Antibiotic Stewardship in Nursing Facilities

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INTRODUCTION

The 15,600 nursing facilities (NFs) in the United States provide medical and residential care for 1.4 million persons on a daily basis. Each year, 3.2 million persons will reside in one of these facilities.1 No longer exclusively tasked with providing long-term custodial care, NFs provide care for an increasingly complex patient population that requires a wide array of skilled care services, including intensive rehabilitation, wound care, and parenterally administered medications. Infections are a common problem in NFs; residents experiencing an infection are at significant risk of hospitalization and death, which promotes the overuse of antibiotics in this setting. Approximately 75% of residents who stay in an NF for 6 months or longer will receive at least one course of antibiotics.2 More than half of the antibiotic courses initiated in NFs are

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unnecessary\textsuperscript{3–9}; even when necessary, the antibiotics prescribed are often excessively broad spectrum\textsuperscript{5,7} or administered for a duration longer than necessary for treatment of the underlying infection.\textsuperscript{10} The overuse and misuse of antibiotics in NFs are major causes of adverse drug events and future infections such as those caused by \textit{Clostridium difficile} and antibiotic-resistant bacteria. Once acquired by a resident, \textit{C difficile} and/or antibiotic-resistant bacteria may then be spread to other residents and to patients in hospitals when resident illness requires a higher level of care.\textsuperscript{11}

An antibiotic stewardship program (ASP) is a coordinated effort that monitors patterns of antibiotic use and antibiotic-related outcomes as well as oversees identification and implementation of strategies to improve these measures.\textsuperscript{12} Until recently, ASPs existed almost exclusively in the hospital setting. However, human consumption of antibiotics in nonhospital settings greatly exceeds that in hospitals, which has led to calls for implementation of ASPs across the health care continuum.\textsuperscript{13} Recent revisions to regulations governing NFs will require facilities to have an ASP in place by November of 2017 in order to participate in the Medicare and Medicaid programs.\textsuperscript{14} Although hospitals and NFs share common antibiotic stewardship goals, the structure and process of ASPs in these two settings differ considerably. In this review, the authors (1) describe the factors that influence antibiotic prescribing decisions in NFs; (2) review the evidence supporting strategies to improve antibiotic prescribing in these facilities; (3) describe the current state of ASPs in NFs; and (4) provide suggestions for how antibiotic stewardship activity can be further expanded in NFs.

**FACTORS DRIVING ANTIBIOTIC USE IN NURSING FACILITIES**

Antibiotic prescribing is a multistep, often iterative process that involves consideration of the potential diagnoses, a decision to initiate antibiotic therapy, consideration of the different therapeutic options, and, ideally, reevaluation of patients and available diagnostic information to determine if treatment modification is indicated (Fig. 1). These decisions are complex and often involve high levels of uncertainty as well as risk. Most NF residents are frail and may not always exhibit classic signs and symptoms of infection. Fever, the cardinal symptomatic response to serious bacterial or viral systemic infections, may be blunted 20% to 30% of the time in older patients.\textsuperscript{15} Difficulty in distinguishing between asymptomatic colonization and infection is further complicated by resident inability to communicate symptoms due to advanced dementia or other medical conditions associated with impairments in verbal capacity. Many facilities lack on-site laboratory or radiologic diagnostics, necessitating transfer of the resident or their specimens to an outside facility. These transfers impose additional burdens on residents and their health care givers and may result in either decreased use of diagnostic investigations or delays in obtaining test results.\textsuperscript{16}

Although social and contextual influences play a role in antibiotic prescribing in all health care settings,\textsuperscript{17–19} they seem particularly strong in the NF setting.\textsuperscript{20} In other clinical settings, the prescribing provider assesses patients before engaging in the
decisions detailed in Fig. 1. In NFs, however, clinicians may not always be available to physically evaluate the residents before prescribing an antibiotic or, if they operate primarily in a cross-cover capacity, may be unfamiliar with the resident. Consequently, most antibiotic decisions in NFs rely heavily on the content of information communicated by nurses, nursing assistants, or other on-site health care personnel, with medical decision-making largely influenced by the quality of these communications.

