

Partnering with Local Hospitals and Public Health to Manage COVID-19 Outbreaks in Nursing Homes

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See related editorial by Kathleen Unroe in this issue.

BACKGROUND/OBJECTIVES: Almost half of deaths related to COVID-19 in the United States are linked to nursing homes (NHs). We describe among short-term and long-term residents at three NHs in Michigan the outbreak identification process, universal testing, point prevalence of COVID-19, and subsequent containment efforts, outcomes, and challenges.

DESIGN: Outbreak investigation.

SETTING: Three NHs in southeast Michigan.

PARTICIPANTS: All residents ($N = 215$) at three NHs (total beds = 356) affiliated with a large academic healthcare system.

METHODS: Upon detection of confirmed cases within the facility, each NH in collaboration and consultation with local hospital, public health officials, and parent corporation implemented immediate facility-wide testing and the following intervention measures: cohorting of COVID-19 positive residents; communication regarding testing and results with residents, healthcare professionals, and families; personal protective equipment reeducation and use throughout facilities; and dedicated staffing for infected patients cohorted in a dedicated COVID-19 wing. We collected patient data regarding demographics, symptoms, comorbidities, hospitalization, and 14-day outcomes.

RESULTS: A total of 29 cases of COVID-19 were identified at three participating NHs. Nineteen cases of COVID-19

were identified through symptom-triggered testing from March 23 to April 23, 2020; 10 (4.7%) additional cases were identified through universal testing of 215 residents conducted from April 7 to 15, 2020. The hospitalization rate was 37.9%. The case fatality rate was 20.7% (6/29); these patients had multiple comorbidities. No residents who tested positive through the point-prevalence survey required hospitalization, and five were discharged home within 14 days.

CONCLUSION: Proactive and coordinated steps between NH medical directors and administrators, referral hospitals including their laboratories, and local public health officials are necessary to rapidly respond to an outbreak and limit the transmission of COVID-19. This coordinated public health approach may save lives, minimize the burden to the healthcare system, and reduce healthcare costs. *J Am Geriatr Soc* 69:30-36, 2021.

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In December 2019, the novel coronavirus SARS-CoV-2 was detected in a cluster of patients in Wuhan, China. COVID-19, the disease caused by SARS-CoV-2, has since spread rapidly across the globe. In the United States, individuals aged 65 and older comprise 31% of COVID-19 cases, 45% of hospitalizations, 53% of intensive care unit admissions, and 80% of deaths.^{1,2} The Washington State outbreak in particular demonstrated how devastating COVID-19 is to the vulnerable nursing home (NH) population: 167 confirmed cases were identified between February 28 and March 18, 2020.^{3,4}

On March 13, a national emergency was declared in the United States in response to COVID-19, and the Centers

for Medicare & Medicaid Services (CMS) released guidance for NHs to restrict visitation including nonessential healthcare personnel (HCP) and volunteers, except for end-of-life situations.⁵ These guidelines were endorsed by the Centers for Disease Control and Prevention (CDC) including optimization of personal protective equipment (PPE), strategic planning to mitigate potential staffing shortages, and planning for a dedicated area to care for residents with suspected or confirmed COVID-19.⁶⁻⁹

The state of Michigan reported its first case on March 10, and in the following 2 weeks, 1,035 cases emerged.¹⁰ We provide details of the outbreak investigation at three NHs and describe the role of preexisting relationships that allowed for rapid testing at a time when testing was rationed, identifying asymptomatic cases and containing an outbreak.

METHODS

Facility Characteristics

Our academic health system provides clinical and teaching services to four local NHs, each part of a well-established hospital skilled nursing facility (SNF) collaborative involving quarterly meetings between NH administrators, medical directors, and hospital and post-acute care services administrators to discuss topics including quality metrics and clinical initiatives around readmissions, transition of care, and communication issues. These sites also have academic medical directors who reinforce infection prevention interventions and have close connections with the local hospital and the health department.¹¹⁻¹⁴ Three NHs are discussed in this report; the fourth NH is not included because they did not experience a COVID-19 outbreak. The three NHs have a combined capacity of 356 beds and house between 7 and 19 residents per hallway. Patient care is delivered by five groups of physicians and advance practice providers. One group is employed by a local hospital and provides care in all three NHs; the other four groups are private practice and provide care in one or two of the three NHs. Two of the three NHs are nonprofit, one is for profit, and each of the three NHs is part of a different corporate chain. Medicare five-star quality ratings were between 4 and 5 at the time of the outbreak investigation that aligns with 58% of Michigan NHs.

