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An Online Course Improves Nurses' Awareness of their Role as Antimicrobial Stewards in Nursing Homes

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Abstract

Background—To support the role of nurses as active proponents of antimicrobial stewardship in long-term care facilities, we developed an educational intervention consisting of a free online course comprised of 6 interactive modules. Here, we report the effect of the course on the knowledge, beliefs and attitudes towards antimicrobial stewardship of nurses working in long-term care facilities.

Measurements—We used a paired pre- and post-course survey instrument to assess nurses' knowledge regarding the care of long-term care facility residents with infections as well as attitudes and beliefs regarding antimicrobial stewardship.

Results—103 respondents, RNs or LPNs, completed the pre and post-surveys. Their mean knowledge scores improved, from 75% (pre-course) to 86% (post-course, $P < 0.001$). Following the course, nurses' agreement that their role influences whether or not residents receive antimicrobials increased significantly ($P < 0.001$).

Discussion—The online course improves nurses' knowledge regarding the care of long-term care facility residents with infections and improves their confidence to engage in antimicrobial stewardship activities.

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Conclusion—Empowering nurses to be antimicrobial stewards may help reduce unnecessary antibiotic use among institutionalized older adults.

Keywords

antimicrobial stewardship; professional education; nursing home; registered nurses; licensed practical nurses; aged

Introduction

Antimicrobial-resistant and healthcare-associated pathogens cause over 2.5 million infections in the United States each year [1]. Nearly 2% of these infections end in death [1,2]. Antimicrobial stewardship is a critical part of preventing illness caused by antimicrobial-resistant and healthcare-associated pathogens. The goals of antimicrobial stewardship are to minimize unnecessary and inappropriate antimicrobial use.

While there is sufficient evidence to develop guidelines in support of antimicrobial stewardship in acute care facilities [3,4], there is limited evidence describing successful antimicrobial stewardship practices in nursing homes [5–8]. There are nearly 1.4 million nursing home residents in the United States [9] and an estimated 10% of them receive antimicrobials each day [10]. Unfortunately, 40–75% of antimicrobial use in nursing home residents is either inappropriate or unnecessary [11,12]. In recognition of the scope of this problem, both the Center for Medicare and Medicaid Service (CMS), as well as the Executive Order, Combating Antibiotic-Resistance Bacteria, call for improving antimicrobial stewardship in nursing homes [13,14].

Although most proponents of antimicrobial stewardship recommend a multidisciplinary approach, the role of nurses as antimicrobial stewards is often overlooked [15]. Registered nurses (RNs) and licensed practical nurses (LPNs) have a strong influence on the evaluation of potential infections through their clinical assessments, collection of samples for microbiological culture and communication with other team members. This is especially true in nursing homes where RNs and LPNs function as both the frontline clinicians who assess and care for residents and as the principal communicators among prescribers, other nursing home staff, residents and their family members.

Previously, we described a course distributed through the Veterans Affairs (VA) Employee Education System that presented content intended to help nursing staff improve the care of nursing home residents with possible infections [16]. Building upon that work, we updated and adapted the content to an online format readily accessible to healthcare providers outside of the VA system. The target audience for the course remained RNs and LPNs working in nursing home and other long-term care settings. Here, we report results from paired surveys used to compare changes in the attitudes, beliefs and knowledge of RNs and LPNs before and after completing the online course

Methods

Ethics Statement

The study protocol and survey was reviewed and exempted by the Institutional Review Board at the corresponding author's institution.

Online Course

The course was made available online at no cost to participants [17]. Described in greater detail elsewhere [16], the course consisted of 6 interactive modules (30 minutes each) that addressed the following topics: signs and symptoms of infection in older adults; differentiating urinary tract infections from asymptomatic bacteriuria; recognition and evaluation of upper respiratory tract infections, bronchitis and pneumonia; appropriate application of transmission-based precautions; proper collection of samples for microbiological culture; and improving communication with providers using SBAR, which stands for Situation, Background, Assessment and Recommendation. As a communication style, SBAR has improved communication in other healthcare settings [18]. All clinical content was developed using published guidelines. In order to claim 3.0 nursing contact hours, course participants had to complete all 6 modules as well as the pre- and post-course surveys.