Physicians practicing in general clinics outside of the NF setting may be difficult to reach directly during working hours, increasing the chance of losing important clinical information during repeated attempts at communication. Biases related to staff knowledge, attitudes, and beliefs regarding the appropriate course of action or existent prescriber-nursing relationships are, therefore, easily introduced. In addition to nursing staff's points of view, pressures from patients and their families may also contribute to prescribing decisions, as physicians may feel inclined to comply with family wishes, especially for uncertain clinical situations or during end-of-life care. This circumstance seems to be particularly true for the NF environment in the United States, Canada, and Australia, though less so for the Netherlands. Hospitals have significantly invested in the development of information technology infrastructure that can provide clinicians with access to updated information on local antimicrobial resistance patterns and institution-specific antibiotic prescribing guidelines. The same is not necessarily true in the NF setting, which further complicates medical decision-making.

Rather than a relatively straightforward dyadic interaction between patient and provider, what emerges from this literature is a complex interaction between multiple factors and individuals that may enhance, but more commonly degrade, the quality of antibiotic decision-making in NFs (Fig. 2). Efforts to improve antibiotic stewardship in NFs will likely need to target several of these factors in order to be successful.

EFFECTS OF ANTIBIOTIC STEWARDSHIP INTERVENTIONS IN NURSING FACILITIES

Antibiotic stewardship is accomplished through centralized (programmatic) and/or decentralized (nonprogrammatic) approaches. Centralized approaches include formulary restriction, preauthorization, as well as prospective audit and feedback. With notable exceptions, these approaches have been primarily used in hospitals and typically rely on individuals with specific training and expertise in the diagnosis and management of infectious diseases (IDs). Noncentralized antibiotic stewardship interventions seek to positively impact antibiotic prescribing quality through education as well as introduction of guidelines and decision-support tools. These interventions have been the predominant strategies used in NFs and generally do not rely on individuals with ID and/or antibiotic stewardship expertise.

Centralized Antibiotic Stewardship Interventions

There have been 3 studies that have examined the impact of a centralized antibiotic stewardship approach in NFs. Implementation of an ID consultative service in a Veterans Affairs (VA) Community Living Center, the VA equivalent of an NF, was associated with significant improvements in antibiotic utilization. The ID service performed in-person consultation on residents once weekly and was available for remote consultations the remainder of the week. They completed 291 consults on 250 study facility residents during the 18-month intervention period (~7 patient visits and 5–10 calls per week). Ninety-five percent of the consultative team
Fig. 2. Framework of the factors influencing antibiotic decision-making in NFs. Antibiotic decisions in NFs often occur off-site during communication events with nursing staff who have performed the primary resident evaluation on behalf of the prescriber. Characteristics of the individuals involved in this process as well as the nursing facility and prescriber practice environment likely play an important role in the quality of the decision-making that emerges from this process. APCP, advanced practice care provider; CNA, certified nursing assistant; LPN, licensed practical nurse; MD, doctor of medicine; RN, registered nurse.
recommendations were accepted. Compared with a 3-year baseline period, total anti-
biotic use in the study facility decreased by 30% (175–122 days of therapy [DOT] per
1000 resident-days, \( P < .01 \)) with statistically significant reductions in the use of fluoro-
quinolones, sulfamethoxazole/trimethoprim, \( \beta \)-lactam/\( \beta \)-lactamase inhibitors, clinda-
mycin, and tetracycline antibiotics. Rates of hospitalization during the intervention
period did not change; however, rates of positive \( C \) difficile tests declined significantly
relative to the baseline period.

Although current levels of pharmacist involvement in stewardship activities in most
NFs are limited,\(^36\) pharmacist-driven interventions have been shown to positively
impact the quality of antibiotic prescribing in this setting.\(^9,37\) A pharmacist-led pro-
spective audit and feedback intervention focused on antibiotics initiated for treatment
of culture-positive infections was associated with a 50% reduction in inappropriate
antibiotic therapy in a single hospital-affiliated NF.\(^37\) More recently, prospective audit
and feedback intervention of antibiotics initiated for treatment of urinary tract infec-
tions (UTIs) in 3 California NFs was associated with a significant reduction in UTI-
specific and all-cause antibiotic starts.\(^9\) The intervention in this study involved once-
weekly site visits by an ID-trained pharmacist who performed chart reviews, discussed
the cases with an off-site ID physician, and communicated recommendations to facility
prescribers. The ID pharmacist reviewed 57% (104 of 183) of UTI treatment events
during the intervention phase and left specific modification recommendations for 40 of
these cases, 10 of which were accepted by providers (25%). The investigators hypoth-
esized that notifying providers of the intent of the study, to improve the quality of anti-
biotic prescribing, created an unexpected normative influence that may have led to
reductions in antibiotic utilization independent of those driven by pharmacist
recommendations.

