Technical Report: Correlational Analysis of Nursing Home Quality Measures

Evaluation of the NF Payment Reform Legislation

2021 Report to the Legislature

Prepared for: Minnesota Department of Human Services

Prepared by:

Dongjuan Xu, PhD RN

School of Nursing, Purdue University

December 21, 2020

Executive Summary

The measures of nursing home quality of care can be grouped into four main components: clinical care quality, staffing, resident and family experience, and consumer choice (community discharge). The clinical care quality component includes health inspection survey, clinical quality indicators (QIs), and hospitalization. The value based reimbursement (VBR) quality score has three components: long-stay resident quality total score (quality of life score, clinical QI score, and family satisfaction score), short-stay resident quality score (resident survey score, 30-day hospitalization, two clinical QIs including pain and pressure ulcers), and state inspection results score.

The main objective was to explore the correlations between quality measures and the relationships between VBR quality score components. Quality measures over the 2013-2019 period were used in the correlational analysis, except the VBR score. The VBR score was only available in 2019. Pearson or Spearman correlation, as appropriate, was used to evaluate the relationships between quality measures.

We found evidence for the construct validity of the resident and family experience measures. Resident and family experience measures were correlated with several of the other quality measures. Residents and families tended to give higher satisfaction scores for facilities with better performance on multiple indicators: health inspections and clinical quality indicators, lower hospitalization rates, higher community discharge rates, more nurse staffing hours, higher retention rates, and higher proportion of single rooms. In addition, facilities with higher scores on these resident and family experience measures had higher occupancy rates. Better resident and family experience is likely a pivotal factor in attracting residents to the facility. For these reasons, the state should continue to invest in resident and family surveys, and they should be essential components of the quality measurement system.

Correlational findings also suggest that more licensed nurse and social worker hours is positively correlated with higher hospitalization rate for 30+ days per 1000 resident days. One possible reason for this unexpected relationship is that the hospitalization rate does not adjust for the acuity of residents in the facility. Facilities with higher resident acuity may have more licensed nurses and more residents at risk of entering the hospital. We recommend to adjust the 30 days or more hospitalization rate by case mix acuity in the same manner as the acuity adjustment is applied to rates of hospitalization for short-stay residents (less than 30 days).

The CMS staffing and inspection measures offer more comprehensive and timely composite scores than comparable Minnesota measures. We recommend considering integration selected CMS Nursing Home Compare measures into the VBR scoring system. The CMS staffing and inspection measures could replace comparable Minnesota VBR measure. Besides the substitution of CMS staffing and inspection scores for MN measures, we recommended changes in the short- and long-stay QIs (described in the Clinical Quality Indicators Report) and quality of life measures (describe in the Long Stay Resident Quality of Life Survey Report). After deciding on these recommended changes and any other changes to the quality measurement system, the next step would be to construct corresponding new VBR quality scores for long- and short-stay residents.

We also recommend systematic and extensive input from key stakeholders in evaluating the VBR quality scoring and in determining the weights assigned to different components. Due to the COVID-19 pandemic, we obtained viewpoints about the quality measures from only a small proportion of the nursing home industry (described in the Qualitative Component Report). We recommend that DHS conduct an extensive evaluation of quality measures by convening focus groups and conducting surveys on this topic in the coming months after the COVID-19 pandemic has subsided. Also, participation in this process should be expanded to include not only quality experts from the industry but also consumer/advocacy groups.

1. Background

1.1 Quality Measures

The measures of nursing home quality of care can be grouped into four main components: clinical care quality, staffing, resident and family experience, and consumer choice (Table 1). The clinical care quality component includes health inspection survey, clinical quality indicators (QIs), and hospitalization.

We assume that quality measures are to a degree independent of each other; they each represent a different dimension of care quality. Further, we assume that quality measures may be correlated with each other without one being the cause of another. Rather, they may each fall under a common global construct of care quality. Better overall "care quality" contributes to a positive score on each of the measures, as well as accounting for the correlation between the measures. For example, we found correlations between performance on health inspections (deficiency), differences in certain aspects of clinical care quality, and variation in resident and family experience. Facilities with better overall quality of care probably do well on all three measures. These facilities likely will have better performance on health inspections, better clinical care quality, more satisfied residents and a more positive family experience. Moreover, their better care quality probably results, at least in part, from characteristics not currently measured, such as leadership, organizational structure, and organizational culture; adherence to protocols (procedures, standards, and rules); knowledge, skills, and experience of staff; and staff workload, teamwork, and effective communication. Although these organizational factors are very important in achieving better quality, they are difficult to measure objectively. Future iterations of the Minnesota nursing home quality measurement system might incorporate these types of organizational measures.

