

Community COVID-19 activity level and nursing home staff testing for active SARS-CoV-2 infection in Indiana

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Conflicts of Interest

KU is CEO and Founder of Probari, Inc., a program to train nurses to reduce nursing home hospital transfers. No other authors have conflicts of interest to disclose.

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Summary: This brief report describes a statewide effort to test nursing home staff and assesses the feasibility of using community COVID-19 activity level to adjust testing frequency. If the goal is to identify all asymptomatic infections comprehensive repeat testing may be needed and should not be based solely on measures of community spread.

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1 **Abstract**

2 **Objectives:** To assess whether using coronavirus disease 2019 (COVID-19) community activity
3 level can accurately inform strategies for routine testing of facility staff for active severe acute
4 respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.

5 **Design:** Cross-sectional study

6 **Setting and Participants:** 59,930 nursing home staff tested for active SARS-CoV-2 infection in
7 Indiana.

8 **Measures:** Receiver operator characteristic curves and the area under the curve (AUC) to
9 compare the sensitivity and specificity of identifying positive cases of staff within facilities
10 based on community COVID-19 activity level including county positivity rate and county cases
11 per 10,000.

12 **Results:** The detection of any infected staff within a facility using county cases per 10,000
13 population or county positivity rate resulted in an AUC of 0.648 (95% CI 0.601-0.696) and 0.649
14 (95% CI 0.601-0.696), respectively. Of staff tested, 28.0% were certified nursing assistants
15 (CNAs), yet accounted for 36.9% of all staff testing positive. Similarly, licensed practical nurses
16 (LPNs) were 1.4% of staff, but 4.7% of positive cases.

17 **Conclusions and Implications:** We failed to observe a meaningful threshold of community
18 COVID-19 activity for the purpose of predicting nursing homes with any positive staff.
19 Guidance issued by the Centers for Medicare and Medicaid Services (CMS) in August 2020 sets
20 the minimum frequency of routine testing for nursing home staff based on county positivity
21 rates. Using the recommended 5% county positivity rate to require weekly testing may miss
22 asymptomatic infections among nursing home staff. Further data on results of all-staff testing
23 efforts, particularly with the implementation of new widespread strategies such as point-of-care

24 testing, is needed to guide policy to protect high risk nursing home residents and staff. If the goal
25 is to identify all asymptomatic SARS-Cov-2 infected nursing home staff, comprehensive repeat
26 testing may be needed regardless of community level activity.

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28

29 **Introduction**

30 Nursing home residents have been disproportionately affected by the coronavirus 2019
31 (COVID-19) pandemic. In the US, 33-82% of COVID-19 deaths are residents of long-term care
32 facilities, a proportion similar to Canada and across Europe.^{1,2} Underlying conditions, including
33 type 2 diabetes mellitus, serious heart conditions, and chronic kidney disease, make residents at
34 high risk for complications of infection from severe acute respiratory coronavirus 2 (SARS-CoV-
35 2).^{3,4} Until recently, facilities had largely shut down visitation and only allowed essential staff,
36 who are screened for SARS-CoV-2 symptoms, to enter and provide care for residents and
37 monitor their health status.⁴ Despite these measures, 50,000-80,000 deaths have occurred in
38 long-term care facilities as of October 1, 2020.^{2,5} As cases continue to rise, surveillance of
39 infected staff is paramount to protecting nursing home residents.

40 Asymptomatic transmission of SARS-CoV-2 by staff, followed by rapid spread, is
41 believed to be the major contributing factor to outbreaks in nursing homes.^{6,7} On May 18, 2020,
42 CMS first recommended weekly testing of all nursing home staff, but advised that local and state
43 governments could adjust this frequency according to local factors.⁸ Resource limitations
44 including testing supply shortages (e.g. swabs, reagents), costs, reporting delays, and logistical
45 issues have challenged states and facilities to develop and implement comprehensive weekly
46 testing programs.⁹⁻¹¹ CMS has begun to distribute 15,000 point-of-care testing machines, along
47 with an initial supply of testing materials, to every nursing home in the United States.¹² Testing
48 capacity is also being supplemented by the distribution of Abbott BinaxNOW point-of-care
49 antigen test cards by the Department of Health and Human Services.¹³ New guidance issued by
50 CMS on August 26, 2020 has set the minimum frequency of routine staff testing based on
51 community COVID-19 activity: <5% monthly, 5% to 10% weekly, >10% twice weekly.¹⁴

52 Noncompliance with testing frequency as recommended will result in citations and financial
53 consequences.¹⁴ A new SARS-CoV-2 infection in any staff member is considered an outbreak by
54 CMS;¹⁵ relying on community COVID-19 activity level remains an untested strategy to identify
55 any facility with at least one infected staff member.

