


BMJ Open Quality Predicting COVID-19 at skilled nursing facilities in California: do the stars align?

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INTRODUCTION

A notable proportion of cases of COVID-19 have occurred among older adults living in congregant settings.^{1 2} Once an outbreak occurs in such settings, few mitigation strategies exist. Identifying predictors of COVID-19 would facilitate enhanced surveillance to prevent future outbreaks. The Centers for Medicare and Medicaid Services have long required that all skilled nursing facilities (SNFs) report quality metrics, including the Five-Star Quality Rating System for comparing SNFs: 1 star (lowest score) to 5 star (highest score).³ This metric is predicated on patient and stakeholder perceptions. We examined the relationship of star ratings and other facility-related metrics to COVID-19 occurrence among nursing home residents using a newly established reporting mechanism by the state of California.

METHODS

Beginning 17 April 2020, the California Department of Public Health (CDPH) started reporting the daily and cumulative numbers of positive cases of COVID-19 among the residents and staff of SNFs.⁴ For this study, we used the category ‘Cumulative Positive Residents’, and compiled data available through 31 May 2020.

SNF characteristics were obtained from the Facilities Compare Website³ as follows: Overall Star Rating, its three domains—Health Inspections, Staffing and Quality Measures, plus Provider and Ownership Types, Number of Certified Beds and Medicare Claims Quality Measures, and linked using the Federal Provider Number. Descriptive statistics were used for SNF characteristics with and without COVID-19 among the residents, and univariate-adjusted and multivariable-adjusted logistic regression models explored an association between the SNF characteristics

with COVID-19 presence in SNF, while handling multicollinearity. The proportion of infected residents was calculated as the ratio of the maximum cumulative number of cases reported to the number of certified beds and visualised as bar plots for all levels of Five-Star ratings—SNFs with ‘<11’ infected residents were treated as having one infected resident per CDPH reporting requirements.⁴

RESULTS

A total of 1184 of 1224 facilities that reported data are included in analyses. The cumulative number of residents with COVID-19 is 9650.⁴ Approximately 24% of facilities reported COVID-19 as of 31 May 2020. **Figure 1** displays the proportions of facilities with residents with COVID-19 by star ratings. There appears to be an inverse relationship with COVID-19 with the Health Inspection and Overall Star ratings. Univariate regression shows that Health Inspection ratings and Overall ratings are significantly associated with facilities reporting COVID-19, and with multivariable adjustment, health inspections, emergency room visits and short-stay hospitalisations remain significant. Particularly, Health Inspection (among the three domains of the Overall rating) showed a consistent monotonic relationship between the star value and the presence of COVID-19, OR 2.6–6.5 (**table 1** and online supplemental table S1).

DISCUSSION

Publicly reported SNF metrics are associated with COVID-19 presence in facilities. While not directly compared with each other, the findings suggest that facility star ratings directly driven by *recent* patient and stakeholder complaints are more potent predictors of COVID-19 than staffing or

