

Antibiotic Stewardship in Long-Term Care Facilities: Challenges and Strategies for Optimizing Antibiotic Use

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Abstract:

Antibiotic stewardship is an indispensable facet of modern healthcare, aimed at safeguarding the efficacy of antibiotics while optimizing patient care. In the context of long-term care facilities (LTCFs), a unique set of challenges arises, necessitating tailored strategies to ensure responsible antibiotic use. The burgeoning elderly population, often frail and with multiple comorbidities, makes up the majority of LTCF residents. Compounding the issue, diagnostic challenges in LTCFs can lead to delayed or inaccurate diagnoses, hampering the timely initiation of appropriate treatment. LTCFs frequently grapple with infection control issues, exacerbated by the lack of resources and expertise found in acute care settings. Inadequate infection control can result in outbreaks and drive the inappropriate use of antibiotics as a preventive measure. Moreover, high staff turnover and the absence of well-defined guidelines for antibiotic use in LTCFs pose further challenges to stewardship efforts. In response to these challenges, a multifaceted approach to antibiotic stewardship is crucial. The implementation of LTCF-specific antibiotic use protocols, involving physicians, pharmacists, and infection prevention specialists, is imperative. Regular audits and feedback mechanisms, coupled with educational initiatives, can foster a culture of responsible antibiotic use. This review paper provides a comprehensive analysis of the challenges faced by LTCFs in antibiotic stewardship and offers a thorough exploration of effective strategies to enhance the judicious use of antibiotics.

Keywords: Antibiotic stewardship, Long-term care facilities, Antibiotic use, Antibiotic resistance, Infection control, Antimicrobial stewardship program.

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Introduction

Antibiotics transformed modern medicine by efficiently treating bacterial infections and saved countless lives. However, their abuse and misapplication have resulted in the rise of antibiotic-resistant bacteria, resulting in a global health problem [1]. Antibiotic stewardship policies must be adopted by healthcare organizations and providers to tackle this serious threat. Long-term care facilities (LTCFs), which house elderly and sometimes frail people with severe medical issues, constitute a unique healthcare situation in which antibiotic stewardship is essential [2].

The worldwide healthcare community has acknowledged the growing threat of antibiotic resistance in recent decades. Antibiotic-resistant infections, which are frequently associated with greater mortality rates, higher healthcare expenses, and longer hospital admissions, have imposed a considerable strain on healthcare systems around the world. Antibiotic stewardship, or the cautious use of antibiotics, has emerged as a critical answer to this epidemic. It entails a series of coordinated

methods aimed at optimizing antibiotic use to assure efficacy while avoiding resistance development [3]. LTCFs, which include nursing homes, assisted living facilities, and rehabilitation centers, are a subset of healthcare. These facilities serve mostly the elderly, many of whom are weak and have many chronic diseases. Because of the nature of their health situation, LTCF residents are especially prone to bacterial infections, necessitating the administration of antibiotics in many cases [4]. However, because this unique environment presents issues that are distinct from those seen in acute care settings, antibiotic stewardship in LTCFs is crucial. Antibiotic stewardship concerns in LTCFs begin with the fragile and vulnerable residents they serve. These people frequently have impaired immune systems and complicated medical histories, making them extremely vulnerable to infections. The tight balance between meeting their medical requirements with antibiotics and preventing overuse poses a significant ethical and medical challenge [5]. The border between appropriate

antibiotic usage and overuse is blurred in LTCFs, and navigating this region requires a nuanced strategy.

The diagnostic problem with LTCFs is another complicating element. The senior population in these facilities may present with atypical signs of infection, and delays in obtaining diagnostic testing can impede the diagnostic process[6]. This quandary emphasizes the need for enhanced diagnostic capabilities inside LTCFs to enable more accurate and fast treatment decisions. Infection control issues are also important in antimicrobial stewardship in LTCFs. LTCFs may lack the same resources, infrastructure, and infection control expertise as acute care facilities[7]. As a result, outbreaks of infectious diseases may arise, necessitating the use of antibiotics to control infection. However, such reactive antibiotic use may unintentionally contribute to the problem of antibiotic resistance. As a result, LTCFs face a crucial issue in striking a balance between infection control and ethical

antibiotic use. Another persistent issue in LTCFs is high worker turnover. Personnel turnover might cause variations in antibiotic prescribing procedures. Continuity of treatment is jeopardized, and implementing long-term antibiotic stewardship programs becomes difficult [8].

To address this issue, an effective system of education, training, and knowledge transfer among LTCF staff members is required. Furthermore, the lack of explicit antibiotic usage guidelines in many LTCFs, as well as a general lack of understanding among healthcare providers about antibiotic stewardship principles, contribute to the issue's complexity [9]. In the absence of defined guidelines, antibiotic prescribing practices may vary unnecessarily, raising the risk of overuse. Antibiotic management in long-term care facilities is critical in the global fight against antibiotic resistance. The major recommended strategies and causes of antibiotic misuse have been tabulated in Table 1.