Decentralized Antibiotic Stewardship Interventions

Given existing limitations in access to clinicians with ID expertise, current efforts to
influence antibiotic prescribing behaviors in NFs have predominantly focused on
noncentralized interventions based on education, practice guidelines, and
decision-support tools.\(^11,38–40\) Several of the interventions described in published
studies have targeted the decision to initiate antibiotic therapy in NF residents
with a suspected UTI. A cluster randomized controlled trial in 24 US and Canadian
NFs found that implementation of UTI testing and treatment pathways was associ-
ated with a short-term reduction in antibiotic treatment of UTIs.\(^41\) Treatment effects
waned over the study period; the intervention did not have a significant impact on
urine culture utilization, suggesting some issues with intervention sustainability
and fidelity.\(^42\) In contrast, a subsequent study in a single VA long-term care facility
using the same testing and treatment pathways demonstrated a 59% reduction in
urine culture utilization (incidence rate ratio [IRR] = 0.41; 95% confidence interval
[CI] 0.27–0.64), a 63% reduction in treatment of asymptomatic bacteriuria (IRR = 0.37; 95% CI 0.19–0.72), and 30% reduction in overall days of antibiotic ther-
apy per 1000 patient-days when comparing the 3-month preintervention phase, the
6-month postintervention phase, and the subsequent 2 years.\(^43\) Although these two
studies addressed both testing and treatment decision-making, other studies have
shown that interventions focusing on testing decision-making can positively impact
antibiotic prescribing in NFs. Implementation of a testing decision-support pathway
in 10 acute and long-term care units at a VA medical center was associated with a
significant reduction in urine culture utilization and overtreatment of asymptomatic
bacteriuria.\(^44\) Similarly, there was a significant decrease in utilization of urine cultures
and antibiotic therapy for UTIs following introduction of a UTI diagnostic pathway in 17 Massachusetts NFs.45

There is substantial evidence that suboptimal assessment of NF residents experiencing a change in condition coupled with poor interdisciplinary communication has an untoward influence on antibiotic decision-making by off-site providers.3,4,27 Not surprisingly, interventions focused on improving nursing assessments of residents and standardizing the content of communication with prescribers have been associated with reductions in antibiotic use in NFs.46,47 A quality-improvement intervention focused on education of NF staff and families and implementation of tools to improve nurse-provider communication led to a 14% reduction in antibiotic utilization in 6 North Carolina NFs relative to control NFs in the same region that did not participate in the quality-improvement intervention.47 Similarly, antibiotic prescribing in Texas NFs was 33% lower in facilities that implemented a standardized communication and UTI decision-support form with high fidelity compared with control facilities that implemented the form with low fidelity.46

Efforts to improve the spectrum and duration of antibiotic therapy through educational interventions have had modest success in NFs. Case-based educational sessions on intervention units in a Chicago long-term care facility were associated with a 28% improvement in the frequency of guideline-concordant treatment courses and a 30% reduction in the days of antibiotic therapy. No changes were noted on care units that did not receive the educational intervention.48 The impact of education-based interventions on a larger scale has been less impressive. A cluster randomized controlled study was performed in 8 Canadian NFs in which providers in intervention NFs were mailed an antibiotic guide describing treatment of common infections (UTI, lower respiratory tract infection, skin and soft tissue infection) as well as a report of their personal prescribing patterns over the previous 3 months.49 Although initial guideline-adherent prescribing improved in intervention NFs, adherence rates were no better when compared with control NFs at the conclusion of the study.49 Similarly, a cluster randomized controlled study in Swedish NFs in which printed educational materials and in-person small group educational sessions were delivered to staff and providers in intervention facilities did not demonstrate a significant impact on the targeted prescribing behavior (reduction in use of fluoroquinolone antibiotics) but was associated with a modest reduction in the numbers of residents treated with antibiotics (difference in difference: −0.12; 95% CI −0.23 to −0.02).50 Interestingly, the effectiveness of educational interventions may rely on the simultaneous delivery of content to facility nursing staff and prescribing providers. A cluster randomized controlled trial of an educational intervention to improve antibiotic prescribing for pneumonia in New York NFs demonstrated significant improvement in adherence to prescribing guidelines (from 50% to 82%) in facilities where education targeted both types of clinical staff.51 In contrast, guideline adherence remained essentially unchanged in NFs where education was targeted solely at prescribing providers (from 65% to 69%).51