Table 1. Four main components of nursing home quality of care

Quality of Care		Sources	Quality Measures
Clinical care quality	health inspection survey	CMS NHC	- five-star rating: health inspection survey - total health inspection score - number of facility-reported incidents - number of substantiated complaints - number of fines - total amount of fines in dollars
		MN	MDH five-star rating: health inspection survey
	clinical quality indicators	CMS NHC	five-star rating: clinical quality indicator
		MN	- clinical quality indicator summary score - twenty-one quality indicators (19 long-stay and 2 short-stay)

	hospital-ization	MN	• adjusted 30-day hospitalization rate • hospitalization rate for 30+ days per 1000 resident days
Staffing		CMS NHC	• five-star rating: overall staffing and RN • hours per resident per day: RN, LPN, CNA, total nurse, and physical therapy staffing
		MN	• overall staffing score • hours per resident per day: nurse administrators, RN, LPN, CNA, trained medication aides, total nurse, activities staff, mental health workers, social workers, other direct care staff, and total direct care staff • retention: overall, nurse administrators, RN, LPN, CNA, trained medication aides, activities staff, mental health workers, social workers, and other direct care staff • percentage of temporal/pool nursing staff hours
Resident and family experience		MN	• long-stay resident quality of life survey • family satisfaction survey (long-stay residents; 2019) • short-stay residents survey (2019)
Consumer choice	community discharge	MN	• adjusted 3-30 day community discharge rate • adjusted 30-90 day community discharge rate
Overall quality		CMS NHC	• five-star rating: overall
		MN	• VBR score • VBR new score (2019)

Notes: Five-star rating with one star representing the lowest possible rating and five stars representing the highest possible rating. CMS NHC measures come from Center for Medicare and Medicaid Services, Nursing Home Compare; MN measures come from the Minnesota Nursing Home Report Card or VBR measures.

## 1.2 Value Based Reimbursement (VBR) Components

As shown in Figure 1, the VBR quality score has three components: long-stay resident quality score, short-stay resident quality score, and state inspection results score.

There are three steps to create the VBR quality total score (max 100 points). In Step 1, long-stay and short-stay resident quality scores (max 90 points) are calculated separately. The long-stay resident quality score has three components: quality of life (QOL) score (max 40 points), clinical quality indicator score (max 40 points; 19 long-stay quality indicators), and family satisfaction score (max 10 points). The short-stay resident quality score also has three components: resident survey score (max 50 points), 30-day hospitalization (max 30 points), and two short-stay quality indicators "prevalence of moderate to serious pain" (max 5 points) and "prevalence of new or worsening pressure ulcers" (max 5 points). Two quality total scores (actual vs. rescaled) are calculated, reflecting how many facilities have data on all the components of this quality score and how many are missing 1+ components. Using the short-stay quality score as an example, some facilities do not participate in the short-stay resident survey and some facilities do not have rates on one or both of the quality indicators. A facility's actual quality score is calculated based on how many quality components the facility has. This actual quality score is then rescaled to 90 total for those facilities with 1+ missing components to compare them fairly to facilities that have all the components.

In Step 2, the percentages of long- and short-stay resident days, rather than residents, are counted and used as weights for long- and short-stay resident quality scores respectively.

In Step 3, the Minnesota Department of Health (MDH) inspection score (max 10 points) is added to the total weighted long- and short-stay quality score. As a result, the highest possible total score of VBR quality is 100.