Table 1: Main strategies of antimicrobial stewardship and causes of antibiotic misuse in long-term care facilities

Main recommended antimicrobial stewardship strategies in long-term care facilities	Common causes of antibiotic misuse in long-term care facilities
<ul style="list-style-type: none"> Prohibit antibiotic prescriptions without a clinical checkup. 	<ul style="list-style-type: none"> Antibiotic treatments for colonization that are unnecessary (e.g., asymptomatic bacteriuria)
<ul style="list-style-type: none"> Education (for medical and nursing personnel, as well as patients and their families) 	<ul style="list-style-type: none"> Unnecessary antibiotic prophylaxis for urinary tract infections
<ul style="list-style-type: none"> Target areas where antibiotics are most misused: antibiotic prophylaxis, bacterial colonization, topical antibiotics, and treatment durations. 	<ul style="list-style-type: none"> Antibiotic therapies for viral infections (e.g., influenza) that are unnecessary
<ul style="list-style-type: none"> For the most common infections, use locally modified diagnostic and treatment guidelines. 	<ul style="list-style-type: none"> Unnecessary application of topical antibiotics
<ul style="list-style-type: none"> Reevaluate antibiotic therapy around day 3. Reduce the number of needless microbiological investigations. 	<ul style="list-style-type: none"> The absence of antibiotic therapy evaluation about day 3
<ul style="list-style-type: none"> Improve the microbiology laboratory's reporting. Use diagnostic tests at the point of care 	<ul style="list-style-type: none"> The absence of antibiotic therapy evaluation about day 3

This study goes into the complexities of this complicated problem and offers practical, evidence-based recommendations for navigating the complex environment of antibiotic use in LTCFs. By implementing these measures, LTCFs can play a critical role in preserving antibiotic efficacy and combating the worrying growth of antibiotic-resistant bacteria. Finally, this study is a helpful resource for all stakeholders committed to enhancing antibiotic stewardship in LTCFs and contributing to the larger mission of responsible antibiotic use in healthcare. This review paper looks into the complicated difficulties of antibiotic stewardship in LTCFs and provides a comprehensive set of antibiotic-use improvement techniques.

Challenges in Antibiotic Stewardship in LTCFs

Frail and Vulnerable Residents

LTCF populations are predominantly composed of elderly people who are often fragile and burdened with multiple co-morbidities, making them especially vulnerable to infections [10]. Balancing the need for antibiotics with the risk of misuse in this population is a daunting task. Residents of LTCFs who are frail or elderly frequently have impaired immune systems, chronic diseases, and various co-morbidities [11]. Because of these disorders, they are more vulnerable to infections such as urinary tract infections, lung infections, and skin and soft tissue infections. As a result, these residents are more likely to require antibiotics. Infections in the elderly may appear with uncommon or subtle symptoms, making it difficult for healthcare personnel to appropriately diagnose

[12]. This can result in both under diagnosis and over diagnosis of infections, with antibiotics being supplied when they are unnecessary or not prescribed at all. The psychological and emotional well-being of elderly residents must be taken into account. Fear of infection, abuse of antibiotics, or underuse of antibiotics due to side effects can all have an influence on residents' overall quality of life and mental well-being.

Diagnostic Challenges

Due to unique clinical presentations, delays in getting diagnostic testing, and the presence of many chronic diseases that might mimic infection symptoms, diagnosing infections in LTCFs can be difficult [13]. This complication frequently leads to inappropriate antibiotic prescriptions. When residents in LTCFs become infected, they may exhibit abnormal or nonspecific symptoms. This makes it harder for healthcare providers to detect infections early on, resulting in delayed diagnoses. Inappropriate or delayed antibiotic use may arise from a delayed diagnosis [12]. Residents of long-term care facilities are frequently elderly persons with many chronic diseases and complicated medical histories. These co-morbidities can confound the clinical picture, making it difficult to differentiate between symptoms of infection and those of underlying chronic disorders. As a result, both over diagnosis and under diagnosis of infections are possible. When compared to acute care settings, LTCFs may have limited access to diagnostic resources [13]. Access to diagnostic tests, such as blood cultures, imaging, and laboratory tests, may be limited, making accurate infection diagnosis difficult. In cases with clinical suspicion, this limitation may necessitate the use of empirical antibiotic treatment. Non-infectious problems, such as delirium, dehydration, or bad treatment reactions, might mirror infection symptoms in LTCF residents [14]. Communicating with LTCF residents, particularly those with cognitive impairments or communication issues, might make it challenging to acquire essential clinical information for proper diagnosis. Incomplete or incorrect information can have an impact on diagnostic accuracy as well as antibiotic prescribing decisions [15].

Infection Control Issues

LTCFs often lack the same degree of infection control resources and experience as acute care settings. This can cause epidemics and encourage the improper use of antibiotics as a preventative strategy [16]. LTCFs frequently shelter elderly and vulnerable persons who may have compromised immune systems and are more vulnerable to infectious infections [17]. Because of the tight living quarters and shared common areas in these facilities, infections, including those caused by

antibiotic-resistant bacteria, can spread quickly. In general, long-term care facilities (LTCFs) have limited access to the specialized infection control resources and expertise found in acute care hospitals [18]. This could include fewer infection prevention professionals and access to diagnostic and laboratory services, all of which are critical for early infection detection and management. Understaffing and frequent staff turnover are common issues in long-term care facilities [19]. As a result, there may be insufficient time and resources to implement stringent infection control procedures. Because of common living spaces and a lack of isolation rooms or facilities, LTCFs sometimes face difficulties in isolating people with contagious diseases. This increases the danger of outbreaks, necessitating the use of antibiotics as a prophylactic approach to control illness spread. Antibiotic overuse and misuse in LTCFs can contribute to the development of antibiotic-resistant bacteria, which can impede treatment [20].