The course was advertised to attendees at academic conferences for infectious diseases, infection control and prevention, post-acute and long-term care. It was also publicized in professional newsletters and on websites directed towards nurses working in infection control and long-term care settings. Interested healthcare professionals were encouraged to distribute course information among their colleagues.

Survey Instrument

We developed a survey consisting of 8 demographic queries, 25 items about attitudes and beliefs answered on a 5-point Likert scale and 12 multiple choice knowledge questions. Six of the attitudes and beliefs items [19] and all of the knowledge questions were previously validated [16]. Six questions assessed confidence related to the learning objectives for each module and 13 questions related to factors that influence the decision to initiate antibiotics in nursing homes [20]. The anonymous surveys, administered using a survey platform (Qualtrics, Provo, UT), were accessed via an internet link embedded within the course immediately before starting and after course completion. Course participants were required to complete the pre-course survey in order to access the first module. All 6 modules had to be completed before respondents could access the post-course survey and subsequently claim nursing contact hours. Each survey (pre- and post-course) took approximately 20 minutes to complete. To match the pre- and post-course surveys, respondents entered a numeric identifier that included non-identifiable information from their date of birth and cell phone numbers. The pre- and post-course surveys contained the same 12 multiple choice knowledge questions as well as the 25 items about confidence and beliefs. Respondents were not provided the correct answers to the knowledge questions after they completed the pre-test.

Data Analysis

Respondent-generated identifiers permitted matching of the pre- and post-course surveys. Quantitative data were summarized using descriptive statistics, including a mean score for each 5-point Likert response. For the knowledge questions, we determined the number of correct responses (out of 12 questions). Differences between pre- and post-course responses in the Likert-scale items and the knowledge score were assessed using paired t-tests with a Bonferroni correction to adjust for multiple comparisons. All statistical analytics were conducted using R (version 3.1.3; Vienna, Austria) [21].

Results

Among the 108 people that completed a matched pre- and post-course survey, 103 respondents were our target population of nurses, either RNs (N = 71; 66%) or LPNs (N = 32; 30%). Of these, 98 (95%) were female, 65 (60%) worked at a community-based nursing home and 61(59%) reported at least 10 years of experience caring for older adults (**Table 1**).

The surveys permitted comparison of respondents' attitudes, beliefs and knowledge before and after completion of the online course (**Table 2**). The items assessing attitudes indicated an increase in respondents' confidence pertaining to the learning objectives for each module, particularly for Modules 2 and 3, which describe how to differentiate urinary tract infections from asymptomatic bacteriuria and upper respiratory tract infections, bronchitis and pneumonia. Notably, for each of the 4 items about their role in antimicrobial stewardship, the respondents' mean scores showed a significant increase in confidence ($P < 0.001$). The 2 items that showed the greatest changes considered the influence of nurses' knowledge of a resident's baseline status and nurses' assessment of residents on antibiotic prescriptions (3.8/5 to 4.5/5 for both items). Beliefs changed little between the pre- and post-course surveys. Most respondents agreed with the idea of watchful waiting as a potential strategy to avoid antibiotics (4.1/5) and disagreed with the statement that only vulnerable people acquire multi-drug resistant pathogens (2.0/5).

Finally, for the 12-item knowledge assessment, the proportion of questions answered correctly increased from 75% (9.0 of 12 questions; 95% confidence interval [CI] 8.7–9.3) to 86% (10.4 of 12 questions; 95% CI 10.1–10.6) following completion of the educational content ($P < 0.001$). **Table 3** details the scores for individual questions. Respondents showed the most improvement in recognizing the definition of fever in older adults (question 1) and in strategies to prevent catheter-associated urinary tract infections (question 4). Items with average scores of 90% on the pre-test indicated that the group had acceptable prior knowledge of some of the material while other scores, most notably for the 2 questions about collecting samples for microbiological culture (questions 9 and 10), suggest the persistence of a knowledge gap. To a lesser degree, the results regarding the purpose of SBAR as well as symptoms of a UTI also indicate a knowledge gap. A post-hoc analysis comparing the responses of RNs and LPNs showed that RNs had a higher pre- and post-course knowledge score (9.2; 95% CI 8.8–9.5 and 10.5; 95% CI 10.2–10.9, respectively) compared to LPNs (8.5; 95% CI 8.0–9.1 and 9.9; 95% CI 9.5–10.5, respectively). Notably, the change in knowledge score was similar for RNs and LPNs (1.3 and 1.4, respectively, $P = 0.24$).