Outbreak Identification, Data Collection, and Survey

Upon identification of cases, NH medical directors/administrators, local hospital leadership, epidemiology, health department, and hospital-based laboratory services immediately devised a strategy to implement point-prevalence SARS-CoV-2 testing of all asymptomatic residents in each NH in a single day (Supplementary Figure S1). Nasopharyngeal (NP) swabs were collected on April 7, 10, and 15 at NH 1, NH 2, and NH 3, respectively. Figure 1 illustrates the timeline of events as COVID-19 cases were confirmed at the three NHs, relative to when point-prevalence SARS-CoV-2 testing was completed.

Subsequent to a positive test, cases were followed for 14 days. Data regarding patient location (room/hall) at diagnosis and after moving to a separate COVID

wing, dates of symptom onset, testing, results, and 14-day outcomes were collected. Demographic data, comorbidities, and signs and symptoms were obtained through review of electronic health records. This study was approved by the University of Michigan institutional review board. We defined hypoxemia as oxygen saturation as measured by pulse oximetry ($SpO_2 \leq 93\%$)¹⁵ and hypotension as systolic blood pressure of 100 mm Hg or lower.¹⁶

Testing for SARS-CoV-2 was performed on NP swabs collected from patients and transported in viral transport media to our local hospital's Clinical Microbiology Laboratory. Samples were analyzed using Abbott Real Time SARS-CoV-2 EUA assay (Abbott Molecular, Des Plaines, IL). Results were available within 24 to 48 hours of collection.

Implementation of Interventions

Cohorting

Upon identification, COVID-19 residents were moved to a dedicated COVID unit in each NH. Cleaning and cohorting was accomplished within 48 hours of initial testing. Low NH census allowed for room changes without the need of a holding area. Room changes occurred after deep cleaning with hospital-grade disinfectants registered with the Environmental Protection Agency. Nurse managers, nursing, and housekeeping staff were involved in the rapid move process and room cleaning. Universal masking, appropriate hand hygiene, and environmental cleaning were enforced in all care areas. A strict no-visitation policy was enacted in all Michigan NHs on March 14, 2020. In one NH, dedicated staff entered and exited this unit through a separate entryway than the rest of the staff. NHs did not admit new residents for 48 hours until cohorting and room changes were completed.

Communication

All residents and HCP in the NHs were informed in person of the outbreak and response. Residents testing positive and their families were notified of their results, and roommates were notified of potential exposure. Local hospitals and the county health department were notified of the positive cases. Well-established relationships between the three NHs and hospital leadership (through the SNF Collaborative and prior research initiatives) allowed for daily communication via e-mail and phone to facilitate testing and refine response. Nurse managers communicated with staff daily and conducted regular infection control audits to ensure adherence to proper procedures.

Personal Protection Equipment Assessment and Use

All staff were reeducated on PPE use. Donning and doffing techniques were posted in each unit. COVID unit staff were required to wear gowns, gloves, eye protection, and N95 respirators (with additional overlaying surgical mask to conserve N95) and were instructed to reuse the gown, N95 respirator, and eye protection between patients. Masks and gowns were changed only when soiled, torn, or wet as per CDC recommendations.⁶ Face shields and goggles were