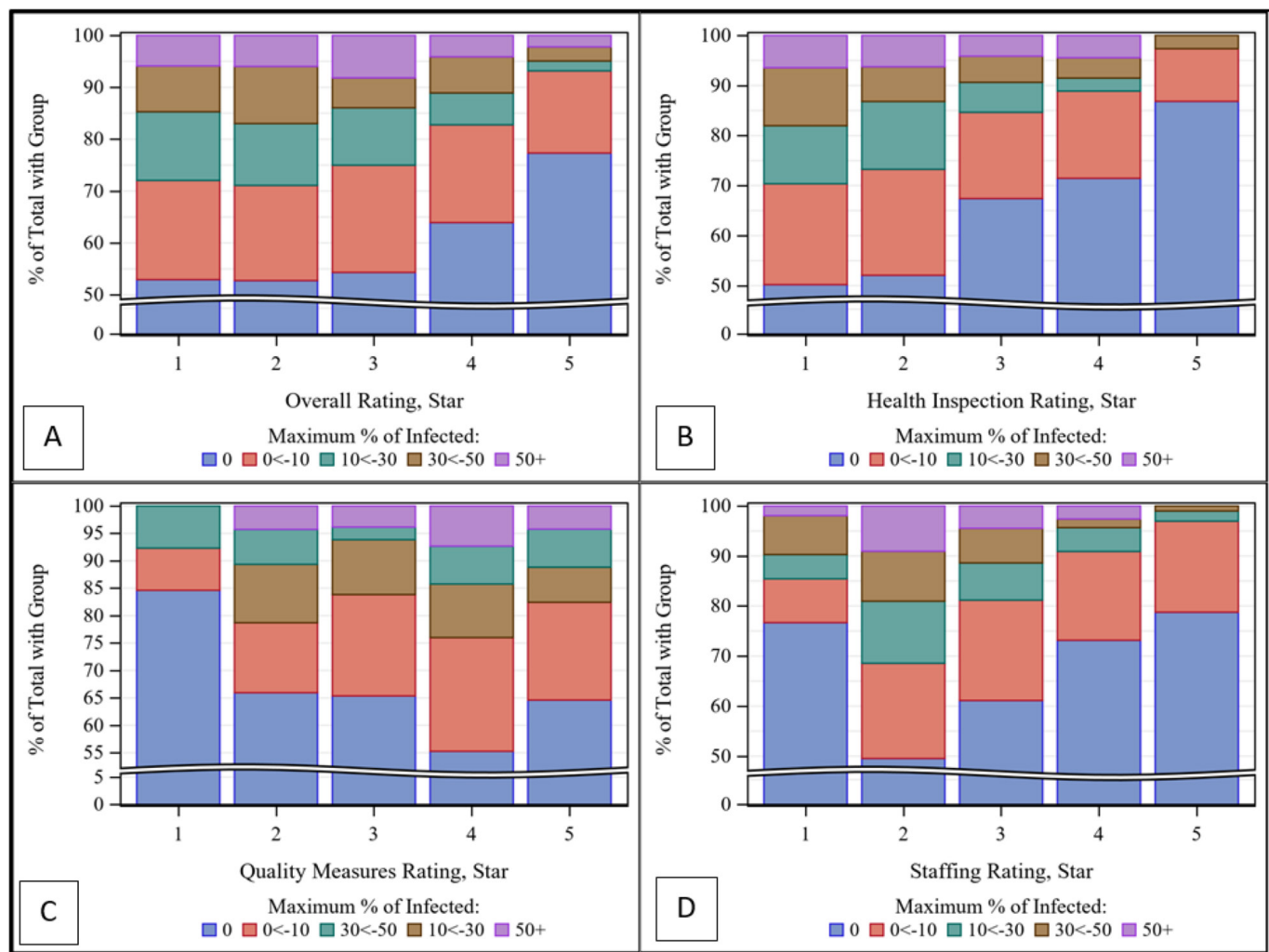


Figure 1 Star ratings (overall and its three domains) and percentage of having COVID-19 case among residents. (A) Overall Star Rating*; (B) Health Inspection star rating**; (C) Quality Measures star rating*** and (D) Staffing star rating****. Within each panel, the percentage of total COVID-19 cases by numeric value of the star rating, 1 (minimum) to 5 (maximum). *Overall Five-Star Rating includes components of the three domains of star ratings. **The Health Inspection rating contains the three most recent health inspections and investigations due to complaints, with the most recent survey findings are weighted more than the prior year. ***The Staffing rating has information about the number of hours of care provided on average to each resident each day by nursing staff, and considers differences in the levels of residents' care need in nursing home. ****The Quality Measures rating has information on 15 different physical and clinical measures for nursing home residents to assess care delivery for their residents' physical and clinical needs (see <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandCompliance/downloads/usersguide.pdf> for more details).

