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Contents lists available at ScienceDirect

## American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)

## Major article

## Impact of infection preventionists on Centers for Medicare and Medicaid quality measures in Maryland nursing homes

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## Key Words:

Long-term care  
 Outbreak  
 Quality improvement  
 Patient safety

**Background:** Health care-associated infections are the leading cause of morbidity and mortality in US nursing homes (NHs). The objective of the research is to assess the impact of Maryland NH infection preventionists (IPs) on NH quality measures.

**Methods:** Two hundred thirty-four NHs were queried through mailed survey. These survey data were then linked with 2008 quality data from Nursing Home Compare and the On-line Survey Certification of Automated Records.

**Results:** Three of the 8 quality measures examined—fluenza vaccination for both short- and long-stay residents and pressure ulcer prevention in high-risk residents—were significantly associated with the number of IPs. None of the quality measures were shown to be significant with IPs who received specialized training on infection prevention and management compared with those who did not receive specialized training.

**Conclusion:** IPs play a critical role in preventing and managing health care-associated infections in nursing homes, especially in the areas of influenza vaccination and pressure ulcer prevention among high-risk nursing home residents. Quality measures that reflect the effects of IP training may not have been elucidated yet. Further research is needed to support the IP role in order for policy to advocate for increased IP funding.

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Health care-associated infections (HAIs) are the leading cause of morbidity and mortality in US nursing homes (NHs) with between 1.6 and 3.8 million infections and almost 388,000 deaths occurring annually in this setting.<sup>1</sup> The costs associated with infections in NH settings have a significant impact on the health care system, with annual estimates ranging from \$38 to \$137 million for antimicrobial therapy and \$673 million to \$2 billion for hospitalizations.<sup>2</sup> Infections are the reason for one-fourth of all hospitalizations from long-term care facilities.<sup>3,4</sup> Therefore, the importance of infections in NHs extends beyond just these facilities because millions of NH residents every year are transferred to and from acute care settings and can potentially spread pathogens between settings.<sup>5</sup> Furthermore, outbreaks occur frequently, endemic rates of infection are

substantial, and antibiotics are often inappropriately prescribed, leading to greater susceptibility to antibiotic-resistant organisms.<sup>6</sup>

NHs have been scrutinized in recent years regarding their handling of HAIs. One study found an average of 15% of all NHs per year received a deficiency citation for infection control from 2000 to 2007. These deficiency citations were received while state surveyors conducted an inspection of the facility. Several staffing levels were also associated with receiving a deficiency citation for infection control. Furthermore, approximately 9% of all NHs per year receive a hand hygiene deficiency citation (ie, F-tag F-444). An upward trend is also evident, with the average yearly percentage of citations increasing from 7.37% (in 2000) to 11.98% (in 2009).<sup>7</sup>

One method of preventing and managing HAIs in NHs is through the facility's infection prevention and control program. The Nursing Home Reform Act mandated that NHs were to have a functioning infection control program in place.<sup>8</sup> These programs are to be multifactorial<sup>9</sup> in nature and include surveillance, outbreak investigations, isolation procedures, educational programs for both employees and residents, antibiotic stewardship, employee and

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Conflicts of interest: None to report.

**Table 1**  
Descriptive statistics of participating nursing homes: n = 123

Dependent variables	% (SD)	Independent variables	Mean (SD)
High-risk residents with pressure ulcers	42.08 (21.91)	FTE infection control professional	0.43 (0.19)
Postacute residents with pressure ulcers	32.18 (9.68)	Received training on infection control practices	0.80 (0.40)
Residents who had a catheter inserted and left in bladder	36.13 (23.77)	Chain member	0.48 (0.50)
Residents with urinary tract infections	42.87 (22.48)	For-profit ownership	0.57 (0.50)
Pneumococcal vaccination provided (long-stay residents)	38.36 (18.47)	RN staffing (FTEs per 100 beds)	0.07 (0.13)
Pneumococcal vaccination provided (short-stay residents)	46.10 (23.29)	LPN staffing (FTEs per 100 beds)	0.16 (0.18)
Influenza vaccination provided (long-stay residents)	40.71 (21.16)	Nurse aide staffing (FTEs per 100 beds)	0.35 (0.11)
Influenza vaccination provided (short-stay residents)	59.92 (25.02)	Size (number of beds)	128 (68)
		Occupancy rate	0.87 (0.11)
		Medicaid resident occupancy	0.56 (0.25)
		Resident case mix (ADL score)	0.30 (0.12)