56

57 **Methods**

58 The Indiana State Department of Health (ISDH) aimed to test all Indiana nursing home
59 staff in the month of June, 2020. Consistent with the CMS definition, staff included employees,
60 consultants, contractors, volunteers, or other individuals regularly providing care within and on
61 behalf of the facility. Nursing homes acquired samples from staff using test kits provided by
62 ISDH, or requested on-site sampling. All samples were taken using nasopharyngeal swabs for a
63 polymerase chain reaction (PCR)-based test by a laboratory contracted with the ISDH. Facilities
64 could also report results from PCR-based testing done elsewhere. Staff with a documented prior
65 positive PCR test were exempted. Employee demographic information, role, facility name (only
66 one could be chosen), test date, any close contact with a person infected with SARS-CoV-2, and
67 current symptoms were collected during registration for those tested onsite with ISDH test kits.
68 Individuals with inconclusive results were retested. Staff with multiple tests were identified by
69 matching name (first and last) and date of birth, and only the most recent test was included.

70 Employee data were aggregated to the facility-level. Facility-level measures were
71 calculated to represent the total number of staff tested and the total that tested positive. Facility
72 location was linked with county COVID-19 activity level, for the month of June, as was
73 displayed on the ISDH public dashboard. This included the number of reported cases, number of

74 tests performed, and number of positive tests. County population estimates were extracted from
75 the 2019 American Communities Survey.

76 Characteristics of staff overall and by those positive are presented. Facilities were
77 categorized based on whether they had any positive staff or three or more positive staff, which
78 was considered as higher risk of infection to residents. The sensitivity and specificity of both
79 these outcomes were calculated for each observed level of county test positivity rate (0.31% to
80 25.08%) and cases per 10,000 population (11 to 951). Receiver operator characteristic (ROC)
81 curves were plotted and the area under the curve (AUC) was estimated using the trapezoidal rule.

82

83 **Results**

84 Of 44,065 staff with complete test results (73% of all nursing home staff), 1% (n=466)
85 were positive for active SARS-CoV-2 infection and 177 facilities (32.5%) had at least one
86 positive staff member. Of staff tested, 35,685 were done so onsite (81.0%) and 8,380 (19.0%)
87 results were confirmed by facilities through outside laboratories. Data were missing for 23.3% of
88 staff statewide, due to missing data or inconclusive results (see Appendix 1). Additionally, some
89 staff were tested prior to June and exempted (1.8%) or were documented as refusing testing
90 (1.3%).

91 The detection of any positive cases within a facility using county cases per 10,000
92 population or county positivity rate resulted in an AUC of 0.648 (95% CI 0.601-0.696) and 0.649
93 (95% CI 0.601-0.696), respectively (Figure 1). The AUC values for detecting facilities with 3 or
94 more positive staff were 0.682 (95% CI 0.612-0.753) for county cases per 10,000 population and
95 0.691 (0.622-0.760) for county positivity rate.

96 Certified nursing assistants (CNAs) were 28.0% of staff tested, yet accounted for 36.9%
97 of all staff testing positive (Table 1). Similarly, licensed practical nurses (LPNs) represented
98 1.4% of staff tested, but 4.7% of positive cases. Of staff tested onsite, 11.6% reported close
99 contact with a SARS-CoV-2 infected person, including 39.1% who tested positive.

100 Of 544 facilities, 177 (32.5%) had at least one staff member test positive and 47 (8.6%)
101 had three or more (Table 2). Facilities in counties in the highest quartile of community positivity
102 represented 17.8% of all facilities yet 27.1% of facilities with a positive staff member; and
103 31.9% of those with three or more positive staff. Similarly, facilities in counties with the greatest
104 number of cases per 10,000 population represented 20.6% of all facilities, yet accounted for
105 30.5% of facilities with a positive staff member; and 36.2% of facilities with three or more
106 positive staff members.

107

108 **Discussion**

109 If the goal of the CMS testing strategy is to identify all asymptomatic SARS-Cov-2
110 infected nursing home staff,^{14,15} results from Indiana's statewide all-staff testing initiative reveal
111 that some outbreaks may be missed if thresholds are set using community COVID-19 activity.
112 For example, if weekly testing occurred only in facilities within Indiana counties with a
113 positivity rate of 5% or greater, 47.7% of facilities with a positive case would be identified and
114 21.2% of facilities without a case would be tested. This strategy may miss over half of the
115 facilities with a SARS-CoV-2 infected staff member, particularly if asymptomatic. Based on
116 Indiana's data, in order to capture all facilities with a positive staff (i.e., sensitivity of 100%), the
117 testing threshold must be set at 1% county positivity rate; consequently, this would also test 97%
118 of facilities without any positive staff. As evidenced by AUC values near 0.5, the use of

119 community COVID-19 activity was slightly better than chance at distinguishing facilities with
120 positive cases versus none.