Discussion

Our matched surveys indicate that after participating in the online course, nurses had a greater awareness of their role as antimicrobial stewards in nursing homes. Specifically, nurses reported increased agreement that their own knowledge of a resident's baseline, assessment and communication with providers and families influences whether or not a resident receive antibiotics. Additionally, their overall knowledge scores improved as did their perceptions that people in other roles (*i.e.*, physicians, nurse practitioners, physician assistants and pharmacists) routinely practice antimicrobial stewardship. Compared to our previous survey of VA providers, the respondents described here reported greater agreement that pharmaceutical companies will make new, equally effective antibiotics and that infection control practices are more important than antimicrobial stewardship in the prevention of acquiring multi-drug resistant pathogens and *C. difficile* [16]. The outcomes from the knowledge questions reveal similar gaps to those revealed in our survey of VA employees who took a previous version of this course [19]. While 100% of the respondents to the survey described here correctly defined SBAR in the pre- and post-course, a smaller proportion of the respondents here correctly identified the purpose of SBAR compared to VA employees in our prior survey [19].

Nurses affect many aspects of the evaluation and care of people with potential infections, from timing and quality of microbiological cultures to administering and monitoring the response to antimicrobials [15]. Through a survey of hospital-based nurse educators, Olans *et al.* identified several educational needs, suggesting that addressing these would support nurses' efforts to become active members of antimicrobial stewardship programs [22]. Our online course described here addressed some of these educational needs, including proper techniques for obtaining good culture samples, recognizing the difference between colonization and infection, awareness of signs and symptoms of infection and, most notably, improving confidence to ask prescribers about antimicrobial use. Because of their lower pre- and post-course knowledge, our online course may be particularly valuable for LPNs, who provide approximately 70% of licensed care provided to residents in long-term care settings [23].

In contrast to acute care, nurses working in long-term care settings strongly influence the antibiotic prescribing process [20]. Previous qualitative studies of the perceptions of nursing home staff indicated that, especially around the issue of positive urine cultures, nurses were central to decisions about prescribing antibiotics [24,25]. Educational interventions that include both nurses and prescribers may be an effective means to influence the decisions leading to antibiotic prescriptions and to promote effective antimicrobial stewardship [26–30]. At a single VA community living center, an educational intervention which included nurses and providers reduced inappropriate treatment of asymptomatic bacteriuria [28]. The intervention had a sustained effect lasting over 2 years following the intervention. While targeting nurses alone is unlikely to lead to measurable improvements in the appropriate use in antibiotics, the outcomes described here suggest that an interactive online format is able to improve nurses' knowledge and confidence and offers a possible component for a broader, multidisciplinary effort.

Healthcare regulatory and accreditation agencies recognize the importance of antimicrobial stewardship in nursing homes. In 2015, CMS proposed that nursing homes need to have an antibiotic stewardship program as a condition of participation in Medicare and Medicaid programs [13]. In concordance with CMS and as an outgrowth of the White House Forum on Antibiotic Stewardship in June 2015, The Joint Commission released revisions for their Medication Management (MM) standards. Effective January 2017, The Joint Commission's new MM standard (MM.09.01.01) will require nursing homes, as well as hospitals and critical access hospitals, to have antimicrobial stewardship programs [31]. Among the nursing home-related MM standards, several patient care criteria were added. MM's Element of performance (EP) 2 will require nursing homes to educate all staff and licensed independent practitioners about antimicrobial resistance and antimicrobial stewardship. Similarly, EP 3 will call for nursing homes to extend educational efforts to residents and their families about the appropriate use of antimicrobials; bedside nurses will be ideal for fulfilling this responsibility. Further, EP 5 will require nursing homes to identify nursing leaders, working as part of an interprofessional team, to be responsible for overseeing antimicrobial stewardship in the facility. These revised MM standards are closely aligned with the Core Elements of Antibiotic Stewardship for Nursing Homes issued by the Centers for Disease Control and Prevention, which call for providing educational resources about antimicrobial stewardship to nursing staff, residents and families and for incorporating antimicrobial stewardship into the position description for directors of nursing [32]. Online education targeting nurses and their role in antimicrobial stewardship could be a useful and practical component of comprehensive antimicrobial stewardship programs in nursing homes.

