

## Research Report

# The Effect of Race and Dementia Prevalence on a COVID-19 Infection Control Intervention in Massachusetts Nursing Homes

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Received: May 27, 2021; Editorial Decision Date: November 4, 2021

**Decision Editor:** Roger Fielding, PhD

## Abstract

**Background:** Nursing home (NH) residents, especially those who were Black or with dementia, had the highest infection rates during the COVID-19 pandemic. A 9-week COVID-19 infection control intervention in 360 Massachusetts NHs showed adherence to an infection control checklist with proper personal protective equipment (PPE) use and cohorting was associated with declines in weekly infection rates. NHs were offered weekly webinars, answers to infection control questions, resources to acquire PPE, backup staff, and SARS-CoV-2 testing. We asked whether the effect of this intervention differed by racial and dementia composition of the NHs.

**Methods:** Data were obtained from 4 state audits using infection control checklists, weekly infection rates, and Minimum Data Set variables on race and dementia to determine whether adherence to checklist competencies was associated with decline in average weekly rates of new COVID-19 infections.

**Results:** Using a mixed-effects hurdle model, adjusted for county COVID-19 prevalence, we found the overall effect of the intervention did not differ by racial composition, but proper cohorting of residents was associated with a greater reduction in infection rates among facilities with  $\geq 20\%$  non-Whites ( $n = 83$ ). Facilities in the middle ( $>50\%–62\%$ ;  $n = 121$ ) and upper ( $>62\%$ ;  $n = 115$ ) tertiles of dementia prevalence had the largest reduction in infection rates as checklist scores improved. Cohorting was associated with greater reductions in infection rates among facilities in the middle and upper tertiles of dementia prevalence.

**Conclusions:** Adherence to proper infection control procedures, particularly cohorting of residents, can reduce COVID-19 infections, even in facilities with high percentages of high-risk residents (non-White and dementia).

**Keywords:** COVID-19, Cognition, Health disparities, Racial disparities

The COVID-19 pandemic has caused over 32 million infections in the United States as of May, 2021, with 50% of infections occurring in people who identified as non-White and a 16% increase in deaths among people with dementia (1,2). Prior studies have shown that persons with dementia are at higher risk for infection and are more likely to experience severe infection and complications compared to those without dementia (3). Persons identifying as non-White are more likely to seek care from facilities and nursing homes (NHs)

that have serious deficiencies, lower staffing ratios, and greater financial vulnerability than their White counterparts (4,5). Studies of racial disparities among COVID-19 infection have shown that people identifying as non-White experience higher rates of infections compared to those who identify as White (6), citing facility size and community prevalence of COVID-19 as important factors. NH residents in particular, especially those who were Black or with dementia diagnoses, had the highest infection rates during the

COVID-19 pandemic (7–10). In order to improve infection control in Massachusetts NHs, a 9-week COVID-19 infection control intervention was initiated in April of 2020 and showed that adherence to an infection control checklist, particularly with proper personal protective equipment (PPE) use and cohorting of residents infected with COVID-19, was associated with declines in weekly infection rates (11). Given the established increased risk of COVID-19 infection rates in NH residents who are non-White or have dementia, we aimed to determine whether this infection control intervention was effective at reducing infection rates even in these high-risk populations. The purpose of the current study was to determine whether the reduction in rates of infection associated with this intervention differed by racial and dementia composition of the NHs. We additionally aimed to determine whether the association between infection rates and compliance with components of the intervention, specifically proper cohorting and proper PPE use, differed by racial and dementia composition of the NHs.

## Method

On April 27, 2020, Governor Baker announced that \$130 million in additional funding would be available for 2 months to Massachusetts NHs to improve their infection control processes in response to the COVID-19 pandemic. The Massachusetts Senior Care Association (MSCA) and Hebrew SeniorLife (HSL) then deployed a state-wide infection control intervention to prevent COVID-19 in Massachusetts NHs beginning on May 4, 2020. This intervention has been described in detail previously (11). In brief, the intervention consisted of 6 components, including: (i) a 28-item infection control competency checklist, (ii) a payment incentive contingent on passing state inspection audits based on the 28-item checklist, (iii) on-site and virtual infection control consultation, (iv) access to weekly webinars focused on the checklist competencies and areas of poor performance on the audits, (v) weekly question and answer communications with the Massachusetts Department of Public Health (DPH), and (vi) access to resources for obtaining PPE, staffing and testing. Six of the 28 items on the checklist were considered “core-competencies,” which included proper cohorting of COVID-19 cases, closing of congregate spaces, training and demonstrated proficiency in the donning and doffing of PPE, proper wearing of PPE, the presence of appropriate infection control policies, and the ability to recognize and respond to the signs and symptoms of COVID-19 infection.