121 Other findings from this statewide testing initiative suggest key characteristics of staff
122 and facilities may require additional monitoring. Among CNAs, infections were nearly 9
123 percentage points greater than expected based on their proportional make-up, and 3 percentage
124 points greater for LPNs. Both roles provide direct patient care and present higher risk of staff-to-
125 resident or resident-to-staff transmission than other roles. Likewise, facilities with the most staff
126 were overrepresented with positive cases, perhaps because of more potential exposures by staff
127 outside the facility or because these were located in areas with greater transmission. Although its
128 usefulness is limited in guiding testing efforts, per our results, we do observe facilities are more
129 likely to have SARS-CoV-2 infected staff in areas with higher COVID-19 activity. As the
130 nursing home industry, state and federal governments grapple with the logistics and costs of
131 ongoing staff testing, thresholds to determine frequencies needed to identify outbreaks quickly
132 will require continued examination.

133 Our analyses have limitations which include using cross-sectional data not suited for
134 determining cause-and-effect. Although we used the official state counts for community COVID-
135 19 spread, we recognize that the data systems and reporting procedures are rapidly evolving and
136 could affect our conclusions as data quality improves. Missing information and staff refusal rates
137 may have affected our conclusions, as approximately 21% of the estimated number of staff had
138 missing data. A considerable number of staff were on extended leave due to COVID-19 concerns
139 and likely contributed to this proportion with missing data. This missing data also highlight
140 challenges to facilities in administering and coordinating testing efforts and the lack of any prior
141 infrastructure for facilities to report results for state officials to monitor. Furthermore, per current

142 CMS guidance, nursing homes are required to ensure testing is done not just for employed staff,
143 but consultants and contractors as well. The small numbers of physicians and advance practice
144 providers who were tested during this state-sponsored initiative may reflect additional challenges
145 in coordinating testing or receiving test results from outside laboratories for these providers
146 within narrow timeframes.

147

148 **Conclusions and Implications**

149 Using the recommended 5% county positivity rate to guide weekly testing of all nursing
150 home staff may miss asymptomatic staff in these facilities. Further data on results of all-staff
151 testing efforts, particularly with the implementation of new widespread strategies such as point-
152 of-care testing, is needed to guide policy to protect high risk nursing home residents and staff.

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216 Figure 1. Receiver operator characteristic curves (ROC) representing community COVID-19
217 activity levels to guide nursing home staff testing in Indiana.

218

219 Figure legend:

220 A, ROC curve for detecting any positive staff using county cases per 10,000. B, ROC curve for identifying 3 or
221 more positive staff using county cases per 10,000. C, ROC curve for identifying any positive staff using county
222 positivity rate. D, ROC curve for identifying 3 or more positive staff using county positivity rate. Source: Authors'
223 calculations based upon Indiana State Department of Health data from staff tested for SARS-CoV-2 during the
224 month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were
225 obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Data represent 44,065 nursing
226 home staff in 544 facilities statewide. AUC = area under the curve.

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228

229 Table 1. Characteristics of nursing home staff tested for SARS-CoV-2 infection in Indiana
 230 during June 2020, overall and by those testing positive for active infection.

	No. of staff with recorded results, %		No. with positive test recorded in June, %	
	N	%	N	%
Total	44,065	73	466	1.1
Age Category				
15-25	8,776	19.9	113	24.2
26-35	9,200	20.9	93	20.0
36-45	9,198	20.9	91	19.5
46-55	8,544	19.4	87	18.7
56-65	6,641	15.1	62	13.3
66-75	1,493	8.4	13	2.8
76+	165	0.4	X	X
Unknown	48	0.1	X	X
Race				
White	25,258	57.3	148	31.8
Black or African American	5,914	13.4	71	15.2
Asian	589	1.3	X	X
Multiracial	601	1.4	X	X
Other	891	2.0	11	2.4
Unknown	10,763	24.4	225	48.3
Hispanic	1,187	2.7	16	3.4
Unknown Ethnicity	12,696	28.8	237	50.9
Role				
Activities	1,545	3.5	X	X
Administration	1,825	4.1	X	X
Certified nursing assistant	12,332	28.0	172	36.9
Dietary	5,251	11.9	39	8.4
Physician	82	0.2	0	0
Nurse practitioner/physician assistant	84	0.2	X	X
Housekeeping	3,503	7.9	21	4.5
Licensed practical nurse	637	1.4	22	4.7
Other	3,473	7.9	27	5.8
Registered nurse (administrative)	1,610	3.7	15	3.2
Registered nurse (patient care)	5,760	13.1	48	10.3
Social Services	545	1.2	X	X
Therapy (physical, occupational, speech)	2,389	5.4	22	4.7
Role not recorded	5,029	11.4	81	17.4
Contact with SARS-CoV-2 infected person ¹				
Yes	4,154	11.5	97	39.1
No	31,493	88.3	151	60.9
Use of tobacco or e-cigarettes ¹				
Some Days	2,256	6.3	26	10.5
Every Day	7,662	21.5	28	11.3

231 ¹Questions were asked of n=36,685 staff tested on-site, including n=248 with a positive test; this information was
 232 not collected for staff members with confirmed PCR-based test results from outside laboratories.

