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Effects of Excessive Antibiotic Use in Nursing Homes

Lona Mody, MD, MSc and Christopher Crnich, MD, PhD

Division of Geriatric and Palliative Care Medicine, Department of Internal Medicine, University of Michigan Medical School, Ann Arbor (Mody); Geriatric Research Education and Clinical Center, Veteran Affairs Ann Arbor Healthcare System, Ann Arbor, Michigan (Mody); Division of Infectious Diseases, Department of Medicine, University of Wisconsin School of Medicine and Public Health, Madison (Crnich); William S. Middleton Veterans Affairs Hospital, Madison, Wisconsin (Crnich)

In the United States, on any given day, approximately 1.4 million people reside in more than 15 000 nursing homes (NHs).¹ As a testament to the burgeoning post-acute care population, approximately 3.3 million Medicare recipients are admitted to NHs for short stays each year, making NHs a crucial segment of the overall health care provision system within the United States.² Antibiotics are one of the most frequently prescribed medications in NHs where 6% to 10% of residents are taking antibiotics at any given time and more than half receive at least one antibiotic prescription in a single year.³ Much of this use is inappropriate. An estimated 25% to 75% of antibiotic prescriptions do not meet clinical guidelines for appropriate prescribing.³ The most common infection leading to inappropriate antibiotic therapy is suspected urinary tract infection, which accounts for 30% to 56% of antibiotics prescribed, with up to a third of these prescribed for NH residents with asymptomatic bacteriuria.⁴

It is well established that antibiotic use is associated with a number of potential treatment-related harms when assessed at the level of the individual NH resident, including *Clostridium difficile* infection, adverse drug reactions, and an increased risk of colonization and infection with multidrug-resistant organisms. Documenting direct evidence of the harms of antibiotic use at the population level has proven challenging. Therefore, the article by Daneman et al⁵ in this issue of *JAMA Internal Medicine* is a welcome addition to the field. In this 2-year study of 110 000 NH residents in Ontario, Canada, participants residing in facilities with high rates of antibiotic use were significantly more likely to experience an antibiotic-related harm whether or not they had recently received an antibiotic. On the basis of their findings, the authors predict that one additional antibiotic-related harm is generated for every 53 patients admitted to a high-use compared with low-use NH. Assuming similar patterns of antibiotic use and population-level effects in US NHs, the results of this study suggest that nearly 20 000 individuals experience an antibiotic-related harm simply through residence in NHs with high rates of antibiotic use.⁵ Antibiotic-related harms in this study were most commonly identified through administrative records generated during hospital

Corresponding Author: Lona Mody, MD, MSc, Division of Geriatric and Palliative Care Medicine, University of Michigan Medical School, 300 N Ingalls Rd, Room 905, Ann Arbor, MI 48109 (lonamody@umich.edu)..

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admissions and emergency department visits and less commonly through outpatient practitioner billing records. Consequently, the results of the study likely represent and underestimate the effect of antibiotic overuse in NHs.

The study by Daneman et al has a number of methodologic strengths. The authors merged information from multiple administrative data sets to create a robust cohort of nearly 110 000 residents in 607 Ontario NHs with a follow-up of 51 million days. As a result, the authors were able to create meaningful tertiles of facilities with equal distribution of resident-level characteristics and to find facility-level characteristics that differentiated low- from high-prescribing facilities. This nearly complete data set also permitted the authors to measure the association between facility antibiotic use and resident risk of experiencing an antibiotic-related harm with a high level of precision after appropriate adjustments for a number of important covariates. Although imbalances in the prevalence of do-not-hospitalize orders, which were more frequent in medium- and high-use NHs, raise concern for selection bias, this would, if anything, bias results toward the null because residents excluded from the analyses would be expected to be more frail and susceptible to antibiotic-related harm.

Despite these strengths, the authors made a number of methodologic decisions that bear closer scrutiny. First, facility-level antibiotic use in this study was measured by days of therapy rather than the number of treatment courses. Prior research has indicated that relative positioning (high vs low) within groups of NHs changes considerably based on how one chooses to measure antibiotic use.⁶ Nevertheless, measurement of antibiotic use on the basis of days of therapy appears to be the more appropriate choice given the strong relation between the duration of antibiotic exposure and the risk of treatment-related harms.⁷ Second, the authors' decision to specify measured use as a constant exposure variable, although simplifying their model, may have resulted in biased model estimates. Prior research⁸ has found considerable seasonal variation in the use of antibiotics in NHs, and, in the current study, the authors note that nearly a third of facilities switched tertiles when antibiotic use was assessed year to year. Use of an alternative analytic approach in which facility-level antibiotic use is allowed to vary over time would have further strengthened confidence that the associations identified in this study are causal. Finally, as is common to all observational studies, allocation to NHs with different levels of antibiotic use was nonrandom. Use of advanced statistical methods to account for the nonrandom allocation of patients, such as propensity score matching or instrumented variable analyses,⁹ may have led to less biased estimates of the association between facility-level antibiotic use and antibiotic-related harms. These methodologic concerns aside, the large number of patients studied and the effect sizes identified convince us that the associations identified in the study are real.

With numerous studies using a variety of methods and diverse geographic locations providing the near-universal message of the adverse consequences of antimicrobial overuse to individuals and society, it is time for action. The high levels of diagnostic uncertainty involved in the management of the NH population, along with the constrained resources and frequent staff turnover, are important barriers to change in NHs. However, demonstrable improvements in antibiotic-prescribing patterns has been achieved in a number of settings.³

Leadership in NHs, including the medical director, director of nursing, and the infection preventionist, must create a sense of urgency among prescribers and staff around the need to improve antibiotic use. Leadership should also bring together an antibiotic improvement team that identifies priorities and strategies to overcome barriers and develops methods to evaluate progress toward designated improvement objectives.¹⁰ Although these teams should tailor their improvement efforts based on a locally generated needs assessment, interventions focused on reducing unnecessary cultures of urine specimens, given the inordinate influence these test results have on prescribing decisions, have been particularly effective in a number of studies.^{3,11} The use of interactive educational interventions that target nursing staff and prescribers, which have improved other related care processes in NHs,¹² is another strategy that antibiotic improvement teams in nursing homes should consider. Independent of which improvement strategies are pursued, NHs should strive to monitor their process (eg, frequency of inappropriate antibiotic prescribing) and evaluate outcomes in antibiotic recipients and nonrecipients in a standardized fashion to assess progress and consider alternatives. Antibiotic-prescribing patterns in NHs is a deeply entrenched cultural phenomenon leading to adverse consequences in recipients and nonrecipients.¹³ Altering and improving these behaviors and sustaining these changes will not be easy. However, continuing to accept business as usual is no longer an option.

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