Figure 1. VBR new score
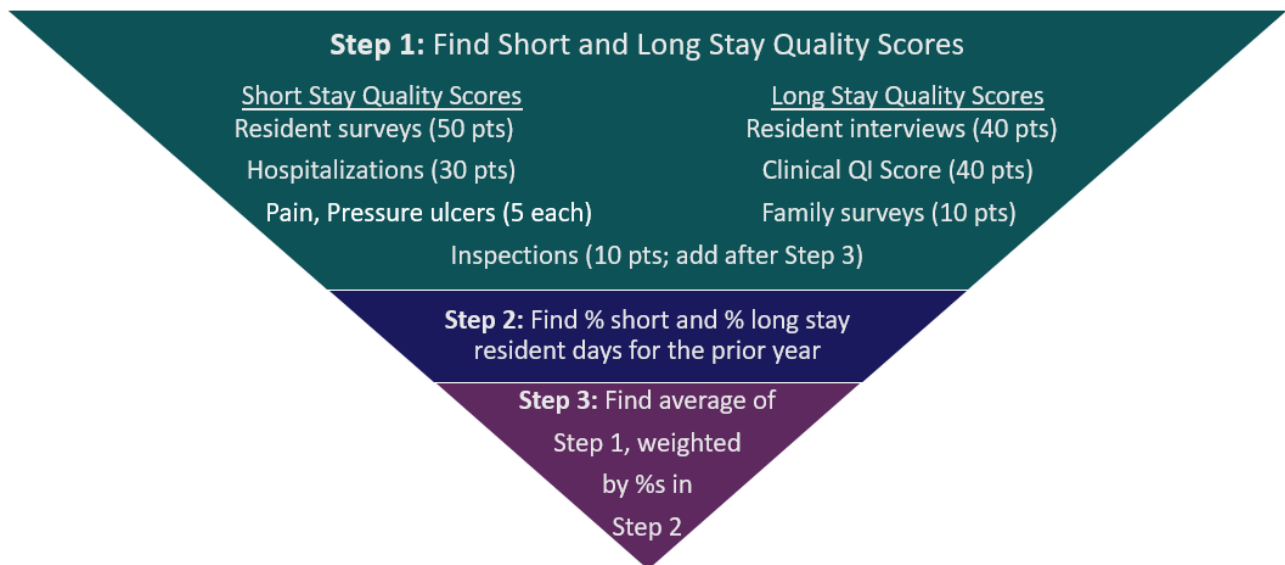
2. Objective

The main objective of our analysis was to examine the correlations between quality measures and the relationships between VBR quality score components. The scoring system should best reflect the relative clinical importance and potential for quality improvement of each VBR score component.

3. Data and Methods

Most measures over the 2013-2019 period were used in the correlational analysis. However, the new VBR score, with additional measures from the family satisfaction (long-stay residents) and short-stay resident surveys, was available only in 2019. Pearson or Spearman correlation, as appropriate, was used to evaluate the correlations between quality measures. Generally, correlation coefficient values less than 0.3 are considered to be weak; 0.3-0.7 are moderate, and 0.7 or greater are strong. High correlation (≥ 0.7) between two quality measures suggests that they may be duplicative, or measuring redundant aspects of nursing home quality.

We also took into account the survey of providers (described in the Qualitative Component Report). A total of 29 respondents completed the survey regarding the weights of VBR score components. Descriptive statistics was used to summarize the survey results.

4. Results

4.1 Resident and Family Experience

As shown in Table 2, residents and families tend to give higher satisfaction scores for facilities with higher star ratings on overall quality (QOL: correlation coefficient 0.36; family satisfaction: correlation coefficient 0.51; short-stay resident experience: correlation coefficient 0.55).

Regarding clinical care quality, residents and families tend to give higher satisfaction scores for facilities with better performance on health inspections and clinical quality indicators, and facilities with lower hospitalization rates. Resident and family experience scores are positively associated with higher star ratings on health inspection. The correlations tend to be stronger with five-staring ratings from CMS NHC (QOL: correlation coefficient 0.36; family satisfaction: correlation coefficient 0.49; short-stay resident experience: correlation coefficient 0.44) than the five-star ratings from MDH (QOL: correlation coefficient 0.27; family satisfaction: correlation coefficient 0.31; short-stay resident experience: correlation coefficient 0.26), suggesting the measure from CMS NHC is better than that from MDH. As expected, resident and family experience scores are negatively associated with the total inspection survey (QOL: correlation coefficient -0.39; family satisfaction: correlation coefficient -0.51; short-stay resident experience: correlation coefficient -0.46) and the number of substantiated complaints (QOL: correlation coefficient -0.40; family satisfaction: correlation coefficient -0.47; short-stay resident experience: correlation coefficient -0.52). Residents and families are more likely to report better experience for facilities with higher star ratings on clinical quality indicators (QOL: correlation coefficient 0.25; family satisfaction: correlation coefficient 0.36; short-stay resident experience: correlation coefficient 0.56). Clinical quality indicator scores tend to relate more strongly to satisfaction as measured by short-stay resident surveys compared to long-stay

resident surveys. Residents living in facilities with higher hospitalization rates seem to be less satisfied with their experience, particularly for facilities with higher hospitalization rates after 30 days (QOL: correlation coefficient -0.39; family satisfaction: correlation coefficient -0.46; short-stay resident experience: correlation coefficient -0.39).

Residents and families tend to give better satisfaction scores for facilities with higher community discharge rates, particularly for facilities with higher community discharge within 3-30 days (QOL: correlation coefficient 0.33; family satisfaction: correlation coefficient 0.31; short-stay resident experience: correlation coefficient 0.47).

