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CLINICAL INVESTIGATION

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The association of nursing home infection preventionists' training and credentialing with resident COVID 19 deaths

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Abstract

Background: Nursing home (NH) residents' vulnerability to COVID-19 underscores the importance of infection preventionists (IPs) within NHs. Our study aimed to determine whether training and credentialing of NH IPs were associated with resident COVID-19 deaths.

Methods: This retrospective observational study utilized data from the Centers for Disease Control and Prevention's National Healthcare Safety Network NH COVID-19 Module and USAFacts, from May 2020 to February 2021, linked to a 2018 national NH survey. We categorized IP personnel training and credentialing into four groups: (1) LPN without training; (2) RN/advanced clinician without training; (3) LPN with training; and (4) RN/advanced clinician with training. Multivariable linear regression models of facility-level weekly deaths per 1000 residents as a function of facility characteristics, and county-level COVID-19 burden (i.e., weekly cases or deaths per 10,000 population) were estimated.

Results: Our study included 857 NHs (weighted $n = 14{,}840$) across 489 counties and 50 states. Most NHs had over 100 beds, were for profit, part of chain organizations, and located in urban areas. Approximately 53% of NH IPs had infection control training and 82% were RNs/advanced clinicians. Compared with NHs employing IPs who were LPNs without training, NHs employing IPs who were RNs/advanced clinicians without training had lower weekly COVID-19 death rates (−1.04 deaths per 1000 residents; 95% CI −1.90, −0.18), and NHs employing IPs who were LPNs with training had lower COVID-19 death rates (−1.09 deaths per 1000 residents; 95% CI −2.07, −0.11) in adjusted models.

Conclusions: NHs with LPN IPs without training in infection control had higher death rates than NHs with LPN IPs with training in infection control, or NHs with RN/advanced clinicians in the IP role, regardless of IP training. IP training of RN/advanced clinician IPs was not associated with death rates. These findings suggest that efforts to standardize and improve IP training may be warranted.

KEYWORDS

COVID-19, credentialing, infection preventionists, nursing homes, staffing, training

INTRODUCTION

About 90% of nursing home (NH) residents are age 65 and older, with over 50% of residents being long-term.[1,2] NH residents are vulnerable to infectious diseases due to their advanced age, comorbidities, and compromised immune systems as well as communal living.[3] It is estimated that approximately 2.7 million infections occur annually in NHs, resulting in over 380,000 NH resident deaths each year due to infections.[4] The impact of infectious diseases on NH residents has been magnified by the COVID-19 pandemic.[5,6] Despite NH residents making up only 1.2% of the U.S. population, they accounted for one-third of all COVID-19 deaths.[5]

Prior to the pandemic, the Centers for Medicare and Medicaid Services (CMS) Final Rule in 2016 required all CMS-certified NHs to designate at least one infection preventionist (IP) in charge of an infection prevention and control program.[7] An IP is a healthcare professional dedicated to ensuring that both medical staff and patients adhere to the highest standards of practice for infection control. Most IPs are clinicians, but they may also be epidemiologists and other public health professionals.[8] According to the 2016 Final Rule, the IP was also required to participate in the NH's quality assessment and performance improvement committee.[7] However, the implementation of the 2016 Final Rule was not mandated until November 2019, and this federal regulation still lacks specific policies regarding details of IP training and credentialing. Notably, there were marginal changes from 2014 to 2018 in NH IP staffing characteristics, with only 7% of NHs having an IP trained in infection control in 2018 (up from 3% in 2014).[9]

Throughout the pandemic, the Centers for Disease Control and Prevention (CDC) guidance to prevent the spread of COVID-19 in NHs evolved.[6] One of the core infection prevention and control practices includes having one or more IPs with training in infection control to provide on-site management of the infection prevention and control program. Specifically, the CDC recommended having at least one full-time IP for NHs with ≥100 residents or NHs that provide on-site ventilator or hemodialysis services.[6] In addition, the National Academies of Sciences, Engineering, and Medicine (NASEM) recently issued "The National Imperative to Improve Nursing Home Quality 2022," which recommends that NH have an IP who is a registered nurse (RN), advanced practice RN, or a physician.[10] Starting with California in January 2021, several states have passed legislation or have regulations to ensure adequate staffing standards for IPs in NHs including Connecticut, New Jersey, and Illinois.