Our study has some limitations. First, the sample size ($N = 103$) is fairly small and the attrition rate was approximately 50%. While over 200 respondents began the pre-course survey, the length of the course (3 hours) and surveys (20 minutes per survey) likely limited the number of people who could complete all the portions necessary for analysis. Second, our analysis did not exclude or separate respondents of different educational backgrounds (*i.e.*, RNs and LPNs) or roles in long term care settings, including non-clinical roles (*i.e.*, administration or teaching). Given our focus on nurses who work in nursing homes and other long-term care, this mix of educational backgrounds and roles is consistent with the staffing seen in these settings. Third, we included several novel survey items. We applied the same analysis for the novel and the previously validated questions; we did not observe differences among the responses [19,16]. Fourth, we cannot exclude the possibility of social desirability bias, however, the conservative Bonferroni correction, which adjusts the observed P -values based on the total number of tests performed, helped to minimize the risk of false positive results. Finally, we did not assess knowledge retention or change in practice as a result of the online course. We will explore these possibilities in future investigations.

Conclusion

Our results suggest that online education for RNs and LPNs about the principles of antimicrobial stewardship may be a viable component in multi-faceted efforts to reduce inappropriate antibiotic use in the nursing home setting. As nursing homes prepare to meet policy changes proposed by CMS and The Joint Commission that call for antibiotic

stewardship programs, nurses will likely become integral members of multidisciplinary antimicrobial stewardship teams. Antimicrobial stewardship-focused education may increase nurses' confidence, empower them to help effect changes necessary to reduce unnecessary antibiotic prescriptions and improve the overall care and safety of nursing home residents. It is our sincere hope that our free online course will support broader antimicrobial stewardship efforts across an array of health systems and settings.

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REFERENCES

1. Threat Report 2013 | Antimicrobial Resistance | CDC. Available at: <http://www.cdc.gov/drugresistance/threat-report-2013/index.html>. Accessed 21 October 2013
2. Lessa FC, Mu Y, Bamberg WM, et al. Burden of Clostridium difficile Infection in the United States. *New England Journal of Medicine*. 2015; 372:825–834. [PubMed: 25714160]
3. Dellit TH, Owens RC, McGowan JE, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship. *Clinical Infectious Diseases*. 2007; 44:159–177. [PubMed: 17173212]
4. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America. *Clin Infect Dis*. 2016:ciw118.
5. Nicolle LE. Antimicrobial stewardship in long term care facilities: what is effective? *Antimicrobial Resistance and Infection Control*. 2014; 3:6. [PubMed: 24521205]
6. Crnich CJ, Jump R, Trautner B, Sloane PD, Mody L. Optimizing Antibiotic Stewardship in Nursing Homes: A Narrative Review and Recommendations for Improvement. *Drugs Aging*. 2015; 32:699–716. [PubMed: 26316294]
7. Jump RLP, Olds DM, Seifi N, et al. Effective Antimicrobial Stewardship in a Long-Term Care Facility through an Infectious Disease Consultation Service: Keeping a LID on Antibiotic Use. *Infect Control Hosp Epidemiol*. 2012; 33:1185–1192. [PubMed: 23143354]
8. Zimmerman S, Sloane PD, Bertrand R, et al. Successfully reducing antibiotic prescribing in nursing homes. *J Am Geriatr Soc*. 2014; 62:907–912. [PubMed: 24697789]
9. Harris-Kojetin L, Sengupta M, Park-Lee E, Valverde R. Long-Term Care Services in the United States: 2013 Overview. *Vital Health Stat 3*. 2013:1–107. [PubMed: 26158640]
10. Pakyz AL, Dwyer LL. Prevalence of Antimicrobial Use among United States Nursing Home Residents: Results from a National Survey. *Infection Control & Hospital Epidemiology*. 2010; 31:661–662. [PubMed: 20426578]