All facilities underwent baseline and monthly audits for adherence to checklist items, and those that scored less than 24 on the checklist or were deficient in any of the core competencies were re-inspected within 2 weeks. The baseline audit occurred during the week of May 4, 2020 and the last audit occurred during the week of June 22, 2020. A copy of the checklist is available at: <https://www.mass.gov/doc/nursing-facility-infection-control-competency-checklist/download>.

To quantify our study outcome of weekly COVID-19 infection rates, we used weekly reports submitted by each NH to the Massachusetts Center for Health Information and Analysis (CHIA). Baseline and monthly audits of the NHs conducted by the Executive Office of Health and Human Services (EOHHS) provided infection control compliance audit scores (our primary independent variable) and compliance with each of the 6 core competencies. As facilities were most often non-compliant with proper wearing of PPE, and proper cohorting, and our previous work found those to be significantly associated with reduction in infection rates (11), compliance with these 2 core competencies were examined as secondary

independent variables of interest. Proper wearing of PPE occurred when the health care professional wore recommended PPE for care of all residents, in line with the most recent DPH PPE guidance when COVID-19 cases were identified in the facility. Proper cohorting occurred when residents who were confirmed by testing to be infected with COVID-19 or who were recovering from COVID-19 were separated from residents who were not infected or had unknown status (ie, in dedicated wings/units or in separate rooms). Monthly, or bi-weekly, audit scores were carried forward to each weekly infection rate and were updated when the next audit occurred.

To estimate the percent of residents in each facility who were non-White or who had dementia, we used minimum data set (MDS) data describing NH demographics as of January 31, 2020 (12). MDS data were also used to obtain number of residents, percent female, average age, average activities of daily living (ADL; Morris long-form 28-point ADL scale, higher scores indicate greater independence) scores of residents (13,14) and the percent of residents with a dementia diagnosis (based upon the MDS check box) in each NH as of January 31, 2020. For the purposes of this analysis, we grouped NHs in 2 ways to achieve distributions with sufficient numbers for comparison: (i) NHs with <20% of residents who were non-White versus ≥20% residents who were non-White; and (ii) by tertiles of dementia prevalence (low: 0%–50%, middle: >50%–62%, high: >62%–100%).

Characteristics of the NHs were described using means and standard deviations (*SD*) and are presented overall and by racial composition and dementia prevalence. We used a mixed-effects hurdle model to account for the excessive zeros in weekly infection rates (15–17). The hurdle model employs a logistic regression to estimate the odds of any infection rate and a mixed-effects linear regression to model infection rates greater than zero. In the logistic models, the odds ratios indicate the odds of having zero infections with 1-unit increase in the independent variable. In the mixed models, the  $\beta$  coefficients indicate the change in weekly infection rate with a 1-unit increase in the independent variable. We tested for interactions for intervention effects on infection rates by racial composition and dementia prevalence, and provide the interaction *p*-values for each model. Since these analyses were prespecified, stratified results are provided even when the interaction test was not statistically significant. Each model was adjusted for the surrounding county prevalence of COVID-19, which is an important correlate of facility infection rates (18). Additional variables considered as covariates in the models included number of residents in each NH, percent female residents, average age, and average ADL score of residents.

## Results

Among the 358 Massachusetts NHs included in this study, the mean (*SD*) number of residents in each facility was 92 (35), while the average (*SD*) age of the residents was 81 (7.5) years. On average, 66% of residents were women (interquartile interval: 58%–76%), and residents' mean (*SD*) ADL score was 17 (2.3, range: 7.2–27.8). Facilities were, on average, 15% (*SD* = 17%) non-White and 55% (*SD* = 16%) of residents had dementia. Table 1 shows descriptive characteristics of the 358 facilities combined and by % non-White and % dementia tertiles. Eighty-three (23%) facilities had more than 20% of their residents who were non-White.