The role of the IP in NHs is relatively new. It is common for the person in charge of the infection prevention and control program in NHs to have multiple roles and responsibilities.[11] Furthermore, persons in charge of the infection control program in NHs are less likely to receive formal training in infection control compared with IPs in acute care settings.[11] Indeed, in a national survey, it was found that most individuals in charge of the NH infection control program had minimal training in infection control and lacked a formal IP role.[12]

The impact of IP training and credentialing policies on the COVID-19 burden in NHs remains unknown. Therefore, to understand how to prevent and mitigate future outbreaks, this study aimed to determine whether COVID-19 resident deaths were associated with differences in the training and credentialing of the person in charge of the infection prevention and control program. We hypothesized that after adjusting for NH resident and facility characteristics, as well as county-level COVID-19 severity, NHs with infection control-trained and RN or advanced clinician IPs will have lower rates of COVID-19 resident deaths compared with NHs with non-trained and licensed practical nurse (LPN) in charge of the infection prevention and control program.

Key points

- Infection control training was associated with lower rates of COVID-19 deaths for nursing homes with LPN infection preventionists but not for nursing homes with RN/advanced clinician infection preventionists.
- The lack of an association between training for RNs/advanced infection preventionists and COVID-19 deaths may be related to the limited training options available pre-pandemic.

Why does this paper matter?

Infection preventionist staffing policies, such as training standards and credentialing requirements, are critical to preventing future infectious disease outbreaks in nursing homes. This paper sheds light on the association between IP training for LPNs infection preventionists in nursing homes and reduced resident COVID-19 deaths.

METHODS

Data

Since May 2020, the CMS mandated that all NHs report COVID-19 metrics every week, including resident

TABLE 1 Nursing home and resident characteristics in sample.

IP training and credentialing						
	Total NHs	**LPN with no training**	**RN or advanced clinician with no training**	**LPN with training**	**RN or advanced clinician with training**	***p***
Number of NHs	857	62	316	76	403	
Weighted %	100	8.5	38.3	9.3	43.9	
Types of training (%)[a]						
Certified in infection control	7.4			12.2	14.4	
State, local, or professional society	34.6			71.0	63.7	
Other	11.2			16.8	21.9	
None	46.8	100	100			<0.001
Types of credential (%)[a]						
LPN	17.7	100		100		
RN	80.7		98.5		97.8	
NP	0.8		1.0		1.0	
Other	0.8		0.5		1.2	<0.001
NH characteristics (%)[a]						
Bed size						
0–99	46.5	40.6	46.4	56.3	45.7	
100+	53.5	59.4	53.6	43.7	54.3	<0.001
Ownership						
For-profit	69.3	69.5	72.8	78.3	64.3	
Not-for-profit	23.9	17.1	21.2	15.4	29.4	
Government	6.8	13.4	6.0	6.3	6.3	<0.001
Change of ownership						
No	95.0	91.9	93.3	97.6	96.5	
Yes	5.0	8.1	6.7	2.4	3.5	<0.001
Chain organization						
No	42.7	39.1	38.7	38.2	47.9	
Yes	57.3	60.9	61.3	61.8	52.1	<0.001
Urban rural location						
Urban	71.4	73.0	68.2	74.9	71.4	
Rural	28.6	27.0	31.8	25.1	28.6	<0.001
NH resident characteristics						
Percent female	60.5	58.3	59.9	59.9	61.4	
95% CI	(60.3, 60.6)	(57.9, 58.8)	(59.8, 60.1)	(59.5, 60.3)	(61.2, 61.6)	<0.001
Percent age 65–84	48.9	48.4	49.8	50.7	47.9	
95% CI	(48.8, 49.0)	(48.0, 48.8)	(49.6, 49.9)	(50.4, 50.9)	(47.7, 48.0)	<0.001
Percent age 85 and older	35.3	29.8	33.8	34.2	37.8	
95% CI	(35.1, 35.4)	(29.2, 30.4)	(33.6, 34.1)	(33.7, 34.7)	(37.5, 38.1)	<0.001
Percent White	80.0	73.3	81.5	77.0	80.8	
95% CI	(79.8, 80.3)	(72.2, 74.4)	(81.1, 81.9)	(76.2, 77.8)	(80.3, 81.2)	<0.001