High Staff Turnover

Frequent staff turnover in LTCFs can lead to variations in antibiotic prescribing practices, as well as a stumbling block in establishing and maintaining effective stewardship programs [21]. Inconsistencies in care, especially antibiotic prescribing procedures, might come from high staff turnover. Staff turnover can cause differences in how various healthcare practitioners detect, diagnose, and manage infections, making it difficult to create uniform antibiotic stewardship strategies [22, 23]. For effective antibiotic stewardship, continuity of care is vital. Frequent personnel changes can jeopardize the continuity of care for LTCF residents. Antibiotics may be prescribed as a preventative approach by healthcare practitioners who are unfamiliar with a resident's medical history or prior antibiotic treatments. Healthcare professionals with minimal expertise or awareness of antibiotic stewardship guidelines may be substituted for experienced personnel. A lack of effective knowledge transfer might stymie the implementation of stewardship initiatives, perpetuating incorrect antibiotic prescribing practices [24].

Lack of Guidelines

Antibiotic usage in LTCFs frequently necessitates particular protocols and guidelines that address the unique demands and challenges that these facilities encounter [25]. In the absence of such personalized recommendations, healthcare professionals' antibiotic prescribing methods may vary, raising the risk of antibiotic misuse. In the lack of clear guidelines and a thorough understanding of antibiotic stewardship principles, healthcare practitioners may be hesitant to prescribe antibiotics. Because of this ambiguity, antibiotics

may be overused or underused. The lack of defined norms might also have an impact on accountability [26]. Healthcare practitioners may not feel as accountable for their antibiotic-prescribing decisions if there are no well-defined guidelines and expectations for antibiotic use. As a result, there may be a lack of oversight and monitoring, aggravating the problem of antibiotic overuse.

Strategies for Optimizing Antibiotic Use

Education and Training

Antibiotic use in healthcare settings, particularly long-term care facilities (LTCFs), is optimized through education and training [27]. Comprehensive education and training activities are critical tools for empowering healthcare practitioners to make informed, evidence-based antibiotic prescribing and treatment decisions. This ensures they understand the principles and best practices of antibiotic stewardship. Education and training initiatives can help raise awareness about the global problem of antibiotic resistance and the critical role that healthcare providers play in combating it [28]. Understanding the repercussions of antibiotic abuse can inspire providers to implement antibiotic stewardship guidelines. Provides healthcare practitioners with the knowledge they need to prioritize appropriate antibiotic usage. Through practical application, training reinforces this information by educating clinicians when and how to give antibiotics effectively, as well as when to avoid them. Understanding which antibiotics are most effective in their unique situation can help guide prescribing decisions and prevent treatment failure [29]. Training programs should emphasize improving diagnostic accuracy. Providers learn to distinguish between bacterial and viral infections, which help limit antibiotic misuse for viral illnesses. To promote consistent, evidence-based care, healthcare providers should be introduced to facility-specific or nationally recognized antibiotic usage guidelines and taught how to follow these standards in their daily practice. To promote effective antibiotic stewardship measures, comprehensive education and training programs should be on going, adaptive, and integrated into the culture of LTCFs [30].

Antibiotic Use Protocols

It is critical to develop and implement antibiotic use strategies tailored to the needs of LTCFs. These protocols should include infection diagnosis, treatment, and monitoring guidelines [31]. Antibiotic use protocols offer consistent antibiotic prescribing standards within the LTCF. These recommendations are based on evidence-based practices and local antibiotic resistance patterns, allowing healthcare clinicians to make educated judgments. Protocols are tailored to the LTCF's

individual needs, challenges, and patient groups. For example, they examine infection prevalence, local resistance patterns, diagnostic options, and resident demographics. Protocols specify the antibiotics that should be used for particular types of infections [32]. They underline the need of selecting antibiotics that are effective against the detected diseases while taking into account the specific variables of the resident (e.g., allergies, comorbidities). The protocols propose dosing and duration of therapy for certain infections. This guarantees that antibiotics are given at the correct dose and duration, lowering the risk of inadequate therapy and the development of antibiotic resistance [33]. The protocols assist healthcare providers in distinguishing between empirical and targeted therapy. Empirical therapy is started before definite diagnostic results are available, whereas targeted therapy is based on pathogens that have been identified [34]. This distinction prevents the overuse of broad-spectrum antibiotics. Protocols cover allergy management and probable antibiotic side effects. They assist healthcare providers in selecting alternate antibiotics and monitoring for adverse responses as necessary. LTCFs can improve the quality of care for their residents while actively contributing to the global effort to combat antibiotic resistance by following well-structured protocols.

Multidisciplinary Teams

Multidisciplinary teams are an effective technique for reducing antibiotic resistance in healthcare settings, including LTCFs [35]. Professionals from several disciplines collaborate on these teams to guarantee prudent and effective antibiotic prescribing and management. They bring together a varied range of healthcare providers, including physicians, pharmacists, nurses, infection control specialists, microbiologists, and quality improvement specialists [36]. This diversity guarantees that antimicrobial stewardship is approached from a variety of views and understanding. The many team members contribute to a thorough assessment of each patient's condition, taking clinical, microbiological, and pharmaceutical factors into account. This comprehensive approach leads to more accurate diagnoses and treatment recommendations. Effective team collaboration promotes shared decision-making.

