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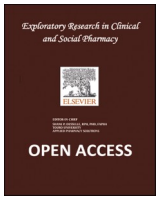

Understanding and mapping the antibiotic prescribing and administration process in assisted living facilities☆

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ABSTRACT

Objective: Inappropriate prescribing practices significantly contribute to antibiotic resistance which poses a significant public health challenge. While antibiotic prescribing and administration process has been widely studied in various settings including nursing homes, little is known about Assisted Living Facilities (ALFs). This study aims to map the antibiotic prescribing and administration processes in ALFs.

Design: A qualitative descriptive study using the Systems Engineering Initiative for Patient Safety (SEIPS) 2.0 model.

Methods: Seven semi-structured interviews were conducted with staff from five ALFs located in a mid-western state. Participating staff were either involved in or knowledgeable about the process. The interviews were analyzed in NVivo using SEIPS 2.0 model as a theoretical framework.

Results: The analysis informed the mapping of a 33-step antibiotic prescribing and administration process for residents in ALFs. They were grouped into five sections: admission, resident having a change in condition, antibiotic prescribing, obtaining the prescription from the pharmacy, and antibiotic administration and follow-up. Pharmacies played critical role in delivery of prescriptions to ALFs and are uniquely positioned to support antibiotic stewardship efforts.

Conclusions and implications: This study is among the first to systematically map the antibiotic prescribing and administration process in ALFs. Insights gathered regarding the use of preferred pharmacies highlight opportunities for pharmacists in stewardship practices. Comparison of the process to that of nursing homes, suggests that several pharmacist-led stewardship interventions used there could be adapted effectively in ALFs. Further research is essential to assess the impact of antibiotic prescribing and pharmacist-driven stewardship interventions tailored specifically for ALFs.

1. Introduction

"Antibiotic resistance" is a phenomenon where bacteria evolve and evade effects of antibiotics,[1,2] leading to the development of resistant strains.[3] Infections, such as pneumonia and tuberculosis become harder to treat.[4] This leads to increased risk of adverse drug events,[5] delays initiating effective therapy,[6] longer hospital stays,[7] higher medical costs, and increased mortality.[8]

In 2015, the Centers for Disease Control and Prevention (CDC) implemented a national action plan for Combating Antibiotic-Resistant Bacteria[9] and the World Health Assembly adopted a global action plan on antimicrobial resistance.[10] Surveillance in the US estimated approximately 2,868,700 infections and 35,900 deaths caused by antibiotic-resistant bacteria and fungi each year.[3] Furthermore, WHO 2021 report of Global Antimicrobial Resistance and Use Surveillance System gave a global summary of reported antimicrobial resistance, which estimated high resistance among commonly used antimicrobials.[11]

Antibiotic resistance is associated with multiple factors, including excessive prescriptions, poor regimen adherence, inadequate infection control in healthcare facilities, poor hygiene and sanitation practices, and absence of new antibiotic discoveries.[12] Suboptimal utilization of antibiotics including inappropriate prescribing of antibiotics lead to antibiotic resistance.[13] Each specific context of antibiotic usage may involve unique combinations of factors contributing to the deterioration of the situation. The CDC reports a minimum of 30 % of all prescribed

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antibiotics are unnecessary in the US and the remaining 70 % deemed necessary can be improved in terms of selecting the appropriate drug, dosage, and duration.[4]

Understanding the process of prescribing of antibiotics in various settings can give key insights in to how to further reduce the issue of inappropriate prescribing.[14] Research have been conducted in understanding the antibiotic prescribing process in various settings including outpatient setting[16,17] and inpatient setting like hospitals[14,15] and long-term care facilities like nursing homes.[18] Given organizational influence on process outcomes, it is crucial to analyze the process across different types of care facilities.[19] In this regard, assisted living facilities (ALFs) have not yet been examined.

This study explores the antibiotic prescribing and administration processes on a largely overlooked setting of ALFs to inform future antibiotic stewardship efforts. By documenting the workflow of the antibiotics prescribing and administration process this study aims to map and understand how a resident at an ALF receives an antibiotic and to identify opportunities for pharmacist-led antibiotic stewardship practices.

2. Methods

Seven semi-structured interviews were conducted with staff from five ALFs located in Wisconsin. Participating staff were either involved in the process or knowledgeable about the process by which a resident at the ALF receives an antibiotic. The qualitative interviews were analyzed in NVivo using the SEIPS 2.0 model as a theoretical framework.