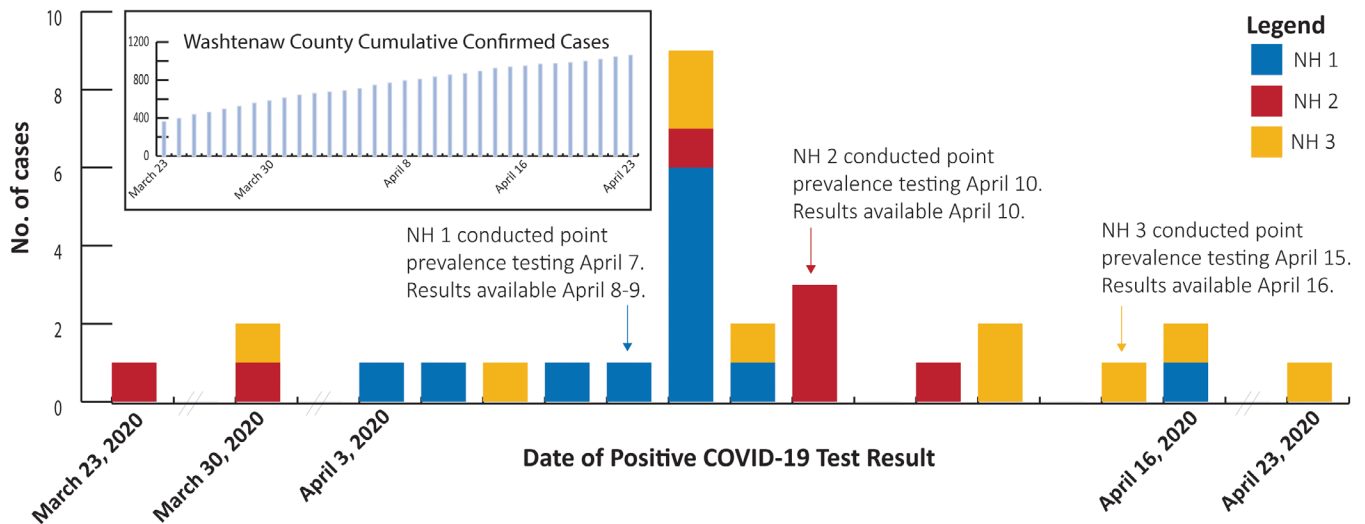


Figure 1. The first confirmed case of COVID-19 identified at NH 1, NH 2, and NH 3 occurred on April 3, March 23, and March 30, respectively. NH 1: Four COVID-19 patients were tested and identified between April 2 and 7; point-prevalence testing was conducted on April 7, with results available April 8 to 9, and six COVID-19 patients were identified; one case from a sample obtained before point-prevalence testing was identified on April 8; an additional COVID-19 patient was identified through symptom-triggered testing on April 16. NH 2: Three COVID-19 patients were identified between March 23 and April 9; point-prevalence testing was conducted on April 10, and three COVID-19 patients were identified; an additional COVID-19 patient was identified through symptom-triggered testing on April 12. NH 3: Eight COVID-19 patients were identified between March 30 and April 14; point-prevalence testing was conducted on April 15, with results available the next day, one COVID-19 patient was identified; an additional COVID-19 patient was identified through symptom-triggered testing on April 23.

cleaned after each use. Additional PPE was made available in the COVID unit. Trash cans were placed near the wing exit. Universal surgical mask and PPE use for persons under investigation was implemented while isolated in their room. PPE appropriate use and adherence was monitored in daily rounds by the infection control nurse, nurse managers, and directors of nursing.

Staffing

All three NHs allocated a dedicated nurse, nurse assistant, physical and occupational therapist, and an environmental services technician to the COVID unit. In one NH, staff shared cleaning duties due to low census. Nursing leadership communicated with nursing staff twice daily to monitor residents' progress, identify supply needs, and offer support. Offices, resident rooms, or dining areas were converted into a break room for the dedicated staff where they received free meals and beverages. Incentive pay was allocated for all nursing staff. In one NH, a designated living area within the campus was made available for HCP to stay to diminish their fear of exposing their families.