Overall, residents and families tend to be more satisfied with facilities with more staffing hours (QOL: correlation coefficient 0.16; family satisfaction: correlation coefficient 0.31; short-stay resident experience: correlation coefficient 0.39), and higher staffing retention rates (QOL: correlation coefficient 0.20; family satisfaction: correlation coefficient 0.32; short-stay resident experience: correlation coefficient 0.34). In particular, more certified nursing assistants, total nurses, activity staff, other direct care staff, and total direct care staff are positively correlated with better resident and family experience. Similarly, higher retention rates of RN, social worker, and other direct care staff are positively related to better resident and family experience. The strongest correlation is between total nursing/direct care staffing hours and short stay resident survey results.

In addition, residents and families tend to give higher satisfaction scores for facilities with higher proportion of single rooms and higher occupancy rates. The positive correlations between occupancy and resident and family experience indicate that achieving high satisfaction scores is rewarded by attracting more residents.

Table 2. Correlations between resident and family experience and other quality measures

			long-stay resident quality of life survey	family satisfaction survey (long-stay)	short-stay residents survey
Overall quality		overall quality (five-star rating, CMS NHC)	**0.36**	**0.51**	**0.55**
		VBR score	**0.37**	**0.34**	**0.40**
		VBR new score	**0.47**	**0.46**	**0.43**
Clinical care quality	health inspection survey	health inspection survey (five-star rating, CMS NHC)	**0.36**	**0.49**	**0.44**
		total health inspection score (CMS NHC)	**-0.39**	**-0.51**	**-0.46**
		number of substantiated complaints (CMS NHC)	**-0.40**	**-0.47**	**-0.52**
		MDH health inspection survey (five-star rating)	0.27	**0.31**	0.26

	clinical quality indicators	clinical quality indicator (five-star rating, CMS NHC)	0.25	**0.36**	**0.56**
	hospitalization	adjusted 30-day hospitalization rate	-0.17	-0.26	**-0.30**
		hospitalization rate for 30+ days per 1000 resident days	**-0.39**	**-0.46**	**-0.39**
Consumer choice	community discharge	adjusted 3-30 day community discharge rate	**0.33**	**0.31**	**0.47**
		adjusted 30-90 day community discharge rate	0.22	0.18	**0.30**
Staffing		overall staffing (five-star rating, CMS NHC)	0.16	**0.31**	**0.39**
	hours per resident per day	certified nursing assistant (CMS NHC)	0.19	**0.33**	**0.32**
		certified nursing assistant	0.14	0.24	**0.39**
		activity staff	0.25	**0.30**	**0.34**
		other direct care staff	0.14	0.15	**0.39**
		total direct care staff	0.26	**0.33**	0.54
		total nurse (CMS NHC)	**0.33**	**0.38**	**0.56**
	retention	overall staff	0.20	**0.32**	**0.34**
		RN	0.17	0.18	**0.30**
		social worker	0.22	**0.35**	**0.31**
		other direct care staff	0.18	0.20	**0.31**
Private room		MN proportion of beds in single rooms	0.19	0.21	**0.34**
Occupancy			**0.30**	**0.36**	**0.40**

Notes: Five-star rating with one star representing the lowest possible rating and five stars representing the highest possible rating. Bolded numbers indicate correlation coefficients 0.3 or higher.

4.2 Hospitalization and Community Discharge

As expected, hospitalization rates are negatively associated with community discharge rates, particularly among short-stay residents (correlation coefficient: -0.33; Table 3). These hospitalization and community discharge measures are calculated on the same pool of residents and they are not independent. If residents are being hospitalized in the first 30 days, they are unlikely to also be discharging to the community.

Table 3. Correlations between hospitalization and community discharge rate

		Hospitalization		Community Discharge	
		adjusted 30-day hospitalization rate	hospitalization rate for 30+ days per 1000 resident days	adjusted 3-30 day community discharge rate	adjusted 30-90 day community discharge rate
hospitalization	adjusted 30-day hospitalization rate	1			
	hospitalization rate for 30+ days per 1000 resident days	**0.36**	1		
community discharge	adjusted 3-30 day community discharge rate	**-0.33**	-0.15	1	
	adjusted 30-90 day community discharge rate	-0.18	-0.01	**0.43**	1

Notes: Bolded numbers indicate correlation coefficients above 0.3.

As shown in Table 4, facilities with better overall quality scores are negatively associated with hospitalization rates and positively associated with community discharge rates.

More nurse staffing hours is positively correlated with higher adjusted community discharge rates. The strongest relationship is between total nursing/direct care staffing hours and adjusted community discharge rates within 30 days (total direct care staff: correlation coefficient 0.36; total nurse: correlation coefficient 0.31).