(Continues)

TABLE 1 (Continued)

IP training and credentialing	Total NHs	LPN with no training	RN or advanced clinician with no training	LPN with training	RN or advanced clinician with training	*p*
$N = 33{,}414$ NH-weeks						
Mean weekly COVID-19 deaths/1000 residents	2.9	3.6	2.9	2.8	2.8	
95% CI	(2.7, 3.0)	(2.9, 4.2)	(2.6, 3.2)	(2.3, 3.4)	(2.5, 3.0)	0.1
Mean weekly COVID-19 cases/1000 residents	13.8	15.2	14.5	15.8	12.4	
95% CI	(13.1, 14.4)	(12.7, 17.6)	(13.4, 15.7)	(13.2, 18.5)	(11.5, 13.3)	0.003

Abbreviations: CI, confidence interval; IP, infection preventionist; LPN, licensed practical nurse; NHs, nursing homes; NP, nurse practitioner; RN, registered nurse.

[a]Values are column percents.

mortality, to the CDC's National Healthcare Safety Network (NHSN) Long-Term Care Facility COVID-19 Module. Using a retrospective observational study design, we examined the CDC's COVID-19 NH resident mortality data from May 25, 2020 to February 21, 2021.[13]

This publicly available dataset was merged with data from a 2018 national survey of NHs (R01 NR013687 PI: Stone).[14] We used the 2018 survey as it was the most recent data available prior to the pandemic and it included a comprehensive description of the training and credentialing of the professional in charge of the infection prevention and control program. The survey was a cross-sectional facility-level survey of a stratified, random sample of U.S. NHs ($N = 892$; a 49% response rate). The random sampling process involved stratification based on the regions of Quality Innovation Network-Quality Improvement Organizations, ensuring a balanced representation of NHs across all 14 regions. The survey was completed by the Director of Nursing at each facility, encompassing questions about infection prevention and control programs, including IP training and credentialing. Additional details on the survey have been published elsewhere.[14]

The survey data were merged with the 2018 Minimum Data Set[15] and 2020 Provider of Services data[15] to identify facility and resident characteristics. Lastly, we linked USAFacts data to identify county-level COVID-19 cases and deaths.[16] This study was approved by the Columbia University and RAND Institutional Review Boards.

Measures

Our primary outcome was the NH weekly rate of resident COVID-19 deaths per 1000 residents. This variable was defined as the number of residents with suspected or laboratory-positive COVID-19 who died in the facility or another location as reported by the NH.[13]

The primary exposure variables were the pre-pandemic training and credentialing of the professional in charge of the infection prevention and control program from the survey data. The survey question inquired about any personnel who were in charge of the infection prevention and control program in NHs, encompassing their characteristics such as training and credentialing. For simplicity, irrespective of training and credentialing, we define this professional as an IP and training was defined as (1) certification in infection control; (2) state or local training by a professional society; or (3) other training. If a NH reported that their IP had no specific infection control training or responded with "don't know," we treated that NH as having an untrained IP. The measure of IP credentialing was based on the professional degree, grouped as "RN or advanced clinician" and "LPN." The category of "RN or advanced clinician" included individuals with the credentials of RN, nurse practitioner (NP), or other advanced clinical roles (e.g., physician, master-level nurse educator, clinical nurse specialist). We then created a four-category measure (henceforth referred to as *IP training and credentialing*): (1) LPN without training; (2) RN or advanced clinician without training; (3) LPN with training; and (4) RN or advanced clinician with training.

We controlled for facility-level characteristics, including bed size (categorized as 1–99 and 100+ beds); ownership (for-profit, not-for-profit, and government); change of ownership (since 2019); part of a multi-facility organization; and urban/rural. We also controlled for facility-level aggregates of resident characteristics, such as age (categorized by the proportion of residents aged 64 and below, 65–84 years old, and 85 years and older), sex

TABLE 2 Multivariable linear regression model estimating weekly COVID-19 deaths per 1000 residents.