233 Source: Authors' calculations based upon Indiana Department of Health data from staff tested for SARS-CoV-2
 234 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population

235 data were obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Cell counts denoted
236 with an "X" are suppressed due small samples (<10) and privacy concerns.

237 Table 2. Number of staff and measures of community spread of SARS-CoV-2 for nursing home
 238 facilities in Indiana during June 2020.

	No. of facilities, %		No. of facilities with any positive, %		No. of facilities with 3+ positive, %	
	N	%	N	%	N	%
Total	544	100	177	32.5	47	8.6
No. of Facility staff (quartiles)						
76 or fewer	147	27.0	27	15.3	3	6.4
77 to 102	133	24.4	35	19.8	7	14.9
103 to 140	142	26.1	49	27.7	15	31.9
140 or more	122	22.4	66	37.3	22	46.8
County positivity rate (quartiles)						
2.33% or less	138	25.6	31	17.5	3	6.4
2.34 to 3.64%	135	25.0	34	19.2	8	17.0
3.65 to 5.33%	172	31.9	63	35.6	21	44.7
5.34% or higher	95	17.8	48	27.1	15	31.9
County Cases per 10,000 population (quartiles)						
74 or lower	139	25.6	30	16.9	6	12.8
75 to 113	134	25.0	33	18.6	4	8.5
114 to 171	156	28.9	59	33.3	20	42.6
172 or higher	111	20.6	54	30.5	17	36.2

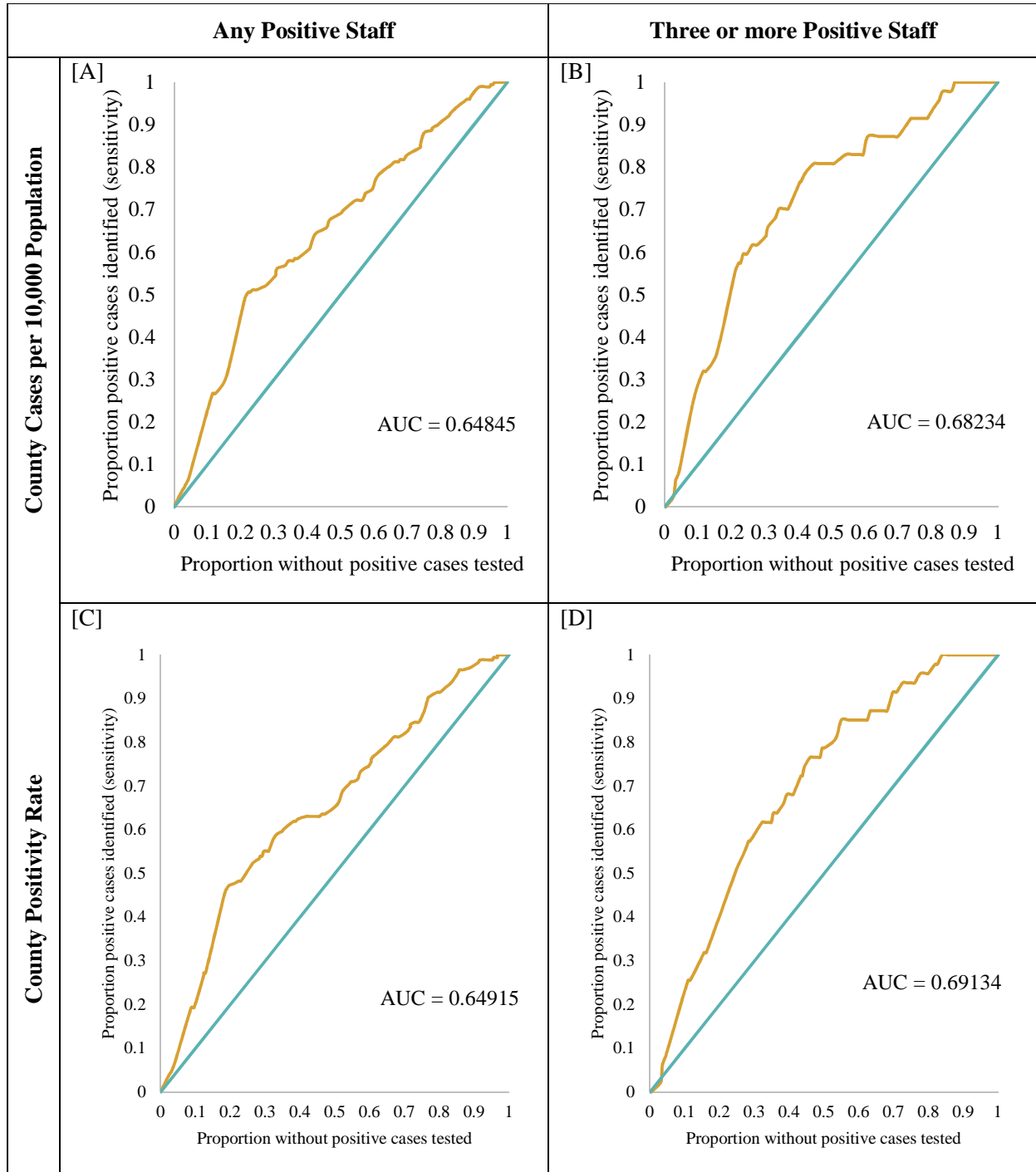
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Figure 1. Receiver operator characteristic curves (ROC) representing community COVID-19 activity levels to guide nursing home staff testing in Indiana.