Patient Care Processes

Residents remained inside their assigned rooms, where nursing care and therapies took place. Assistance with activities of daily living occurred within each resident's room including washcloth body cleaning when individual showers were not available in the room. Rehabilitation therapies with a dedicated therapist continued for residents in the COVID unit to prevent deconditioning. No shareable equipment was used during therapy. Several interventions were

implemented in the COVID-19 areas to reduce staff exposure including daily multidisciplinary tele-huddles, medication review to discontinue aerosol-generating procedures, unnecessary supplements and decrease dosing frequency if possible, and elimination of unnecessary blood draws and imaging. Residents did leave their rooms for outpatient appointments (i.e., hemodialysis) and wore a surgical mask when outside of their room. Residents with COVID-19 were not required to wear a mask inside their rooms. One NH requested virtual visits by clinicians when possible in the COVID unit. One clinician group implemented virtual visits on a case-by-case basis; NH staff helped facilitate. Standard goals of care discussions occurred and were readdressed when residents were diagnosed with COVID-19.

RESULTS

Universal Testing (Point-Prevalence Survey)

Ten of 215 (4.7%) residents tested positive for COVID-19: 6 of 79 (7.6%), 3 of 40 (7.5%), and 1 of 96 (1%) in NH 1, NH 2, and NH 3, respectively. Six of 10 residents who tested positive through point-prevalence sampling and were asymptomatic at the time of testing, developed symptoms within 7 days of testing (i.e., were presymptomatic).

Patient Characteristics

Before the point-prevalence survey, 16 residents were diagnosed with "symptom-triggered" testing. Ten SARS-CoV-2 positive residents (asymptomatic) were identified through

Table 1. Patient Characteristics

Characteristic	SARS-CoV-2 positive patients (N = 29 ^a)
Median age, y (range)	73 (30–95)
Sex, n (%)	
Male	17 (58.6)
Female	12 (41.4)
Race, n (%)	
White	24 (82.8)
African American	5 (17.2)
Chronic underlying comorbidities, n (%)	
Hypertension	24 (82.8)
Cardiovascular disease	18 (62.1)
Diabetes mellitus	10 (34.5)
Renal disease	9 (31.0)
Obesity	6 (20.7)
COPD	6 (20.7)
End-stage renal disease	3 (10.3)
Asthma	2 (6.9)
Liver disease	1 (3.5)
Compromised immune system	0
Symptoms of COVID-19, n (%)	
Typical symptoms	
Fever	14 (48.3)
Low oxygen saturation	12/25 (48.0)
Cough	9 (31.0)
Shortness of breath at rest	8 (27.6)
Shortness of breath with activity	5 (17.2)
Hypotension	3/26 (11.5)
Sore throat	1 (3.5)
Myalgia	1 (3.5)
Headache	1 (3.5)
Loss of taste	1 (3.5)
Loss of smell	0
Chills	0
Atypical symptoms	
Fatigue	10 (34.5)
Diarrhea	3 (10.3)
Ocular symptoms	0
Lab results, n (%) of patients tested	
Increased CRP	20/20 (100.0)
Increased ESR	4/4 (100.0)
Elevated IL-6	2/2 (100.0)
Increased D-dimer	13/16 (81.3)
Increased fibrin/fibrinogen degradation products	3/4 (75.0)
Uptrending high-sensitive cardiac troponin T	11/16 (68.8)
Increased lactate dehydrogenase	11/18 (61.1)
Abnormal blood urea nitrogen	14/26 (53.9)
Lower lymphocyte count	13/25 (52.0)
Decreased albumin	10/20 (50.0)
Increased PTT	7/14 (50.0)
Increased cardiac troponin	5/10 (50.0)
Elevated ferritin	8/18 (44.4)
Increased creatinine	10/26 (38.5)
Higher neutrophil count	9/25 (36.0)
Increased AST	7/22 (31.8)
Increased procalcitonin	4/14 (28.6)

(Continues)

Table 1 (Contd.)

Characteristic	SARS-CoV-2 positive patients (N = 29 ^a)
Transaminitis	2/9 (22.2)
Thrombocytopenia	5/27 (18.5)
Higher white blood cell count	3/27 (11.1)
Increased prothrombin time	2/18 (11.1)
INR	2/18 (11.1)
Increased ALT	2/22 (9.1)
Increased total bilirubin	0/22

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; IL-6, interleukin-6; INR, international normalized ratio; PTT, partial thromboplastin time.

