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Influence of staff infection control training on infection-related quality measures in United States nursing homes

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Abstract

Healthcare-associated infections are a leading cause of morbidity and mortality in U.S. nursing home residents. Ongoing training of nursing home staff is vital to the implementation of infection prevention and control processes. Our aim was to describe associations between methods, frequency, and timing of staff infection control training and infection-related quality measures. In this national survey of nursing homes, timing of staff infection control training was associated with reduced indwelling urinary catheter use.

Keywords

Nursing homes; Infection control; Staff training; Quality measures

Introduction

Healthcare-associated infections (HAIs) are a leading cause of morbidity and mortality in nursing home (NH) residents, with between 1.6 and 3.8 million infections and about 388,000 deaths occurring annually.¹ Most HAIs are preventable² and in a recent national survey of NHs, considerable variation in resources and practices for infection control (IC) activities was found such as time dedicated to IC, staff knowledge on IC practices, and environmental decontamination practices.³ In addition, there is variation in infection rates across facilities.⁴ Together, this indicates that HAIs are important quality indicators.⁵ Since 2002, CMS has published quality measures (QMs) for both long-stay and short-stay NH residents on Nursing Home Compare, an online tool for consumers to distinguish between higher and

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lower quality NHs.⁶ Several QMs are related to infection control and prevention, such as the percentage of residents with a urinary tract infection (UTI) or with an indwelling urinary catheter. These infection-related QMs are used to calculate overall 5-star ratings for NHs.⁶

Training and education of NH staff is crucial to the implementation and compliance of recommended IC practices, especially for those providing direct patient care (i.e. certified nursing assistants [CNAs]). Lack of knowledge on IC topics is perceived to limit the ability of NH staff to adhere to infection IC processes.⁷ We aimed to describe relationships between methods, frequency, and timing of staff IC training and infection-related QMs in a national sample of NHs.

Methods

A survey of 2,514 randomly sampled US NHs was conducted between December 2013 and December 2014 to describe the current state of NH IC programs (response rate=39%). The professional in charge of the IC program was invited to complete the survey. A detailed description of the survey has been published elsewhere.⁸

For this analysis, the main exposures were derived from the survey and were related to staff IC training: methods (computer-based training [yes vs. no], handouts/flyers [yes vs. no], and in-services [yes vs. no]); frequency (monthly/bi-weekly/weekly vs. quarterly vs. annually); timing (at new employee orientation and when an infection outbreak occurred vs. other [only at new employee orientation, only when an infection outbreak occurred, or neither]) to evaluate intensity of training. See Table A.1 in the Appendix for a detailed list of variables.

Survey responses were linked with concurrent Certification and Survey Provider Enhanced Reporting data to evaluate facility characteristics and with averages from the last 3 quarters of 2015 QM data from Nursing Home Compare. The outcomes of interest were five infection-related QMs: percentage of long-stay residents with pressure ulcers, UTI, and urinary catheters, and who were vaccinated with the influenza and pneumococcal vaccines. Vaccination prevalence was dichotomized as low and high based on the Healthy People 2020 90% target.⁹ The other QMs were dichotomized based on median prevalence among respondents to compare better versus poorer performing NHs.

For each QM, descriptive statistics were computed using χ^2 , Fisher's exact, or *t*-tests, as appropriate, to identify differences between facilities with high versus low QM scores. Based on previous research, occupancy, ownership, setting, and CNA staffing were included as a priori covariates in multivariable logistic regression models.^{5,10} Setting was defined as metropolitan, nonmetropolitan with an urban population, and rural using the 2013 Rural-Urban Continuum Codes.¹¹ Inclusion of additional covariates was determined based on the following criteria to identify potential confounding: (1) association with the QM with p-value <0.10, (2) association with method, frequency, or timing of training on IC topics with p-value <0.10, and (3) change in beta for method, frequency, or timing of training was greater than 10%. In multivariable analyses, variables with p-value <.05 were considered statistically significant. To assess for potential selection bias, NH characteristics were compared for facilities with and without 2015 QM data. All analyses were conducted using

SAS version 9.3 (SAS Institute, Cary, NC). This research was approved by Columbia University Medical Center's institutional review board.