2.1. Theoretical framework: SEIPS 2.0

The Systems Engineering Initiative for Patient Safety (SEIPS2.0) (Fig. 1)[19] framework informed development of the interview guide (Supplement_1) and analysis of the transcripts. Its three main components are work system, process and outcomes. 'Person' performs a range of 'tasks' using various 'tools and technologies' in an 'internal and external environment', under specific 'organizational conditions', all of which influence the 'care processes', which in turn influence the 'outcomes'.[20] The care processes through which a resident receives an antibiotic is dependent on the organizational work system of the ALF and the interaction of components within that work system.[19]

A qualitative descriptive study, published in 2022, used SEIPS 2.0. for deductive content analysis to describe nurses' experiences in delivering care within the critical care work system, midst the COVID-19 pandemic. It also provided insight into how nurses adapted nursing care to avoid the impacts of system barriers on patients.[21] Similarly, the SEIPS 2.0 model has been utilized to examine the telemedicine work process in nursing homes.[22,23] These studies show how SEIPS2.0. is a suitable work system model to assess both the care processes and the relevant work system characteristics that may impact that process. However, it has not yet been applied to investigate a work system process for antibiotic prescribing and administration within an ALF setting. This study represents a new application of the SEIPS 2.0 model in this setting, aiming to provide valuable insights into the intricate processes surrounding antibiotic prescribing and administration to residents.

This study employed a qualitative descriptive design with deductive thematic analysis using SEIPS 2.0 as a theoretical framework. The design offers structured, yet flexible exploration of the workflow involved in antibiotic prescribing and administration. This is well-suited for capturing the nuanced perspectives of ALF staff and their experiences in care processes. This approach provided a systematic method for analyzing process complexities while remaining grounded in participants' narratives.

2.2. Setting

ALFs in Wisconsin are licensed and regulated by the Division of Quality Assurance.[24] They are classified into four categories: Adult Day Care Center, Adult Family Home, Community-Based Residential Facility and Residential Care Apartment Complex. The differences are explored in supplement_2. This study specifically concentrates on mid-sized Community-Based Residential Facilities and Residential Care Apartment Complexes with approximately 21 to 99 beds (mid-sized). This selection was made after reviewing a comprehensive list of ALFs in the state of Wisconsin. In Wisconsin, ALFs vary widely in size, ranging from small with few beds to large facilities with hundreds of beds. However, mid-sized ALFs are the most common and were chosen to represent the typical ALF in the state.

