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Major Article

Influencing duration of antibiotic therapy: A behavior change analysis in long-term care

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Background: Prolonged antibiotic duration of therapy is common in long-term care (LTC) settings and associated with increased risk of harm for residents. To identify potential antibiotic stewardship opportunities aimed at prolonged duration of therapy, this study examined barriers and enablers to using shorter courses of antibiotic therapy in the LTC setting.

Methods: Semistructured interviews were conducted with prescribers in LTC home settings, and a total of 8 LTC clinicians participated in the study. Questions and clinical scenarios explored the factors influencing the decisions of prescribers about duration of therapy. Using the Theoretical Domains Framework, interview data were analyzed deductively.

Results: The themes identified that influence duration of antibiotic therapy in LTC were environmental context and resources, knowledge, beliefs about consequences, social influences, and behavioral regulation. Specific concerns described by participants included the perceived lack of evidence to support shorter courses in LTC residents, the misconception that shorter courses could lead to greater rates of resistance, and the strong role of habit and prior experience in selecting antibiotic duration.

Discussion: There are several factors affecting antimicrobial duration prescribing behavior aside from the clinical scenario itself. Tackling misconceptions and providing educational support may be helpful approaches.

Conclusions: These findings provide theory-informed evidence to support the development of antimicrobial stewardship interventions aimed at improving duration of antibiotic therapy.

Overuse of antimicrobial therapy in the long-term care (LTC) setting is common and contributes to preventable harm for residents.[1] Up to 78% of LTC residents will receive at least 1 course of antimicrobial therapy over the course of 1 year. A total of 63% of prescribed courses of antibiotic treatment in LTC are >10 days,[2] although most uncomplicated infections can be adequately treated for ≤7 days.[3-5] Additionally, older individuals receiving prolonged duration of therapy may be more prone to the harmful effects of antibiotics. These potential harms include adverse effects,[6,7] drug interactions,[8] the development of antibiotic resistance,[9,10] and increased risk of *Clostridium difficile* infection.[11]

Duration of therapy varies widely based on the prescriber, but is unexplained by differences in characteristics among patients treated by those prescribers.[12] Recent evidence shows that prior prescribing of prolonged antibiotic duration is strongly associated with future prescribing of prolonged duration, indicating consistency among individual prescribers over time.[13] However, there is a lack of understanding as to the reason for inter-prescriber variability in selection of antibiotic duration. Understanding these drivers can help influence effective antimicrobial stewardship interventions aimed at duration of therapy.

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Table 1
Infections in LTC case scenario results

Clinical condition	Case summary	Prescriber selected initial duration of therapy
Urinary tract infection	An 86-year-old female LTC home resident with uncomplicated cystitis and pan-susceptible *Escherichia coli* in urine culture	A. Nitrofurantoin, 5 d B. Trimethoprim-Sulfamethoxazole, 7 d C. Fosfomycin, 1 d D. Trimethoprim, 3 d E. Trimethoprim-Sulfamethoxazole, 3 d F. Nitrofurantoin, 7 d G. Trimethoprim-Sulfamethoxazole, 7 d H. Amoxicillin, 1 d or Trimethoprim 3, d
Pneumonia	A 79-year-old male LTC home resident with pneumonia and improvement by d 3 of therapy	A. Azithromycin, 5 d and Amoxicillin/Clavulanate, 7 d B. Azithromycin, 5 d and Amoxicillin/Clavulanate, 10 d C. Antibiotic not specified, 7-10 d D. Consider no antibiotics E. Azithromycin, 7 d F. Antibiotic not specified, 10 d G. Azithromycin, 5 d and Amoxicillin/Clavulanate 10 d H. Azithromycin, 5 d and Amoxicillin/Clavulanate or Cefuroxime, 7-10 d
Cellulitis	An 82-year-old male LTC home resident with left lower leg cellulitis	A. Cephalexin, 7 d B. Cephalexin, 7 d C. Cephalexin, 7 d D. Cephalexin, 5 d E. Cloxacillin, 7 d F. Cephalexin, 7 d G. Cephalexin, 7 d H. Cephalexin, 10 d

LTC, long-term care.