^aNot all patients had data point obtained; denominators indicated.

the point-prevalence survey, and three residents (one at each facility) who tested negative during point-prevalence sampling later tested positive through symptom-triggered testing, resulting in a total sample size of 29 residents (Figure 1). Full facility universal testing of asymptomatic residents indicated a COVID-19 infection prevalence of 4.7%. SARS-CoV-2 positive cases, hospitalized from the community and subsequently discharged to any of the three NHs, were not included in this study.

Demographic characteristics, comorbidities, and presenting signs and symptoms of COVID-19 patients are summarized in Table 1. Of the 29 infected residents, 17 (58.6%) were male; 5 (17.2%) were African American; and median age was 73 years. Multiple comorbidities were common, and most residents (24/29 [82.8%]) experienced typical symptoms like fever, cough, shortness of breath, chills, sore throat, headache, muscle pain, loss of smell/taste, hypotension, or low oxygen saturation. Ten (41.7%) of these patients also reported symptoms considered atypical such as fatigue or diarrhea. One resident experienced only fatigue.

Patient Outcomes

Outcomes were measured 14 days after a SARS-CoV-2 positive test. Of the 29 residents who tested positive, 11 (37.9%) were hospitalized: five required care in the intensive care unit and one required ventilator support. By the end of the 14-day period, 15 (51.7%) residents were recovering at an NH, 5 (17.2%) were discharged to their previous living location (3 to home, 1 to assisted living apartment, 1 to long-term care room), 2 (6.9%) were still hospitalized, 1 (3.4%) was transferred to hospice care, and 6 died at the hospital, representing a mortality rate of 20.7% (Supplementary Table S1).

Among the six residents who died, five were older than aged 70, all had multiple comorbidities, and five were male. Four were treated in an intensive care unit, and one (aged >65 years) received mechanical ventilation. Three of these had do-not-resuscitate (DNR) orders in place at the time of diagnosis. The other three residents had goals of care addressed after diagnosis, and they requested DNR.

Table 2. Residents and Nursing Home Staff with Positive SARS-CoV-2 Test Results

NH site	Before point-prevalence survey	From point-prevalence survey		After point-prevalence survey	NH staff
	Symptomatic residents who tested (+)/total residents tested (%)	Asymptomatic residents who tested (+)/total residents tested (%)	Residents who tested (+) and became symptomatic/residents who tested (+) (%)	Symptomatic residents who tested (+)/total residents tested (%)	Staff who tested (+)/total staff (%)
NH 1	5/12 (41.7)	6/79 (7.6)	3/6 (50)	1/8 (12.5)	9/200 (4.5)
NH 2	3/13 (23.1)	3/40 (7.5)	3/3 (100)	1/1 (100)	6/141 (4.3)
NH 3	8/32 (25.0)	1/96 (1.0)	0/1 (0)	1/1 (100)	8/265 (3.0)
Total	16/57 (28.1)	10/215 (4.7)	6/10 (60)	3/10 (30)	23/606 (3.8)

Abbreviation: NH, nursing home.

Importantly, none of the 10 residents who tested positive by point-prevalence survey and were asymptomatic required hospitalization. Four were discharged home; three required NH stay 14 days after testing.

Staff Outcomes

A total of 23 of 606 (3.8%) NH staff tested positive (Table 2). Sixteen had direct patient contact within 14 days of testing positive. It is unclear whether transmission occurred in the NH or in the community. It was difficult to track them because community transmission was high and assignments varied due to staff shortages and resident room changes.

DISCUSSION

We report response to an outbreak of COVID-19 cases and subsequent interventions including universal testing, cohorting, and outcomes at three Michigan NHs closely affiliated with an academic health system. Our experience suggests that despite their many challenges,¹⁷⁻²⁴ NHs can respond to a pandemic by fostering collaborative relationships with hospitals, infectious disease experts, laboratory services, and local public health officials.^{25,26} Such collaborative relationships allowed a rapid turnaround time for universal testing and subsequent expeditious cohorting that likely contributed to lower asymptomatic transmission and outbreak control.