### Effect of Racial Composition

Overall, there was a 9% reduction in infection rates with a one unit increase in total audit score. This effect did not differ by

racial composition and the tests for interaction were not significant ( $p$ -interaction = .42, Table 2). Proper cohorting of residents was associated with a 78% reduction in infection rates among facilities with  $\geq 20\%$  non-Whites, compared to 51% reduction in infection rates among facilities with  $< 20\%$

non-Whites, however the tests for interaction were not statistically significant ( $p = .42$ ). Proper PPE use was associated with a 29% ( $p = .02$ ) and 32% ( $p = .16$ ) reduction in infection rates among facilities with  $< 20\%$  and  $\geq 20\%$  non-Whites, respectively ( $p$ -interaction = .69).

**Table 1.** Descriptive Characteristics of Nursing Homes Participating in the Infection Control Intervention

Outcome variable	<i>n</i>	Mean (SD)	Non-White Categories				Dementia Tertiles					
			0% to <20%		20%+		0%–50%		>50–62%		>62%–100%	
			<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)
Resident weekly new infection rate (per thousand residents)	2864	2.1 (6.8)	2200	2.0 (6.5)	664	2.2 (8.0)	976	1.6 (6.4)	968	2.4 (7.1)	920	2.1 (7.1)
Resident weekly new mortality rate (per thousand residents)	2506	0.6 (1.9)	1925	0.6 (1.8)	581	0.7 (2.0)	854	0.4 (1.4)	847	0.7 (2.3)	805	0.7 (1.8)
Resident weekly new hospitalization rate (per thousand residents)	3222	1.5 (2.1)	2475	1.4 (2.1)	747	1.6 (2.0)	1098	1.6 (2.2)	1089	1.5 (2.1)	1035	1.3 (1.9)
Independent variables												
Time-varying												
County COVID-19 prevalence	3222	6.5 (5.6)	2475	6.4 (5.6)	747	6.9 (5.5)	1098	6.3 (5.6)	1089	6.4 (5.4)	1035	6.8 (5.7)
Static												
Baseline Audit Score	358	26 (2.5)	275	26 (2.4)	83	26 (2.8)	122	26 (2.28)	121	26 (2.3)	115	26 (3.0)
Facility size	358	92 (35.5)	275	91 (36.9)	83	94 (30.6)	122	87 (31.3)	121	94 (30.0)	115	94 (43.8)
Non-White	358	15 (17.0)	275	8 (5.7)	83	39 (19.1)	120	19 (20.0)	121	15 (17.4)	115	11 (11.4)
Female	356	66 (14.0)	273	68 (12.9)	83	57 (13.8)	122	59 (14.9)	121	66 (13.3)	115	72 (10.3)
Age	358	81 (7.5)	275	82 (5.4)	83	75 (10.2)	122	77 (9.8)	121	81 (5.7)	115	84 (3.8)
Dementia prevalence	358	55 (15.8)	275	57 (14.6)	83	49 (17.9)	122	40 (11.7)	121	56 (3.5)	115	72 (8.9)
ADL Score	358	17 (2.3)	275	17 (1.9)	83	17 (3.4)	122	17 (2.7)	121	17 (2.2)	115	18 (2.0)

Note: ADL = activities of daily living.

**Table 2.** Association Between Infection Control Scores and Weekly COVID-19 Infection Rates by Non-White Categories, Adjusted for Community Prevalence of COVID-19