The purpose of this study was to examine the perceived barriers of the prescribers and enablers barriers and to using shorter courses of antibiotic therapy in the LTC setting. The results will assist in the development of the tools and resources to promote prescribing shorter courses of therapy.

METHODS

Study design

A mixed-methods research design was employed. Semistructured interviews were conducted with prescribers, including physicians and nurse practitioners practicing in Ontario, Canada LTC homes. An evaluation specialist and knowledge exchange specialist, with experience in qualitative interviewing and research methodology, performed all interviews. Interviews took place by telephone and lasted for approximately 60 minutes. All interviews were audio recorded and transcribed.

Sample

A convenience sampling method was used for recruiting interviewees, with an aim to include a variety of prescribers from different LTC settings. A contact with the Ontario Long-Term Care Clinicians organization assisted in recruiting physicians and nurse practitioners through their mailing lists.

Ethics and privacy

This project was reviewed (level 1) and approved by the Ethics Review Board at Public Health Ontario. The privacy office at Public Health Ontario also reviewed and approved the project.

Interview guide

An interview guide (Appendix A) was developed based on consensus from discussions with antimicrobial stewardship pharmacists, infectious disease clinicians and researchers, LTC clinicians, an evaluation specialist, and a knowledge exchange specialist. The interview included general questions about duration of therapy and varied case scenarios designed to explore considerations made when deciding about duration of therapy. The remaining interview questions explored ideas around awareness of antimicrobial resistance development, potential barriers or facilitators to changing prescribing behaviors, and additional contextual factors to consider.

Theoretical framework

The Theoretical Domains Framework (TDF)[14] was used to identify thematic components of the interviews. This framework synthesizes key theoretical constructs from relevant behavior change theories, and is commonly used in the implementation science field to analyze barriers and facilitators to clinical behavior change. The TDF was developed in collaboration with psychologists and implementation researchers and consists of the following 14 domains: knowledge; skills; memory, attention, and decision processes; behavioral regulation; social/professional role and identity; beliefs about capabilities; optimism; beliefs about consequences; intentions; goals; reinforcement; emotion; environmental context and resources; and social influences. The TDF was selected for our study because of its ability to support the development of theory-driven interventions to address implementation challenges.[15]

Data analysis

Transcripts were analyzed using a qualitative coding software (NVivo; QSR International, Australia). A coding manual was developed to reflect the 14 domains of the TDF. Two coders (S.C. and J.Q.) independently analyzed the data, and disagreements were resolved using discussion and consensus. (See Appendix B for the coding guide). The coders purposefully focused on identifying influencers (ie, barriers and facilitators) for decision making about the duration of therapy, particularly with respect to using shorter courses of treatment. Given the deductive approach to the analysis, whereby pre-identified codes and themes are applied to the data, rather than identifying new theories, evaluation of thematic saturation was not performed.[16] With the longer interview length, the aim was to obtain rich data from a small number of interviewees.

RESULTS

A total of 8 prescribers agreed to participate (n = 4 physicians, n = 4 nurse practitioners) out of 13 clinicians invited to participate. There was variability in case scenario responses for duration of therapy with a general trend towards longer courses in residents with pneumonia and cellulitis (Table 1). Clinicians cited the importance of individual patient scenario characteristics (eg, past medical history, complicating factors, speed of recovery, and antibiotic agent used) in duration selection. From a behavioral perspective, 5 main domains emerged concerning their duration of therapy decisions. These TDF domains and their frequency of occurrence were: environmental context and resources (n = 84), knowledge (n = 32), beliefs about consequences (n = 29), social influences (n = 21), and behavioral regulation (n = 19).