Although most of the stewardship interventions studied in NFs have focused on reducing unnecessary antibiotic use, there is ample evidence that the quality of antibiotic prescribing in NFs could be improved through efforts to reduce length of treatment courses10,52 and decreasing use of broad-spectrum agents.7 These two goals have been successfully achieved through a centralized prospective audit and feedback approach as detailed earlier but the scalability of this approach in NFs remains uncertain. Self-directed postprescriptive review, which has been shown to be modestly effective in the hospital setting,33,34 has been studied on a limited basis in NFs. A cluster randomized controlled study of a multicomponent intervention that
included protocol-guided postprescription review of antibiotic courses initiated in 30 NFs in London demonstrated a 5% reduction in antibiotic consumption in intervention facilities compared with control facilities despite only a 26% adherence to the postprescription review protocol.53

CURRENT STATE OF ANTIBIOTIC STEWARDSHIP PROGRAMS IN NURSING FACILITIES

Although many NFs may be capable of implementing the stewardship interventions described earlier, adoption and sustainment of these practice changes are likely to be more successful in facilities with infrastructure and procedures dedicated to the improvement of antibiotic use (ie, an ASP). Although there is significant variability, ASPs in hospitals are typically built around a team with broad expertise in IDs, pharmacodynamics/pharmacokinetics, and informatics.54 Although ASPs in hospitals engage in several activities to promote more judicious use of antibiotics, the most effective strategies are built around prior authorization, postprescribing review and feedback interventions.55,56 Although the data are limited, there are several studies that have begun to characterize the status of ASPs in US NFs.36,57–61 Perhaps, not surprisingly, these studies show that most NFs lack the resources to achieve models of ASP like those observed in the hospital setting.

Although most NFs report having written policies and procedures that address antibiotic prescribing in some form, less than half of the facilities queried in published survey studies had a formally recognized ASP.36,57–61 Unlike the situation in hospitals, ASP programs in NFs are largely overseen by facility nursing staff and infection preventionists.36,57–60 The medical director and pharmacist are actively engaged in NF ASPs in less than 50% of facilities,36,57–60 and involvement of individuals with formal ID training is seen in less than 15% of facilities.60

From 52% to 92% of NFs report tracking antibiotic use,36,57–61 although a minority employ standardized utilization metrics or trend data longitudinally.36 Most NFs track antibiotic-related outcomes like C difficile and methicillin-resistant Staphylococcus aureus (MRSA) infections and several NFs (9%–89%) report availability of an antibiogram.36,57–60 However, on closer inspection less than 10% of NFs employ a facility-specific antibiogram59 and most repurpose microbiological data generated in their referring hospitals.

Education on the appropriate use of antibiotics is provided to nursing staff is common in NFs, but the providers ultimately responsible for antibiotic orders are rarely targeted by these efforts.57,59–61 Antibiotic prescribing guidelines, although often present, predominantly focus on nursing practices; a limited number of NFs report having infection-specific (eg, UTI) treatment guidelines or protocols.36 A minority of NFs use antibiotic formularies, and less than 25% report use of preauthorization as a strategy to improve the quality of antibiotic prescribing.57,59,61 Finally, although most NFs report tracking appropriateness of antibiotic prescribing,57–59 these data are rarely fed back to providers; less than 15% of facilities use postprescribing review and feedback as a means of improving prescribing practices.36

EXPANDING ANTIBIOTIC STEWARDSHIP PROGRAMS IN NURSING FACILITIES

The findings of the survey studies described in the preceding section speak to a critical need to enhance the spread and scope of ASPs in NFs. The Centers for Disease Control and Prevention (CDC) has identified the core elements of ASPs in NFs.62 It is expected that facilities will tailor implementation of the core elements based on existing organizational structure and resource availability (Table 1). Importantly, NFs are encouraged to develop their ASP in a stepwise fashion, starting with
Table 1
Core elements of antibiotic stewardship in nursing facilities