Variables/coefficient (95% CI)	Weekly COVID-19 deaths per 1000 residents	
	Adjusting for county-level cases	Adjusting for county-level deaths
IP training and credentialing		
LPN with no training	Ref	Ref
RN or advanced clinician with no training	−1.04* (−1.90, −0.18)	−1.05* (−1.97, −0.13)
LPN with training	−1.09* (−2.07, −0.11)	−0.92 (−1.94, 0.10)
RN or advanced clinician with training	−0.87 (−1.75, 0.01)	−0.97* (−1.88, −0.05)
Nursing home characteristics		
Bed size		
0–99	Ref	Ref
100+	−0.01 (−0.55, 0.52)	−0.35 (−0.85, 0.16)
Ownership		
For-profit	Ref	Ref
Not-for-profit	−0.35 (−1.04, 0.33)	−0.13 (−0.75, 0.48)
Government	−0.25 (−1.13, 0.63)	0.16 (−0.48, 1.00)
Change of ownership		
No	Ref	Ref
Yes	0.90 (−0.51, 2.30)	−0.11 (−0.78, 0.56)
Chain organization		
No	Ref	Ref
Yes	0.05 (−0.50, 0.60)	0.03 (−0.47, 0.53)
Urban rural location		
Urban	Ref	Ref
Rural	0.29 (−0.32, 0.89)	−0.27 (−0.84, 0.31)

Note: Models were adjusted for weekly calendar time fixed effects, 5-week moving average of county-level COVID-19 intensity (normalized cases or deaths per capita), and interactions between the county-level COVID-19 measure and facility characteristics (age, sex, and race). Standard errors were clustered at the facility level. Measures of county-level COVID-19 intensity were transformed to have a standard deviation of 1.
Abbreviations: IP, infection preventionist; LPN, licensed practical nurse; Ref, reference; RN, registered nurse.
*$p < 0.05$.

(proportion of female residents), and race (proportion of non-Hispanic White residents). In addition, we controlled for the county-level burden of COVID-19 cases (and alternatively deaths) from USAFacts data, operationalized as a 5-week moving average (current week and the prior 4 weeks) of county-level COVID-19 cases (alternatively deaths) per 10,000 people in the county.

Analyses

We assessed the association between NH IP training and credentialing and resident COVID-19 deaths between May 25, 2020 and February 21, 2021. The unit of observation was the NH-week, and to ensure the accuracy of our analysis, we excluded the first period of the NHSN data. This decision stemmed from the CDC's reporting of accumulated deaths occurring anytime between January 01, 2020 and May 24, 2020. Notably, it is acknowledged that about 40% of COVID-19 deaths that occurred before May 24, 2020 were not reported in the NHSN NH COVID-19 data.[17] Consequently, we excluded this period from our analyses to avoid drawing misleading conclusions about the factors influencing NH outbreaks.[17] The CDC reporting for subsequent periods was on a weekly basis. By extending our analysis up to February 2021, we captured not only early response to the pandemic but also the peak periods of COVID-19 transmission, particularly around December 2020. This broader time frame enabled us to examine how IP training and credentialing were associated with COVID-19 outcomes during different phases of the pandemic.

Probability weights were used to account for the stratified sampling design of the NH survey, making the data nationally representative. Weighted descriptive statistics were stratified by the four IP training and credentialing categories and calculated using the Pearson chi-square test and adjusted Wald test when appropriate. We then estimated multivariable linear regression given by

$$Y_{\mathrm{jct}} = \beta_0 + \mathrm{COVID}_{\mathrm{ct}} * \left(\beta_1 + \beta_2 \mathrm{IP}_{\mathrm{jc}} + \beta_3 \mathrm{NH}_{\mathrm{jc}}\right) + \mu_t + \varepsilon_{\mathrm{jct}},$$

where Y_{jct} is COVID deaths/1000 residents in NH j and county c during week t; $\mathrm{COVID}_{\mathrm{jt}}$ is a 5-week moving average of COVID-19 burden for county c, including week t and the 4 weeks prior to t; $\mathrm{IP}_{\mathrm{jc}}$ is a vector of the NH IP-training and credentialing measures with untrained-LPN as the referent; $\mathrm{NH}_{\mathrm{jc}}$ is a vector of NH characteristics and aggregate resident characteristics, which do not vary with t; μ_t are weekly calendar-time fixed effects; and $\varepsilon_{\mathrm{jct}}$ is an error term. Although we