Environmental context and resources

Guidelines were cited as an important factor in selection of antibiotic duration. Most prescribers (n = 7) referenced a Canadian guideline for anti-infective use in primary care that influenced their antibiotic prescribing.[17] Clinicians indicated the importance of having guidelines that are evidence-based and that provide details on any new recommended changes in clinical practice. Pharmacists were also mentioned as an important resource in determining the appropriate treatment regimen.

The frequency at which prescribers visit the LTC home also seemed to be a key factor. Since physicians tend to visit weekly, a 7day duration is often selected to allow for adequate follow up.

> "I would put a 7-day course on him, because I know I'd be in to the home within that timeframe, and reassess it, so that's, that's how I would start treatment."

The impact of other clinicians and services was also noted as a factor in duration selection. For example, patients sent to the emergency department may receive a regimen different than that chosen by the LTC clinician.

> "So, I'm not always the physician seeing my patient on weekends, or, patient may have been sent to Emergency and been told to get a longer duration, or, they are on antibiotic and there's no real good indication to change the antibiotic, but it got changed because the formulary at the hospital is different than the formulary in the LTC facility. And then, they've gotten a longer duration, but the antibiotics when they really didn't need that."

Knowledge

Awareness of the current evidence for appropriate duration of therapy also emerged as a key theme in interviews with clinicians. Clinicians indicated concern that not all individuals involved in the care of residents were equally aware of antibiotic duration recommendations and potential harmful effects of antibiotic overuse.

> "So, I think the challenge would be around ensuring that you've educated the residents, their families, the powers of attorneys, the decision makers, as well as the nursing staff who are giving that medication. It only takes 1 person saying 1 little wrong thing; it takes forever to correct it."

Clinicians in the interviews stressed the importance of having this up-to-date evidence of shorter durations as a key factor in changing their prescribing habits.

> "I would hope that most people understand that duration is also hugely important. Unfortunately, we don't have a lot of information on that, so it's not had enough attention, and it's not had enough research."

> "It would have to be evidence-based. . .you'd have to have solid evidence such as a study where you looked at 3 days versus 5 days, versus 7 days and showed that the outcomes were either non-inferior or similar so, I'd have to see evidence."

> "I think the biggest problem that we have for the duration of, of treatment is that. . .we don't have evidence."

Beliefs about consequences

Prescribers expressed concern about unintended consequences of using shorter courses, particularly with respect to lower efficacy and reduced likelihood of recovery from the infection, resulting in situations in which an additional course of antibiotics would be needed.

> "My first question's going to be, 'How can you guarantee that at day 4 my patient's not going to come back in and say Doc I'm not better I need more. . .?"

There were misconceptions about the harms of shorter courses of duration for treatment. Clinicians perceived that using shorter courses would result in higher rates of resistance, owing to inadequate treatment of the infection, leaving behind organisms, which will subsequently develop resistance mutations.

> "So, the way I understand it is if I don't treat long enough, I'm likely to have left some of the bacteria there that has then mutated-, can mutate, it can mutate and grow and become stronger and now are not going to work when I go to try to treat with that antibiotic again. . .. . .I understand that if I don't, if I don't continue a treatment that's when I'm doing somebody , I would probably do 7 days, and at day 3, he's improved, but I would continue him on his antibiotics. It would continue for the duration of the therapy so that we don't get resistance."

Social influences

Participants described an awareness of antimicrobial stewardship and a perception of its increasing importance; however, the concept of appropriate duration of therapy was not a top priority, particularly for their colleagues. Some key change agents with the potential to influence practice change included nurses, pharmacists, and their peers. Some participants felt that pharmacists could be more influential in prescribing decisions, and that pharmacists in community settings may be less likely to intervene on an inappropriate antibiotic prescription than those in hospital settings. Meetings and conferences with other LTC clinicians were suggested as opportunities to influence knowledge and practice change.

> "I don't think that the front-line staff really pay attention so much to the duration, um, I think they just care more about the fact that they are on an antibiotic."