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| 1. Leadership commitment | Dedicate support and commitment to safe and appropriate antibiotic use in the facility. | • Medical director, chief nursing official, and director of pharmacy should be visible and vocal champions for the facility ASP.  
• Structure, roles, and responsibilities of facility ASP should be detailed in a policy that is reviewed and approved by the facility leadership (the QAPI committee).  
• Other policies and guidelines developed by the facility ASP should be reviewed and approved through these same committees.  
• The facility ASP program should periodically report to the QAPI committee. |
| 2. Accountability | Identify which members of the facility will be part of the stewardship team and clearly delineate their roles and responsibilities.  
Assign administrative leadership of the stewardship team to a single individual. | • Antibiotic stewardship is a team-based process that requires involvement and collaboration between leadership, providers, nursing staff, and pharmacy.  
• Although responsibility for completing the various stewardship-related tasks (eg, policy/guideline development, staff education/training, process/outcome tracking and reporting, stewardship intervention development and implementation) may be delegated to different members of the team, administrative oversight should be assigned to a single individual.  
• The stewardship team leader should have a clinical background plus a demonstrated capacity to work and communicate well with stakeholders in other disciplines who operate in the facility. The director of nursing, infection preventionist, nurse educator, or facility pharmacist are appropriate for this position. |
| 3. Drug expertise | Ensure access to individuals with experience and/or training in antibiotic stewardship. | • Ideally, the individual selected to lead the facility stewardship team will have prior training/expertise in ID and/or antibiotic stewardship; but this will be unusual in most NFs.  
• In the absence of local expertise, the facility should  
  ○ Provide support for the stewardship team to attend stewardship training opportunities and pursue formal certification, if available.  
  ○ Identify and collaborate with experts in the region (eg, referring acute care hospital) who can help develop facility policies/guidelines and provide input on selection and implementation of different stewardship interventions. |

(continued on next page)
one or 2 activities and gradually adding new strategies over time. Assessment checklists such as those developed by the CDC are an excellent starting point for facilities and can help leadership identify and prioritize resource needs and also develop a road map for implementation of the various policies and procedures that can be used to improve antibiotic prescribing practices.

**Leadership Commitment**

There is little doubt that NFs will face increasing external pressures to demonstrate action focused around judicious use of antibiotics. Revised Centers for Medicare and Medicaid Services’ (CMS) regulatory requirements will require all NFs to have an ASP in place by November of 2017; facilities that fail to meet this standard are at risk of receiving a state survey deficiency citation (F-tag), which can incur

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<td>4. Action</td>
<td>Implement at least one policy or practice to improve antibiotic use in the facility.</td>
<td>- Specific strategies should be chosen based on facility resources and needs identified through tracking measures. - Strategies that focus on reducing unnecessary testing of urine samples and treatment of asymptomatic bacteriuria seem to have the greatest potential for immediate impact (see text).</td>
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<td>5. Tracking</td>
<td>Monitor at least one antibiotic utilization outcome and one clinical outcome measure of antibiotic use in the facility.</td>
<td>- At a minimum, track facility-initiated antibiotic starts on a monthly basis (ideally, denominated by resident-days). Other measures to consider include proportion of antibiotic starts prescribed for &gt;7 d and proportion of antibiotic starts that meet appropriateness criteria. - Clinical outcomes that should be considered include the monthly number of residents colonized or infected with different multidrug-resistant organisms (eg, MRSA), C difficile, and the facility antibiogram.</td>
</tr>
<tr>
<td>6. Reporting</td>
<td>Provide regular feedback of antibiotic use and antibiotic resistance to staff and providers in the facility.</td>
<td>- Antibiotic utilization and clinical outcomes data should be presented at least quarterly at the facility QAPI meeting. - Providing individual feedback to providers on their prescribing patterns relative to their peers may have a beneficial normative influence on outliers.</td>
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<tr>
<td>7. Education</td>
<td>Provide resources to staff, providers, and patients/residents about the risks of antibiotics and opportunities for improving antibiotic use.</td>
<td>- Education on the importance of antibiotic stewardship and the strategies the facility is using to promote better antibiotic stewardship should be delivered at hire and periodically thereafter. - Education should target both nursing staff and prescribers.</td>
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**Abbreviation**: QAPI, quality assurance/performance improvement.