11. Nicolle LE, Bentley DW, Garibaldi R, Neuhaus EG, Smith PW. Antimicrobial Use in Long-Term-Care Facilities. *Infection Control and Hospital Epidemiology*. 2000; 21:537–545. [PubMed: 10968724]
12. Peron EP, Hirsch AA, Jury LA, Jump RLP, Donskey CJ. Another setting for stewardship: high rate of unnecessary antimicrobial use in a veterans affairs long-term care facility. *J Am Geriatr Soc*. 2013; 61:289–290. [PubMed: 23405923]
13. Centers for Medicare & Medicaid Services. Medicare and Medicaid Programs; Reform of Requirements for Long-Term Care Facilities. 2015. Available at: <https://www.federalregister.gov/articles/2015/07/16/2015-17207/medicare-and-medicicaid-programs-reform-of-requirements-for-long-term-care-facilities>. Accessed 29 August 2015
14. Executive Order -- Combating Antibiotic-Resistant Bacteria. Available at: <https://www.whitehouse.gov/node/298751>. Accessed 24 March 2015
15. Olans RN, Olans RD, DeMaria A. The Critical Role of the Staff Nurse in Antimicrobial Stewardship—Unrecognized, but Already There. *Clin Infect Dis*. 2016; 62:84–89. [PubMed: 26265496]
16. Jump RLP, Heath B, Crnich CJ, et al. Knowledge, beliefs, and confidence regarding infections and antimicrobial stewardship: A survey of Veterans Affairs providers who care for older adults. *Am J Infect Control*. 2015; 43:298–300. [PubMed: 25728158]
17. Improving the Care of Long-Term Care Facility Residents with Infections. Available at: <https://robinjump.coursesites.com/>. Accessed 29 August 2016
18. Beckett CD, Kipnis G. Collaborative communication: integrating SBAR to improve quality/patient safety outcomes. *J Healthc Qual*. 2009; 31:19–28. [PubMed: 19813557]
19. Heath B, Bernhardt J, Michalski TJ, et al. Results of a Veterans Affairs employee education program on antimicrobial stewardship for older adults. *Am J Infect Control*. 2016; 44:349–351. [PubMed: 26553404]
20. Crnich CJ, Jump R, Trautner B, Sloane PD, Mody L. Optimizing Antibiotic Stewardship in Nursing Homes: A Narrative Review and Recommendations for Improvement. *Drugs Aging*. 2015; 32:699–716. [PubMed: 26316294]
21. R: The R Project for Statistical Computing. Available at: <https://www.r-project.org/>. Accessed 10 October 2015
22. Olans RD, Nicholas PK, Hanley D, DeMaria A. Defining a Role for Nursing Education in Staff Nurse Participation in Antimicrobial Stewardship. *J Contin Educ Nurs*. 2015; 46:318–321. [PubMed: 26154674]
23. Corazzini KN, Anderson RA, Mueller C, et al. Regulation of LPN Scope of Practice in Long-Term Care. *Journal of Nursing Regulation*. 2011; 2:30–36.
24. Walker S, McGeer A, Simor AE, Armstrong-Evans, Loeb M. Why are antibiotics prescribed for asymptomatic bacteriuria in institutionalized elderly people?: A qualitative study of physicians' and nurses' perceptions. *CMAJ*. 2000; 163:273–277. [PubMed: 10951723]
25. Schweizer AK, Hughes CM, Macauley DC, O'Neill C. Managing urinary tract infections in nursing homes: a qualitative assessment. *Pharm World Sci*. 2005; 27:159–165. [PubMed: 16096881]
26. Naughton BJ, Mylotte JM, Ramadan F, Karuza J, Priore RL. Antibiotic Use, Hospital Admissions, and Mortality Before and After Implementing Guidelines for Nursing Home–Acquired Pneumonia. *Journal of the American Geriatrics Society*. 2001; 49:1020–1024. [PubMed: 11555061]
27. Schwartz DN, Abiad H, DeMarais PL, et al. An Educational Intervention to Improve Antimicrobial Use in a Hospital-Based Long-Term Care Facility. *Journal of the American Geriatrics Society*. 2007; 55:1236–1242. [PubMed: 17661963]
28. Zabarsky TF, Sethi AK, Donskey CJ. Sustained reduction in inappropriate treatment of asymptomatic bacteriuria in a long-term care facility through an educational intervention. *Am J Infect Control*. 2008; 36:476–480. [PubMed: 18786450]
29. Pettersson E, Vernby A, Molstad S, Lundborg CS. Can a multifaceted educational intervention targeting both nurses and physicians change the prescribing of antibiotics to nursing home