assumed NH COVID-19 death rates were a function of levels of county COVID-19 intensity (β_1), we also assumed the relationships with other covariates would be proportional to the COVID-19 risk. Thus, we interacted all remaining covariates with county-level COVID-19 burden. In the absence of the interaction, each covariate would have the same effect size regardless of the COVID-19 risk. In sensitivity analyses, we used county COVID-19 deaths rather than cases, excluding a NH's deaths from the measure of county deaths to avoid endogeneity. We normalized each of the county-level COVID burden measures by its standard deviation so that a 1-unit change represented a change of 1 standard deviation in the weekly county COVID-19 cases or deaths. We calculated empirical Huber–White standard errors, clustered at the NH level, to account for the potentially correlated errors across all observations of a NH. Coefficient estimates of indicator variables therefore represent the effect size given a one standard deviation change in COVID-19 risk, as measured by the 5-week moving average of county COVID-19 cases (alternatively deaths). Finally, we generated adjusted predictions from the models and created figures to help visualize and interpret substantive effect sizes of the model estimates. We considered $p < 0.05$ as statistically significant. All statistical analyses were performed using STATA 17.0 (StataCorp).

RESULTS

Descriptive statistics

Table 1 shows descriptive statistics of the NHs stratified by IP training and credentialing. A total of 857 NHs (weighted $n = 14{,}840$; N of NH-weeks = 33,414) located in 489 counties and 50 states were identified and included in this study. The majority of NHs had over 100 beds (53.5%), were for profit (69.3%), part of a chain organization (57.3%), and located in urban areas (71.4%). NH residents were mostly female (60.5%), between 65 and 84 years old (48.9%), and White (80.0%). Just over half of the (53.2%) of NHs IP had training in infection control. Most of the NH IPs were RNs or advanced clinicians (82.2%). Among the IPs who were RNs or advanced clinicians, 44% had training in infection control.

IP training and credentialing

Table 2 shows the results from the multivariable linear regression models. Overall, IP training and credentialing measures were associated with weekly resident COVID-19 death rates. When compared with NHs with untrained LPNs serving as IPs, NHs with each of the other categories of IP training and credentialing had similar reductions in COVID-19 deaths, as described below. Furthermore, the size of the gap in NH deaths between untrained LPNs serving as IPs and other IPs widened as the county COVID burden increased (Figures 1 and 2).

NHs employing IPs who were RNs or advanced clinicians with no training: For each increase of 1 standard deviation of COVID-19 burden, NHs employing RNs or advanced clinicians with no training as IPs had fewer COVID-19 deaths (−1.04 per 1000 residents; 95% CI: −1.90 to −0.18) than NHs with LPNs without training. The estimate was similar (−1.05 deaths per 1000 residents; 95% CI: −1.97 to −0.13) when controlling for county COVID-19 deaths rather than cases.

NHs employing IPs who were LPNs with training: For each increase of 1 standard deviation of COVID-19 burden, NHs that employed trained LPNs had fewer deaths (−1.09 per 1000 residents; 95% CI: −2.07 to −0.11) than those employing LPNs without training. Although

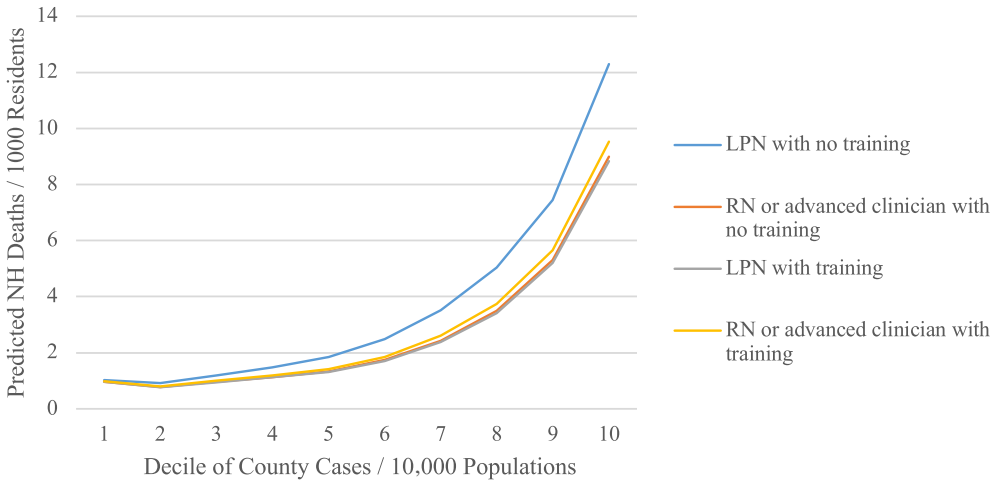

FIGURE 1 Predicted NH Deaths per 1000 Residents by Decile of County Cases.