*From* Centers for Disease Control and Prevention. The core elements of antibiotic stewardship for nursing homes. Atlanta (GA): US Department of Health and Human Services, CDC; 2015; with permission.
significant financial penalties. Although external pressures such as those from CMS provide a needed initial impetus for change, it is critical that commitment for developing ASPs be internally motivated. Failure to proactively identify local needs, opportunities, and resources for improvement will likely result in a stewardship program that reacts only in response to regulatory actions and is unlikely to improve the outcomes of patients and residents. Consequently, it is critical that facility leadership, including the chief executive officer, medical director, and director of nursing (DON), provide visible support for facility ASPs and their attendant activities. Several arguments can be used to secure the support of leadership, including (1) a need to satisfy regulatory requirements focused on appropriate use of medications; (2) federal mandates to demonstrate meaningful organizational quality assurance and performance improvement; (3) emerging federal policies to promote and ultimately require antibiotic stewardship activities across all health care settings; (4) organizational costs of treating antibiotic-resistant and *C. difficile* infections; (5) avoidance of financial penalties arising from survey deficiencies for inappropriate medication use; and (6) how antibiotic stewardship interventions, particularly those focused around enhancing interdisciplinary communication, can generate corollary benefits in other processes and outcomes (eg, enhanced management of resident change in condition). Although the day-to-day involvement of these individuals in running the ASP may be minimal, leadership is responsible for making stewardship an organizational priority and communicating this to providers and staff, identifying the key stakeholders responsible for implementing the facility ASP, and providing the necessary resources and support needed for these stakeholders to be successful.

**Programmatic Structure (Accountability and Expertise)**

Guidelines recommend that the individual or individuals responsible for developing the facility ASP will possess ID expertise and/or specific training in antibiotic stewardship operations. It is unrealistic to assume that NFs will be able to employ or even contract with individuals who have specific antibiotic stewardship expertise, although this may change in the future. Nevertheless, it is important that NFs, at a minimum, identify a local champion to develop and implement the facility’s ASP. Ideally, the local champion will possess operational skills and expertise, including (1) long-term care clinical expertise; (2) an ability to meaningfully engage nursing staff and providers; (3) an understanding of facility pharmacy operations and how medication administration data are structured and stored; (4) an understanding of facility laboratory services and how results are structured and stored; and (5) an ability to interact with other key operational staff (eg, the infection preventionist as well as pharmacy, laboratory, and information technology staff) to identify opportunities to standardize and automate methods for tracking and reporting important process and outcome measures (see later discussion). Although a pharmacist may be the individual best positioned to fill this role, most NFs do not use pharmacists directly. Most pharmacists who work in NFs are contracted by the facilities to provide core services (eg, monthly medication reconciliation), and these individuals often play a limited role in the facility’s day-to-day operations. The infection preventionist or DON, who often performs double duty as the facility infection preventionist, may be the individuals best positioned to assume leadership responsibilities for the facility’s ASP.

When available, the NF should attempt to cultivate collaborative or even formal consultative relationships with ID and antibiotic stewardship experts in referring hospitals. These individuals can be particularly helpful in the development and delivery of educational content for nursing staff and providers, development of guidelines for the
treatment of commonly encountered infections, and development of effective anti-
biotic utilization tracking and reporting systems. The medical director and DON,
even if they are not the designated ASP leaders, can play a critical role in growing
the facility ASP by publicly affirming its importance and supporting improvement
efforts. For example, NFs often have limited organizational influence over providers
and the medical director can exert important social influence on his or her peers to
adhere to ASP policies and practices. A recent case report of a Wisconsin NF identi-
fied medical director support and involvement as a key facilitator in the implementa-
tion of a facility ASP.68 High levels of frontline staff turnover is a continuing problem
in many NFs69; the DON plays an important role in bringing on new staff, continuing
education of existing staff, as well as reinforcing expectations of staff responsible
for assessment and communication of resident change in condition, both of which fac-
tor into provider decisions regarding initiation of antibiotics.3,4,27