quality ratings. Hospital and emergency utilisation are also predictive but less directly patient focused than the star ratings. While the relationship with the Quality Measures star ratings, a subset of the Overall Quality Ratings with COVID-19 seems counterintuitive, it may be the result of hospital practice driving referrals of residents with high comorbidities to facilities with presumably high-quality ratings (≥ 3 stars) and away from facilities with low-quality ratings.⁵

As local governments attempt to mitigate multiple future outbreaks of COVID-19, these readily available metrics may help public health officials triage resources to select facilities, including the use of patient-focused surveys. Preventing outbreaks in congregate groups with heightened morbidity has obvious benefit.⁶ Yet,

the gain may extend beyond as a substantial proportion of its residents have high contact rates with other healthcare venues. For example, nearly 32% of maintenance dialysis patients use SNFs during a calendar year.⁷

We acknowledge the data are limited to a single state in the early stage of the COVID-19 pandemic. Yet, California has a large population and sample size with standardised reporting and high participation by facilities⁴ (near 95%) compared with other states. As national governments begin reporting national data on COVID-19 morbidity in SNF, an opportunity to better align prediction with COVID-19 outcomes may soon arise.

Table 1 Univariate and multivariable logistic regression models of facility characteristics with no reported cases or at least one reported COVID-19 case among residents as the outcome

	Univariate (n=1184 facilities)		Multivariate* (n=894 facilities)	
	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Provider type				
Medicaid only	0.52 (0.23 to 1.15)	0.106	Not included	
Medicare only	0.37 (0.19 to 0.75)	0.006		
Medicare and Medicaid	Ref			
Ownership type				
Government	0.19 (0.07 to 0.05)	0.002	0.26 (0.03 to 2.89)	0.23
Non-profit	0.59 (0.41 to 0.86)	0.006	1.00 (0.55 to 1.84)	0.99
Profit	Ref		Ref	
Number of certified beds	1.01 (1.007 to 1.012)	<0.0001	1.01 (1.00 to 1.01)	<0.0001
Overall Star Rating†	n=1172			
★ ★ ★ ★ ★	3.03 (2.00 to 4.60)	<0.0001		
★ ★ ★ ★ ★	3.05 (2.13 to 4.38)	<0.0001		
★ ★ ★ ★ ★	2.87 (1.99 to 4.14)	<0.0001	Not included†	
★ ★ ★ ★ ★	1.92 (1.35 to 2.75)	0.0003		
★ ★ ★ ★ ★	Ref			
Health Inspection	n=1172			
★ ★ ★ ★ ★	6.54 (3.59 to 11.93)	<0.0001	5.62 (2.03 to 15.59)	0.001
★ ★ ★ ★ ★	6.07 (3.36 to 10.95)	<0.0001	4.86 (1.79 to 13.16)	0.002
★ ★ ★ ★ ★	3.19 (1.75 to 5.81)	0.0002	3.20 (1.18 to 8.66)	0.020
★ ★ ★ ★ ★	2.63 (1.44 to 4.81)	0.002	2.78 (1.01 to 7.61)	0.047
★ ★ ★ ★ ★	Ref		Ref	
Staffing	n=1168			
★ ★ ★ ★ ★	1.13 (0.58 to 2.19)	0.72	1.04 (0.35 to 3.07)	0.95
★ ★ ★ ★ ★	3.78 (2.23 to 6.41)	<0.0001	1.67 (0.68 to 4.11)	0.27
★ ★ ★ ★ ★	2.36 (1.40 to 3.98)	0.001	1.22 (0.50 to 2.96)	0.66
★ ★ ★ ★ ★	1.36 (0.78 to 2.39)	0.28	1.09 (0.44 to 2.70)	0.86
★ ★ ★ ★ ★	Ref		Ref	
Quality Measures	n=1171			
★ ★ ★ ★ ★	0.33 (0.07 to 1.51)	0.15	0.64 (0.11 to 3.72)	0.62
★ ★ ★ ★ ★	0.94 (0.51 to 1.76)	0.85	0.69 (0.29 to 1.63)	0.40
★ ★ ★ ★ ★	0.97 (0.65 to 1.43)	0.87	0.62 (0.36 to 1.09)	0.10
★ ★ ★ ★ ★	1.48 (1.10 to 1.98)	0.009	1.31 (0.87 to 1.98)	0.20
★ ★ ★ ★ ★	Ref		Ref	
Percentage of short-stay residents who were rehospitalised after a nursing home admission	n=1012			
	1.04 (1.02 to 1.07)	0.0005	1.05 (1.01 to 1.08)	0.006
Percentage of short-stay residents with outpatient emergency department visit	n=1012			
	0.91 (0.88 to 0.93)	<0.0001	0.92 (0.88 to 0.96)	0.0002
Number of hospitalisations per 1000 long-stay resident days	n=966			
	2.29 (1.93 to 2.71)	<0.0001	2.09 (1.67 to 2.60)	<0.0001
Number of outpatient emergency department visits per 1000 long-stay resident days	n=966			
	0.66 (0.51 to 0.86)	0.002	0.77 (0.53 to 1.13)	0.18

