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Quality Improvement in Long-Term Care

Antimicrobial Stewardship in Long-Term Care: Metrics and Risk Adjustment

Joseph M. Mylotte MD*

Professor of Medicine Emeritus, School of Medicine and Biomedical Sciences, State University of New York, Buffalo, New York

A B S T R A C T

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An antimicrobial stewardship program (ASP) has been recommended for long-term care facilities because of the increasing problem of antibiotic resistance in this setting to improve prescribing and decrease adverse events. Recommendations have been made for the components of such a program, but there is little evidence to support any specific methodology at the present time. The recommendations make minimal reference to metrics, an essential component of any ASP, to monitor the results of interventions. This article focuses on the role of antibiotic use metrics as part of an ASP for long-term care. Studies specifically focused on development of antibiotic use metrics for long-term care are reviewed. It is stressed that these metrics should be considered as an integral part of an ASP in long-term care. In order to develop benchmarks for antibiotic use for long-term care, there must be appropriate risk adjustment for interfacility comparisons and quality improvement. Studies that have focused on resident functional status as a risk factor for infection and antibiotic use are reviewed. Recommendations for the potentially most useful and feasible metrics for long-term care are provided along with recommendations for future research.

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It has been generally accepted that there is overprescribing of antibiotics in long-term care facilities.¹ Overprescribing includes using an antibiotic with no indication, using the wrong antibiotic when treatment is indicated, using the wrong dose of an antibiotic, or using a longer duration of treatment than necessary. In any given year, 40% to 70% of long-term care residents receive at least one course of an antibiotic.² It has been estimated that 45% to 75% of antibiotic prescriptions in long-term care facilities are unnecessary or inappropriate.^{1,3–5} The consequences of overprescribing include development of antibiotic resistance, *Clostridium difficile* infection, allergic reactions, and other adverse effects.^{6–9}

The response to overprescribing of antibiotics in long-term care has been the promulgation of what has been termed “antimicrobial stewardship.” *Antimicrobial stewardship* refers to the proper or appropriate use of antibiotic therapy meaning to treat only those who are likely to have bacterial infection, use therapy that is appropriate to the infection being treated and the most likely organisms causing the infection, and at the proper dose and duration.¹⁰

Guidelines for infection control in long-term care facilities recommend that an antimicrobial stewardship program (ASP) be established,¹¹ but there were no details as to how the program should be structured or the methods involved. A position paper dealing with antibiotic use in long-term care facilities was initially published in 1996 by the Society for Healthcare Epidemiology of America (SHEA)¹² and updated in 2000.¹³ SHEA also sponsored a position paper on minimum criteria for initiating empiric antibiotic therapy in long-term care facility residents.¹⁴ These position papers deal primarily with empiric antimicrobial therapy decision making and provide useful information on when to initiate antibiotic therapy for suspected infection and could be a starting point for establishing an ASP in a long-term care facility. The Infectious Diseases Society of America (IDSA) and SHEA have also promoted antibiotic stewardship in long-term care facilities.¹⁵ The Centers for Disease Control and Prevention (CDC) has also recommended core elements for an ASP in long-term care facilities.¹⁶ Based on the CDC core elements, Rhee and Stone,¹⁷ Crnich et al,¹⁸ and Morrill et al¹⁹ have provided a general outline for an ASP in long-term care. However, the issue of ASPs in long-term care has now become much more important. In the July 16, 2015 *Federal Register*, the Centers for Medicare & Medicaid Services (CMS) published a draft of a comprehensive overhaul of all long-term care facility regulations that included a revision of infection control requirements for long-term care facilities that mandate an ASP.²⁰

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* Address correspondence to Joseph M. Mylotte, MD, 3613 Galway Ln, Ormond Beach, FL 32174.

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Table 1
Antibiotic Use and Cost Metrics for Long-Term Care Facilities

Metric	Definition*	Advantages	Disadvantages
Incidence	Number of antibiotic courses started per 1000 resident care days	Provides rate of number of residents treated each month Useful to monitor impact of interventions to lower use	Not a measure of length of therapy Requires resident-level data
Antibiotic utilization ratio	Ratio of total antibiotic days to total resident care days	Most common metric used in published studies (usually expressed as total days per 1000 resident days) Used by CDC NHSN Useful to monitor impact of interventions to lower use	Not a measure of length of therapy Requires resident-level data
Cost per antibiotic day	Ratio of total antibiotic cost to total antibiotic days	May provide insight into prescribing of high cost antibiotics	Requires cost data and resident-level data
Cost per resident care day	Ratio of total antibiotic cost to total resident care days	May appeal to administrators because it relates cost to whole population	Requires cost data Not all residents treated with an antibiotic

CDC NHSN, Centers for Disease Control and Prevention National Healthcare Safety Network.

