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APPENDIX AND REFERENCES

Nursing Home Staffing Shortages and the New Federal Nursing Home Standard

George Miller, Matthew Daly

Nursing Home Staffing Shortages and the New Federal Nursing Home Standards

Nursing homes in the U.S have major staffing shortages that can lead to poor quality of care for residents. New minimum staffing standards mandated by the U.S. Centers for Medicare and Medicaid Services are intended to address this problem. The standards include requirements for a daily minimum of 2.45 hours of nurse aide (NA) time per resident (referred to as hours per resident day, or HPRD) and 0.55 daily hours of time by registered nurses (RNs) per resident. Most nursing homes in the U.S. do not currently meet these new standards, but there is significant variation among nursing homes around these overall HPRD levels. This has led us to investigate the following question: What characteristics of nursing homes are associated with a higher probability of meeting the newly proposed standards? Using logistic regression and national datasets, we investigate the association between whether a nursing home meets the standards and the following characteristics of the home:

- Whether the home is in a rural rather than non-rural county
- Whether the home is operated by a for-profit rather than nonprofit provider
- The percent of residents in the home who are persons of color
- The percent of residents in the home whose primary funding is Medicaid, as opposed to higher funding levels from Medicare or private payers

While the location of a nursing home is not a significant predictor of the probability of meeting the standards, all of the other three characteristics lower the probability of meeting the standards and are highly significant ($p<.001$). We also examine variation among states in the extent to which the above four characteristics affect the percent of nursing homes meeting the standards in each state.

Read the entire brief here:
https://altarum.org/news-and-insights/nursing-home-staffing-shortages-and-new-federal-nursing-home-standards

Appendix: Analytic Methods and Detailed Results

National Model

A multivariable logistic regression model was used to assess the impact across all nursing homes in the U.S. of four independent variables (for-profit vs. nonprofit, urban vs. rural location, percent of residents who are persons of color, and percent of residents for whom Medicaid is the payer). The model, which incorporates interactions among the four independent variables, has the following structure:

$$\log [(p/(1-p)] = \beta_0 + \beta_R*R + \beta_F*F + \beta_M*M + \beta_C*C + \beta_{RF}*R*F + \beta_{RM}*R*M + \beta_{RC}*R*C + \beta_{FM}*F*M + \beta_{FC}*F*C + \beta_{MC}*M*C + \beta_{RFM}*R*F*M + \beta_{RFC}*R*F*C + \beta_{RMC}*R*M*C + \beta_{FMC}*F*M*C + \beta_{RFMC}*R*F*M*C$$

where

p = probability a nursing home meets the standard
R = 1 if home is in a rural county, otherwise 0
F = 1 if home is for-profit, otherwise 0
M = percent of residents in the home that are Medicaid funded
C = percent of residents in the home that are persons of color

Results are shown in Exhibit A1.

Exhibit A1: National Model Results

	Estimate	Std Error	z value	Pr(>|z|)	Sig
(Intercept)	-0.850	0.050	-17.048	2.00E-16	***
rural	0.156	0.110	1.417	0.156	
profit	-1.193	0.064	-18.715	2.00E-16	***
nonwhite	-0.008	0.002	-3.305	9.49E-04	***
medicaid	-0.021	0.002	-12.492	2.00E-16	***
rural:profit	-0.248	0.146	-1.699	0.089	.
rural:nonwhite	0.002	0.006	0.434	0.664	
profit:nonwhite	0.002	0.003	0.642	0.521	
rural:medicaid	0.000	0.005	0.023	0.982	
profit:medicaid	-0.005	0.002	-2.295	2.17E-02	*
nonwhite:medicaid	0.000	0.000	0.469	0.639	
rural:profit:nonwhite	-0.006	0.007	-0.736	0.461	
rural:profit:medicaid	0.005	0.007	0.774	0.439	
rural:nonwhite:medicaid	0.000	0.000	-1.342	0.180	
profit:nonwhite:medicaid	0.000	0.000	1.410	0.158	
rural:profit:nonwhite:medicaid	0.000	0.000	0.030	0.976	

Sig (significance): ***<.001, **<.01, *<.05

For more information, please contact George Miller, Fellow and Research Team Leader, Applied Research and Analytics, at george.miller@altarum.org

State-Level Analysis: Rural vs. Non-Rural Location

Exhibit A2 shows the fraction of rural and of non-rural homes in each state that meet the standards and displays the results of Fisher's exact test of the hypothesis that a rural county does not influence the probability that the standards are met.