	% non-White <20			% non-White 20+			
Audit Score	B Coefficient*	95% CI	<i>p</i> -value	B Coefficient*	95% CI	<i>p</i> -value	<i>p</i> -value interaction
Mixed Model	-0.09	(-0.14, -0.03)	<.01	-0.09	(-0.17, -0.01)	.04	.42
	Odds Ratio†	95% CI	<i>p</i> -value	Odds Ratio†	95% CI	<i>p</i> -value	<i>p</i> -value interaction
Logistic Model	1.16	(1.05, 1.28)	<.01	1.19	(1.02, 1.40)	.03	.96
Proper Cohorting (Q3)							
Mixed Model	B Coefficient	95% CI	<i>p</i> -value	B Coefficient	95% CI	<i>p</i> -value	<i>p</i> -value interaction
	-0.51	(-0.90, -0.13)	.01	-0.78	(-1.45, -0.10)	.02	.42
	Odds Ratio	95% CI	<i>p</i> -value	Odds Ratio	95% CI	<i>p</i> -value	<i>p</i> -value interaction
Logistic Model	5.40	(2.06, 14.15)	<.01	5.03	(1.00, 25.39)	.05	.15
Proper wearing of PPE (Q17)							
Mixed Model	B Coefficient	95% CI	<i>p</i> -value	B Coefficient	95% CI	<i>p</i> -value	<i>p</i> -value interaction
	-0.29	(-0.54, -0.05)	.02	-0.32	(-0.76, 0.12)	.16	.69
	Odds Ratio	95% CI	<i>p</i> -value	Odds Ratio	95% CI	<i>p</i> -value	<i>p</i> -value interaction
Logistic Model	2.58	(1.58, 4.20)	<.01	2.36	(1.08, 5.20)	.03	.30

Notes: CI = confidence interval; PPE = personal protective equipment.

\*A negative  $\beta$  coefficient indicates a decrease in weekly infection rate with a 1-unit increase in the independent variable.

†Odds ratio indicates increased odds of having zero infections with 1-unit increase in independent variable.

### Effect of Dementia Prevalence

Facilities in the middle (>50%–62%;  $n = 121$ ) and upper (>62%;  $n=115$ ) tertiles of dementia prevalence had an 8% and 12% reduction in infection rates with a one unit increase in checklist scores, respectively, compared to 1% reduction in the lowest tertile ( $p$ -interaction = .04, Table 3). Cohorting was also associated with greater reductions in infection rates among facilities in the middle and upper tertiles of dementia prevalence, with 63% and 56% reduction in infection rates, respectively, compared to 38% reduction in the lowest tertile ( $p$ -interaction = .60). Proper wearing of PPE was associated with the greatest reduction in infection rates among facilities in the middle tertile of dementia prevalence, with a 67% reduction in infection rates, compared to 16% and 19% in the lowest and highest tertiles, respectively ( $p$ -interaction = .45). Additional adjustments for number of residents in each NH, percent female residents, average age, and average ADL score of residents did not change the results.

### Discussion

Although NHs with the highest prevalence of residents with dementia or non-White racial backgrounds were thought to have the highest

rates of COVID-19 infections due to the known vulnerabilities of their residents, our data indicate that adherence to infection control guidelines, especially proper cohorting and PPE use, can effectively reduce COVID-19 infection rates, even in these high-risk populations. In fact, the Massachusetts infection control intervention was more effective at reducing COVID-19 infections in NHs with the highest prevalence of residents with dementia, and was effective regardless of the racial composition of the facility. Additionally, proper cohorting was associated with lower rates of infection in NHs where more than 20% of residents were non-White.

Because the Massachusetts intervention had multiple components, including a financial incentive and frequent audits, it is impossible to determine which ones made the greatest impact on a facility's ability to comply with infection control guidelines. However, we were able to demonstrate that adherence to a checklist of infection control procedures, particularly proper cohorting and PPE use, were key to reducing rates of COVID-19 infections, especially in facilities where the risk of COVID-19 infection was greatest and control was presumably most challenging.