The sample sizes differ for univariate and multivariable regression model because of the availability of reported data.

*Limited to SNFs with Medicare claims.

†Overall Star Rating is not included in the multivariable regression model because of collinearity as Overall rating is a composite score of three domains: Health Inspections ratings, Quality Metrics ratings and Staffing ratings (see <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandCompliance/downloads/usersguide.pdf> and <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandCompliance/downloads/usersguide.pdf>).

SNFs, skilled nursing facilities.



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Supplemental Table 1. Univariate and Multivariate Models of Predictors for COVID-19 Skilled Nursing Facilities with Sample Sizes

	Total n=1,184	No COVID n=745	COVID n=439	Univariate		Multivariate Model 1, n=1,167		Multivariate Model 2**, n=894	
				Unadjusted OR (95% CI)	p- value	Adjusted OR (95% CI)	p- value	Adjusted OR (95% CI)	p- value
Provider Type									
Medicaid only	33	25(75.7%)	8(24.2%)	0.52(0.23-1.15)	0.11	0.56(0.23-1.39)	0.21	Not included	
Medicare only	53	43(81.1%)	10(18.9%)	0.37(0.19-0.75)	0.006	0.88(0.41-1.89)	0.75		
Medicare & Medicaid	1098	677(61.7%)	421(38.34%)	Ref		Ref			
Ownership Type									
Government	36	32(88.9%)	4(11.1%)	0.19(0.07-0.055)	0.002	0.26(0.07-0.92)	0.04	0.26(0.03-2.89)	0.23
Non-profit	155	112(72.3%)	43(27.7%)	0.59(0.41-0.86)	0.006	1.04(0.67-1.63)	0.87	1.00(0.55-1.84)	0.99
Profit	933	601(60.5%)	392(39.5%)	Ref		Ref		Ref	
Number of Certified Beds				1.01(1.01-1.01)	<.0001	1.01(1.00-1.01)	<.0001	1.01(1.00-1.01)	<.0001
Median (IQR)	95(59-120)	89(58-108)	99(80-139)						
Overall Star Rating									
★★★★★	233	72(52.9%)	64(47.1%)	3.03(2.00-4.60)	<.0001	Not included***		Not included***	
★★★★★	288	115(52.8%)	103(47.3%)	3.05(2.13-4.38)	<.0001				
★★★★★	267	113(54.3%)	95(45.7%)	2.87(1.99-4.14)	<.0001				
★★★★★	270	156(63.9%)	88(36.1%)	1.92(1.35-2.75)	0.0003				