*Metric calculated on a monthly basis.

In response to the concern about overprescribing of antibiotics in long-term care, studies have been published that describe various approaches to improving prescribing in this setting using various methodologies. There have been several reviews of these studies that all came to the conclusion that it was difficult to recommend any specific approach for an ASP in long-term care because of the variability in methodology of published studies and the labor intensity of some interventions.^{18,21–23} A major criticism of all studies was the focus on reducing antibiotic use with no evaluation of impact on clinical outcomes such as the need for hospitalization, adverse drug events, and *C. difficile* infection.

Ibrahim and Polk²⁴ have stated that a successful ASP must (1) be able to measure antibiotic use to detect a change in use with interventions and (2) measure an outcome that is related to the change in use observed. They also emphasized the importance of risk adjustment of metrics in order to develop valid benchmarks for antibiotic use that can be utilized for interfacility comparisons and quality improvement. However, metrics for antibiotic use have not been emphasized in any guideline or publication related to antibiotic use or resistance in long-term care facilities mentioned previously. In addition, there has been no mention of risk adjustment of metrics for benchmarking purposes.

Therefore, this article provides a review of studies that have specifically focused on development of metrics for antibiotic use in long-term care facilities. Based on these studies, recommendations as to the potentially most useful and feasible metrics for use in the long-term care setting will be provided. The metrics that have been used in recent studies or recommended in reviews will also be compared to these recommendations. Potential methods of risk adjustment of antibiotic use metrics in long-term care will be reviewed along with research considerations for future study.

Studies of Antibiotic Use Metrics in Long-Term Care

There have been four studies specifically focused on the development of metrics for monitoring antibiotic use and cost in long-term care facilities. A review of these studies is provided in this section.

The first study was a pilot project to identify antibiotic use metrics that would be feasible for the long-term care setting.²⁵ This study was done in a 120-bed skilled nursing facility located within a public, university-affiliated hospital in Buffalo, New York, from January to December 1989. Several potential metrics were evaluated including the number of antibiotic days per 100 resident care days, number of residents treated per month, number of antibiotic courses started per month, number of antibiotic courses started per 1000 resident care

days, percent of courses started and completed in the facility each month, and percent of courses started and completed each month that were >7 days in duration. After review of the findings, monitoring the number of residents treated per month was suggested as the most practical approach for monitoring antibiotic use in the long-term care setting.

It became apparent, however, that monitoring only the number of residents treated with an antibiotic per month was not an effective metric of antibiotic prescribing in the long-term care setting. This metric did not provide information on the rate of antibiotic treatment or duration of treatment. Therefore, a second prospective study was performed in four long-term care facilities in the Buffalo, New York region for the period of February 1996 to March 1998 in which two antibiotic use metrics and two antibiotic cost metrics were evaluated.²⁶ These metrics are listed in Table 1. For this study, infections were identified using the McGeer surveillance definitions, and infection rates were expressed as the number of infections per 1000 resident care days. Correlations between monthly infection rate and monthly antibiotic use and cost metrics were evaluated. Using this methodology, there was a significant difference in antibiotic use, cost parameters, and overall infection rate among the four facilities. When antibiotic use data (incidence or antibiotic utilization ratio; see Table 1 for definitions) were pooled monthly from the four facilities and compared to the pooled monthly infection rate using linear regression, 48% of the monthly variation in incidence of antibiotic use and 31% of the variation in monthly AUR were explained by the variation in incidence of infection ($P < .001$).

The findings in this study²⁶ suggested that the antibiotic use and cost metrics evaluated might be useful for monitoring in long-term care facilities and quality improvement, but there were several limitations. First, there was no adjustment for potential differences in case mix that might have an impact on a facility infection rate. Second, no attempt was made to assess appropriateness of antibiotic therapy. Third, the study was done in only four long-term care facilities, and the general applicability of the findings was unclear.

A third study of the antibiotic use and cost metrics was done in one 433-bed long-term care facility in Syracuse, New York.²⁷ This facility had 10 separate units, and there were only 6 physicians providing care with well-defined unit assignments that allowed for an evaluation of antibiotic use according to unit and physician. The analysis of the study data showed a significant difference in incidence of antibiotic use between the 10 units as well as between the 6 physicians. There was also a significant positive correlation between infection rate and incidence of antibiotic use. After controlling for functional status using a case-mix index and a cost indicator, the variation in infection rate

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