> "Now, I go to meetings that belong to a LTC. . .clinician(s). And, we talked about this at meetings and we've talked about antibiotic stewardship, and use of antibiotics, so certainly treating urinary tract infections—we've shortened the course."

> "The best always is the pharmacist communication piece. So, if the pharmacist sends me. . .a thing to consider change, here's the

Table 2
Potential interventions to address prolonged antimicrobial duration of therapy[27,28]

Theoretical domain	Definition	COM-B component	Intervention function	Intervention examples
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behavior	Opportunity (physical)	• Training • Restriction • Environmental restructuring • Enablement	• Incorporate duration recommendations into medical record/prescribing process • Provide financial incentive for shorter course antibiotic prescribing • Engage consultant and/or centralized pharmacists in duration of antibiotic therapy activities • Engage nurses in duration of antibiotic therapy activities
Knowledge	An awareness of the existence of something	Capability (psychological)	• Education	• Distribution of educational materials • Educational meetings • Campaigns regarding using shorter courses of therapy when appropriate • Providing information or education
Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation	Motivation (reflective)	• Education • Persuasion • Modeling	• Audit and feedback • Distribution of educational materials • Educational meetings • Educational outreach visits • Local opinion leaders • Providing information or education • Communication and case discussion between distant health professionals
Social influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviors	Opportunity (social)	• Restriction • Environmental restructuring • Modeling • Enablement	• Local opinion leaders • Local consensus processes • Campaigns regarding using shorter courses of therapy when appropriate • Communication and case discussion between distant health professionals • Engage nurses in duration of antibiotic therapy activities • Engage consultant and/or centralized pharmacists in duration of antibiotic therapy activities
Behavioural regulation	Anything aimed at managing or changing objectively observed or measured actions	Capability (Psychological)	• Education • Training • Modelling • Enablement	• Distribution of educational materials • Educational meetings • Educational outreach visits • Local opinion leaders • Audit and feedback • Reminders • Providing information or education • Incorporate duration recommendations into medical record/prescribing process

evidence, I will never refuse because that's their job. . .I don't have a problem with that."

Behavioral regulation

Habit was a key influencer of duration of therapy decisions described by participants. Prior training and practice were referred to as common reasons for current practice, with respect to duration of antibiotic therapy. Based on clinician responses to the case studies and interview prompts about decision making, it was evident that selecting duration of therapy is often linked to what they felt they were historically supposed to do, or what they were trained to do.

"I think 1 of the biggest challenges that I see in the homes is people who have practiced for a really long time, and this is the way we've always done it."

"I would treat them for 10 days because I think historically that's what we're supposed to do."

"So, when the problem is gone, I treat for another 2 days . . . and no one taught me to do that. It s just what I do."

"I ve been doing that since I was taught that back in the 80s."

DISCUSSION

We describe key considerations related to antibiotic duration of therapy decision making for clinicians in a LTC setting. Previous studies focusing primarily on the initiation of antibiotic therapy reveal a complex array of influencers, with a particular emphasis on social and contextual factors.[18] Duration of therapy also has a variety of influencers, specifically the environmental context of the LTC home, knowledge (or lack thereof) about the evidence supporting shorter courses of therapy, concern about negative consequences of using shorter courses of therapy, the influence of other clinicians, and the role of habit and experience in selecting antibiotic duration.

Data from other studies indicates prescribers are often not on-site when antibiotic decisions are made, therefore, initiation of therapy is commonly done over the phone. In fact, there is evidence that <one-half of residents are visited around the time of their prescription.[2] Prescriber's selected treatment duration often takes into account this extended interval between LTC visits. Some clinicians stated that they prescribe a minimum of 7 days of treatment to ensure they will have a chance to follow up on the resident at the time of their next visit before the antibiotic course is complete. This reinforces the importance of other team members in both monitoring and ensuring the appropriateness of antibiotic initiation and duration of therapy.