★★★★★	114	283(77.3%)	83(22.7%)	Ref					
Missing	12	6	6						
Health Inspection Star Rating									
★★★★★	136	117 (50.2%)	116(49.8%)	6.54(3.59-11.93)	<.0001	3.85(2.02-7.34)	<.0001	5.62(2.03-15.59)	0.001
★★★★★	218	150(52.1%)	138(47.9%)	6.07(3.36-11.00)	<.0001	4.00(2.13-7.35)	<.0001	4.86(1.79-13.16)	0.002
★★★★★	208	180(67.4%)	87(32.6%)	3.19(1.75-5.81)	0.0002	2.33(1.25-4.34)	0.008	3.20(1.18-8.66)	0.022
★★★★★	244	193(71.5%)	77(28.5%)	2.63(1.44-4.81)	0.002	2.17(1.17-4.02)	0.014	2.78(1.01-7.61)	0.047
★★★★★	366	99(86.8%)	15(13.2%)	Ref		Ref		Ref	
Missing	12	6	6						
Staffing Star Rating									
★★★★★	103	79(76.7%)	24(23.3%)	1.13(0.58-2.19)	0.72	1.00(0.46-2.13)	0.99	1.04(0.35-3.07)	0.95
★★★★★	331	164(49.6%)	167(50.5%)	3.78(2.23-6.41)	<.0001	2.19(1.15-4.15)	0.017	1.67(0.68-4.11)	0.27
★★★★★	404	247(61.1%)	157(38.9%)	2.36(1.40-3.98)	0.001	1.41(0.75-2.65)	0.28	1.22(0.50-2.96)	0.66
★★★★★	231	169(73.2%)	62(26.8%)	1.36(0.78-2.39)	0.28	0.99(0.52-1.88)	0.97	1.09(0.44-2.70)	0.86
★★★★★	99	78(78.8%)	21(21.2%)	Ref		Ref		Ref	
Missing	16	8	8						
Quality Measure Rating									
★★★★★	13	11(84.6%)	2(15.4%)	0.33 (0.07-1.51)	0.15	0.31(0.06-1.52)	0.15	0.64(0.11-3.72)	0.62

★★★★★	47	31(66.0%)	16(34.0%)	0.94 (0.51-1.76)	0.85	0.79(0.40-1.56)	0.50	0.69(0.29-1.63)	0.40
★★★★★	130	85(65.4%)	45(34.6%)	0.97 (0.65-1.43)	0.87	0.76(0.49-1.16)	0.20	0.62(0.36-1.09)	0.10
★★★★★	246	136(55.3%)	110(44.7%)	1.48 (1.10-1.98)	0.009	1.18(0.86-1.62)	0.30	1.31(0.87-1.98)	0.20
★★★★★	735	475(64.6%)	260(35.4%)	Ref		Ref		Ref	
Missing	13	7	6						
Percentage of short-stay residents who were rehospitalized after a nursing home admission*				1.04(1.02-1.07)	0.0005			1.05(1.01-1.08)	0.006
Median (IQR)	22.2(18.6-25.4)	21.7(18.1-24.7)	23.0(19.4-26.0)						
Missing	172	132	40						
Percentage of short-stay residents who had an outpatient emergency department visit*				0.91(0.88-0.93)	<.0001			0.92(0.88-0.96)	0.0002
Median (IQR)	9.8(6.8-13.0)	10.7(7.7-14.0)	8.5(5.9-11.4)						
Missing	172	132	40						
Number of hospitalizations per 1000				2.29(1.93-2.71)	<.0001			2.09(1.67-2.60)	<.0001

long-stay resident days*									
Median (IQR)	1.8(1.3-2.5)	1.6(1.2-2.2)	2.2(1.6-2.9)						
Missing	218	155	63						
Number of outpatient emergency department visits per 1000 long-stay resident days*				0.66(0.51-0.86)	0.002			0.77(0.53-1.13)	0.179
Median (IQR)	0.7(0.5-1.1)	0.8(0.5-1.1)	0.7(0.5-1.0)						
Missing	218	155	63						

*Based on Medicare claims data.

**Limited to SNFs with Medicare claims.

*** Overall five-star rating includes components of the three domains of star ratings.