ADL, activities of daily living; FTE, full-time equivalent; LPNs, licensed practical nurses; RNs, registered nurses; SD, standard deviation.

resident health programs, hand hygiene approaches, and reporting procedures.<sup>5</sup> In summary, the research shows that infection control guidelines and infection definitions varied widely across NHs<sup>10</sup>; NHs only spend an average of 8 hours per week on infection control; and few NHs have a full-time infection preventionist (IP) devoted to preventing infections and managing the infection control program.<sup>11</sup>

Maryland is one state that had improved the quality of IPs in NHs. After finding in a statewide study that IP support in NHs was significantly less than in hospitals (in terms of number of IPs per beds and infection control training),<sup>12</sup> it was determined that NHs in this state could benefit from training and regulatory upgrades sponsored by the Maryland Department of Health and Mental Hygiene (DHMH). The DHMH subsequently rolled out a combined approach to both revise the state regulations aimed at requiring at least 1 designated IP in each NH as well as providing a basic infection control training course for these designated IPs. This course would seek to train these long-term care IPs in 3 basic skills: (1) infection surveillance techniques, (2) isolation and multidrug-resistant organism precautions, and (3) recognition and management of outbreaks. Additional information, such as hand hygiene, environmental infection control, tuberculosis prevention, microbiology, and immunization of health care workers, is also covered in the curriculum. This initiative resulted in an increased number of trained IPs in NHs; the NHs with trained IPs responded more quickly to an outbreak than NHs without trained IPs.<sup>13</sup>

Whereas some research supports that IPs can result in improved outcomes (eg, reduced infections),<sup>14</sup> this link has not been studied in the NH setting. Therefore, the aim of this study was to assess the impact of NH IPs on NH quality measures. Specifically, we sought to understand better the relationships among the number of IP staff, IP training, and preventing and managing infections. We hypothesize that a higher number of IPs is associated with better quality in NH settings and whether the IPs' basic training in infection prevention and control is associated with better quality in NH settings.

## METHODS

### Primary data

This study analyzed data obtained from a statewide survey conducted to determine whether DHMH initiatives had an impact on building capacity in IPs in Maryland NHs<sup>13</sup> as well as examine the NH's response to an infection outbreak. A total of 234 NHs was queried in 2008 through a mailed survey approach on the types of IP activities, personnel, and approaches to reduce HAIs in their setting. Further details of the sample size calculation, study limitations, and instrument validity and reliability are available.<sup>12,13</sup> From these 234 NHs, 54% responded (n = 127).

These survey data were then linked with 2008 quality data (described below) from Nursing Home Compare (NHC) and data from the On-line Survey Certification of Automated Records (OSCAR). The primary survey independent variables included the number (in full-time equivalent [FTE] hours) of IPs present in the facility and also whether these IPs attended a basic infection control training course, sponsored either by the Association for Professionals in Infection Control and Epidemiology, Inc, or a government or private sector agency.