- residents? A cluster randomized controlled trial. *Journal of Antimicrobial Chemotherapy*. 2011; 66:2659–2666. [PubMed: 21893568]
30. Trautner BW, Greene MT, Krein SL, et al. Infection Prevention and Antimicrobial Stewardship Knowledge for Selected Infections Among Nursing Home Personnel. *Infection Control & Hospital Epidemiology*. 2016:1–6. [PubMed: 26633292]
31. Prepublication Standards – New Antimicrobial Stewardship Standard. Available at: https://www.jointcommission.org/prepublication_standards_antimicrobial_stewardship_standard/. Accessed 10 September 2016
32. The Core Elements of Antibiotic Stewardship for Nursing Homes | Nursing Homes and Assisted Living (LTC) | CDC. Available at: <http://www.cdc.gov/longtermcare/prevention/antibiotic-stewardship.html>. Accessed 25 June 2016

Highlights

- Free online course for nurses working in community long-term care facilities
- Six interactive modules about infectious diseases, sample collection, communication
- Opportunities for nurses to support antimicrobial stewardship embedded in the course
- Course participants reported increased knowledge and confidence
- Empowering nurses may enhance overall efforts to improve antibiotic use

Table 1

Characteristics of Respondents

Characteristics	Respondents N = 103 (%)
Sex	
Female	98 (95%)
License	
Licensed Practical or Vocational Nurse	32 (30%)
Registered Nurse	71 (66%)
Level of education	
Diploma	30 (28%)
Associate's Degree	39 (36%)
Baccalaureate Degree	24 (22%)
Master's Degree	8 (7%)
Other [*]	2 (2%)
Current Roles [†]	
Clinical	74 (69%)
Administrative	34 (31%)
Teaching	20 (19%)
Research	2 (2%)
Years of Experience in Caring for Older Adults	
1 - 9 years	42 (41%)
10 - 19 years	25 (24%)
20 or more years	36 (35%)
Type of Long-Term Care Facility [‡]	
Community-based nursing home	65 (60%)
Hospital-owned nursing home or nursing home ward in hospital	32 (31%)
Hospital	14 (13%)
Long-term acute care facility	11 (10%)
Other [‡]	10 (10%)
Geographic Region [§]	
Northeast	33 (31%)
Midwest	29 (27%)
South	39 (36%)
West	2 (2%)

* Doctoral degree, and degree not specified

† Respondents could select more than one answer

‡ Includes a Veterans Affairs Community Living Center (1), outpatient clinic (1), continuing care retirement community (1), facility for adults with disabilities (1), home care (2) or not specified (4).

§ Based regions defined by the US Census Bureau

Table 2

Changes in Attitudes and Beliefs Before and After the Online Course.

Attitude and Beliefs	Pre-Course * Survey	Post-Course * Survey	P-values [†]
Confidence related to learning objective for each module [‡]			
Module 1: To recognize signs and symptoms of infection in older adults.	4.2	4.5	0.05
Module 2: To decide if a resident with a positive urine culture has a urinary tract infection or asymptomatic bacteriuria.	3.9	4.4	0.01
Module 3: To determine if resident has a cough from an upper respiratory infection (a cold), pneumonia or some other cause.	3.9	4.4	0.01
Module 4: Implement isolation precautions as a means to improve resident safety.	4.1	4.5	0.04
Module 5: To collect samples for microbiological cultures that will inform decisions about patient care	4.1	4.4	0.04
Module 6: To gather information about a resident's change in status and communicate it to the provider.	4.1	4.5	0.03
Attitudes towards their clinical assessment of residents			
I can usually tell when one of my patients has a change in their clinical status.	4.6	4.8	0.11
When my patients have a change in their clinical status, I can usually tell whether that change is due to an infection or not.	4.0	4.5	<0.01
When I think one of my patients has an infection, I can usually tell if they need an antibiotic to feel better.	4.0	4.2	0.16
When I think one of my patients has an infection, I can offer supportive care to help them feel better.	4.5	4.7	0.04
Attitudes regarding role in antimicrobial stewardship			
My knowledge of a patient's baseline influences whether or not the patient receives antibiotics.	3.8	4.5	<0.01
My assessment influences whether or not a patient receives antibiotics.	3.8	4.5	<0.01