This guarantees that the viewpoints and expertise of all team members are taken into account while deciding the best antibiotic medication. This reduces unnecessary antibiotic prescriptions, reduces the use of broad-spectrum antibiotics when narrower alternatives are more beneficial, and facilitates antibiotic de-escalation when the patient's health allows it [37]. The team is in charge of data processing and reporting, as well as

monitoring antibiotic use and resistance tendencies. This data-driven approach allows the LTCF to identify trends, areas of concern, and intervention opportunities. A designated leader who supervises the antibiotic stewardship program is frequently included in multidisciplinary teams. This leadership ensures that stewardship actions are coordinated and implemented consistently.

Regular Audits and Feedback

Audits and feedback on a regular basis are key techniques for optimizing antibiotic use in healthcare settings, including LTCFs [38]. These procedures entail comprehensive reviews of antibiotic prescribing practices and provide positive feedback to healthcare providers on their performance. Regular audits entail the systematic collecting and analysis of data pertaining to antibiotic prescribing procedures in the LTCF. This evaluation assists in identifying trends, patterns, and potential areas of concern, such as antibiotic overuse or incorrect antibiotic selection. Audits are designed to detect departures from best practices, such as unnecessary antibiotic usage, poor antibiotic selection, inaccurate dose, prolonged treatment duration, and other variables that contribute to antibiotic misuse[39]. Audits frequently analyze how well healthcare practitioners follow clinical decision-support tools like guidelines, protocols, and electronic health record alerts. Feedback and education can be used to address deviations from these tools[40,41]. LTCFs can improve patient care, prevent antibiotic abuse, and contribute to the worldwide effort to battle antibiotic resistance by systematically examining and improving antibiotic prescribing policies.

Infection Prevention

Infection control is an important technique for reducing antibiotic use in healthcare settings, particularly LTCFs. Healthcare practitioners can limit the demand for antibiotics by reducing the occurrence and transmission of illnesses, leading to responsible antibiotic use [42]. The major purpose of infection prevention is to limit the number of infections in the long-term care facility. By introducing infection-prevention measures, the requirement for antibiotics is reduced as fewer residents become infected. Infection prevention measures attempt to keep infectious disease epidemics at bay within the LTCF. Isolation procedures can reduce the transmission of

infectious diseases in circumstances where inhabitants have infectious disorders [43, 44]. This strategy reduces the demand for antibiotics as preventive measures while also reducing the likelihood of outbreaks. Keeping residents and staff up to date on vaccines can help to prevent vaccine-preventable diseases. This preventative measure minimizes the probability of infections and the need for antibiotic therapy. Infection prevention measures frequently coexist with antimicrobial stewardship. Preventing healthcare-associated infections, for example, minimizes the need for prophylactic antibiotics prior to surgeries and treatments. Outbreak response techniques should be included in infection prevention initiatives. In the event of an outbreak, quick identification, isolation, and treatment of affected persons can reduce antibiotic use and control infection transmission. Healthcare professionals can minimize the need for antibiotics and contribute to responsible antibiotic use by minimizing the frequency of infections, outbreaks, and healthcare-associated illnesses. Infection control techniques are critical components of LTCF antibiotic stewardship programs [45-47].

Improved Diagnostics

Improved diagnostics are critical to optimizing antibiotic use in healthcare settings, including LTCFs [48]. Improved diagnostic technologies and practices allow healthcare providers to reliably diagnose infections, differentiate between viral and bacterial illnesses, and make informed antibiotic treatment recommendations. Improved availability to diagnostic tests to promote accurate and prompt infection diagnosis decreasing antibiotic prescriptions. Healthcare practitioners can personalize antibiotic therapy to the exact pathogen causing the infection thanks to enhanced testing. This enables more accurate and tailored treatment, reducing the need for broad-spectrum antibiotics. Imaging technologies such as X-rays and CT scans are essential for identifying infections, especially those affecting the respiratory and urinary systems [49]. Improved availability to these diagnostic technologies improves diagnostic precision and guides antibiotic selection. Advanced diagnostics aid healthcare providers in making an accurate differential diagnosis [50]. This method distinguishes between infections and non-infectious diseases, lowering the danger of overuse of antibiotics. The key elements of improved diagnostics are represented in Figure 1.