In addition to these 2 variables, other control variables were also included in the analysis. Table 1 lists the NH characteristic variables that were used in this analysis as control variables. The variables included in the analyses were derived from the prior research in this area that has examined NH quality.<sup>15,16</sup>

### Quality measures

As quality indicators for the analysis, the NH quality measures reported on the NHC Web site were used ([www.medicare.gov/NHCompare](http://www.medicare.gov/NHCompare)). NHC is a Web-based report card providing public information on all Medicare and Medicaid certified NHs. Five quality measures were examined in this investigation as the dependent variables: percent of residents with pressure ulcers (high risk and postacute), indwelling urinary catheter, urinary tract infection, pneumococcal vaccination provided (short-stay and long-stay residents), and influenza vaccination provided (short-stay and long-stay residents). These quality measures were chosen based on their relationships to HAIs. These measures have been studied extensively and are generally thought to represent infections in NHs.<sup>9,17–19</sup>

### OSCAR

OSCAR data contain information collected as part of state/federal NH inspections. NHs that accept residents with Medicare and/or Medicaid payments are surveyed. This includes approximately 97% of NHs in the United States. The survey process occurs approximately yearly and includes the recording of many characteristics of the NH (eg, number of beds) and aggregate characteristics of residents (eg, number with dementia). The data are commonly used as a secondary source of NH characteristics.<sup>20</sup>

Facility characteristic variables included in this research are Medicaid resident occupancy, private-pay occupancy, size, ownership, chain membership, and occupancy rate. The percent of residents paid for by Medicaid or private pay were used as measures of Medicaid resident occupancy and private-pay resident occupancy, respectively. The number of NH beds was used as a measure of size. Two classes of facility ownership were used: for-profit and not-for-profit. Two classes of chain membership were used: chain and

**Table 2**  
Regression coefficients for the effects of infection preventionists on nursing home quality measures

Variable	Percent high-risk residents with pressure ulcers	Percent postacute residents with pressure ulcers	Percent of residents who had a catheter inserted and left in bladder	Percent of residents with urinary tract infections	Percent pneumococcal vaccination provided (long-stay residents)	Percent pneumococcal vaccination provided (short-stay residents)	Percent influenza vaccination provided (long-stay residents)	Percent influenza vaccination provided (short-stay residents)
ICP FTE	-7.54 (2.68)*	-0.24 (1.26)	-0.44 (3.44)	-4.86 (2.88)	-3.25 (2.78)	-2.83 (2.07)	-8.97 (2.70) <sup>†</sup>	-6.14 (2.29)*
ICP received training	-1.23 (4.94)	-1.06 (2.25)	-4.54 (6.23)	-2.72 (5.20)	-4.68 (6.05)	5.34 (4.27)	-7.92 (5.67)	4.50 (4.72)

FTE, full-time equivalent; ICP, infection control professional.

NOTE. Robust standard errors in parentheses.

\* $P < .01$ .

<sup>†</sup> $P < .001$ .

nonchain. The overall occupancy rate is the percent of beds occupied by residents.

Three different types of nursing staff were included in the analyses: the number (measured as FTE) of registered nurses, licensed practical nurses, and nurse aides per 100 beds. An average activities of daily living (ADL) score was used to represent case mix. For each of 3 ADL questions (eating, toileting, and transferring) in the OSCAR, a score from 0 to 3 was assigned for using no assistance, moderate need for assistance, and high degree of need for assistance, respectively. These scores were then summed, with higher scores indicating a greater average ADL impairment within the facility.

#### Statistical analysis

To examine NH quality measures and their association with the number of IP staff and amount of IP training, multivariate regression analyses were used (specifically, ordinary least squares regression). We explored possible transformations for all of the dependent variables and concluded, based on normality tests, that transformations were not necessary. To account for possible correlation of outcomes within markets, which can bias the standard errors of the estimates, the Huber-White sandwich estimator (ie, robust standard errors) clustered by county was used for all of the multivariate analyses.

#### RESULTS

Once the data sets were merged, full data were available on 123 NHs. The variables describing the independent and dependent variables are shown in Table 1. In general, NHs in the sample are representative of NHs in Maryland. That is, no significant differences between this sample and organizational characteristics from all NHs in MD were identified.