In contrast, more licensed nursing hours as well as social worker hours is positively correlated with higher unadjusted hospitalization rates after 30 days (RN: correlation coefficient 0.38; RN+LPN: correlation coefficient 0.33; social worker: correlation coefficient 0.32).The positive

correlation between staffing hours and unadjusted hospitalization rates may be explained by case mix. Facilities taking care of higher acuity residents would be expected to have more licensed nurse staffing and relatively higher hospitalization rates. Our analysis tended to support this explanation. A facility's case mix score was not only positively correlated with staffing hours (RN: correlation coefficient 0.46; RN+LPN: correlation coefficient 0.50; social worker: correlation coefficient 0.30), but it was also positively correlated with unadjusted hospitalization rates (correlation coefficient 0.29). The best way of addressing this problem is to adjust the >30 day hospitalization rate for case-mix.

Table 4. Correlations between hospitalization, community discharge rate, and staffing

		Hospitalization		Community Discharge	
		adjusted 30-day hospitalization rate	hospitalization rate for 30+ days per 1000 resident days	adjusted 3-30 day community discharge rate	adjusted 30-90 day community discharge rate
Overall quality	overall quality (five-star rating, CMS NHC)	-0.15	-0.28	0.23	0.16
	VBR score	-0.11	-0.25	0.14	0.13
	VBR new score	-0.27	**-0.33**	0.28	0.20
Staffing (hours per resident per day)	RN	-0.03	**0.38**	0.24	0.26
	RN+LPN	-0.04	**0.33**	0.27	0.24
	social worker	0.03	**0.32**	0.10	0.17
	total direct care staff	-0.10	0.16	**0.36**	**0.30**
	total nurse (CMS NHC)	-0.08	-0.08	**0.31**	0.21

Notes: Bolded numbers indicate correlation coefficients 0.3 or higher.

4.3 Weak Correlations between Measures of Clinical Care Quality

The correlations between health inspection survey, clinical quality indicators, and hospitalization rates are weak (Tables 5-8 and Appendix Tables 1-6). The findings indicate that health inspection, quality indicators, and hospitalization rates may tap different aspects of quality in nursing homes. Health inspections cover a wide range of care-related regulations, some of which may be directly related to hospitalization risk and others not. Similarly, the QIs tap multiple types of quality. In an earlier study, we found an association between selected QIs and hospitalizations in nursing homes (Xu et. al., 2019). Future research should involve a careful examination of regulatory deficiency types and hospitalizations, as well as individual QIs and hospitalization.

Table 5. Correlations between CMS NHC quality measures

	CMS NHC: Five Star Rating				
	Overall quality	**Health inspection**	**Clinical QIs**	**Overall staffing**	**RN**
CMS NHC: Five Star Rating					
Overall quality	1	**0.89**	**0.48**	**0.40**	0.29
Health inspection	**0.89**	1	0.23	0.21	0.17
Clinical quality indicators (QIs)	**0.48**	0.23	1	0.09	0.08
Overall staffing	**0.40**	0.21	0.09	1	**0.68**
RN	0.29	0.17	0.08	**0.68**	1
CMS NHC: Staffing (Hours per Resident per Day)					
RN	0.20	0.12	-0.01	**0.57**	**0.85**
Adjusted RN	0.27	0.16	0.07	**0.64**	**0.88**
LPN	-0.04	-0.07	-0.05	0.10	-0.19
Adjusted LPN	-0.03	-0.05	-0.02	0.05	-0.24
CNA	**0.33**	0.22	0.09	**0.61**	0.17
Adjusted CNA	**0.32**	0.21	0.07	**0.61**	0.15
RN+LPN	0.13	0.05	-0.04	**0.50**	**0.48**
Total nurse	**0.33**	0.19	0.06	**0.75**	**0.40**
Adjusted total nurse	**0.31**	0.18	0.05	**0.70**	**0.31**
Physical therapy	0.08	0.05	-0.01	0.21	0.20
CMS NHC: Health Inspection					
Total Health Inspection Score	**-0.87**	**-0.97**	-0.22	-0.20	-0.17
Number of Facility-Reported Incidents	-0.13	-0.17	-0.10	0.06	0.03
Number of Substantiated Complaints	**-0.33**	**-0.36**	-0.12	-0.09	0.01
Number of Fines	**-0.34**	**-0.37**	-0.12	-0.01	-0.05
Total Amount of Fines in Dollars	**-0.33**	**-0.37**	-0.12	0.00	-0.05

Notes: Bolded numbers indicate correlation coefficients 0.3 or higher.