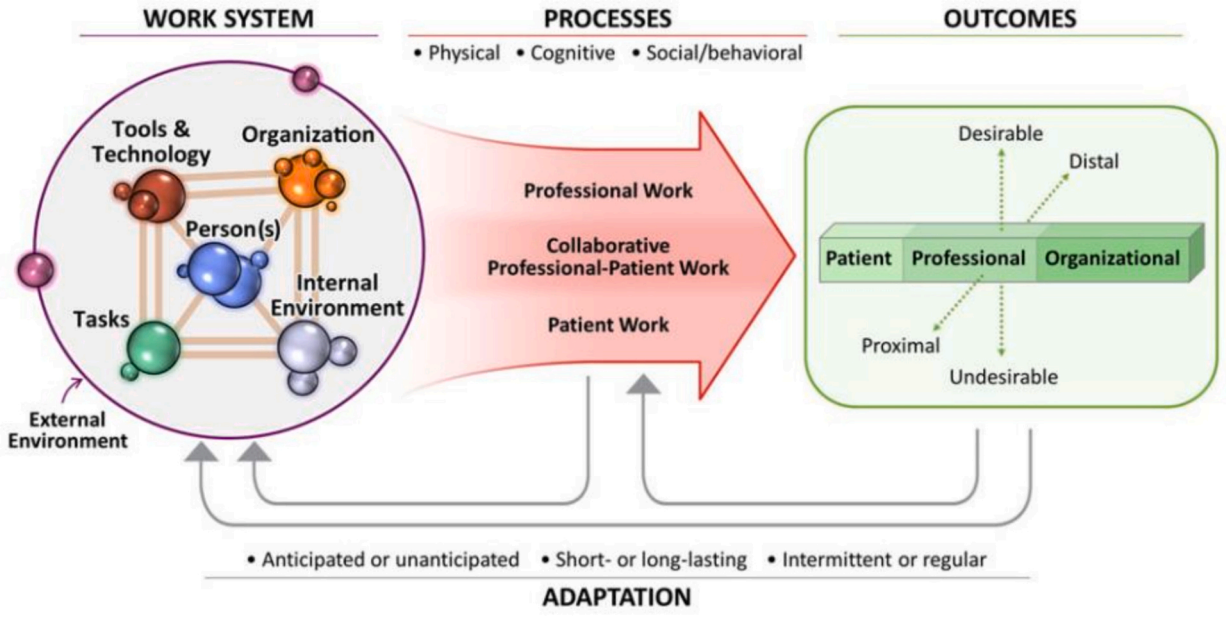

Fig. 1. Systems Engineering Initiative for Patient Safety (SEIPS) 2.0 model (Holden et al., 2013).

2.3. Data collection

We used a combination of purposive and snowball sampling. We contacted three ALF associations in Wisconsin namely LeadingAge, Wisconsin Assisted Living Association, and Wisconsin Center for Assisted Living to recommend ALFs in Dane County, WI for data collection. All recommended ALFs were located in urban areas of the southern county in Wisconsin with access to multiple urban medical care centers. We emailed the recommended ALFs to nominate staff within their facility who are knowledgeable about the care process leading to residents receiving antibiotics. All eight nominated individuals were emailed a description of the study and invited to participate in an interview and seven staff accepted the invitation. This sampling strategy ensured that participants had direct involvement or expertise in the processes being studied, enhancing the reliability and relevance of the data collected. We scheduled all seven participant interviews through Zoom, a certified secure video conferencing platform for research purposes. Participants were offered remuneration.

The interview guide (Supplement_1) for the semi-structured data collection interviews was designed based on prior work on antibiotic prescribing process in nursing homes[18] and literature on antibiotic prescribing in ALFs related to physician, staff, resident, and family member perspectives.[25,26] To ensure that the interview guide effectively captured the intended concepts, cognitive interview was conducted with one participant.[27] The participant confirmed its alignment, and no modifications were required.

The interview guide was divided into six sections: resident admission, recognizing changes in condition, communicating with the prescriber, prescribing antibiotics, antibiotic follow-up, and questions about training. Within each section appropriate questions were devised to encourage respondents to talk about the people (prescribers, informal caregivers, and residents) involved, tasks they were responsible for, tools and technology they used in the process, and how the external and internal environment as well as the organization played a part in the process that forms the work system component of the selected theoretical framework SEIPS 2.0.[19] Not all sections of the interview guide incorporated every component of the SEIPS 2.0 framework. Instead, each section focused on the components most relevant to the specific stage in the antibiotic prescribing and administration workflow being addressed. The questions were neutral and open ended to guide the semi-structured data collection interviews.

Additional prompts were used during the interview process to explore areas which were unclear. These inquiries prompted participants to contemplate the entirety of the process involved when a resident obtains an antibiotic. They were encouraged to consider their general practice in scenarios such as a resident's admission with an antibiotic, changes in their condition that may signal a potential infection necessitating antibiotics, communication with the prescriber, acquiring and administering the antibiotics, and subsequent follow-up.

The interviews, conducted between February and April 2022, were digitally recorded with consent from the participants. Informed consent was verbally obtained before the interviews which lasted an average of 45 min each.

2.4. Data analysis and creation of flowchart

The researcher reviewed the audio recordings and compared them with the initial automatic transcript obtained from Zoom. Whenever discrepancies were identified, the transcripts were revised to incorporate those variations. This iterative process ensured accuracy and quality of the final transcripts and allowed the researcher to familiarize with the raw data.

Deductive thematic analysis was performed using NVivo, version 12.0[28] on all interview transcripts. The researcher systematically coded the data into the six SEIPS 2.0 work system components: person, task, tool/technology, organization, internal environment, and external environment. Within each component, common themes that emerged were organized into subcodes. For the task component, these subcodes formed the basis for identifying steps in the process flowchart. Key steps were selected based on whether most participants referred to them. Tasks that involved individuals and their use of tools and technology were grouped under a 'process' code, establishing the flowchart's boundaries. This information was then used to visually represent the process. Each key step was added to the flowchart in the order that participants described, creating a generalizable sequence. Basic flowchart symbols were used to illustrate each step clearly.