A, ROC curve for detecting any positive staff using county cases per 10,000. B, ROC curve for identifying 3 or more positive staff using county cases per 10,000. C, ROC curve for identifying any positive staff using county positivity rate. D, ROC curve for identifying 3 or more positive staff using county positivity rate. Source: Authors' calculations based upon Indiana State Department of Health data from staff tested for SARS-CoV-2 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were

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1 **Abstract**

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4 respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.

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7 Indiana.

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29 **Introduction**

30 Nursing home residents have been disproportionately affected by the coronavirus 2019
31 (COVID-19) pandemic. In the US, 33-82% of COVID-19 deaths are residents of long-term care
32 facilities, a proportion similar to Canada and across Europe.^{1,2} Underlying conditions, including
33 type 2 diabetes mellitus, serious heart conditions, and chronic kidney disease, make residents at
34 high risk for complications of infection from severe acute respiratory coronavirus 2 (SARS-CoV-
35 2).^{3,4} Until recently, facilities had largely shut down visitation and only allowed essential staff,
36 who are screened for SARS-CoV-2 symptoms, to enter and provide care for residents and
37 monitor their health status.⁴ Despite these measures, 50,000-80,000 deaths have occurred in
38 long-term care facilities as of October 1, 2020.^{2,5} As cases continue to rise, surveillance of
39 infected staff is paramount to protecting nursing home residents.

40 Asymptomatic transmission of SARS-CoV-2 by staff, followed by rapid spread, is
41 believed to be the major contributing factor to outbreaks in nursing homes.^{6,7} On May 18, 2020,
42 CMS first recommended weekly testing of all nursing home staff, but advised that local and state
43 governments could adjust this frequency according to local factors.⁸ Resource limitations
44 including testing supply shortages (e.g. swabs, reagents), costs, reporting delays, and logistical
45 issues have challenged states and facilities to develop and implement comprehensive weekly
46 testing programs.⁹⁻¹¹ CMS has begun to distribute 15,000 point-of-care testing machines, along
47 with an initial supply of testing materials, to every nursing home in the United States.¹² Testing
48 capacity is also being supplemented by the distribution of Abbott BinaxNOW point-of-care
49 antigen test cards by the Department of Health and Human Services.¹³ New guidance issued by
50 CMS on August 26, 2020 has set the minimum frequency of routine staff testing based on
51 community COVID-19 activity: <5% monthly, 5% to 10% weekly, >10% twice weekly.¹⁴

52 Noncompliance with testing frequency as recommended will result in citations and financial
53 consequences.¹⁴ A new SARS-CoV-2 infection in any staff member is considered an outbreak by
54 CMS;¹⁵ relying on community COVID-19 activity level remains an untested strategy to identify
55 any facility with at least one infected staff member.

56

57 **Methods**

58 The Indiana State Department of Health (ISDH) aimed to test all Indiana nursing home
59 staff in the month of June, 2020. Consistent with the CMS definition, staff included employees,
60 consultants, contractors, volunteers, or other individuals regularly providing care within and on
61 behalf of the facility. Nursing homes acquired samples from staff using test kits provided by
62 ISDH, or requested on-site sampling. All samples were taken using nasopharyngeal swabs for a
63 polymerase chain reaction (PCR)-based test by a laboratory contracted with the ISDH. Facilities
64 could also report results from PCR-based testing done elsewhere. Staff with a documented prior
65 positive PCR test were exempted. Employee demographic information, role, facility name (only
66 one could be chosen), test date, any close contact with a person infected with SARS-CoV-2, and
67 current symptoms were collected during registration for those tested onsite with ISDH test kits.
68 Individuals with inconclusive results were retested. Staff with multiple tests were identified by
69 matching name (first and last) and date of birth, and only the most recent test was included.

70 Employee data were aggregated to the facility-level. Facility-level measures were
71 calculated to represent the total number of staff tested and the total that tested positive. Facility
72 location was linked with county COVID-19 activity level, for the month of June, as was
73 displayed on the ISDH public dashboard. This included the number of reported cases, number of

74 tests performed, and number of positive tests. County population estimates were extracted from
75 the 2019 American Communities Survey.