Results

Analyses of surveys from NHs for which we had both exposures and QM data (n=851) were performed: n=796 for both urinary catheter and UTI; n=805 for both influenza and pneumococcal vaccination; n=790 for pressure ulcers.

Compared with respondents without QM data, those with QM data were more likely to provide computer-based training (51% vs. 38%; p-value=.01) and conduct training at both new employee orientation and when an infection outbreak occurred (64% vs 59%; p-value=.27) (Table A.2 in Appendix). Based on the sample of NHs with QM data, the majority of NHs were for-profit (68%), located in metropolitan areas (72%) and in the Midwest (38%) (Table A.2). On average, occupancy, bed size and CNA staffing level were 82%, 120 beds, and 2.42 hours per resident per day, respectively. About 77% provided handouts or posted flyers in care units. Almost all provided in-services and, due to lack of variation, associations between in-services and QMs were not evaluated. About 30% conducted trainings frequently (i.e. monthly/biweekly/weekly). Eleven percent, 6% and 17% of NHs conducted IC training only at new employee orientation, only when an infection outbreak occurred, or neither, respectively (data not shown). About 64% of NHs conducted training at both orientation and when an outbreak occurred. The median prevalence of residents vaccinated for influenza and pneumococcal was 98% (interquartile range [IQR]=94–100). The median prevalence of residents with pressure ulcers, indwelling catheters, and UTI was 5.0% (IQR=3.0–8.0), 2.5% (IQR=1.4–4.1), and 4.0% (IQR=2.4–6.8), respectively.

In the bivariate analyses, timing of training was associated with urinary catheter use (p-value=.01; Table 1); however, no other QMs were associated with the exposures of interest (data not shown and are available upon request). In the multivariable analysis (Table 2), NHs with high urinary catheter use (i.e. poorer quality with regards to catheter use) were less likely to conduct training at both new employee orientation and when an infection outbreak occurred (odds ratio=0.70; p-value=.02).

Discussion

NHs that conducted staff training at both new employee orientation and when outbreaks occurred had better quality related to urinary catheter use. While prior research has assessed the role of IC professional training on NH quality,¹⁰ to our knowledge none have examined the impact of IC training of other NH staff. Furthermore, a NH with IC training at both orientation and when an outbreak occurred may have a more robust IC program. Our results support existing evidence that a tailored and continuous training program was better than a single intervention in reducing HAIs.¹²

Direct patient care staff are responsible for the identification, assessment, and reporting of residents with infections. These responsibilities require sufficient understanding of IC practices and are vital to the proper implementation of IC processes. Our results indicate that more intensive training may improve staff knowledge of IC processes, an important step

towards improving overall quality of care. Moreover, urinary catheter use is strongly associated with development of catheter-associated UTIs in NHs,¹³ suggesting that reinforcement of prevention and control processes through timely staff training may be one way to decrease infection rates in NHs, though additional research is warranted.

We found that IC training did not significantly impact the UTI and pressure ulcer QMs. Even though urinary catheter use is a strong predictor of UTI, the majority of UTI in NHs are among residents without catheters,¹³ indicating that other factors are involved. Additionally, pressure ulcers might result more from a resident's clinical condition rather than IC practices and, therefore, pressure ulcer prevention may not receive as much attention during IC training as other topics.¹

This study has several limitations. The data were cross-sectional; however, we addressed temporality concerns by linking 2014 survey exposure data with 2015 NH Compare outcome measures. Survey data were self-reported and therefore subject to bias. However, it is likely that exposure misclassification would have been non-differential and therefore biased the results towards the null. Based on the comparison of NHs with and without QM data, facilities differed on several characteristics; facilities with QM data had more robust IC training programs. Due to possible selection bias, our analysis likely included facilities with better overall quality and robust training programs which could lead to an underestimation of the odds ratio. Another limitation was our inability to account for infection outbreaks. It is possible that NHs that experience more frequent outbreaks may provide more timely training specific to the outbreak or more broadly, which may have resulted in an overestimation of the relationship between IC training and catheter use. However, no association was found between IC training and pressure ulcers or urinary tract infections which are infection outcomes rather than processes.