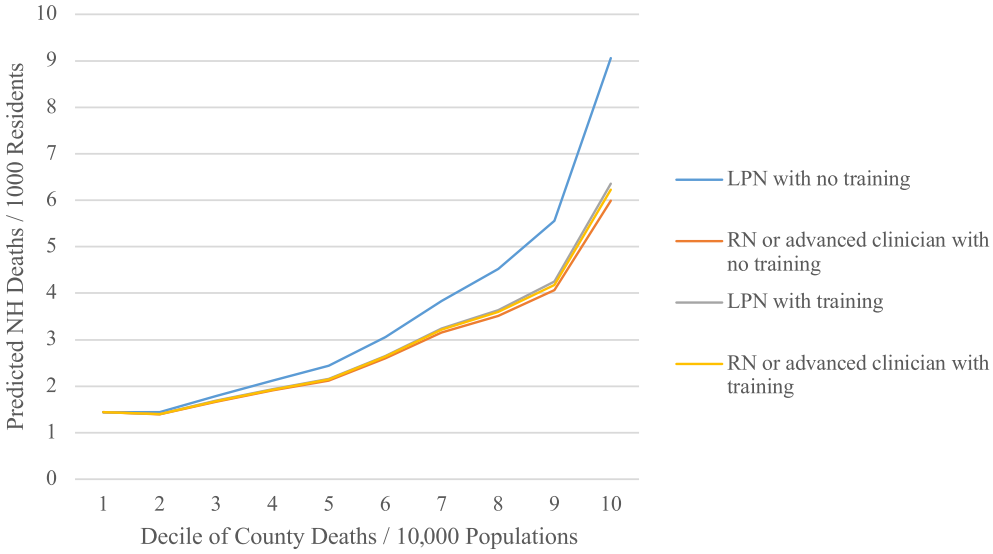

FIGURE 2 Predicted NH Deaths per 1000 Residents by Decile of County Deaths.

similar in magnitude, this reduction was not significant when adjusting for county-level deaths (−0.92 deaths per 1000 residents; 95% CI: −1.94 to 0.10).

NHs employing IPs who were RNs or advanced clinicians with training: For each increase of 1 standard deviation of COVID-19 intensity, NHs employing IPs who were RNs or advanced clinicians with training had similar reductions in deaths as LPNs with training (−0.87 deaths per 1000 residents; 95% CI: −1.75 to 0.01), although this reduction was not significantly different from the referent group. However, when adjusting for county-level deaths rather than cases, the reduction was significant (−0.97 deaths per 1000 residents; 95% CI: −1.88 to −0.05).

DISCUSSION

To our knowledge, our study is the first study to examine the relationship between IP training and credentialing and COVID-19 deaths in NHs. Overall, NHs that employed an LPN as an IP without training had higher rates of COVID-19 deaths than other NHs and this gap increased when COVID-19 burden in the community was higher. This finding likely resulted from the ability of a more highly trained or credentialed IP to better oversee the infection prevention and control program in NHs including educating staff and residents.[7] Furthermore, it is likely that these IPs would have been more able to rapidly implement evidence-based infection prevention and control policies than untrained LPNs.

Consistent with our findings, prior studies have demonstrated a positive association between IP training in infection control and enhanced infection-related outcomes, as well as the implementation of more comprehensive infection prevention and control programs within NHs.[3,18,19] Notably, national-level studies have revealed that NHs with infection control-trained IPs have more comprehensive antibiotic stewardship programs compared with those lacking specific training.[3,18] Additionally, the likelihood of receiving an infection control deficiency citation was higher in NHs with non-trained IPs, coupled with reduced resources for ongoing infection control education.[19]

During the pandemic, a qualitative study involving 73 NH IPs underscored the persistent challenge of inadequate COVID-related training programs faced by IPs.[20] Furthermore, an environmental scan identified training and knowledge in infection control as one of the areas to improve NH infection prevention and control during COVID-19 pandemic.[21] Despite these findings regarding the role of IP training in infection control, there is wide variation in IP training standards across NHs.[18] About 46% of NHs in the national survey reported that their IP had no specific infection control training, and most of them were not certified or trained in infection control.[18] Our findings highlight the importance of infection control training when infection prevention and control programs are overseen by LPNs. This is an area that should be a focus for enhancement of NH infection prevention and control programs.

