the provider on their own; provide patient education about AMR in the context of their concerns |
| Communicate with the provider/Medication management | <ul style="list-style-type: none">• Provide accurate information to assist in making the decision about a potential infection and the need for antibiotics• Accurate allergy history• Medication reconciliation• Request the need for a culture if appropriate based on the patient’s condition• Do not ask the provider to prescribe an antibiotic |
| Obtain cultures before a patient starts antibiotics and obtain cultures using sound procedures | <ul style="list-style-type: none">• Obtain cultures via proper procedures• Review culture and sensitivity results; and ensure that the results are received by the provider; report mismatches between the microbe and the antibiotic |
| Provide patient/family education when prescribed an antibiotic | <ul style="list-style-type: none">• Teach to take as prescribed and complete entire course even if symptoms improve• Teach to report s/s of adverse reactions• Medication reconciliation |
| Monitor patient adherence and patient response; Identify and report adverse reactions | <ul style="list-style-type: none">• Monitor clinical progress toward resolution of infection s/s• Monitor and reports the results of laboratory studies as required by the antibiotic (e.g., serum creatinine, drug levels)• Monitor patient/caregiver adherence to proper self-administration• Identify and report adverse events• Identify 3 or more episodes of watery diarrhea and other s/s indicative of <i>C. difficile</i>; reports to provider with follow-up of stool cultures |
| Organizational infection surveillance | <ul style="list-style-type: none">• Infection reporting and review• Share infection reports with home care staff• Work with clinicians to identify opportunities for improvement when infection rates/antibiotic usage is elevated |

Note. Adapted from ANA (2017); McGoldrick (2014); Monsees et al. (2019); WHO (2019); Zimmerman et al. (2014).

or more courses of antibiotic in a year (CDC, 2015). Why does this matter? The harm of antibiotic use is often underestimated. The notable implications for inappropriate antibiotic use include adverse drug effects such as *C. difficile* colitis and subsequent serious diarrhea, drug interactions, and emergence of AMR bacteria in residents of these facilities (CDC, 2015).

Nurses and Antimicrobial Stewardship

Staff nurses work across the continuum of care, inclusive of community/ambulatory-based care, yet lack the resources needed to participate significantly in AS programs (Monsees et al., 2017). As stated earlier, there is a paucity of literature specifically addressing the role of home care nurses in AS. In 2008, Sienkiewicz and colleagues

Figure 1.

A ONE HEALTH CHALLENGE

The Interconnected Threat of Antibiotic Resistance

Resistance happens when germs (bacteria and fungi) defeat the drugs designed to kill them. Any antibiotic use—in people, animals, or crops—can lead to resistance. Resistant germs are a One Health problem—they can spread between people, animals, and the environment (e.g., water, soil).



Examples of How Antibiotic Resistance Affects Humans, Animals & the Environment

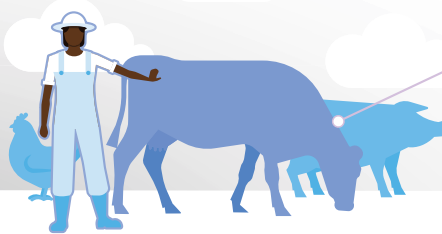
People

Some types of antibiotic-resistant germs can spread person to person. “Nightmare bacteria” carbapenem-resistant Enterobacteriaceae (CRE) can also survive and grow in sink drains at healthcare facilities and spread to patients and to the environment through the wastewater.



Animals

Resistant germs can spread between animals and people through food or contact with animals. For example, *Salmonella* Heidelberg bacteria can make both cattle and people sick.



Environment

Antibiotic-resistant germs can spread in the environment. *Aspergillus fumigatus*, a common mold, can make people with weak immune systems sick. In 2018, resistant *A. fumigatus* was reported in three patients. It was also found in U.S. crop fields treated with fungicides that are similar to antifungals used in human medicine.



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reviewed data from home care agencies in New Jersey, identifying the problem of urine cultures being obtained without sound reason, based only on urine character, and leading to overprescription of antibiotics. Their work led to use of a standard definition for UTI that provided reliable rationale for appropriate use of antibiotics as a component of reducing AMR. McGoldrick (2014) addressed the problem of AMR in home care and identified components of AS, including accuracy in identifying infections, communicating with the provider to provide accurate information in decision-making about treatment, not asking providers for an antibiotic, appropriate culturing, and appropriate identification of signs/symptoms for *C. Difficile* testing. The American Nurses Association (2017) published a white paper providing recommendations for registered nurses in hospital AS practices with only brief mention for outpatient, long-term care, and home care nurses with only the recommendation to receive communication from acute care about the patient's diagnoses, management, and medications.

Antimicrobial stewardship was not specifically addressed in the 2017 Conditions for Participation for Home Health Agencies (Centers for Medicare and Medicaid, 2017) home care regulations. However, for long-term care facilities, the Conditions of Participation (CMS, 2016) specifically include the requirement for an antibiotic stewardship program that includes antibiotic use protocols and a system to monitor antibiotic use. The challenges of implementing AS in long-term care settings were addressed in a literature review (Katz et al., 2017). Challenges are similar to home care, including an older population vulnerable to infection, off-site prescribers, and limited access to timely diagnostic testing. Based on a review of quasi-experimental studies and randomized controlled trials, effective strategies for AS included multidisciplinary education and tools to facilitate antibiotic review such as written forms to support signs/symptoms of infection prior to starting antibiotic therapy. The researchers emphasize that education alone may be effective to initiate AS but to sustain changes in practice, integration of tools can aid in sustaining practice. One of the cited quality improvement studies in the review addressed not only the education of nurses about appropriate antibiotic use but also included the long-term care residents and their families in the education, with a significant reduction in antibi-

otic use achieved (Zimmerman et al., 2014). We believe home care organizations can learn from the AS efforts in long-term care settings.