In summary, HAIs are a major issue in NHs and infection-related QMs are used to evaluate quality. Timing of staff IC training at both new employee orientation and when an outbreak occurred was associated with lower urinary catheter use QM. Further research is needed to assess whether timing of training can reduce infections in NHs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix

Table A.1

Data sources and variables used in analyses

Variables	Responses and Coding
Survey	
How does your facility typically provide infection control training to staff?	Computer-based training tools (yes/no); Handouts/flyers posted on care units (yes/no); In-services (yes/no)
How frequently does your facility typically conduct staff training on infection control topics?	Annually, Quarterly, Monthly/Weekly/Bi-weekly
Timing of staff training on infection control topics	At new employee orientation (yes/no); when an infection outbreak occurred (yes/no)
Timing of staff training on infection control topics (combined)	At both new employee orientation and when an infection outbreak occurred vs. other (only at new employee orientation, only when an infection outbreak occurred, or neither)

Variables	Responses and Coding
Percent time infection control professional spends on infection control per week	0–100%
Sum of infection control professional responsibilities in addition to infection control	<2 vs. 2
What is the highest level of training of the infection control professional?	CNA/LPN/LVN, RN/BSN/MSN, NP/MPH/MD
How many years of experience does the infection control professional have doing infection control-related work (overall in any NH and in current NH)?	Tertiles Any: 0–4.5, 5–13, 14–40 Current: 0–1.7, 2–4.5, 5–35
Has the infection control professional received any specific infection control training or certification?	Yes/No
How often does your facility's infection control committee meet?	Annually, Quarterly, Monthly/Weekly/Bi-weekly
Within the past two years, has your facility used financial resources for continuing education in infection control?	Yes/No
What methods do your facility use to monitor compliance with hand hygiene policies in at least one resident area?	Proximity monitors (yes/no) Product consumption (yes/no)
If your facility does monitor hand hygiene compliance, does your facility have a mechanism for providing feedback on compliance to staff?	Yes/No
Nursing Home Compare	
Percentage of long-stay residents who have/had a catheter inserted and left in their bladder	Low: <2.5% ; High: 2.5%
Percentage of long-stay residents assessed and appropriately given the seasonal influenza vaccine	Low: <90%; High: 90%
Percentage of long-stay residents assessed and appropriately given the pneumococcal vaccine	Low: <90%; High: 90%
Percentage of long-stay high-risk residents with pressure ulcers	Low: <5.0%; High: 5.0%
Percentage of long-stay residents with a urinary tract infection	Low: <4.0%; High: 4.0%
CASPER	
Bed size	31–816
Percent occupancy	6–100% (scaled to 1 standard deviation in multivariable model)
Ownership	For-profit, Government/Nonprofit
Chain member	Yes/No
Staffing (RN, LPN/LVN, and CNA hrd)	0–5.65
Payment source	% of residents on Medicaid, Medicare, or Other (e.g. private-pay, self-pay)
Setting	Metropolitan, nonmetropolitan with urban population, rural
Region	Midwest, Northeast, South, West

Notes: *NH*, nursing home; *CASPER*, Certification and Survey Provider Enhanced Reporting; *CNA*, certified nursing assistant; *hrd*, hours per resident per day; *LPN/LVN*, licensed practical nurse/licensed vocational nurse; *RN*, registered nurse; *BSN*, Bachelor of Science in Nursing; *MSN*, Master of Science in Nursing; *NP*, Nurse Practitioner; *MPH*, Master of Public Health, *MD*, Doctor of Medicine

Table A.2

Comparison of nursing homes with and without 2015 Nursing Home Compare quality measures data