Exhibit A2. State-Level Impact of Rural vs. Non-Rural Location

	Fraction Meeting Standards					Fraction Meeting Standards			
State	Non-Rural	Rural	P-Value	Significance	State	Non-Rural	Rural	P-Value	Significance
AL	0.154	0.233	0.190		MT	0.200	0.389	0.229	
AR	0.027	0.098	0.043	*	NC	0.140	0.078	0.095	
AZ	0.206	0.000	0.206		ND	0.727	0.654	0.597	
CA	0.246	0.091	0.039	*	NE	0.478	0.383	0.220	
CO	0.172	0.185	0.838		NH	0.256	0.294	0.795	
CT	0.200	0.000	0.129		NM	0.237	0.200	0.776	
FL	0.522	0.351	0.062		NV	0.294	0.500	0.273	
GA	0.071	0.053	0.652		NY	0.137	0.066	0.097	
HI	0.759	0.583	0.285		OH	0.116	0.103	0.641	
IA	0.318	0.217	0.033	*	OK	0.081	0.071	0.823	*
ID	0.370	0.455	0.492		OR	0.647	0.900	0.033	*
IL	0.129	0.130	1.000		PA	0.150	0.046	0.003	
IN	0.113	0.060	0.057		SC	0.228	0.135	0.264	
KS	0.243	0.422	0.001	*	SD	0.172	0.265	0.437	*
KY	0.159	0.155	1.000		TN	0.103	0.035	0.045	
LA	0.031	0.000	0.341		TX	0.048	0.048	1.000	
MA	0.111	0.250	0.381		UT	0.301	0.400	0.548	
MD	0.154	0.250	0.412		VA	0.149	0.114	0.566	
ME	0.587	0.833	0.018	*	VT	0.375	0.308	1.000	
MI	0.166	0.451	0.000	*	WA	0.434	0.520	0.518	
MN	0.415	0.514	0.077		WI	0.337	0.346	0.907	
MO	0.112	0.062	0.073		WV	0.143	0.175	0.803	
MS	0.138	0.147	1.000		WY	0.000	0.321	0.162	

Significance: *<.05

Note: DC, DE, NJ, and RI are not included because they have no rural counties. AK is not included because all facilities meet the standards.

For more information, please contact George Miller, Fellow and Research Team Leader, Applied Research and Analytics, at george.miller@altarum.org

State-Level Analysis: Nonprofit vs. For-Profit Status

Exhibit A3 shows the fraction of nonprofit and for-profit homes in each state that meet the standards and displays the results of Fisher's exact test of the hypothesis that profit status does not influence the probability that the standards are met.