Habit and experience appear to play a particularly important role in selection of antibiotic duration. The role of habit is supported by

evidence that prior antibiotic prescribing is predictive of future antibiotic prescribing in LTC.[13] Additionally, years since graduation has recently been associated with physician tendency to prescribe longer courses of antibiotic treatment for primary care patients.[19] Without explicit and robust duration recommendations to counter commonly held practice patterns, it is understandable that experience and habit may predominate as key drivers in this facet of antibiotic decision making.

Although clinicians cited guidelines as an important resource in guiding antibiotic use, they were generally unaware that data exist to support shorter courses of antibiotic treatment. Many felt that little is known with respect to antibiotic duration of therapy. This may be in part because guidelines primarily used by clinicians[17] provided minimal guidance regarding short course antibiotic therapy for LTC residents. Although there is a lack of research focusing on duration of therapy, specifically in LTC residents, there is an abundance of data to support shorter courses of antibiotic therapy for infections commonly encountered in these residents.[3-5,20] With robust data in inpatient and outpatient settings for short course antibiotic therapy, in the absence of data signaling harm with shorter courses of therapy in LTC residents, and the known risks of longer therapy, it is reasonable to extrapolate this robust data to residents of LTC homes.

A common concern with using shorter courses of antibiotics was the risk of antibiotic resistance. Many clinicians felt that longer courses would prevent the development of antimicrobial resistance, therefore, continuing therapy even if no longer indicated, would be an approach to prevent the emergence of bacterial resistance in their patients. However, the overwhelming majority of emerging evidence indicates this is not the case. In fact, longer duration of therapy has been shown to correlate with greater rates of antimicrobial resistance.[9,21] As such, there have been recent calls to abandon the "finish the full course" dogma in favor of shorter, more patient-oriented durations of treatment.[22,23]

Although pressure from family members of the resident to prescribe an antibiotic has been identified as a key factor in initiating antibiotic therapy in previous literature,[18,24] it did not emerge as a key theme regarding duration of antibiotic regimens. However, other social influences on selection of antibiotic duration included pharmacists, nurses, and peers of the physician. This finding highlights the potential role of local champions advocating for shorter courses of antibiotic therapy and an interdisciplinary approach to improve the appropriateness of antibiotic duration.

However, there are some limitations to this work. With a sample of 8 clinicians of different disciplines, the generalizability of these findings is uncertain. However, given the semistructured interviews evaluating the very focused topic of duration of therapy, definitive themes emerged and were repeated across interviewees. Because there is no definitive sample size required for deductive mixed-methods research, data saturation was not formally evaluated. However, smaller sample sizes with in-depth interviews are often able to produce robust findings that can inform future work.[25,26] With the repeated themes that had emerged from multiple interviewees, it is unlikely that additional interviews would have revealed substantially different results.

Our results suggest a knowledge-to-practice gap with respect to duration of antibiotic therapy in LTC. Knowledge translation activities should be employed to ensure that this information is incorporated into the practice for LTC prescribers to avoid excessive antibiotic exposure for these patients. The rich results of these clinician interviews are helpful in identifying opportunities for potential antimicrobial stewardship interventions addressing duration of therapy. Table 2 provides key strategies that may be considered, given the behavior change theories and themes identified from the interviews. Potential interventions to address inappropriately prolonged duration of antibiotic therapy include providing educational materials or campaigns, audit and feedback, engaging local opinion leaders/champions, and incorporating duration recommendations into the workflow of prescribing antimicrobial agents via the use of technology.

CONCLUSIONS

Prolonged antibiotic duration of therapy is influenced by a number of important factors, including the environmental context, knowledge (or lack thereof) about the evidence supporting shorter courses of therapy, concern about negative consequences of using shorter courses of therapy, the influence of other clinicians, and the role of habit and experience in selecting antibiotic duration. Mixed-methods research and behavior change theory mapping are an important first step in the design of antimicrobial stewardship interventions aimed at improving duration of antibiotic therapy.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.ajic.2019.05.020.

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