Tracking and Reporting Antibiotic Utilization and Related Outcomes

A capability to track and report process and outcomes is a fundamental characteristic
of successful quality improvement.70 The infection preventionists in NFs are already
engaged in tracking infections71,72 and adapting this process to track antibiotic utiliza-
tion and related outcomes (C difficile and multidrug-resistant organisms) should be
feasible in most NFs. The penetration of electronic medical records in NFs remains
limited; however, tracking methods to identify residents experiencing a change in con-
dition, including those residents who are currently receiving antibiotics, is a common
practice in these facilities.73 Consequently, information on antibiotic starts is readily
available and can be tracked at predefined time periods by the individual responsible
for infection surveillance in the facility. At a minimum, facilities should periodically
assess antibiotic utilization in the facility using a cross-sectional approach (eg, the num-
ber of residents on antibiotics during a given day, week, or month). However, cross-
sectional assessments are not as sensitive to change as measures that are tracked
more regularly. In order to monitor the effects of improvement interventions and detect
aberrant prescribing patterns, post–acute care facilities should ideally track antibiotic
starts and/or antibiotic DOT prospectively. Although tracking counts may be reason-
able in settings where monthly census patterns are stable, tracking antibiotic utilization
using incidence density measures (eg, antibiotic starts or DOT per 1000 resident-days)
is more appropriate in settings where there is variation in monthly census data. Stratifi-
ying tracking measures by indication (eg, UTI) and antibiotic class (eg, fluoroquinolo-
lones) can help facilities better ascertain conditions in need of focused attention and
follow the effects of condition-specific interventions. Supplementing utilization mea-
sures with assessments of appropriateness (eg, proportion of monthly antibiotic
courses meeting explicit criteria72,74 or proportion of monthly antibiotic courses
exceeding 7 days75) can provide additional insights into opportunities for improvement.

Staff and Provider Education

Education is a foundational activity of the ASP. Educational content should cover the
importance of antibiotic stewardship, plans for implementation of specific ASP activ-
ities, and the responsibilities of clinical staff in achieving ASP goals. Education should
be targeted and tailored to nursing assistants, nursing staff, providers, residents, and
families. Resident and family education, when combined with staff and provider
education as well as interventions to enhance interdisciplinary communication, has
also been shown to be associated with reductions in antibiotic use in NFs.47 Studies
such as these demonstrate that educational interventions can be powerful tools for
changing behaviors but likely need to target multiple individuals51 and be delivered

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via several modalities, including in-service training sessions, newsletters, pocket guides, posters, and brochures, in order to be maximally effective.

Giving providers feedback on their antibiotic prescribing patterns and engaging in interactive academic detailing are strategies that have been used to improve antibiotic prescribing in hospitals and outpatient settings \(^{76,77}\) but has not been well studied in NFs. An educational intervention in which the aggregate prescribing practices of providers in a Chicago NF were compared with existing guideline recommendations was associated with a significant reduction in antibiotic utilization and improvement in adherence to prescribing guidelines.\(^{48}\) However, giving providers a summary of the quality of their antibiotic prescribing did not have a sustained impact on antibiotic utilization in a cluster randomized controlled trial in French NFs.\(^{49}\)

**Antibiotic Stewardship Program Improvement Activities**

There are several ASP activities from which post–acute care facilities can choose to implement. In general, these strategies map to one of 4 categories: (1) antibiotic prescribing policies/guidelines; (2) broad interventions; (3) pharmacy-driven interventions; and (4) syndrome-specific interventions. NFs should not attempt to implement all of these strategies simultaneously but rather should start with a single intervention, particularly one that is feasible based on available resources within a given setting.

**Antibiotic prescribing policies**

NFs should have policies stipulating that antibiotic orders include clear documentation of the drug, dose, duration and indication for treatment (eg, UTI).\(^{62}\) Many hospitals use standardized antibiotic order forms to ensure that this information is captured reliably.\(^{78}\) Use of standardized order forms can help the local ASP leader track antibiotic use more effectively and, when adapted to include decision-support content (eg, preferred agents, dosage adjustments for renal function and appropriateness criteria\(^{74}\)), these tools can be a mechanism for educating facility providers. Unnecessary laboratory testing is a driver of antibiotic overuse.\(^{79}\) There is considerable evidence that positive urine culture results exert an undue influence on prescriber decisions to initiate antibiotics, particularly in the post–acute care setting.\(^{80–82}\) Accordingly, policies focused on reducing utilization of urine cultures should be assigned a high priority. Policies should specifically address testing urine samples with reagent strips (ie, the dipstick)\(^{83,84}\) and performing urine cultures to confirm test of cure both of which are unnecessary and likely promote antibiotic overuse in NFs.\(^{81}\) Other policy topics that facilities should consider include (1) appropriate testing for *C difficile*; (2) prohibitions against the routine use of broad-spectrum antibiotics (eg, fluoroquinolones)\(^{85,86}\); and (3) guidelines on how to treat commonly encountered infections. However, drafting effective treatment guidelines may require input from individuals with ID expertise who may not be easily available.\(^{48}\)