Exhibit A3. State-Level Impact of Nonprofit vs. For-Profit Status

	Fraction Meeting Standards					Fraction Meeting Standards			
State	Nonprofit	For-Profit	P-Value	Significance	State	Nonprofit	For-Profit	P-Value	Significance
AL	0.371	0.144	0.003	*	NC	0.431	0.054	0.000	*
AR	0.111	0.052	0.244		ND	0.704	0.000	0.031	*
AZ	0.333	0.162	0.075		NE	0.519	0.243	0.000	*
CA	0.540	0.186	0.000	*	NH	0.625	0.065	0.000	*
CO	0.341	0.131	0.003	*	NJ	0.405	0.075	0.000	*
CT	0.528	0.110	0.000	*	NM	0.267	0.196	0.720	
DE	0.313	0.074	0.082		NV	0.727	0.245	0.004	*
FL	0.686	0.434	0.000	*	NY	0.276	0.043	0.000	*
GA	0.092	0.045	0.099		OH	0.314	0.055	0.000	*
HI	0.938	0.542	0.012	*	OK	0.167	0.066	0.065	
IA	0.298	0.203	0.042	*	OR	0.882	0.670	0.091	
ID	0.667	0.333	0.015	*	PA	0.256	0.017	0.000	*
IL	0.307	0.068	0.000	*	RI	0.667	0.234	0.005	*
IN	0.131	0.057	0.005	*	SC	0.488	0.126	0.000	*
KS	0.590	0.150	0.000	*	SD	0.333	0.033	0.001	*
KY	0.468	0.093	0.000	*	TN	0.159	0.054	0.013	*
LA	0.068	0.010	0.040	*	TX	0.133	0.021	0.000	*
MA	0.245	0.062	0.000	*	UT	0.265	0.339	0.498	
MD	0.429	0.068	0.000	*	VA	0.405	0.030	0.000	*
ME	0.828	0.644	0.088		VT	0.636	0.174	0.016	*
MI	0.559	0.115	0.000	*	WA	0.667	0.385	0.001	*
MN	0.542	0.253	0.000	*	WI	0.532	0.169	0.000	*
MO	0.271	0.040	0.000	*	WV	0.350	0.108	0.012	*
MS	0.220	0.111	0.118		WY	0.471	0.059	0.017	*
MT	0.655	0.103	0.000	*					

Significance: *<.05
Note: AK and DC are not included because they are not included in the LTCFocus data.

For more information, please contact George Miller, Fellow and Research Team Leader, Applied Research and Analytics, at george.miller@altarum.org

State-Level Analysis: Percent of Residents Who Are Persons of Color

To investigate the relationship at the state level between the percent of nursing home residents who are persons of color and the probability that the home meets the standards, we developed a logistic regression model with the following structure:

$$\log [(p_k/(1-p_k)] = \beta_0 + \Sigma \beta_i * C_i$$

where

p = probability a nursing home in state k meets the standard
C_i = percent of residents in the home that are persons of color if i = k; 0 otherwise

Results of the regression are in Exhibit A5.

Exhibit A4. State-Level Impact of Percent of Residents Who Are Persons of Color

State	Non-White Coefficient	P-Value	Significance	State	Non-White Coefficient	P-Value	Significance
AL	-0.021	0.034	*	NC	-0.063	0.000	*
AR	0.009	0.490		ND	-0.029	0.445	
AZ	-0.008	0.463		NE	-0.029	0.073	
CA	-0.015	0.000	*	NH	-0.179	0.141	
CO	-0.023	0.051		NJ	-0.020	0.011	*
CT	-0.055	0.001	*	NM	-0.020	0.301	
DE	-0.041	0.424		NV	-0.009	0.566	
FL	-0.004	0.234		NY	-0.009	0.064	
GA	-0.050	0.001	*	OH	-0.025	0.001	*
HI	-0.016	0.575		OK	-0.057	0.022	*
IA	-0.003	0.839		OR	0.007	0.589	
ID	-0.043	0.178		PA	-0.012	0.102	
IL	-0.054	0.000	*	RI	-0.057	0.059	
IN	-0.030	0.010	*	SC	-0.085	0.000	*
KS	-0.065	0.000	*	SD	0.019	0.213	
KY	-0.061	0.008	*	TN	-0.041	0.049	*
LA	-0.033	0.256		TX	-0.024	0.005	*
MA	-0.045	0.012	*	UT	-0.021	0.221	
MD	-0.034	0.000	*	VA	-0.058	0.000	*
ME	-0.011	0.621		VT	-0.046	0.315	
MI	-0.053	0.000	*	WA	-0.007	0.552	
MN	-0.017	0.010	*	WI	-0.051	0.000	*
MO	-0.021	0.070		WV	0.023	0.335	
MS	-0.027	0.033	*	WY	-0.230	0.065	
MT	0.008	0.549					

Significance: *<.05
Note: AK and DC are not included because they are not included in the LTCFocus data.