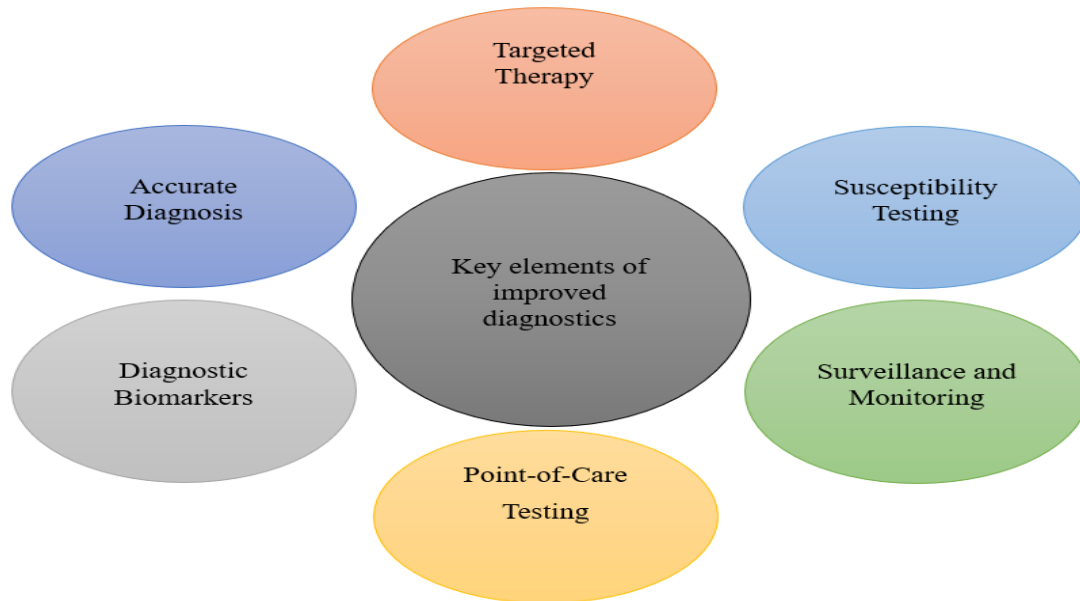


Figure 1: The key elements of improved diagnostics

Communication

Communication is an important technique for optimizing antibiotic usage in healthcare settings, including LTCFs [4,8]. Communication between healthcare practitioners, residents, their families, and all other stakeholders is critical to ensure responsible antibiotic prescribing and administration. Communication between healthcare practitioners and residents promotes collaborative decision-making. Encouraging residents to report symptoms and changes in their health as soon as possible can result in early intervention and accurate diagnosis, lowering the demand for broad-spectrum antibiotics. Antibiotic side effects and bad reactions should be communicated to residents and their families by healthcare providers. This information assists residents in making educated

treatment decisions [51]. A commitment to open and clear communication is required to promote appropriate antibiotic usage and improve overall care quality in LTCFs.

Antibiotic Review and De-escalation

Antibiotic re-evaluation and de-escalation are important techniques for improving antibiotic usage in healthcare settings, including long-term care facilities (LTCFs) [52, 53].

These approaches entail evaluating antibiotic therapy critically and adjusting treatment plans as needed to ensure that residents receive the most appropriate, focused, and limited-duration antibiotic medication. Table 2 lists the key components of antibiotic evaluation and de-escalation in antibiotic stewardship [52, 54-58].

Table 2: Key Elements of De-escalation

S.No	Element	Features
1.	Regular Assessment	Regular assessment of antibiotic therapy for each resident to be conducted by a multidisciplinary team
2.	Clinical Improvement	Healthcare team should look for signs of clinical improvement and upon improvement, de-escalation may be considered to transition to a narrower-spectrum or less intensive antibiotic therapy.
3.	Targeted Therapy	De-escalation aims to transition from broad-spectrum antibiotics to narrower-spectrum antibiotics or a more targeted therapy once the causative pathogen is identified
4.	Microbiological Data	Diagnostic test results help healthcare providers choose the most appropriate antibiotic to target the specific pathogen.
5.	Susceptibility Testing	It identifies the susceptibility of pathogens to specific antibiotics and enables the selection of the most effective and least broad-spectrum antibiotics.
6.	Duration of Treatment	Healthcare providers should determine whether the antibiotic course can be shortened without compromising treatment efficacy.
7.	Reassessment of Clinical Indications	Antibiotic review should reassess the clinical indications for antibiotic therapy. If there is no evidence of an active infection, the antibiotic course

		should be discontinued.
8.	Allergy and Adverse Effects	If a resident develops an allergic reaction or experiences severe side effects, the antibiotic should be changed or discontinued as appropriate.
9.	Antibiotic Review Rounds	Regular antibiotic review rounds or meetings are a structured way to facilitate the de-escalation process. These rounds allow for systematic assessment and discussion of residents on antibiotic therapy.
10.	Communication with Residents and Families	Residents should be informed of the rationale for treatment changes, and their consent or agreement should be sought when applicable.

Reporting and Tracking

Antibiotic use in healthcare settings, especially LTCFs, requires reporting and tracking [59]. The gathering of data linked to antibiotic prescribing practices is the first step in reporting and tracking. This information contains the types of antibiotics prescribed, indications for their usage, dosages, treatment duration, and patient demographics. The information gathered can be utilized for surveillance. It allows LTCFs to track antibiotic use trends and identify any unexpected patterns, such as increased use of certain antibiotics or an increase in healthcare-associated illnesses.

Regular audits of antibiotic prescribing procedures are performed to check compliance with antibiotic stewardship principles, guidelines, and protocols [60]. These audits allow for the identification of areas for improvement. LTCFs can assure responsible antibiotic prescribing, prevent antibiotic overuse, and actively participate to the worldwide effort to combat antibiotic resistance by collecting and analyzing data systematically, conducting audits, providing feedback, and encouraging education.