Flowchart accuracy was then verified, via member checking to establish workflow.[29] The process flowchart was emailed to the selected interviewee who is knowledgeable of the process. They were asked to provide feedback on its accuracy, and they verified the process flowchart to be accurate to their knowledge. This confirmed that the generalized process flowchart aligned with what was described during the interviews. Following this process, the steps of the flowchart were numbered and salient and clear quotes for the selected themes were picked to represent the theme.

2.5. Results

Eight staff at five mid-sized ALFs in Dane County, WI were invited to participate and seven accepted. Table 1 summarizes characteristics about the interviewees and the ALFs. Four of those facilities were Community-Based Residential Facility and one a Residential Care Apartment Complex and all 5 were in urban areas. Two of the interviewed staff oversaw management of the facilities - an assisted living administrator and a campus director. Four interviewees were registered nurses, and one was a resident care aid who was a designated resident service coordinator.

By thoroughly reviewing all seven interview transcripts, a generalizable process of antibiotic prescribing and administration process was established. Consensus on a step in this study was considered to be met when at least 5 out of the 7 interviewees mentioned a particular step during their interview, with representation from all 5 ALFs. This approach helps ensure that the findings reflect patterns observed across all participating facilities, thereby strengthening the generalizability of the data. This outcome served as the main result of the study (Fig. 2), providing insights into the typical process observed across multiple interviews. The antibiotic prescribing and administration process in ALFs consists of 33-steps from resident admission to the final follow up.

The 33-step process is divided into five sections. The first section describes the admission process of a resident entering the assisted living facility. The second section details the process from the point when staff at the facility notice the resident having a change in condition to deciding to seek out provider input. The third section starts with seeking

Table 1
Overview of assisted living facilities (ALF) and interviewees.

ALF number	Facility type	Total number of beds (non-memory care beds + memory care beds)	Profession of interviewee
1	CBRF* with Memory care	68(50 + 18)	Case Manager (RN†)
2	RCAC‡	70	Case Manager (RN†)
3	CBRF* with Memory care	24	Campus director
4	CBRF* with Memory care	48 (36 + 12)	Case Manager (RN†) Assisted Living administrator Resident services coordinator
5	CBRF*-Memory care only	63	Care Coordinator (RN†)

*CBRF: Community based residential facility, †RN: Registered Nurse, ‡RCAC: Residential care apartment complex.