Full facility universal testing of asymptomatic residents revealed a lower COVID-19 infection prevalence of 4.7% compared with other NH studies.^{4,18,27,28} Most initially asymptomatic COVID residents identified by point-prevalence testing developed symptoms within 7 days of testing, suggesting that symptom-based screening may be insufficient. Because COVID-19 spreads rapidly, early recognition of infected residents and implementation of appropriate infection control measures is crucial.^{23,29} All of the asymptomatic residents found to be SARS-CoV-2 positive during the point-prevalence survey later developed mild symptoms not requiring hospitalization.

Our experience shows that even after cohorting COVID-19 cases with dedicated staff and diligent use of

recommended infection control practices, a few new cases occurred (Figure 1 and Table 2). This suggests either continued exposure by asymptomatic staff and other residents or an initial false-negative result due to a low viral load or poor technique. The emergence of new cases is an important and concerning observation suggesting ongoing risk of transmission. NHs accepted new admissions from hospitals regardless of COVID-19 diagnosis. At the time of the outbreak, testing availability was limited and guidelines for universal testing were not in place. CMS now recommends universal weekly testing of NH staff and residents to detect asymptomatic and presymptomatic individuals.³⁰

During the COVID-19 pandemic, prolonged laboratory turnaround time for SARS-CoV-2 testing in the community and in NHs has become a substantial obstacle. Some NHs have reported variable turnaround times of 3, 7, and up to 10 days for patient and staff testing. This delay has hampered efforts to cohort rapidly and potentially control outbreaks. Because of established collaborations,^{12-14,17} rapid communications with the local hospital COVID-19 command center about local NH outbreaks allowed the implementation of universal testing at the three NHs. To this day, we have been able to rely on the hospital laboratory for rapid testing with a turnaround time of 8 to 48 hours that allows cohorting of all SARS-CoV-2 positive residents in a dedicated area, minimizes transmission, and optimizes PPE use. This experience is shared by others in academic health centers.³¹ Relying on large national testing companies to provide rapid turnaround times to help with surveillance in NHs can be a challenge as these companies struggle to prioritize a growing community demand. NHs in rural and poorly resourced areas need to seek access to similar resources and collaborations. Local hospitals stand to gain from this collaboration and helping control outbreaks because many admissions come from outbreaks in NHs.

The main limitations of this study include a small sample size of three NHs and inability to conduct facility-wide staff testing due to low testing availability at the time of this outbreak. Individuals working in multiple NHs likely contribute to intra- and interfacility spread. Lack of staff testing can limit ability to make inferences about effectiveness of resident testing procedures. Additionally, each NH was part of a different corporation with varying

policies that may have impacted interventions including approval of testing, cohorting, and resident outcomes. Low census counts, low community prevalence of COVID, and strict two negative swabs admission criteria (at that time) may have contributed to the low rate of COVID. Lastly, clinical assessment of delirium/agitation was not conducted.

It is important that every NH, their referral hospital and their laboratories, and local public health authorities build on this early experience and create sustainable and long-lasting collaborative relationships that allow for rapid turnaround time of SARS-CoV-2 testing for a possible resurgence of COVID-19 as well as other outbreaks. Future research should focus on developing effective, evidence-based rapid testing, addressing staffing shortages, and developing aging-friendly infection prevention policies to preserve the health of older adults and well-being of HCP.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Supplementary Table S1: Outcomes of SARS-CoV-2 Positive Residents at 14 days

Supplementary Figure S1: Workflow diagram to implement point-prevalence SARS-CoV-2 batch testing of all asymptomatic residents in nursing homes (NHs). This workflow required coordination between NH medical directors/administrators, local hospital leadership, hospital epidemiologist, and hospital-based laboratory services. Lab, laboratory; STAT, immediately.