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

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ABSTRACT

Objective: Almost half of COVID-19 related deaths 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 (PPE) re-education 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-April 23, 2020; 10 (4.7%) additional cases were identified through universal testing of 215 residents

conducted April 7-15, 2020. The hospitalization rate was 37.9%. The case fatality rate was 20.7% (6/29); these cases had multiple comorbidities. No residents who tested positive through the point-prevalence survey required hospitalization, and four were discharged home within fourteen days.

Conclusions: Proactive and coordinated steps are needed between NH medical directors and administrators, referral hospitals and their laboratories, and local public health officials to rapidly respond to an outbreak and limit the transmission of COVID-19. This coordinated approach may be an effective measure to save lives, minimize the burden to the healthcare system, and save healthcare costs.

Keywords: COVID-19, SARS-CoV-2, nursing home, outbreak, pandemic

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 U.S., individuals age 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, as 167 confirmed cases were identified between February 28 and March 18, 2020.[3,4]

On March 13, a national emergency was declared in the U.S. in response to COVID-19 and the Centers for Medicare & Medicaid Services (CMS) released guidance for NHs to restrict visitation, including non-essential 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 two weeks, 1,035 cases emerged.[10] We provide details of the outbreak investigation at three NHs and describe the role of pre-existing relationships that allowed for rapid testing at a time where testing was rationed, identifying asymptomatic cases, and containing an outbreak.

METHODS

Facility Characteristics

Michigan Medicine 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 since they did not experience a COVID-19 outbreak. The three NHs have a combined capacity of 356 beds and house between 7-19 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, while the other four groups are private practice and provide care in one or two of the three NHs. Two of the three NHs are non-profit, 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, which 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 (**Supplemental Figure 1**). 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 fourteen days. Data regarding patient location (room/hall) at diagnosis and after moving to a separate COVID wing, dates of symptom onset, testing, results and fourteen-day outcomes were collected. Demographic data, comorbidities, signs and symptoms were obtained through review of electronic health records (EHR). This study was approved by the University of Michigan IRB. We defined hypoxemia as spO2 $\leq$ 93%[15] and hypotension as systolic blood pressure $\leq$ 100 mm Hg.[16]

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

Implementation of Interventions

1. *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 EPA-registered hospital-grade disinfectants. 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.

2. *Communication*

All residents and HCPs 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 email 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.

3. *PPE 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 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 usage 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.

4. *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.

5. *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 out of 215 (4.7%) residents tested positive for COVID-19: 6/79 (7.6%), 3/40 (7.5%), and 1/96 (1%) in NH 1, NH 2, and NH 3, respectively. Six out 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 pre-symptomatic).

Patient Characteristics

Prior to the point-prevalence survey, 16 residents were diagnosed with 'symptom-triggered' testing. Ten SARS-CoV-2 positive residents (asymptomatic) were identified through 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 an overall COVID-19 infection prevalence of 4.7%. SARS-CoV-2 positive cases who originated outside of the NH, were hospitalized, 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 the majority of 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 like 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 a 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 was transferred to hospice care, and 6 died at the hospital, representing a mortality rate of 20.7% (**Supplemental Table 1**).

Among the six residents who died, five were over the age of 70, all had multiple comorbidities, and five were male. Four were treated in an intensive care unit, and one (< 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.

None of the ten residents who tested positive by point-prevalence survey and were asymptomatic required hospitalization. Four were discharged home and three required NH stay fourteen days after testing.

Staff Outcomes

Twenty-three out of 606 (3.8%) NH staff tested positive (**Table 2**). Sixteen had direct patient contact fourteen days prior to testing positive. It is unclear whether transmission occurred in the NH or in the community. It was difficult to track them as 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 MI 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 which 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 to other NH studies.[4,18,27,28] A majority of initially asymptomatic COVID residents identified by point-prevalence testing developed symptoms within seven days of testing, suggesting that symptom-based screening may be insufficient. As 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, 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 were required to accept 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 pre-symptomatic 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, which 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, as 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 inter-facility 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 HCPs.