For more information, please contact George Miller, Fellow and Research Team Leader, Applied Research and Analytics, at george.miller@altarum.org

State-Level Analysis: Percent of Residents Who Are Medicaid-Funded

To investigate the relationship at the state level between the extent to which nursing home residents are funded by Medicaid and the probability that the home meets the standard, we developed a logistic regression model with the following structure:

$$\log [(p_k/(1-p_k)] = \beta_0 + \Sigma \beta_i * M_i$$

where

p = probability a nursing home in state k meets the standard
M_i = percent of residents in the home that are Medicaid funded if I = k; 0 otherwise

Results of the regression are in Exhibit A5.

Exhibit A5. State-Level Impact of Percent of Residents Who Are Medicaid Funded

State	Medicaid Coefficient	P-Value	Significance	State	Medicaid Coefficient	P-Value	Significance
AL	-0.020	0.020	*	NC	-0.056	0.000	*
AR	-0.028	0.110		ND	0.026	0.173	
AZ	-0.025	0.000	*	NE	-0.048	0.000	*
CA	-0.016	0.000	*	NH	-0.025	0.062	
CO	-0.031	0.000	*	NJ	-0.017	0.001	*
CT	-0.040	0.000	*	NM	-0.033	0.004	*
DE	-0.009	0.558		NV	-0.020	0.030	*
FL	-0.025	0.000	*	NY	-0.033	0.000	*
GA	-0.051	0.000	*	OH	-0.023	0.000	*
HI	-0.003	0.791		OK	-0.014	0.112	
IA	-0.023	0.000	*	OR	-0.015	0.180	
ID	-0.026	0.008	*	PA	-0.040	0.000	*
IL	-0.042	0.000	*	RI	-0.009	0.511	
IN	-0.025	0.000	*	SC	-0.043	0.000	*
KS	-0.037	0.000	*	SD	-0.034	0.028	*
KY	-0.024	0.000	*	TN	-0.046	0.000	*
LA	-0.071	0.000	*	TX	-0.034	0.000	*
MA	-0.024	0.001	*	UT	-0.041	0.000	*
MD	-0.048	0.000	*	VA	-0.048	0.000	*
ME	-0.012	0.382		VT	-0.035	0.174	
MI	0.003	0.648		WA	-0.023	0.001	*
MN	-0.016	0.008	*	WI	-0.039	0.000	*
MO	-0.046	0.000	*	WV	-0.023	0.055	
MS	-0.006	0.551		WY	0.027	0.394	
MT	-0.027	0.097					

Significance: *<.05
Note: AK and DC are not included because they are not included in the LTCFocus data.

For more information, please contact George Miller, Fellow and Research Team Leader, Applied Research and Analytics, at george.miller@altarum.org

State-Level Analysis Summary

Results of these state-level analyses are summarized in Exhibit A6. Colored cells indicate statistically significant differences in rates of meeting the proposed staffing levels for nursing homes:

- in rural (vs. nonrural) counties,
- that are for-profit (vs. nonprofit),
- with a greater percent of residents who are persons of color, and
- with a greater percent of residents who are covered by Medicaid.

Exhibit A6. Impact of Independent Variables by State

State	Rural	For-Profit	Non-White	Medicaid
AL				
AR				
AZ				
CA				
CO				
CT				
DE				
FL				
GA				
HI				
IA				
ID				
IL				
IN				
KS				
KY				
LA				
MA				
MD				
ME				
MI				
MN				
MO				
MS				
MT				

State	Rural	For-Profit	Non-White	Medicaid
NC				
ND				
NE				
NH				
NJ				
NM				
NV				
NY				
OH				
OK				
OR				
PA				
RI				
SC				
SD				
TN				
TX				
UT				
VA				
VT				
WA				
WI				
WV				
WY				

indicates higher rate of meeting standards

indicates lower rate of meeting standards

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