Table 6. Correlations between CMS NHC quality measures

	CMS NHC: Hours per Resident per Day					
	RN	LPN	CNA	RN+LPN	Total Nurse	Physical Therapy
CMS NHC: Five Star Rating						
Overall quality	0.20	-0.04	**0.33**	0.13	**0.33**	0.08
Health inspection	0.12	-0.07	0.22	0.05	0.19	0.05
Clinical quality indicators	-0.01	-0.05	0.09	-0.04	0.06	-0.01
Overall staffing	**0.57**	0.10	**0.61**	**0.50**	**0.75**	0.21
RN	**0.85**	-0.19	0.17	**0.48**	**0.40**	0.20
CMS NHC: Staffing						
RN	1	-0.13	0.13	**0.65**	**0.46**	**0.35**
Adjusted RN	**0.83**	-0.21	0.15	**0.47**	**0.38**	0.19
LPN	-0.13	1	0.04	**0.61**	**0.34**	0.12
Adjusted LPN	-0.24	**0.94**	0.02	**0.49**	0.26	0.02
CNA	0.13	0.04	1	0.11	**0.81**	0.15
Adjusted CNA	0.07	0.00	**0.95**	0.03	**0.73**	0.08
RN+LPN	**0.65**	**0.61**	0.11	1	**0.61**	**0.37**
Total nurse	**0.46**	**0.34**	**0.81**	**0.61**	1	**0.32**
Adjusted total nurse	0.27	0.23	**0.68**	**0.39**	**0.77**	0.14
Physical therapy	**0.35**	0.12	0.15	**0.37**	**0.32**	1
CMS NHC: Health Inspection						
Total Health Inspection Score	-0.14	0.08	-0.22	-0.05	-0.20	-0.06
Number of Facility-Reported Incidents	0.04	0.05	0.02	0.06	0.05	0.05
Number of Substantiated Complaints	0.05	-0.01	-0.16	0.02	-0.10	0.07
Number of Fines	-0.04	0.01	-0.01	-0.03	-0.02	-0.02
Total Amount of Fines in Dollars	-0.03	0.01	-0.01	-0.03	-0.02	-0.02

Notes: Bolded numbers indicate correlation coefficients 0.3 or higher.

Table 7. Correlations between CMS NHC quality measures

	CMS NHC: Health Inspection				
	Inspection	**Incidents**	**Complaints**	**Fine Number**	**Fine Dollar**
CMS NHC: Five Star Rating					
Overall quality	**-0.87**	-0.13	**-0.33**	**-0.34**	**-0.33**
Health inspection	**-0.97**	-0.17	**-0.36**	**-0.37**	**-0.37**
Clinical quality indicators	-0.22	-0.10	-0.12	-0.12	-0.12
Overall staffing	-0.20	0.06	-0.09	-0.01	0.00
RN	-0.17	0.03	0.01	-0.05	-0.05
CMS NHC: Staffing (Hours per Resident per Day)					
RN	-0.14	0.04	0.05	-0.04	-0.03
Adjusted RN	-0.17	0.12	0.05	-0.01	0.00
LPN	0.08	0.05	-0.01	0.01	0.01
Adjusted LPN	0.07	-0.04	-0.07	-0.02	-0.03
CNA	-0.22	0.02	-0.16	-0.01	-0.01
Adjusted CNA	-0.20	0.01	-0.15	-0.01	0.00
RN+LPN	-0.05	0.06	0.02	-0.03	-0.03
Total nurse	-0.20	0.05	-0.10	-0.02	-0.02
Adjusted total nurse	-0.20	0.06	-0.12	-0.01	0.00
Physical therapy	-0.06	0.05	0.07	-0.02	-0.02
CMS NHC: Health Inspection					
Total Health Inspection Score	1	0.18	**0.37**	**0.39**	**0.39**
Number of Facility-Reported Incidents	0.18	1	0.22	0.23	0.24
Number of Substantiated Complaints	**0.37**	0.22	1	0.22	0.22
Number of Fines	**0.39**	0.23	0.22	1	**0.99**
Total Amount of Fines in Dollars	**0.39**	0.24	0.22	**0.99**	1

Notes: Bolded numbers indicate correlation coefficients 0.3 or higher.