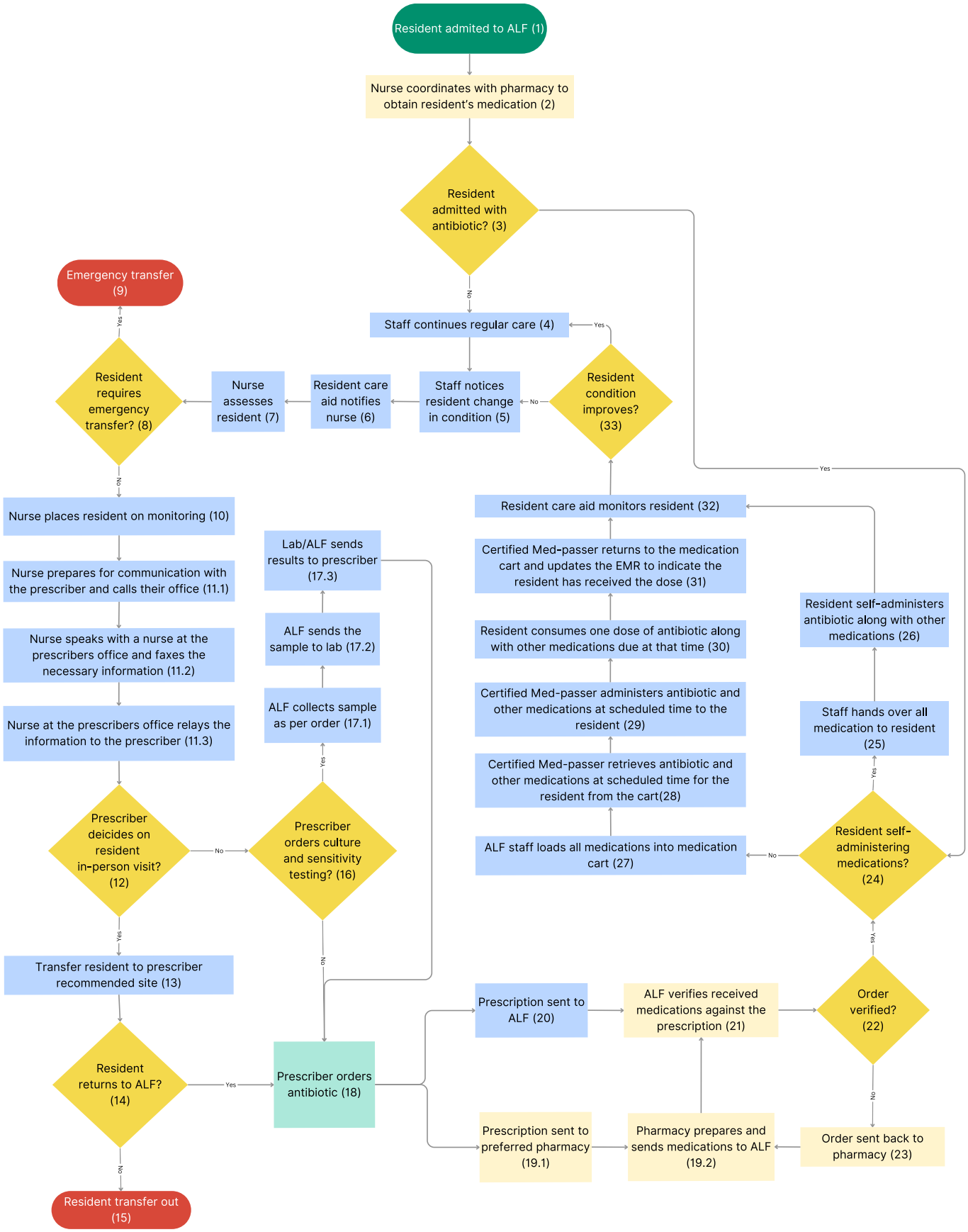

Fig. 2. Workflow model of Antibiotic prescribing and administration in assisted living facilities.

the provider input to obtaining a prescription for the antibiotic. The fourth section is obtaining the prescription from the pharmacy and the fifth section describes the process of administering the antibiotic to the patient.

2.6. Admission

When a resident is admitted to ALF (Fig. 2, flowchart box 1), nurses collaborate with the physician and resident or family to acquire a comprehensive list of the resident's current medications. They then coordinate with the pharmacy to refill any necessary prescriptions (Fig. 2, flowchart box 2). All five facilities reported working with a preferred pharmacy, but only two specified that their pharmacy was dedicated to long-term care. Typically, residents' prescriptions are transferred to the preferred pharmacy during the admission process. Three of the five facilities also mentioned that their preferred pharmacy has access to their electronic medication record of the patient; and at two facilities out of the three, the pharmacy staff enters the medication order into the system which then gets cross verified by the staff at ALF against the faxed order obtained from the physician or clinic or hospital.

"…When somebody is going to be admitted to our community and if we're going to be administering those medications, the processes, is that the physician, the primary physician needs to write out orders on what medications this resident is to be taking. Those orders then go directly to the pharmacy. The pharmacy then processes, these orders into the system. So, they come up on electronically and then I review them and accept them into our EMR so then I can, you know, then we can start administering those medications. So, pharmacy also got a pretty critical role in that, making sure that all those pieces are there… So, there's like a five-page form that we send out to the physician… They print out the medication sheet that they have on file and just send that back along with the form that we have. So, pharmacy gets the orders and then we also get a copy of that…" - ALF 2 Case Manager.

The next step is to verify whether the resident is bringing in any antibiotics, either for the treatment of an existing condition or as prophylaxis (Fig. 2, flowchart box 3). If yes, the process skips to a decision about resident self-administration of the antibiotic (Fig. 2, flowchart box 24).

After admission, ALF staff initiates their regular care processes (Fig. 2, flowchart box 4) which includes aiding with activities of daily living, medication administration, and monitoring the resident.

2.7. Change in resident condition

All staff members are expected to monitor for changes in the resident's condition, but resident care aids are typically the first to notice any change in condition (Fig. 2, flowchart box 5). If noticed, nursing staff are informed (Fig. 2, flowchart box 6) and a more comprehensive evaluation of the resident (Fig. 2, flowchart box 7) is conducted. If the resident requires an emergency transfer to an urgent care or the emergency room (Fig. 2, flowchart box 8), the ALF arranges the appropriate transportation, depending on the severity of the situation. If an emergency transfer is not required, the resident is monitored (Fig. 2, flowchart box 10) while the nurse prepares to communicate with the prescriber.