**Broad interventions**

Two resource-intensive ASP interventions commonly used in hospitals include (1) formulary restrictions with prior authorization and (2) expert-led prospective audit and feedback to frontline providers.\(^{55}\) It is unlikely that most NFs will have the resources to implement either of these intensive ASP activities successfully. Strategies focused on promotion of self-directed stewardship, in which prescribers are trained and/or prompted to engage in review of empirically initiated antibiotics and modify the therapeutic dose, spectrum, and/or duration when appropriate (antibiotic time-out), have been implemented successfully in a hospital setting with limited access to individuals with stewardship expertise.\(^{53}\) Implementation of a checklist tool to foster self-directed...
Fig. 3. Decision pathway to reduce unnecessary diagnostic testing of urine samples in long-term care facilities. (Adapted from Crnich CJ, Drinka P. Improving the management of urinary tract infections in nursing homes: it's time to stop the tail from wagging the dog. Ann Long Term Care 2014:43–7.)
stewardship activities in a cluster randomized controlled trial in 30 UK NFs was associated with a 5% reduction in systemic antibiotic use in intervention facilities versus a 5% increase in antibiotic use in control facilities. Another broad strategy that should be feasible in the NF setting is the introduction of training and tools focused on improving resident assessments and interdisciplinary communication of resident change in condition. As noted earlier, the introduction of standardized communication forms as part of multicomponent interventions has been associated with significant reductions in antibiotic utilization in North Carolina and Texas NFs. Although the CDC recommends that NFs use antibiograms, facility-specific instruments are not widely available in most settings and there is insufficient evidence of their impact on prescribing behaviors to justify routine adoption at this time.

**Pharmacy-driven interventions**

Examples of pharmacy interventions include automatic changes from intravenous to oral antibiotic therapy for highly bioavailable antibiotics (ie, ciprofloxacin, levofloxacin, trimethoprim-sulfamethoxazole, linezolid, and so forth), which reduces the need for intravenous access and improves patient safety and satisfaction. Pharmacists can perform automatic renal dose adjustments and dose optimization based on therapeutic drug monitoring (ie, vancomycin, aminoglycosides). Although postprescription review and feedback seem to be most effective with models that pair pharmacists with ID specialists, pharmacist-only programs have been effective in the NF setting. Pharmacists engaged in postprescription review and feedback activities in this study possessed antibiotic stewardship expertise, which likely limits the implementation of this approach in most NFs. Unfortunately, pharmacists with this advanced antibiotic stewardship training are not typically available in most post–acute care facilities currently.

**Syndrome-specific interventions**

Several practices that promote the overuse of antibiotics are common in many post–acute care facilities, specifically NFs. Prescribing prophylactic antibiotics to prevent recurrent UTIs, sending urine cultures to confirm test of cure and culturing open wounds are just some examples of questionable practices still encountered in NFs. However, treatment of asymptomatic bacteriuria is probably the most prevalent problem encountered in most NFs. Implementation of protocols that restrict urine testing to residents with a high probability of having a UTI (Fig. 3) and similarly designed protocols to limit antibiotic therapy in residents without clear signs and symptoms of UTI have been associated with significant reductions in antibiotic utilization in NFs. These protocols should be operationalized through education of providers and procedures that empower nursing staff to discourage providers from ordering diagnostic tests of the urine in the absence of specific, evidence-based criteria. Tracking the frequency of urine cultures and number of treated UTI events that do not satisfy surveillance definitions provides targets that a facility can follow in order to assess the impact of the ASP intervention.

**FUTURE DIRECTIONS**

The emerging crisis in antibiotic resistance will require a concerted effort to improve antibiotic stewardship across all health care settings. Considerable progress has been made in our understanding of the extent and determinants of inappropriate antibiotic use in NFs. Although there is accumulating evidence that interventions focused on processes (eg, urine testing) associated with the initial antibiotic decision can reduce unnecessary antibiotic use, there remains a critical need to identify the
effectiveness of interventions that target postprescribing decision-making (eg, review and de-escalation) and how these interventions can be delivered in a cost-effective manner. There is also a need for more research on how to implement stewardship interventions with fidelity and sustain them over time, particularly in NFs with limited quality-improvement resources. Finally, there is a need for studies that evaluate the effects of stewardship interventions on facility and resident outcomes, including health care costs and rates of infections caused by *C difficile* and multidrug-resistant bacteria.

REFERENCES


81. Crnich CJ, Drinka P. Improving the management of urinary tract infections in nursing homes: it’s time to stop the tail from wagging the dog. Ann Long Term Care 2014;43–7.