Table 8. Correlations between CMS NHC and MN quality measures

	CMS NHC: Five Star Rating					CMS NHC: Health Inspection				
	Overall quality	Health inspection	Clinical QIs	Overall Staffing	RN	Inspection	Incidents	Complaints	Fine Number	Fine Dollar
QI score	0.22	0.15	**0.34**	0.06	0.07	-0.16	-0.09	-0.03	-0.13	-0.12
QOL score	0.25	0.25	0.15	0.11	0.02	-0.24	-0.15	-0.25	-0.06	-0.07
MDH score	0.27	0.27	0.13	0.08	0.05	-0.28	-0.17	-0.21	-0.12	-0.13
VBR score	**0.33**	0.27	**0.36**	0.10	0.08	-0.28	-0.17	-0.15	-0.15	-0.15
HOSP_HRP	-0.15	-0.12	-0.11	-0.10	-0.04	0.12	0.06	0.14	0.08	0.09
HOSP_LRP	-0.28	-0.23	-0.26	-0.14	-0.05	0.23	0.11	0.23	0.10	0.11
CD30	0.23	0.20	0.09	0.28	0.16	-0.21	0.00	-0.17	-0.07	-0.07
CD90	0.16	0.13	0.05	0.16	0.10	-0.14	-0.05	-0.14	-0.06	-0.06
Staffing (HRD)	0.20	0.12	0.01	**0.49**	**0.30**	-0.15	0.03	-0.06	0.00	0.01
NA	0.01	0.01	-0.04	0.14	0.27	-0.02	0.02	0.02	0.01	0.01
RN	0.21	0.14	0.02	**0.42**	**0.60**	-0.16	0.06	0.06	-0.02	-0.01
LPN	-0.10	-0.10	-0.08	-0.03	-0.25	0.11	0.02	0.00	0.03	0.03
RN+LPN	0.09	0.05	-0.04	**0.31**	0.25	-0.06	0.06	0.02	-0.01	-0.01
CNA	0.22	0.14	0.07	**0.40**	0.15	-0.16	0.04	-0.15	-0.01	0.00
TMA	0.07	0.06	0.05	0.05	-0.08	-0.06	0.00	0.01	0.00	0.01
ACT	0.18	0.14	0.10	0.14	-0.01	-0.14	-0.04	-0.19	-0.02	-0.02

MHW	0.08	0.09	0.08	-0.04	0.04	-0.09	-0.01	-0.04	-0.03	-0.03
SW	0.01	0.02	-0.03	0.06	0.11	-0.03	0.06	0.10	0.01	0.01
ODC	0.09	0.07	0.04	0.20	0.17	-0.08	0.00	-0.02	-0.04	-0.04
Total	0.27	0.18	0.05	**0.55**	**0.31**	-0.20	0.07	-0.10	0.01	0.01
Retention	0.24	0.21	0.16	0.12	0.03	-0.21	-0.08	-0.19	-0.09	-0.08
NA	0.19	0.17	0.12	0.11	0.02	-0.16	-0.04	-0.14	-0.04	-0.04
RN	0.18	0.17	0.12	0.08	-0.02	-0.17	-0.05	-0.12	-0.03	-0.03
LPN	0.16	0.14	0.08	0.07	0.02	-0.14	-0.08	-0.16	-0.08	-0.08
CNA	0.14	0.12	0.09	0.09	0.05	-0.12	-0.04	-0.11	-0.07	-0.07
TMA	0.07	0.07	0.03	0.03	-0.06	-0.07	-0.01	-0.04	-0.01	0.00
CNA/TMA	0.16	0.14	0.12	0.09	0.03	-0.14	-0.05	-0.12	-0.08	-0.07
ACT	0.07	0.07	0.06	0.05	0.00	-0.07	-0.03	-0.06	-0.04	-0.04
MHW	0.08	0.09	0.08	-0.04	0.04	-0.09	-0.01	-0.04	-0.03	-0.03
SW	0.15	0.15	0.08	0.05	-0.04	-0.15	-0.01	-0.18	-0.04	-0.04
ODC	0.12	0.11	0.04	0.18	0.14	-0.11	0.00	-0.02	-0.06	-0.06
Pool_Nurse	-0.12	-0.11	-0.08	-0.07	-0.04	0.09	0.07	0.07	0.02	0.03
Private room	0.13	0.11	-0.02	0.25	0.12	-0.13	-0.01	-0.11	0.01	0.01
Occupancy	0.22	0.21	0.15	0.14	0.04	-0.19	-0.07	-0.13	-0.08	-0.08

Notes: QI: quality indicator; QOL: quality of life; MDH score: five-star rating health inspection; HOSP_HRP: adjusted 30-day hospitalization rate; HOSP_LRP: hospitalization rate for 30+ days per 1000 resident days; CD30: adjusted 3-30 day community discharge rate; CD90: adjusted 30-90 day community discharge rate; HRD: hours per resident per day; NA: nurse administrator; RN:

Registered Nurse; LPN: Licensed Practical Nurse; CNA: Certified Nursing Assistant; TMA: trained medication aides; ACT: activity staff; MHW: mental health worker; SW: social worker; ODC: other direct care staff; Pool_Nurse: percentage of temporary/pool nursing staff hours. Bolded numbers indicate correlation coefficients 0.3 or higher.