Although increasing RN staffing in NHs has been a persistent recommendation to improve the quality of care in NHs, there has been a lack of evidence reflecting optimal NH IP training and credentialing standards.[9,10] Our finding that a NH IP with RN or advanced clinician staffing, whether trained or not, is associated with fewer COVID-19 deaths than a NH staffed with an untrained LPN is in line with the NASEM recommendation that a NH IP be a RN or advanced clinician.[10] Nevertheless, it is important to note that many successful IPs come from other fields such as microbiology or epidemiology.[22]

Adding to the complexity, federal regulations currently lack specific guidelines or recommendations for training or certification standards for IPs. Fortunately, there are now specialized infection prevention and control training programs uniquely designed for IPs in long-term care settings.[23,24] In addition, the Certification Board of Infection Control and Epidemiology now offers certification for long-term care infection prevention, attesting to competence in infection prevention and control practices within such settings.[25] These advancements, which were not available when the survey was conducted, hold promise for addressing the existing gaps in NH and bolstering infection prevention efforts in these long-term care facilities.

Limitations

This study has several limitations that should be acknowledged. We noted the concern about underreporting of COVID-19 deaths to NSHN, estimated to be as many as 40%, during the early stage of the pandemic (through May 24, 2020), prompted us to exclude this period from our analysis. IP training and credentialing may have been particularly important during this early stage of the pandemic. Conversely, the chaos of the early periods of the pandemic may have overwhelmed any IP training and credentialing effects, and IP training and credentialing may have become more important as lessons emerged from the early stage experiences. Another limitation of our data is that the survey took place 2 years prior to the onset of the pandemic, and this temporal gap is an important consideration when interpreting our findings in the context of the pandemic's impact on IP practices. Additionally, we lacked measures about the IP training and credentialing policies that occurred during the pandemic. We know that IP training in NHs underwent significant changes in response to the evolving pandemic situation. As a result, our use of fixed pre-pandemic measures may underestimate the importance of IP training and credentialing particularly during later stages of the pandemic. Although we made efforts to capture relevant workforce data through the survey, the lack of distinction between RNs and advanced practice RNs, and potential confounding influence of NH staffing levels such as dedicated time of the IP are also limitations of our study. We chose to use county-level COVID-19 cases as a proxy for COVID-19 risk in NHs. We recognize that county case rates could be significantly influenced by testing availability during the pandemic period.[26] Testing accessibility and frequency might have introduced variability in the reported case numbers, potentially affecting our results. As a sensitivity analysis, we substituted county-level COVID-19 deaths for cases. Recognizing that NH COVID-19 deaths made up a large fraction of all COVID-19 deaths, particularly early in the pandemic, we adjusted the county data to mitigate concerns regarding endogeneity. We found the results were robust, and although not always significant, the substantive effect sizes were similar across models. Despite these limitations, our study underscores the crucial role of IP policies in NHs by revealing meaningful associations between pre-pandemic levels of IP training and credentialing and COVID-19 deaths.

CONCLUSIONS

NHs with an LPN untrained in infection control in the role of IP had higher death rates than NHs with an IP who was either an LPN trained in infection control or an RN/advanced clinician. Infection control training was only associated with better outcomes when the IP was an LPN and not when the IP was an RN or advanced clinician. Given the wide variability in infection control training, and the lack of evidence that this training is associated with better outcomes in NHs with RN or advanced clinicians in the IP role, efforts to standardize and improve IP training may be warranted.

AUTHOR CONTRIBUTIONS

All authors contributed to the study concept and design. P.W.S., A.W.D., and L.G.G. contributed to the acquisition of data. All authors contributed to the analysis and interpretation of data and preparation of manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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