2.8. Communication with the provider

The nurse calls the prescriber's office (Fig. 2, flowchart box 11.1) with the prepared information about the resident based on their assessment and communicates with another nurse or staff at the prescriber office while also faxing over relevant information (Fig. 2, flowchart box 11.2). The staff then relays that information to the prescriber (Fig. 2, flowchart box 11.3). After reviewing the information about the resident's current condition, the prescriber decides whether an in-person visit is necessary (Fig. 2, flowchart box 12). If an in-person visit is needed, the resident is transferred to the prescriber's recommended location (Fig. 2, flowchart box 13). During the visit, the prescriber evaluates the resident, determines if an antibiotic is needed (Fig. 2, flowchart box 18), and decides if the resident can return to the ALF (Fig. 2, flowchart box 14) or transferred out (Fig. 2, flowchart box 15) for further care.

If a prescriber chooses not to see the resident, they may prescribe an antibiotic (Fig. 2, flowchart box 18) based on symptoms and other relevant information or wait for culture and sensitivity testing to be performed (Fig. 2, flowchart box 16) prior to prescribing an antibiotic. If this occurs, the sample is usually collected by the ALF staff (Fig. 2, flowchart box 17.1) and sent to a laboratory (Fig. 2, flowchart box 17.2). The results are forwarded to the prescriber by the lab or the ALF (Fig. 2, flowchart box 17.3).

2.9. Obtaining the prescription

The prescriber's office sends the prescription, if any, to both the preferred pharmacy (Fig. 2, flowchart box 19.1) and the ALF (Fig. 2, flowchart box 20). The pharmacy delivers the antibiotics to the ALF (Fig. 2, flowchart box 19.2). This allows the pharmacist to review any new medications, such as antibiotics, for appropriateness. Few of the preferred pharmacies that are dedicated to long-term care directly input data into residents' electronic medical records linked with the ALF. The ALF verifies the received antibiotic(s) against the prescription (Fig. 2, flowchart box 21 and 22). Incorrect ones are returned to the pharmacy (Fig. 2, flowchart box 23) and the process is repeated until the correct medications are received.

2.10. Antibiotic administration and follow-up

Once the order is verified, the mode of administration is determined (Fig. 2, flowchart box 24). If self-administration, ALF staff hands over all medications to the resident (Fig. 2, flowchart box 25) who then administers their own antibiotics (Fig. 2, flowchart box 26). In this case ALF staff does not provide any assistance with medication administration, such as reminders.

If the resident is not self-administering, a certified med-passer loads the antibiotic along with other medications into the medication cart (Fig. 2, flowchart box 27) and administers the dose as per prescription (Fig. 2, flowchart boxes 28–30). Then the ALF staff updates the electronic medication administration record indicating that the resident has received the antibiotic (Fig. 2, flowchart box 31) or any discrepancy like the resident's refusal or partial administration. This process of antibiotic administration is generalizable to most oral medication administration in ALFs.

The ALF staff continues to monitor the resident's condition (Fig. 2, flowchart boxes 32,33). If resident symptoms do not improve, the resident care aid notifies the nurse (Fig. 2, flowchart box 6) and follows the appropriate procedures.

"So, when a person's on antibiotics we continue to monitor them, and if we've noticed that after 5 days they're not showing any improvement staff will let me know and I will update the doctor, … not seeing real good improvement, how would you like to proceed, seems to appear to be getting worse, what can we do?" - ALF 1 Case Manager.

ALF staff tend to rely more on external providers in antibiotic decision-making processes. If the resident's condition improves, regular care continues (Fig. 2, flowchart box 4), marking the end of the process flowchart.

3. Discussion

This study centers on understanding the antibiotic prescribing and administration workflow in ALFs. This can inform the development of antibiotic stewardship initiatives tailored to this setting. This study used the SEIPS2.0 model to explore the antibiotic prescribing and

administration process across five ALFs. Specific steps in the antibiotic prescribing and administration process (Fig. 2, flowchart box 5–10) closely mirror those in nursing homes.[18,30] Nursing homes are the most comparable long-term care setting to ALFs, particularly in terms of workflow and care delivery. While the interview guide was adapted from prior research in nursing homes, it was designed to capture the unique aspects of ALFs. The discussion highlights similarities and differences between ALFs and nursing homes to fully represent the specific dynamics of staff roles, communication, and decision-making processes in ALFs.