76 Characteristics of staff overall and by those positive are presented. Facilities were
77 categorized based on whether they had any positive staff or three or more positive staff, which
78 was considered as higher risk of infection to residents. The sensitivity and specificity of both
79 these outcomes were calculated for each observed level of county test positivity rate (0.31% to
80 25.08%) and cases per 10,000 population (11 to 951). Receiver operator characteristic (ROC)
81 curves were plotted and the area under the curve (AUC) was estimated using the trapezoidal rule.

82

83 **Results**

84 Of 44,065 staff with complete test results (73% of all nursing home staff), 1% (n=466)
85 were positive for active SARS-CoV-2 infection and 177 facilities (32.5%) had at least one
86 positive staff member. Of staff tested, 35,685 were done so onsite (81.0%) and 8,380 (19.0%)
87 results were confirmed by facilities through outside laboratories. Data were missing for 23.3% of
88 staff statewide, due to missing data or inconclusive results (see Appendix 1). Additionally, some
89 staff were tested prior to June and exempted (1.8%) or were documented as refusing testing
90 (1.3%).

91 The detection of any positive cases within a facility using county cases per 10,000
92 population or county positivity rate resulted in an AUC of 0.648 (95% CI 0.601-0.696) and 0.649
93 (95% CI 0.601-0.696), respectively (Figure 1). The AUC values for detecting facilities with 3 or
94 more positive staff were 0.682 (95% CI 0.612-0.753) for county cases per 10,000 population and
95 0.691 (0.622-0.760) for county positivity rate.

96 Certified nursing assistants (CNAs) were 28.0% of staff tested, yet accounted for 36.9%
97 of all staff testing positive (Table 1). Similarly, licensed practical nurses (LPNs) represented
98 1.4% of staff tested, but 4.7% of positive cases. Of staff tested onsite, 11.6% reported close
99 contact with a SARS-CoV-2 infected person, including 39.1% who tested positive.

100 Of 544 facilities, 177 (32.5%) had at least one staff member test positive and 47 (8.6%)
101 had three or more (Table 2). Facilities in counties in the highest quartile of community positivity
102 represented 17.8% of all facilities yet 27.1% of facilities with a positive staff member; and
103 31.9% of those with three or more positive staff. Similarly, facilities in counties with the greatest
104 number of cases per 10,000 population represented 20.6% of all facilities, yet accounted for
105 30.5% of facilities with a positive staff member; and 36.2% of facilities with three or more
106 positive staff members.

107

108 **Discussion**

109 If the goal of the CMS testing strategy is to identify all asymptomatic SARS-Cov-2
110 infected nursing home staff,^{14,15} results from Indiana's statewide all-staff testing initiative reveal
111 that some outbreaks may be missed if thresholds are set using community COVID-19 activity.
112 For example, if weekly testing occurred only in facilities within Indiana counties with a
113 positivity rate of 5% or greater, 47.7% of facilities with a positive case would be identified and
114 21.2% of facilities without a case would be tested. This strategy may miss over half of the
115 facilities with a SARS-CoV-2 infected staff member, particularly if asymptomatic. Based on
116 Indiana's data, in order to capture all facilities with a positive staff (i.e., sensitivity of 100%), the
117 testing threshold must be set at 1% county positivity rate; consequently, this would also test 97%
118 of facilities without any positive staff. As evidenced by AUC values near 0.5, the use of

119 community COVID-19 activity was slightly better than chance at distinguishing facilities with
120 positive cases versus none.

121 Other findings from this statewide testing initiative suggest key characteristics of staff
122 and facilities may require additional monitoring. Among CNAs, infections were nearly 9
123 percentage points greater than expected based on their proportional make-up, and 3 percentage
124 points greater for LPNs. Both roles provide direct patient care and present higher risk of staff-to-
125 resident or resident-to-staff transmission than other roles. Likewise, facilities with the most staff
126 were overrepresented with positive cases, perhaps because of more potential exposures by staff
127 outside the facility or because these were located in areas with greater transmission. Although its
128 usefulness is limited in guiding testing efforts, per our results, we do observe facilities are more
129 likely to have SARS-CoV-2 infected staff in areas with higher COVID-19 activity. As the
130 nursing home industry, state and federal governments grapple with the logistics and costs of
131 ongoing staff testing, thresholds to determine frequencies needed to identify outbreaks quickly
132 will require continued examination.

133 Our analyses have limitations which include using cross-sectional data not suited for
134 determining cause-and-effect. Although we used the official state counts for community COVID-
135 19 spread, we recognize that the data systems and reporting procedures are rapidly evolving and
136 could affect our conclusions as data quality improves. Missing information and staff refusal rates
137 may have affected our conclusions, as approximately 21% of the estimated number of staff had
138 missing data. A considerable number of staff were on extended leave due to COVID-19 concerns
139 and likely contributed to this proportion with missing data. This missing data also highlight
140 challenges to facilities in administering and coordinating testing efforts and the lack of any prior
141 infrastructure for facilities to report results for state officials to monitor. Furthermore, per current

142 CMS guidance, nursing homes are required to ensure testing is done not just for employed staff,
143 but consultants and contractors as well. The small numbers of physicians and advance practice
144 providers who were tested during this state-sponsored initiative may reflect additional challenges
145 in coordinating testing or receiving test results from outside laboratories for these providers
146 within narrow timeframes.