It is not clear why proper PPE use was associated with the greatest reduction in infection rates among facilities in the middle

**Table 3.** Association Between Infection Control Scores and Weekly COVID-19 Infection Rates by Tertile of Dementia Prevalence, Adjusted for Community Prevalence of COVID-19

	Low Dementia Prevalence (0 to 50%)			Middle Dementia Prevalence (>50 to 62%)			High Dementia Prevalence (>62 to 100%)			
Audit Score										
	B Coefficient*	95% CI	$p$ -value	B Coefficient*	95% CI	$p$ -value	B Coefficient*	95% CI	$p$ -value	$p$ -value interaction
Mixed Model	-0.01	(-0.08, 0.06)	.71	-0.08	(-0.18, 0.01)	.10	-0.12	(-0.19, -0.05)	<.01	.04
	Odds Ratio <sup>†</sup>	95% CI	$p$ - value	Odds Ratio <sup>†</sup>	95% CI	$p$ - value	Odds Ratio <sup>†</sup>	95% CI	$p$ - value	$p$ -value interaction
Logistic Model	1.22	(1.04, 1.44)	.02	1.12	(0.96, 1.31)	.14	1.16	(1.02, 1.31)	.03	.50
Proper Cohorting (Q3)										
	B Coefficient	95% CI	$p$ - value	B Coefficient	95% CI	$p$ - value	B Coefficient	95% CI	$p$ - value	$p$ -value interaction
Mixed Model	-0.38	(-0.92, 0.16)	.17	-0.63	(-1.14, -0.12)	.02	-0.56	(-1.25, 0.13)	.11	.60
	Odds Ratio	95% CI	$p$ -value	Odds Ratio	95% CI	$p$ - value	Odds Ratio	95% CI	$p$ - value	$p$ -value interaction
Logistic Model	13.6	(1.75, 105.55)	.01	22.49	(3.53, 143.42)	<.01	0.83	(0.25, 2.74)	.76	.01
Proper wearing of PPE (Q17)										
	B Coefficient	95% CI	$p$ - value	B Coefficient	95% CI	$p$ - value	B Coefficient	95% CI	$p$ - value	$p$ -value interaction
Mixed Model	-0.16	(-0.47, 0.15)	.31	-0.67	(-1.09, -0.25)	<.01	-0.19	(-0.58, 0.2)	.35	.45
	Odds Ratio	95% CI	$p$ -value	Odds Ratio	95% CI	$p$ - value	Odds Ratio	95% CI	$p$ - value	$p$ -value interaction
Logistic Model	4.1	(2.09, 8.05)	<.0001	1.44	(0.69, 2.97)	.33	2.68	(1.22, 5.91)	.01	0.32

Notes: CI = confidence interval; PPE = personal protective equipment.

\*A negative  $\beta$  coefficient indicates a decrease in weekly infection rate with a 1-unit increase in the independent variable.

<sup>†</sup>Odds ratio indicates increased odds of having zero infections with 1-unit increase in independent variable.

tertile of dementia prevalence. These facilities may have had too few demented residents to justify having specialized memory support units, and therefore experienced the greatest intermingling of residents. Since this could increase the spread of COVID-19 within the facility, proper PPE use may have been particularly important for curbing infections in these NHs.

Our study was conducted in only one state that was able to provide payments for PPE, testing, consultants, and staff. Therefore, it may not be generalizable or even feasible in other states. However, regardless of the methods used to support infection control procedures, compliance with the most basic principles of PPE and cohorting appear to be effective in preventing the spread of COVID-19, even among the most at-risk residents.

## Funding

This work was supported by the National Institute of Aging (NIA) of the National Institutes of Health under Award Number U54AG063546, which funds NIA Imbedded Pragmatic Alzheimer's Disease and AD-Related Dementias Clinical Trials Collaboratory (NIA IMPACT Collaboratory). Supplemental funding was provided under grant number 3U54AG063546-02S3. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

## Conflict of Interest

V.M. is MPI of the IMPACT Collaborative and Chair of the Scientific Advisory Committee of naviHealth, a post-acute care convener. L.A.L. is the Editor-in-Chief of the Journal of Gerontology, Medical Sciences. A.B.D. and C.K. have no conflict of interest to declare.

## Acknowledgments

The authors are grateful to the Massachusetts Senior Care Association (MSCA) and Alida M. Lujan, MBA, MPA for providing access to the data used in this study. MSCA was also instrumental in carrying out the state-wide COVID-19 infection control intervention.

L.A.L. and V.M. were responsible for initial study concept and data acquisition. A.B.D. performed the data analysis. All authors contributed to data interpretation. A.B.D. wrote the first draft of the manuscript. All authors provided critical review of the manuscript and approved the final version.

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