	Total (n=969)	With QM data (n=851)	Without QM data (n=118)	p-value
Facility Characteristics				
Bed size (mean $\pm$ SD)	118 $\pm$ 70	120 $\pm$ 72	104 $\pm$ 46	.007
Percent occupancy (mean $\pm$ SD)	82 $\pm$ 15	82 $\pm$ 15	80 $\pm$ 20	.22
Ownership				.007
For-profit	677 (68.9)	582 (68.4)	95 (80.5)	
Government/non-profit	292 (30.1)	269 (31.6)	23 (19.5)	
Chain member	533 (55.0)	488 (57.3)	45 (38.1)	<.0001
Staffing (n=967; mean $\pm$ SD)				
RN hrd	0.74 $\pm$ 0.33	0.73 $\pm$ 0.32	0.81 $\pm$ 0.43	.05
LPN/LVN hrd	0.79 $\pm$ 0.35	0.79 $\pm$ 0.38	0.80 $\pm$ 0.41	.73
CNA hrd	2.44 $\pm$ 0.60	2.42 $\pm$ 0.59	2.59 $\pm$ 0.68	.01
Payment source (mean $\pm$ SD)				
% of residents on Medicaid	61 $\pm$ 21	61 $\pm$ 20	61 $\pm$ 26	.97
% of residents on Medicare	14 $\pm$ 12	14 $\pm$ 10	17 $\pm$ 19	.87
% of residents not on Medicaid or Medicare	25 $\pm$ 18	25 $\pm$ 18	22 $\pm$ 18	.02
Setting				.57
Metropolitan	703 (72.6)	615 (72.3)	88 (74.6)	
Nonmetropolitan with an urban population	234 (24.1)	206 (24.2)	28 (23.7)	
Rural	32 (3.3)	30 (3.5)	2 (1.7)	
Region				<.0001
Midwest	337 (34.8)	325 (38.2)	12 (10.1)	
Northeast	215 (22.2)	201 (23.6)	14 (11.9)	
South	288 (29.7)	225 (30.0)	33 (28.0)	
West	129 (13.3)	70 (8.2)	59 (50.0)	
Infection Prevention and Control Program Processes and Resources				
Methods used to provide IC training to staff (n=966)				
Computer-based	474 (49.1)	430 (50.6)	44 (37.9)	.01
Handouts/flyers in care units	752 (77.9)	655 (77.1)	97 (83.6)	.11
Frequency of staff training on IC topics (n=910)				
Monthly/bi-weekly/weekly	276 (30.3)	237 (29.6)	39 (35.5)	.24
Quarterly	254 (27.9)	221 (27.6)	33 (30.0)	
Annually	380 (41.8)	342 (42.8)	38 (34.5)	
Timing of staff training on IC topics (combined; n=967)				

	Total (n=969)	With QM data (n=851)	Without QM data (n=118)	p-value
At new employee orientation and when an infection outbreak occurred	615 (63.6)	546 (64.2)	69 (59.0)	.27
Other *	352 (36.4)	304 (35.8)	48 (41.0)	
Methods to monitor compliance with hand hygiene policies (n=919)				
Proximity monitors	30 (3.3)	29 (3.6)	1 (1.0)	.24
Product consumption	148 (16.1)	128 (15.8)	20 (18.5)	.47
Provides feedback on hand hygiene to staff (n=910)	684 (75.2)	612 (76.1)	72 (67.9)	.07
Financial resources provided for continuing education in IC within the previous two years (n=919)	451 (49.2)	403 (49.8)	48 (44.4)	.29
Frequency of IC committee meetings (n=917)				.39
Monthly/bi-weekly/weekly	588 (61.3)	519 (61.9)	67 (56.8)	
Quarterly	258 (27.0)	220 (26.3)	38 (32.2)	
Annually/does not meet regularly/other	112 (11.7)	99 (11.8)	13 (11.0)	
Infection Prevention and Control Professional				
Highest level of professional training (n=964)				.64
CNA/LPN/LVN	130 (13.5)	111 (13.1)	19 (16.1)	
RN/BSN/MSN	813 (84.3)	717 (84.8)	96 (81.4)	
NP/MPH/MD	21 (2.2)	18 (2.1)	3 (2.5)	
Years of experience (n=880)				
In any NH				.77
0–4.5	279 (31.7)	246 (31.8)	33 (30.8)	
5–13	299 (34.0)	265 (34.3)	34 (31.8)	
14–40	242 (34.3)	262 (33.9)	40 (37.4)	
In current NH (n=894)				.61
0–1.7	286 (32.0)	251 (31.9)	35 (32.7)	
2–4.5	278 (31.1)	249 (31.6)	29 (27.1)	
5–35	330 (36.9)	287 (36.5)	43 (40.2)	
Sum of other responsibilities, in addition to IC (n=971)				.32
At least 2	310 (32.0)	277 (32.6)	33 (28.0)	
Less than 2	659 (68.0)	547 (67.4)	85 (72.0)	
Received specific training and/or certification in IC (n=922)	359 (38.9)	314 (38.7)	45 (40.9)	.65
Percent time spent on IC activities per week (n=919)	29±22	28±21	32±26	.20