In both settings, a change in resident condition triggered a similar process, involving staff notification, nurse assessment, and potential emergency transfer. The process diverged from nursing homes processes regarding prescriber input, with nursing homes emphasizing it as a separate step whereas ALFs appeared to rely more on physician advice, potentially influenced by ALF staffing.

Staffing differs in nursing homes and ALFs in terms of percentage of registered nurses, licensed practical nurses, or certified nursing assistants.[31,32] For example, a study on ALF staffing found that only 33 % of facilities had both a registered nurse and a licensed practical nurse on staff, and 32 % of ALF's had no registered nurse on staff.[33] Moreover, variations in staff expertise and staffing ratios might influence the extent that nursing staff participate in antibiotic decision-making processes in nursing homes compared to ALFs. This could also be due to the differences in the level of care required by the residents at an ALFs compared to that of nursing homes. For example, the structure of nursing homes in terms of resident acuity, is similar to Community-Based Residential Facility, but a Residential Care Apartment Complex or Adult Family Home require different levels of care.[24] Organizational staffing factors that may influence the antibiotic prescribing and administration process in ALFs require further study.

Another key distinction between ALFs and nursing homes is the increased reliance on pharmacies in ALFs. The flowchart (Fig. 2) illuminated various points within the workflow where pharmacists are involved, especially at ALF preferred pharmacies, indicating their unique position to provide antibiotic stewardship services in ALFs. This involves pharmacies obtaining prescriptions from doctors, pharmacies entering data into residents' electronic medical records, and pharmacies delivering antibiotics to the ALFs. Pharmacies are thus uniquely positioned to support antibiotic stewardship programs, particularly in ALFs where residents are more likely to self-administer their medications. In these cases, ALF staff do not assist with medication administration, which often makes pharmacists the final point of contact before residents take antibiotics.

Insights from antibiotic stewardship programs in nursing homes inform the potential application of similar strategies in ALFs. Literature identifies the opportunities for how pharmacists can contribute through pharmacist-driven antibiotic stewardship programs in long-term care facilities.[34–36] Numerous strategies for antibiotic stewardship programs have been developed for nursing homes, like antibiotic time-out, stop orders, de-escalation.[37] However, ALFs in our study did not report utilizing these approaches. A 2022 study investigating antibiotic de-escalation opportunities in ALFs found that such opportunities exist. However, the authors suggested that the limited frequency of on-site physician visits and the physicians' limited familiarity with individual cases may contribute to a lack of antibiotic treatment adjustments or de-escalation in ALFs.[38] This was also the case in this study. Communication and collaboration between physicians and ALF staff are critical to effective care management, particularly concerning antibiotic prescribing. The results section (Fig. 2, ALF flowchart, steps 10–17) underscores the communication process involved in antibiotic prescribing. However, the communication dynamic differs significantly from that of nursing homes, where physicians or nurse practitioners often play a more routine role. While three of the five ALFs in this study had providers visiting few of residents, this was an infrequent occurrence, described by interviewees as an exception rather than the norm. As such, this aspect was thus not highlighted in the flowchart (Fig. 2). Unlike nursing homes that typically employ medical directors to oversee care,[29] ALFs lack such a structured presence. This absence impacts care communication and may contribute to practices such as unnecessary treatment of asymptomatic bacteriuria. For example, one interviewee explained the process of requesting a urine culture:

"…the nurse calls the doctor's office, the clinic, and requests for a urine sample. Then he'll sign out the forms to get that urine sample…" - ALF 4 resident services coordinator.

This suggests that the limited provider presence in ALFs could lead to overdiagnosis, overtreatment, and increased costs associated with testing.

A retrospective repeated cross-sectional study evaluated the nationwide adoption and application of CDC's core elements of antibiotic stewardship in nursing homes. In this 2018 study, 71 % of nursing homes reported pharmacists participated to enhance appropriate antibiotic usage, marking a significant 27 % increase from 2016.[39] One core element of CDCs Core Elements of Antibiotic Stewardship in nursing homes is to establish access to consultant pharmacists with experience or training in antibiotic stewardship.[40] A consultant pharmacist reviews antibiotic courses for appropriateness of administration and/or indication, establishes standards for clinical/laboratory monitoring for adverse drug events, and utilizes microbiology culture data to assess and guide antibiotic selection.[40] Additionally, consultant pharmacists help nursing home facility personnel to implement policies and procedures for effective antibiotic stewardship, assist prescribers and facility staff to understand how to use the facility's antibiogram, find appropriate resources, and provide facility personnel feedback on their antimicrobial stewardship efforts.[41] This recommended process for nursing home offers a model that could be adapted to ALFs as many have existing relationship with pharmacies.