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Table 1. Patient Characteristics

Characteristic	**SARS-CoV-2 Positive Patients (*N*=29*)**
Median age, years (range)	73 (30-95)
Sex – no. (%)	
Male	17 (58.6)
Female	12 (41.4)
Race – no. (%)	
Caucasian	24 (82.8)
African American	5 (17.2)
Chronic underlying comorbidities – no. (%)	
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– no. (%)	
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 – no. (%) of patients tested	
Increased C-reactive protein (CRP)	20/20 (100.0)
Increased erythrocyte sedimentation rate (ESR)	4/4 (100.0)
Elevated IL6	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 partial thromboplastin time (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 aspartate aminotransferase (AST)	7/22 (31.8)
Increased procalcitonin	4/14 (28.6)
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 alanine aminotransferase (ALT)	2/22 (9.1)
Increased total bilirubin	0/22 (0.0)

* Not all patients had data point obtained, denominators indicated.

Abbreviations: COPD, chronic obstructive pulmonary disease; IL6, interleukin-6; INR, international normalized ratio.

Table 2. Residents and NH 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 (%)
NH1	5/12 (41.7)	6/79 (7.6)	3/6 (50)	1/8 (12.5)	9/200 (4.5)
NH2	3/13 (23.1)	3/40 (7.5)	3/3 (100)	1/1 (100)	6/141 (4.3)
NH3	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)

Abbreviations: NH, nursing home

Figure Legend

Figure 1. The first confirmed case of COVID-19 identified at NH 1, NH 2, and NH 3 occurred on April 2, March 23, and March 30, respectively.

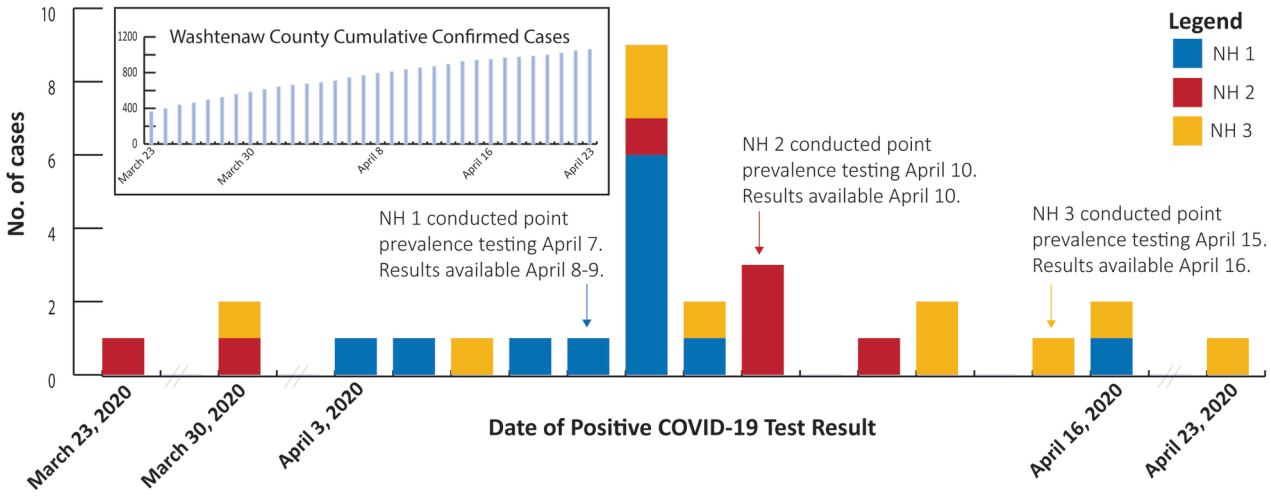
NH 1: four COVID-19 patients were identified between April 2 – 7; point-prevalence testing was conducted on April 7, with results available April 8-9 and six COVID-19 patients were identified; one case from a sample obtained prior to point-prevalence testing was identified on April 8; and one additional COVID-19 patient was identified through symptom-triggered testing on April 16.

NH 2: three COVID-19 patients were identified between March 23 – April 9; point prevalence testing was conducted on April 10 and three COVID-19 patients were identified; and one additional COVID-19 patient was identified through symptom-triggered testing on April 12.

NH 3: eight COVID-19 patients were identified between March 30 – April 14; point prevalence testing was conducted on April 15, with results available the next day and one COVID-19 patient was identified; and one additional COVID-19 patient was identified through symptom-triggered testing on April 23.

Supplemental Table 1. Outcomes of SARS-CoV-2 Positive Residents at 14 days

Supplemental Figure 1. Workflow diagram to implement point-prevalence SARS-CoV-2 batch testing of all asymptomatic residents in nursing homes (NH). This workflow required coordination between NH medical directors/administrators, local hospital leadership, hospital epidemiologist and hospital-based laboratory services. Lab indicates laboratory; STAT, immediately.



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