Policy Support

Policy support is an important method for reducing antibiotic resistance in healthcare settings, particularly LTCFs. Policies that are clear and well-defined can provide a framework for ethical antibiotic prescribing and administration [61]. National and municipal policies should ensure that antibiotic prescribing practices follow evidence-based standards. Guidelines assist healthcare providers in making sound decisions. LTCFs can improve service quality, prevent antibiotic overuse, and encourage responsible antibiotic use through clear regulations and successful implementation [62].

Conclusion

Antibiotic stewardship within LTCFs is vital for preserving the effectiveness of antibiotics and improving the overall health outcomes of residents. This research article offers a comprehensive exploration of the unique challenges faced within LTCFs and a pragmatic set of strategies to effectively address these issues. By adopting and implementing these strategies, LTCFs can play a pivotal role in preserving the efficacy of antibiotics

and combatting the alarming rise of antibiotic-resistant pathogens. This research provides a valuable resource for healthcare practitioners, administrators, and policymakers, equipping them with the knowledge and tools needed to enhance antibiotic stewardship within LTCFs and thus contribute to the broader goal of responsible antibiotic use.

References

1. Aslam B, Wang W, Arshad MI, Khurshid M, Muzammil S, Rasool MH, Nisar MA, Alvi RF, Aslam MA, Qamar MU, Salamat MK. Antibiotic resistance: a rundown of a global crisis. *Infection and drug resistance*. 2018 Oct 10:1645-58.
2. Smith PW, Bennett G, Bradley S, Drinka P, Lautenbach E, Marx J, Mody L, Nicolle L, Stevenson K. SHEA/APIC guideline: infection prevention and control in the long-term care facility. *Infection Control & Hospital Epidemiology*. 2008 Sep; 29(9):785-814.
3. Nicolle LE, Bentley DW, Garibaldi R, Neuhaus EG, Smith PW. Antimicrobial use in long-term-care facilities. SHEA long-term-care committee. *Infect Control Hosp Epidemiol* 2000; 21:537-45.
4. Van Schooneveld T, Miller H, Sayles H, Watkins K, Smith PW. Survey of antimicrobial stewardship practices in Nebraska long-term care facilities. *Infect Control Hosp Epidemiol*. 2011; 32(7):732-734.
5. Suetens C. Healthcare-associated infections in European long-term care facilities: how big is the challenge? *Euro Surveill* 2012; 17(35).pii=20259.
6. Pakyz AL, Dwyer LL. Prevalence of antimicrobial use among United States nursing home residents: results from a national survey. *Infect Control Hosp Epidemiol*. 2010; 31(6):661-662.
7. Madison AGPCNP-BC K. Antibiotic Stewardship for Asymptomatic Bacteriuria in Older Adults Residing in Long-Term Care at End-of-Life; 2022.
8. Jump RL, Crnich CJ, Mody L, Bradley SF, Nicolle LE, Yoshikawa TT. Infectious diseases in older adults of long-term care facilities: update on approach to diagnosis and management. *Journal of the American Geriatrics Society*. 2018 Apr; 66(4):789-803.