The results of the regression analyses are displayed in Table 2. All of the control variables listed in Table 2 were included in each regression model (results for all variables in the models are available from the authors). Eight models were used, examining the following: pressure ulcers (high risk and postacute), indwelling urinary catheter, urinary tract infections, pneumococcal vaccination (short-stay and long-stay residents), and influenza vaccination provided (short-stay and long-stay residents). In the cross-sectional analyses, shown in row 1, three of the 8 quality measures were significantly associated with the FTE of an IP. In other words, for every unit increase in the FTE of an IP, there is a -7.54, -8.97, and -6.14 unit significant decrease in the predicted scores of pressure ulcers, and long-stay and short-stay influenza vaccinations, respectively. This would seem to support the hypothesis that NHs with greater FTEs of an IP are associated with higher quality in terms of influenza vaccination (both short- and long-stay residents) and preventing pressure ulcers in high-risk residents.

In the second set of analyses of interest (shown in row 2 of Table 2), none of the quality measures were shown to be significant with IPs who received training on infection control prevention and management compared with those who did not. This would seem to show that care outcomes are based on factors other than providing specialized training of infection prevention and management. Thus, there is no support for the hypothesis that NHs with IPs who received training on infection control prevention and management are associated with higher NH minimum data set (MDS) quality measures.

#### DISCUSSION

In summary, our results appear to indicate that IPs have an impact on quality measures, especially in the areas of influenza vaccination and pressure ulcer prevention among high-risk NH residents. However, IP training in infection prevention and control did not appear to make a significant difference among the quality measures tested.

There are several reasons why the influenza vaccination quality measure was significantly associated with IPs. Influenza is a frequent cause of upper respiratory infections in NHs and is associated with significant morbidity and mortality.<sup>21</sup> Prevention through a rigorous vaccination program can significantly reduce a NH's likelihood of experiencing an outbreak. In recent years, widespread communication regarding influenza prevention such during the 2009 H1N1 in pandemic and the 2003-2004 epidemic of severe acute respiratory syndrome has also increased the awareness for NHs to prevent influenza outbreaks from occurring.<sup>22</sup> Although significant variability exists, an increased number of NH residents now receive the influenza vaccination.<sup>10,23</sup> This likely can partially be attributed to the inclusion of influenza vaccination as a quality measure. As our study demonstrates, IPs also contribute to increased compliance to this quality measure initiative.

IPs also were influential in reducing pressure ulcers among high-risk NH residents. Not only are preventing pressure ulcers a patient safety goal,<sup>19</sup> but preventing such ulcers that result from a skin and soft-tissue infection is paramount. This is especially true as care providers incorporate strategies to prevent the transmission of methicillin-resistant *Staphylococcus aureus* (MRSA) in NHs. Nearly 25% of residents admitted to NHs are colonized with MRSA, and another 10% will acquire the organism during their stay.<sup>24</sup> Pressure ulcers are a predominant site for MRSA; thus, their prevention is critical,<sup>25</sup> especially because infected pressure ulcers are costly to treat.<sup>9,26</sup> IPs play a critical role in both preventing pressure ulcers and reducing the occurrence of MRSA-infected wounds.

Our results also found that IPs do not significantly impact the indwelling urinary catheter, urinary tract infection, pneumococcal pneumonia vaccination, or postacute care pressure ulcer quality measures. One explanation for this is that these quality measures

have not received a great deal of attention in prevention of outbreaks, for example. Only recently have catheter-associated urinary tract infections (CAUTI) garnered increased attention outside of the hospital setting through national quality improvement initiatives. This is now changing, however. The Department of Health and Human Services National Action Plan for the prevention of HAIs in long-term care settings intends the focus to increase on various infections and their associated metrics, such as facility enrollment in the National Healthcare Safety Network, urinary tract infections/CAUTIs, *Clostridium difficile* infection, resident influenza and pneumococcal vaccination, and health care personnel influenza vaccination.<sup>27</sup>