Attitude and Beliefs	Pre-Course Survey [*]	Post-Course Survey [*]	P-values [†]
My communication with patients and their families influences whether or not a patient receives antibiotics.	3.8	4.2	<0.01
My communication with providers influences whether or not a patient receives antibiotics.	4.1	4.5	<0.01
Attitudes about antimicrobial stewardship in setting			
Where I work, physicians routinely practice antimicrobial stewardship.	3.4	3.7	<0.01
Where I work, nurse practitioners and physician assistants routinely practice antimicrobial stewardship.	3.5	3.8	<0.01
Where I work, pharmacists routinely practice antimicrobial stewardship.	3.3	3.7	<0.01
Where I work, patients and their families often insist on antibiotics.	3.9	3.8	0.09
Where I work, the administration supports our staff's efforts to practice antimicrobial stewardship.	4.0	4.2	0.04
Beliefs about antimicrobial stewardship and infection control and prevention			
If it is unclear if a resident has an infection, it is reasonable to monitor them more frequently and offer supportive care for 1-2 days to see if they get better without an antibiotic.	4.1	4.3	0.07
If our current antibiotics lose their effectiveness, the pharmaceutical companies can make new, equally effective agents.	2.8	2.6	0.01
Only very vulnerable people acquire multi-drug resistant pathogens.	2.0	1.9	0.63
Nurses and aides at long-term care facilities have little control as to whether residents acquire multi-drug resistant pathogens	2.1	2.0	0.59
Where I work, I have at least one patient on isolation precautions every day or nearly every day.	2.5	2.7	0.05
Infection control practices are more important than antimicrobial stewardship in preventing patients from acquiring multi-drug resistant pathogens and <i>Clostridium difficile</i> .	3.6	3.8	0.03

^{*} Mean score for N = 103 RNs and LPNs who completed the pre- and post-course survey. Scores are based on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) unless otherwise noted.

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Bold type indicates P-values that are statistically significant following a Bonferroni adjustment to account for multiple comparisons (25 survey questions and the total knowledge score).
Responses range from very unconfident (1) to very confident (5).

Table 3

Knowledge Questions Answered Correctly Before and After the Online Course.

Topic	Module /Question No., n (%) *	Pre-course survey	Post-course survey
Signs & Symptoms of Infection in Older Adults			
1	Fever in older adults	45 (44%)	92 (89%)
2	Atypical signs & symptoms of infection	90 (87%)	95 (92%)
Urinary tract infection vs. Asymptomatic Bacteriuria			
3	Urinary tract infection symptoms	80 (78%)	80 (84%)
4	Preventing catheter-associated urinary tract infection	64 (62%)	95(92%)
5	Indications to place, change and remove urinary catheters	98 (95%)	95(92%)
Isolation Precautions			
6	Rational for using personal protective equipment for residents colonized with methicillin-resistant <i>Staphylococcus aureus</i>	98 (95%)	98 (94%)
7	Reducing transmission of <i>Clostridium difficile</i>	99 (96%)	93 (90%)
8	Contact precautions for drug-resistant Gram-negatives	89 (86%)	92 (89%)
Collecting Samples for Microbiological Culture			
9	Urine	40 (39%)	64 (62%)
10	Sputum	63 (61%)	77 (75%)
Communication with Providers using SBAR †			
11	Definition of SBAR †	103 (100%)	103 (100%)
12	Purpose of SBAR †	59 (57%)	77 (75%)
Total Score ‡ average number correct (%)		9.0 (75%)	10.4 (86%)

* Unless otherwise indicated; there were no questions specific to the module “Upper respiratory tract infections, bronchitis and pneumonia.”

† SBAR; Situation, Background, Assessment, Recommendations

‡ $P < 0.001$ for total scores on knowledge portion of pre- vs. post-course survey