9. Ohl CA, Luther VP. Health care provider education as a tool to enhance antibiotic stewardship practices. *Infectious Disease Clinics*. 2014 Jun 1; 28(2):177-93.
10. Beharry-Guest R. Antibiotic Stewardship and the Quality of Life for Residents over 65 Years (Doctoral dissertation, Walden University); 2020.
11. Koziol K. Development of an Antibiotic Stewardship Program to Optimize the Treatment of Infection in the Long-Term Care Facility. Saint Francis Medical Center College of Nursing; 2020.
12. Hall J, Hawkins O, Montgomery A, Singh S, Mullan J, Degeling C. Dismantling antibiotic infrastructures in residential aged care: The invisible work of antimicrobial stewardship (AMS). *Social Science & Medicine*. 2022 Jul 1; 305:115094.
13. Weber BR, Noble BN, Bearden DT, Crnich CJ, Ellingson KD, McGregor JC, Furuno JP. Antibiotic prescribing upon discharge from the hospital to long-term care facilities: implications for antimicrobial stewardship requirements in post-acute settings. *Infection Control & Hospital Epidemiology*. 2019 Jan; 40(1):18-23.
14. Gutierrez CM. Infection Control Driven Antibiotic Stewardship in a Long-Term Care Facility; 2020.
15. Wu JH, Langford BJ, Daneman N, Friedrich JO, Garber G. Antimicrobial stewardship programs in long-term care settings: a meta-analysis and systematic review. *Journal of the American Geriatrics Society*. 2019 Feb; 67(2):392-9.
16. Kasset N, Sham R, Aleong R, Yang D, Kirzner M, Craft A. Impact of antimicrobial stewardship on physician practice in a geriatric facility. *Can J Hosp Pharm*. 2016; 69(6):460-465.
17. Beović B, Čižman M, Papst L, Pečavar B, Šubelj M, Dobrin PT. Antibiotic prescribing in long-term care facilities for the elderly. World Health Organization. Regional Office for Europe; 2018.
18. Kullar R, Yang H, Grein J, Murthy R. A roadmap to implementing antimicrobial stewardship principles in long-term care facilities (LTCFs): collaboration between an acute-care hospital and LTCFs. *Clinical Infectious Diseases*. 2018 Apr 3; 66(8):1304-12.
19. Yang M, Vleck K, Bellantoni M, Sood G. Telephone survey of infection-control and antibiotic stewardship practices in long-term care facilities in Maryland. *Journal of the American Medical Directors Association*. 2016 Jun 1; 17(6):491-4.
20. Manning ML, Septimus EJ, Ashley ES, Cosgrove SE, Fakhri MG, Schweon SJ, Myers FE, Moody JA. Antimicrobial stewardship and infection prevention—leveraging the synergy: a position paper update. *Infection control & hospital epidemiology*. 2018 Apr; 39(4):467-72.
21. Daneman N, Gruneir A, Newman A, Fischer HD, Bronskill SE, Rochon PA, et al. Antibiotic use in long-term care facilities. *J Antimicrob Chemother* 2011; 66:2856–63.
22. McClean P, Hughes C, Tunney M, Goossens H, Jans B. Antimicrobial prescribing in European nursing homes. *J Antimicrob Chemother* 2011; 66:1609–16.
23. European Surveillance of Antimicrobial Consumption (ESAC). Results from the national survey of characteristics of nursing homes. 2009. Available from: <http://www.ecdc.europa.eu/en/activities/surveillance/ESAC-Net/publications> [accessed 7.10.23].
24. Lim CJ, Kwong MW, Stuart RL, Busing KL, Friedman ND, Bennett NJ, et al. Antibiotic prescribing practice in residential aged care facilities – health care providers’ perspectives. *Med J Aust* 2014; 201:101–5.
25. Dellit TH, Owens RC, McGowan Jr JE, Gerding DN, Weinstein RA, Burke JP, 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; 44:159–77.
26. Cantudo-Cuenca MR, Jimenez-Morales A, la Plata JE. Pharmacist-driven antimicrobial stewardship program in a long-term care facility by assessment of appropriateness. *European Geriatric Medicine*. 2022 Dec; 13(6):1357-64.
27. Monette J, Miller MA, Monette M, Laurier C, Boivin JF, Sourial N, et al. Effect of an educational intervention on optimizing antibiotic prescribing in long-term care facilities. *J Am Geriatr Soc* 2007; 55:1231–5.
28. Schwartz DN, Abiad H, DeMarais PL, Armeanu E, Trick WE, Wang Y, et al. An educational intervention to improve antimicrobial use in a hospital-based long-term care facility. *J Am Geriatr Soc* 2007; 55: 1236–42.
29. Pulcini C, Crofts S, Campbell D, Davey P. Design, measurement, and evaluation of an education strategy in the hospital setting to combat antimicrobial resistance. *Dis Manage Health Outcomes* 2007; 15: 151–63.
30. Mylotte JM. Measuring antibiotic use in a long-term care facility. *Am J Infect Control* 1996; 24:174–9.
31. Fleet E, Gopal Rao G, Patel B, Cookson B, Charlett A, Bowman C, et al. Impact of