Notes: Values are n (%) unless otherwise noted; n = 969 unless otherwise noted.

RN, registered nurse; *hrd*, hours per resident per day; LPN, licensed practical nurse; LVN, licensed vocational nurse; CNA, certified nursing assistant; IC, infection control; BSN, Bachelor of Science in Nursing; MSN, Master of Science in Nursing; NP, Nurse Practitioner; MPH, Master of Public Health; MD, Doctor of Medicine;

* Other timing of training included only at orientation, only when an infection outbreak occurred, or neither.

Highlights

- About half of nursing homes provide computer-based staff infection control training
- Timing of training was associated with better urinary catheter use quality measures
- Evaluating the impact of nursing home staff training on infections may be warranted

Table 1

Bivariate analysis of associations between nursing home resident indwelling catheter use quality measure and facility and infection prevention and control program characteristics

	Total (n=796)	Low, <2.5% with catheter (n=408)	High, 2.5% with catheter (n=388)	p-value
Facility Characteristics				
Bed size (mean ± SD)	120±71	118±76	122±65	.22
Percent occupancy (mean ± SD)	82±14	83±14	81±15	.02
Ownership				.96
For-profit	543 (68.2)	278 (68.2)	265 (68.3)	
Government/nonprofit	253 (31.8)	130 (31.9)	123 (31.7)	
Chain member	458 (57.5)	224 (54.9)	234 (60.3)	.12
Staffing (mean ± SD)				
RN hrd	0.73±0.31	0.74±0.32	0.72±0.30	.60
LPN/LVN hrd	0.78±0.34	0.77±0.33	0.79±0.35	.43
CNA hrd	2.42±0.58	2.42±0.59	2.42±0.57	.96
Payment source (mean ± SD)				
% of residents on Medicaid	61±20	62±20	60±20	.05
% of residents on Medicare	14±10	13±10	14±11	.28
% of residents no on Medicaid or Medicare	25±18	25±17	26±18	.05
Setting				.11
Metropolitan	578 (72.6)	304 (74.5)	304 (74.2)	
Nonmetropolitan with an urban population	191 (24.0)	87 (21.3)	99 (24.1)	
Rural	27 (3.4)	17 (4.2)	7 (1.7)	
Region				.37
Midwest	305 (28.3)	145 (35.5)	160 (41.2)	
Northeast	190 (23.9)	102 (25.0)	88 (22.7)	
South	235 (29.5)	128 (31.4)	107 (27.6)	
West	66 (8.3)	33 (8.1)	33 (8.5)	
IC citation in the previous year	64 (8.0)	32 (7.8)	32 (8.3)	.83
Infection Prevention and Control Program Processes and Resources				
Methods used to provide IC training to staff				
Computer-based	400 (50.3)	194 (51.1)	204 (49.8)	.48
Handouts/flyers in care units	618 (77.6)	304 (80.0)	310 (75.6)	.83
Frequency of staff training on IC topics				
Monthly/bi-weekly/weekly	235 (29.5)	124 (30.4)	111 (28.6)	.15
Quarterly	221 (27.8)	101 (24.7)	120 (30.9)	
Annually	340 (42.7)	183 (44.9)	157 (40.5)	
Timing of staff training on IC topics				