Although there are no specific data relative to the level of knowledge regarding AMR and AS among home care clinicians, the literature increasingly is exploring the role of acute care nurses with AS. In a survey of hospital nurses, gaps in knowledge regarding AS were identified; only 52% of the nurses were familiar with the term AS, however, nurses were keen to become involved and understand their role (Merrill et al., 2019). Recent reviews of the literature have addressed the “understated, underestimated and poorly understood” role of nurses in AS (van Huizen et al., 2021). Nurses play an important role in AS; education about AMR and AS are important for nurses as well as other healthcare providers (Olans et al., 2020).

Addressing AS at the Home Care Agency Level

So, what can home care agencies and clinicians do at the local level? One of the first steps for implementation of AS in the home care setting is education. Education should address the global problem of AMR, the overuse of antibiotics, defining the role of home care clinicians in AS, and home care clinician opportunities to impact appropriate antibiotic use (Satterfield et al., 2020). Because of the interdisciplinary nature of home care, education should include appropriate nonnurse staff such as therapists. However, it is important to recognize that education alone, without incorporation of other active AS interventions, is only marginally effective in changing practice and has not demonstrated a sustained impact (Dellit et al., 2007). Integration of tools into practice can aid in sustaining practice. Similar to the successful work done in long-term care settings, cues and tools in the electronic health record can be developed such as checklists of signs and symptoms used to quantify a given type of infection (e.g., UTI).

Clinician-oriented interventions aimed at AS are listed in the Table. Infection prevention is always the goal through fundamental practices of hand hygiene, standard and transmission-based precautions, immunizations, and that practice unique to home care—bag technique. It is important to also recognize the increased risk for infection among home care patients with wounds, urinary catheters, and vascular access devices or other types of invasive catheters. Adhere to the practice framework of Aseptic Non-Touch



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Technique when performing these invasive procedures and provide education to ensure the knowledge and ability of patients/caregivers who learn to perform procedures (Mutalib et al., 2015; Gorski, 2021; Rowley & Clare, 2019).

Assess and identify for signs and symptoms of infection to aid in providing accurate information to the provider, requesting the need for a culture if appropriate. Consider UTIs, common both among catheterized and noncatheterized patients. Similar to the Sienkiewicz et al. (2008) study, a survey of acute care nurses revealed that these nurses believed that cloudy urine and sediment were a sign of infection necessitating cultures (Jones et al., 2016). Another finding from that study was poor technique when obtaining cultures. It is a good starting place in any home care organization to investigate the prevalence of UTIs, review clinical procedures for urinary care and culture techniques, and implement specific tools to use in the infection surveillance process.

Also, carefully review the culture and sensitivity reports. It is not uncommon to see evidence of some antibiotic resistance especially in patients with long term chronic illnesses. Patient and caregiver education is essential as it is not uncommon for patients to request an antibiotic. If an antibiotic is started, monitor adherence and for any adverse reactions.

From the organizational standpoint, infection reports should be shared with the home care clini-

cians who can help to identify actions to take when infection rates are elevated. Such ongoing discussion at team/staff meetings helps to generate discussion about infection and infection prevention, reinforces understanding of AMR and AS, and builds a knowledgeable clinical team.

High Level AS Actions

The development of evidence-based practice guidelines for antimicrobial use incorporating local microbiology and resistance patterns is recommended with nurse and physician education about preferred antimicrobial therapy (Satterfield et al., 2020). The challenge in home care is the wide geographic regions served by many home care agencies as well as the fact that nurses and agencies work with many physicians and other providers in many different provider groups. The home care setting is unique in that it is difficult to develop consistency and gain consensus among a multitude of providers.

As the future evolves and as organizations continue to use more advanced technology within electronic medical record (EMR), there are opportunities to optimize antimicrobial use. For example, when an order for an antibiotic is entered into the medication profile, it can be used to direct the nurse to complete an infection surveillance form. Such a process can be used to support signs/symptoms of infection, a process that has found success in long-term care facilities by leading to appropriate antibiotic use (Zimmerman, 2014). Periodic (e.g., monthly) reports can be generated and reviewed by the quality improvement department and/or infection preventionists as available to the home care organization. Looking toward the future, as technology advances toward EMR integration across healthcare settings, systems can be designed to facilitate many AS strategies. For instance, educational strategies may be embedded into the EMR as a link to the antimicrobial guidelines, or electronic integration of patient-specific laboratory and microbiology results with suggested antimicrobial agents (Evans et al., 2015). In addition, the electronic function can be built into the EMR to minimize usage of restricted agents by giving a list of alternative regimes or prompt an alert to seek an authorization whenever a prescriber places an order for restricted antimicrobials. And when an antimicrobial agent targeted for review is ordered, the data could be forwarded in real time or entered into an in-basket for later review by the AS personnel (Harold et al., 2012).

Conclusion

Although current home care regulations do not require an AS program, home care agencies and clinicians can, and should, educate themselves and their patients about AMR and employ AS in the interest of public health. All home care nurses can play a vital role in AS through application of infection prevention interventions, appropriate identification of signs and symptom of infection, and ongoing assessment and monitoring of antimicrobial use/adverse effects. Home care nurses can support AS through patient and community education and advocacy about antimicrobial use. ■

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