- implementation of a novel antimicrobial stewardship tool on antibiotic use in nursing homes: a prospective cluster randomized control pilot study. *J Antimicrob Chemother* 2014; 69: 2265–73.
32. Linnebur SA, Fish DN, Ruscini JM, Radcliff TA, Oman KS, Fink R, et al. Impact of a multidisciplinary intervention on antibiotic use for nursing home-acquired pneumonia. *Am J Geriatr Pharmacother* 2011; 9: 442–50. e1.
 33. Cosgrove SE, Srinivasan A. Antibiotic stewardship: a decade of progress. *Infectious Disease Clinics*. 2023 Aug 1.
 34. Phillips CD, Adepoju O, Stone N, Moudouni DK, Nwaiwu O, Zhao H, et al. Asymptomatic bacteriuria, antibiotic use, and suspected urinary tract infections in four nursing homes. *BMC Geriatr* 2012; 12:73.
 35. Sadeq AA, Shamseddine JM, Babiker ZO, Nsutebu EF, Moukarzel MB, Conway BR, Hasan SS, Conlon-Bingham GM, Aldeyab MA. Impact of multidisciplinary team escalating approach on antibiotic stewardship in the United Arab Emirates. *Antibiotics*. 2021 Oct 22; 10(11): 1289.
 36. Carling P, Fung T, Killion A, Terrin N, Barza M. Favorable impact of a multidisciplinary antibiotic management program conducted during 7 years. *Infect Control Hosp Epidemiol*. 2003; 24(9):699-706.
 37. De Waele JJ, Dhaese S. Antibiotic stewardship in sepsis management: toward a balanced use of antibiotics for the severely ill patient. *Expert review of anti-infective therapy*. 2019 Feb 1; 17(2):89-97.
 38. Peragine CS. Clinical Burden of Antimicrobial Resistance Following Implementation of an Antimicrobial Stewardship Team Prospective Audit and Feedback Initiative at a Tertiary Care Centre: A Controlled Interrupted Time Series Over 14 Years. University of Toronto (Canada); 2018.
 39. Pulcini C, Lions C, Ventelou B, Verger P. Drug-specific quality indicators assessing outpatient antibiotic use among French general practitioners. *Eur J Public Health* 2013; 23:262–4.
 40. Pulcini C, Lions C, Ventelou B, Verger P. Approaching the quality of antibiotic prescriptions in primary care using reimbursement data. *Eur J Clin Microbiol Infect Dis* 2013; 32:325–32.
 41. McClean P, Tunney M, Gilpin D, Parsons C, Hughes C. Antimicrobial prescribing in residential homes. *J Antimicrob Chemother* 2012; 67: 1781–90.
 42. Mathei C, Niclaes L, Suetens C, Jans B, Buntinx F. Infections in residents of nursing homes. *Infect Dis Clin North Am* 2007; 21:761–72. ix.
 43. Abbas S, Stevens MP. The role of the hospital epidemiologist in antibiotic stewardship. *Medical Clinics*. 2018 Sep 1; 102(5):873-82.
 44. Cohen CC, Jeong Choi Y, Stone PW. Costs of infection prevention practices in long-term care settings: a systematic review. *Nurs Econ*. 2016; 34(1):16-24.
 45. US Department of Health and Human Services. Chapter 8: Long-Term Care Facilities. In: National Action Plan to Prevent Health Care-Associated Infections: Road Map to Elimination. April 2013.
 46. Donlon S, Roche F, Byrne H, Dowling S, Cotter M, Fitzpatrick F. A national survey of infection control and antimicrobial stewardship structures in Irish long-term care facilities. *Am J Infect Control*. 2013; 41(6):554-557.
 47. Cookson B, Mackenzie D, Kafatos G, Jans B, Latour K, Moro ML, et al. Development and assessment of national performance indicators for infection prevention and control and antimicrobial stewardship in European long-term care facilities. *J Hosp Infect* 2013; 85:45–53.
 48. Hutt E, Ruscini JM, Corbett K, Radcliff TA, Kramer AM, Williams EM, et al. A multifaceted intervention to implement guidelines improved treatment of nursing home-acquired pneumonia in a state Veterans home. *J Am Geriatr Soc* 2006; 54:1694–700.
 49. Weiss ZF, Cunha CB, Chambers AB, Carr AV, Rochat C, Raglow-Defranco M, Parente DM, Angus A, Mermel LA, Sivaprasad L, Chapin K. Opportunities revealed for antimicrobial stewardship and clinical practice with implementation of a rapid respiratory multiplex assay. *Journal of clinical microbiology*. 2019 Oct; 57(10):10-128.
 50. Crayton E, Richardson M, Fuller C, Smith C, Liu S, Forbes G, Anderson N, Shallcross L, Michie S, Hayward A, Lorencatto F. Interventions to improve appropriate antibiotic prescribing in long-term care facilities: a systematic review. *BMC geriatrics*. 2020 Dec; 20:1-24.
 51. Chiotos K, Tamma PD, Gerber JS. Antibiotic stewardship in the intensive care unit: challenges and opportunities. *Infection Control & Hospital Epidemiology*. 2019 Jun; 40(6): 693-8.
 52. Masterton RG. Antibiotic de-escalation. *Critical care clinics*. 2011 Jan 1; 27(1):149-62.
 53. Umpleby H, Dushianthan A, Catton T, Saeed K. Antimicrobial stewardship programmes focused on de-escalation: a narrative review of efficacy and risks. *Journal of Emergency and Critical Care Medicine*. 2022 Jul 30; 6.
 54. Caroline Nandita E. A Study of Antibiotic De-escalation Practices in Medical Wards in a

- Teaching Hospital (Doctoral dissertation, Christian Medical College, Vellore).
55. Schuts EC, Hulscher ME, Mouton JW, Verduin CM, Stuart JW, Overdiek HW, van der Linden PD, Natsch S, Hertogh CM, Wolfs TF, Schouten JA. Current evidence on hospital antimicrobial stewardship objectives: a systematic review and meta-analysis. *The Lancet infectious diseases*. 2016 Jul 1; 16(7):847-56.
 56. Moehring RW, Ashley ES, Davis AE, Dyer AP, Parish A, Ren X, Lokhnygina Y, Hicks LA, Srinivasan A, Anderson DJ. Development of an electronic definition for de-escalation of antibiotics in hospitalized patients. *Clinical Infectious Diseases*. 2021 Dec 1; 73(11):e4507-14.
 57. Mathieu C, Pastene B, Cassir N, Martin-Loeches I, Leone M. Efficacy and safety of antimicrobial de-escalation as a clinical strategy. *Expert review of anti-infective therapy*. 2019 Feb 1; 17(2):79-88.
 58. Chetty S, Reddy M, Ramsamy Y, Naidoo A, Essack S. Antimicrobial stewardship in South Africa: A scoping review of the published literature. *JAC-antimicrobial resistance*. 2019 Dec;1(3): dlz060.
 59. Davidson HE, Jump RL. Challenges in tracking and reporting antibiotic use in long-term care. *Journal of the American Medical Directors Association*. 2020 Sep 1; 21(9):1191-6.
 60. Coupat C, Pradier C, Degand N, Hofliger P, Pulcini C. Selective reporting of antibiotic susceptibility data improves the appropriateness of intended antibiotic prescriptions in urinary tract infections: a case-vignette randomized study. *Eur J Clin Microbiol Infect Dis* 2013; 32:627–36.
 61. Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS). *Infect Control Hosp Epidemiol* 2012; 33:322–7.
 62. Danaher PJ, Milazzo NA, Kerr KJ, Lagasse CA, Lane JW. The antibiotic support team—a successful educational approach to antibiotic stewardship. *Military medicine*. 2009 Feb 1; 174(2):201-5.