147

148 **Conclusions and Implications**

149 Using the recommended 5% county positivity rate to guide weekly testing of all nursing
150 home staff may miss asymptomatic staff in these facilities. Further data on results of all-staff
151 testing efforts, particularly with the implementation of new widespread strategies such as point-
152 of-care testing, is needed to guide policy to protect high risk nursing home residents and staff.

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215

216 Figure 1. Receiver operator characteristic curves (ROC) representing community COVID-19
217 activity levels to guide nursing home staff testing in Indiana.

218

219 Figure legend:

220 A, ROC curve for detecting any positive staff using county cases per 10,000. B, ROC curve for identifying 3 or
221 more positive staff using county cases per 10,000. C, ROC curve for identifying any positive staff using county
222 positivity rate. D, ROC curve for identifying 3 or more positive staff using county positivity rate. Source: Authors'
223 calculations based upon Indiana State Department of Health data from staff tested for SARS-CoV-2 during the
224 month of June 2020 and county-reported cases and percent of positive tests. Indiana county population data were
225 obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Data represent 44,065 nursing
226 home staff in 544 facilities statewide. AUC = area under the curve.

227

228

229 Table 1. Characteristics of nursing home staff tested for SARS-CoV-2 infection in Indiana
 230 during June 2020, overall and by those testing positive for active infection.

	No. of staff with recorded results, %		No. with positive test recorded in June, %	
	N	%	N	%
Total	44,065	73	466	1.1
Age Category				
15-25	8,776	19.9	113	24.2
26-35	9,200	20.9	93	20.0
36-45	9,198	20.9	91	19.5
46-55	8,544	19.4	87	18.7
56-65	6,641	15.1	62	13.3
66-75	1,493	8.4	13	2.8
76+	165	0.4	X	X
Unknown	48	0.1	X	X
Race				
White	25,258	57.3	148	31.8
Black or African American	5,914	13.4	71	15.2
Asian	589	1.3	X	X
Multiracial	601	1.4	X	X
Other	891	2.0	11	2.4
Unknown	10,763	24.4	225	48.3
Hispanic	1,187	2.7	16	3.4
Unknown Ethnicity	12,696	28.8	237	50.9
Role				
Activities	1,545	3.5	X	X
Administration	1,825	4.1	X	X
Certified nursing assistant	12,332	28.0	172	36.9
Dietary	5,251	11.9	39	8.4
Physician	82	0.2	0	0
Nurse practitioner/physician assistant	84	0.2	X	X
Housekeeping	3,503	7.9	21	4.5
Licensed practical nurse	637	1.4	22	4.7
Other	3,473	7.9	27	5.8
Registered nurse (administrative)	1,610	3.7	15	3.2
Registered nurse (patient care)	5,760	13.1	48	10.3
Social Services	545	1.2	X	X
Therapy (physical, occupational, speech)	2,389	5.4	22	4.7
Role not recorded	5,029	11.4	81	17.4
Contact with SARS-CoV-2 infected person ¹				
Yes	4,154	11.5	97	39.1
No	31,493	88.3	151	60.9
Use of tobacco or e-cigarettes ¹				
Some Days	2,256	6.3	26	10.5
Every Day	7,662	21.5	28	11.3

231 ¹Questions were asked of n=36,685 staff tested on-site, including n=248 with a positive test; this information was
 232 not collected for staff members with confirmed PCR-based test results from outside laboratories.

233 Source: Authors' calculations based upon Indiana Department of Health data from staff tested for SARS-CoV-2
 234 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population

235 data were obtained from the American Communities Survey for 2019 (1-year estimate). Notes: Cell counts denoted
236 with an "X" are suppressed due small samples (<10) and privacy concerns.

237 Table 2. Number of staff and measures of community spread of SARS-CoV-2 for nursing home
 238 facilities in Indiana during June 2020.