	Total (n=796)	Low, <2.5% with catheter (n=408)	High, 2.5% with catheter (n=388)	p-value
At new employee orientation	613 (77.0)	325 (79.7)	288 (74.2)	.07
When an infection outbreak occurred	567 (71.2)	301 (73.8)	266 (68.6)	.10
Timing of staff training on IC topics (combined)				
At new employee orientation and when an infection outbreak occurred	522 (65.6)	284 (69.6)	238 (61.3)	.01
Other *	274 (34.4)	124 (30.4)	150 (38.7)	
Methods to monitor compliance with hand hygiene policies				
Proximity monitors	27 (3.6)	14 (3.6)	13 (3.5)	.93
Product consumption	107 (14.1)	61 (15.8)	46 (12.4)	.18
Provides feedback on hand hygiene to staff	578 (77.0)	297 (78.0)	281 (76.0)	.51
Financial resources provided for continuing education in IC within the previous two years	388 (51.3)	201 (51.9)	187 (50.5)	.70
Frequency of IC committee meetings				.81
Monthly/bi-weekly/weekly	484 (61.7)	250 (62.2)	234 (61.3)	
Quarterly	208 (26.6)	103 (25.6)	105 (27.5)	
Annually/does not meet regularly/other	92 (11.7)	49 (12.2)	43 (11.2)	
Infection Prevention and Control Professional				
Highest level of professional training				.01
CNA/LPN/LVN	108 (13.6)	61 (15.0)	47 (12.2)	
RN/BSN/MSN	670 (84.6)	343 (84.5)	327 (84.7)	
NP/MPH/MD	14 (1.8)	2 (0.5)	12 (3.1)	
Years of experience				
In any NH				.52
0–4.5	229 (32.1)	110 (30.3)	120 (33.6)	
5–13	243 (34.0)	124 (34.2)	123 (34.5)	
14–40	242 (33.9)	129 (35.5)	114 (31.9)	
In current NH				.17
0–1.7	232 (31.8)	126 (33.5)	108 (30.2)	
2–4.5	224 (30.7)	103 (27.4)	121 (33.8)	
5–35	273 (37.5)	147 (39.1)	129 (36.0)	
Sum of other responsibilities, in addition to IC				.71
At least 2	446 (56.0)	226 (55.4)	220 (56.7)	
Less than 2	350 (44.0)	182 (44.6)	168 (43.3)	
Received specific training and/or certification in IC	306 (40.3)	167 (42.9)	139 (37.5)	.12
Percent time spent on IC activities per week	28±21	29±22	27±20	.23

Notes: Values are n (%) unless otherwise noted.

RN, registered nurse; *hrd*, hours per resident per day; LPN, licensed practical nurse; LVN, licensed vocational nurse; CNA, certified nursing assistant; IC, infection control; BSN, Bachelor of Science in Nursing; MSN, Master of Science in Nursing; NP, Nurse Practitioner; MPH, Master of Public Health; MD, Doctor of Medicine;

* Other timing of training included only at orientation, only when an infection outbreak occurred, or neither.

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Table 2

Multivariable logistic regression analysis of associations between nursing home resident indwelling catheter use quality measure and timing of staff training on infection control topics

Characteristic	Adjusted odds ratio	p-value
Timing of staff training on IC topics		
At new employee orientation and when an infection outbreak occurred	0.70	.02
Other * (reference)	-	-
Percent occupancy	0.86	.04
Ownership		
For-profit	0.95	.75
Nonprofit/government (reference)	-	-
Setting		
Metropolitan	0.79	.18
Rural	0.49	.09
Nonmetropolitan with an urban population (reference)	-	-
Staffing		
CNA hrd	1.01	.94

Notes: *IC*, infection control; *CNA*, certified nursing assistant; *hrd*, hours per resident per day

* Other timing of training included only at orientation, only when an infection outbreak occurred, or neither.