Whereas education and professional training has been regarded as one method of increasing infection prevention and control knowledge,<sup>9</sup> this study did not show a significant difference between those IPs who were specially trained to the IPs who were not when examining the quality measures for infections. It is possible that infection control training focuses more on the prevention, control, and epidemiology of resident care management and less on the quality improvement strategies methodology. The quality measures that reflect the long-term effects of IP basic training have not been elucidated. When the Department of Health and Human Services plan begins to be implemented however, IPs will be the individuals to gather the surveillance data and enter it into National Healthcare Safety Network and to initiate any prevention modalities to prevent and/or reduce these infections. The future, therefore, may find that having IPs who have received basic training in infection prevention and control programs will significantly impact current and future quality indicators. Whereas many NHs may have IPs functioning in multiple roles (such as that of the director of nursing, charge nurse, or in-service nurse),<sup>9</sup> we did not account for this in the analysis. In Maryland data, there were no IPs who performed their infection prevention and control job full-time. Of the 123 responding facilities, the IPs performed at least 1 other function and usually 3 or 4.

The IP is responsible for ensuring infection surveillance and contributing to the facility antimicrobial stewardship program, control of outbreaks, educating staff about isolation procedures and hand hygiene, and maximizing the resident and employee health program. Whereas infection control programs are mandated by The Joint Commission, Centers for Medicare and Medicaid Services, and certain state accreditation bodies, our knowledge of such programs and the role of the IP is not well-known on a national level. One area for future research is to examine the IP's role in NH quality assurance and performance improvement activities, as well as their knowledge of NH quality measures related to infection control and prevention.

In October 2012, the Society for Healthcare Epidemiology and the Centers for Disease Control and Prevention National Healthcare Safety Network released a new voluntary tracking component to allow NHs to better monitor HAIs<sup>28</sup> as one emerging strategy to incorporate quality improvement strategies into a NH's infection prevention and control program. The updated surveillance guidance includes revised definitions to standardize terminology regarding infections<sup>29</sup> and provide data for better surveillance of HAIs in NHs. Also, further discussion in how this reporting system can complement the Agency for Healthcare Research and Quality's common format for reporting HAIs<sup>30</sup> is also needed so that multiple forms of reporting do not hinder the reporting process.<sup>31</sup>

However, without substantial infrastructure supports and government requirements in place, the implementation of such quality improvement programs may be futile. Previous research has cited that, whereas infections are extremely common, outbreaks are reported less often than less frequently occurring events such as abuse.<sup>32</sup> This study identified that NHs with greater FTE support of

an IP resulted in better outcomes in some areas. Thus, further research in the role of reporting outbreaks and quality improvement strategies to prevent and track infections in NHs is critical, especially in NHs where minimal support is provided. For example, in the aftermath of severe acute respiratory syndrome, the Ontario Ministry of Health and Long Term Care provided funding to increase IPs in long-term care homes to prevent and better manage future outbreaks of HAIs.<sup>33</sup> Future research examining the cost of IPs and the effectiveness and proper staffing levels for the IP is needed for policy to further guide clinical care.

This study is not without limitations. The data are derived from a single geographic location (Maryland); thus, our ability to generalize these findings on a national level is limited. In addition, the data were from 2008. Thus, history effects such as the influenza outbreaks of 2009 could have contributed to the statistical significance with those particular quality measures. A more recent analysis may find that additional quality measures are being more carefully examined by IPs given the increased attention to infection control.<sup>19</sup>

Furthermore, in our attempt to demonstrate the impact of IPs in NHs, we chose the best available quality measures, yet we do not know which IP duties could impact these measures, especially because the training the IPs received may not have been specialized for the quality measures tested. Another flaw in the study design was our inability to quantify the multiple roles IPs have in this setting and factor these varied roles in our analysis. A future study could attempt to show the IP role on quality improvement efforts rather than specifically focus on quality measures.

In conclusion, IPs play a critical role at preventing and managing HAIs in NHs. Further research is needed to support their role for health care policy to advocate for increased funding. This research fosters more interest in the IP's role in quality improvement strategies with the overall objective of improving resident care and ensuring quality outcomes.

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