	No. of facilities, %		No. of facilities with any positive, %		No. of facilities with 3+ positive, %	
	N	%	N	%	N	%
Total	544	100	177	32.5	47	8.6
No. of Facility staff (quartiles)						
76 or fewer	147	27.0	27	15.3	3	6.4
77 to 102	133	24.4	35	19.8	7	14.9
103 to 140	142	26.1	49	27.7	15	31.9
140 or more	122	22.4	66	37.3	22	46.8
County positivity rate (quartiles)						
2.33% or less	138	25.6	31	17.5	3	6.4
2.34 to 3.64%	135	25.0	34	19.2	8	17.0
3.65 to 5.33%	172	31.9	63	35.6	21	44.7
5.34% or higher	95	17.8	48	27.1	15	31.9
County Cases per 10,000 population (quartiles)						
74 or lower	139	25.6	30	16.9	6	12.8
75 to 113	134	25.0	33	18.6	4	8.5
114 to 171	156	28.9	59	33.3	20	42.6
172 or higher	111	20.6	54	30.5	17	36.2

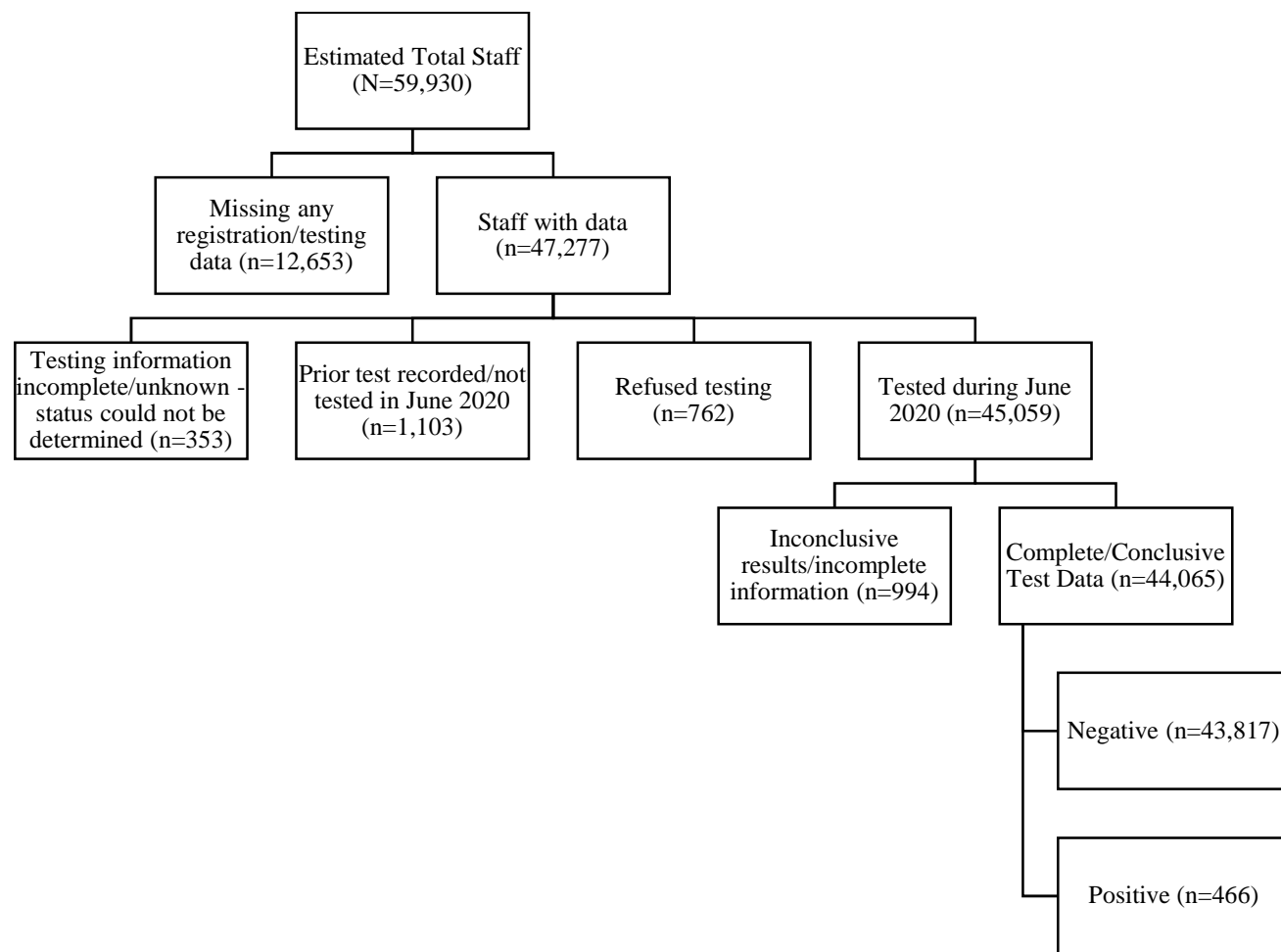
239 Source: Authors' calculations based upon Indiana Department of Health data from staff tested for SARS-CoV-2
 240 during the month of June 2020 and county-reported cases and percent of positive tests. Indiana county population
 241 data were obtained from the American Communities Survey for 2019 (1-year estimate).

242

243

244

Appendix 1. Number and outcome of Indiana nursing home staff tested for active SARS-CoV-2 infection during June 2020.



Notes: The estimated total staff were reported by each facility prior to the launch of the testing effort to enable the Indiana Department of Health to plan for testing supplies and sample collection.