Implementation methods, that yielded the highest success in promoting appropriate antimicrobial usage, involve receiving feedback from nurses and pharmacists.[42] Since opportunities for pharmacist-driven antibiotic stewardship programs in ALFs have not been explored, future studies are needed. Future research could explore the feasibility of expanding the pharmacist's role in ALFs, examining whether consulting pharmacists can help reduce antibiotic use by improving the appropriateness of treatment decisions and identify specific steps in the flowchart (Fig. 2) that would be affected if we involved pharmacists in the process. It could also investigate how pharmacists can be utilized to train staff, residents, and families on appropriate antibiotic use, monitor treatment outcomes, conduct antibiotic use audits, and develop evidence-based protocols tailored to individual facilities. Additionally, identifying early adopters—ALFs that have implemented pharmacist-driven antibiotic stewardship programs—could provide valuable insights into the feasibility and readiness for similar initiatives, as well as highlight potential barriers to successful implementation.[43]

3.1. Limitations

The study employed online methods for data collection, which may have influenced the richness of the responses compared to in-person interactions. While online interviews are practical and reduce logistical challenges, they can limit opportunities for building rapport and capturing non-verbal cues, which are valuable in qualitative research.

Another limitation of this study is that the coding and analysis were conducted by a single researcher who also served as the interviewer. This approach, while practical, may have introduced bias in the interpretation of the data. Future studies should consider incorporating multiple coders and using inter-rater reliability checks or consensus discussions to enhance the credibility and rigor of the analysis.

Additionally, using the SEIPS 2.0 model for deductive content analysis, while providing a structured framework, may have constrained the exploration of themes outside the predefined framework. This methodological limitation could lead to an oversight of emergent

themes that do not align with the model.

The small sample size of seven staff from five ALFs located in one midwestern county may impact the generalizability of the findings. The sampling strategy of purposive and snowball sampling has high probability of introducing selection bias due to lack of randomization. This study focused mainly on mid-sized urban ALFs, with only one Residential Care Apartment Complex and four Community-Based Residential Facilities, which may not fully capture variations across different types and sizes of ALFs. The inclusion of only one frontline caregiver limits the ability to identify challenges related to antibiotic administration to the residents.

Another aspect of the sample that could affect the generalizability of the findings is that all five ALFs included in this study are located in urban areas with access to multiple medical care centers. This proximity may have influenced care processes; for instance, it could influence the likelihood of prescribers visiting the facilities rather than residents being transported to see prescribers.

Future studies should aim at addressing these limitations by including larger and more diverse samples of ALFs, spanning urban, suburban, and rural areas and involving both administrative staff and greater numbers of frontline caregivers. Additionally, to enable comparative analyses and enhance understanding, future research should encompass ALFs of varying sizes, and types such as Residential Care Apartment Complexes and Community-Based Residential Facilities with and without memory care. This will provide a more comprehensive understanding of the antibiotic prescribing and administration process and potential roles of consulting pharmacists in ALFs.

3.2. Conclusion and implication

Our examination of the existing literature on the prevalence of antibiotic resistance, both generally and specifically within long-term care facilities, revealed several gaps. Notably, there is a lack of literature focusing on ALFs. Only a limited number of studies discussed antibiotic utilization in ALFs, and none delved into the process of antibiotic prescribing and administration in these settings. This study aimed at filling these gaps using the SEIPS2.0 model to investigate the workflow of antibiotic prescribing and administration in ALFs.

We identified the sequential steps involved in the antibiotic prescribing and administration process for ALF residents. Our exploratory findings have direct implications for future research. Further research is necessary to comprehend the impact of antibiotic prescribing and to devise targeted stewardship interventions in ALFs. Subsequent investigations involving pharmacy stakeholders to identify their needs and barriers in participation of antibiotic stewardship interventions could help identify and implement pharmacist-driven antibiotic stewardship programs tailored to ALFs.

CRediT authorship contribution statement

Deepthi Jacob: Writing – original draft, Visualization, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Betty Chewning:** Writing – review & editing, Supervision. **James H. Ford:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

The authors have no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.rcsop.2025.100572.

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