4.4 Weak Correlations between Staffing and Health Inspections

The correlations between staffing (hours per resident per day and retention rates) and health inspections are weak (Tables 5-9). The weak correlations indicate that 1) health inspection and staffing may tap different aspects of quality in nursing homes and 2) measurement problems about staffing variables. The benefits of higher nursing staff levels (hours per resident per day) could not be seen until the staffing hours reached some threshold. The current nursing staff may not have reached the needed threshold level, perhaps explaining the weak association between staffing and health inspections. In addition, increasing staffing hours and retention is important, but not necessarily sufficient to guarantee quality of care. Other factors determine the effectiveness of staffing performance, including leadership, knowledge, skills, experience, teamwork, and effective communication. Failure to consider these factors may explain the weak association between staffing and health inspections.

Table 9. Correlations between CMS NHC and MN quality measures

	CMS NHC: Staffing (Hours per Resident per Day)									
	RN	Adjusted RN	LPN	Adjusted LPN	CNA	Adjusted CNA	RN+ LPN	Total Nurse	Adjusted Total	Physical Therapy
QI score	0.07	0.03	-0.05	-0.02	0.11	0.09	0.02	0.09	0.04	0.05
QOL score	-0.02	-0.03	0.01	0.07	0.17	0.16	0.00	0.14	0.14	0.02
MDH score	0.04	0.02	-0.01	0.03	0.10	0.08	0.02	0.08	0.09	0.00
VBR score	0.07	0.02	-0.04	0.01	0.15	0.12	0.02	0.12	0.08	0.04
HOSP_HRP	0.02	-0.03	0.00	-0.03	-0.11	-0.07	0.00	-0.08	-0.09	0.01
HOSP_LRP	0.12	0.01	0.04	-0.07	-0.20	-0.19	0.12	-0.08	-0.14	0.11
CD30	0.15	0.16	0.09	0.07	0.25	0.18	0.20	**0.31**	0.26	0.22
CD90	0.13	0.11	0.02	0.00	0.17	0.13	0.13	0.21	0.17	0.17
Staffing (HRD)	0.24	**0.36**	0.11	0.12	**0.31**	**0.35**	0.28	**0.42**	**0.58**	0.08
NA	**0.32**	**0.31**	-0.12	-0.18	0.02	-0.02	0.17	0.11	0.06	0.16
RN	**0.72**	**0.62**	-0.16	-0.26	0.06	0.02	**0.44**	**0.31**	0.22	**0.32**
LPN	-0.18	-0.29	**0.81**	**0.78**	-0.08	-0.12	**0.45**	0.18	0.13	0.10
RN+LPN	**0.41**	0.26	**0.49**	**0.39**	0.00	-0.08	**0.72**	**0.40**	**0.30**	**0.33**
CNA	0.16	0.16	0.09	0.05	**0.55**	**0.47**	0.21	**0.52**	**0.48**	0.22
TMA	-0.13	-0.06	-0.24	-0.22	0.29	**0.32**	**-0.31**	0.07	0.11	-0.08

ACT	-0.12	0.01	0.03	0.06	0.23	0.23	-0.09	0.10	0.21	-0.14
MHW	-0.02	0.05	-0.09	-0.09	-0.05	-0.04	-0.06	-0.05	-0.05	-0.05
SW	0.24	0.16	0.10	0.00	-0.06	-0.09	0.27	0.12	0.04	0.23
ODC	0.17	0.14	0.01	-0.02	0.18	0.12	0.14	0.23	0.16	0.17
Total	**0.37**	**0.35**	0.21	0.11	**0.53**	**0.45**	**0.45**	**0.69**	**0.63**	0.29
Retention	-0.08	0.02	-0.04	0.01	0.12	0.15	-0.09	0.06	0.13	-0.05
NA	-0.07	0.01	0.01	0.05	0.12	0.13	-0.05	0.07	0.10	-0.07
RN	-0.12	-0.02	-0.01	0.03	0.10	0.13	-0.10	0.04	0.12	-0.09
LPN	-0.04	0.01	-0.03	-0.01	0.08	0.09	-0.06	0.04	0.07	-0.03
CNA	-0.01	0.03	-0.04	-0.01	0.09	0.11	-0.03	0.05	0.09	0.00
TMA	-0.10	-0.06	-0.12	-0.10	0.19	0.21	-0.19	0.04	0.06	-0.06
CNA/TMA	-0.04	0.01	-0.07	-0.03	0.10	0.13	-0.09	0.03	0.10	-0.04
ACT	-0.04	-0.02	0.00	0.04	0.06	0.07	-0.03	0.04	0.06	-0.04
MHW	-0.02	0.05	-0.09	-0.09	-0.05	-0.04	-0.06	-0.05	-0.05	-0.05
SW	-0.10	-0.05	-0.01	0.02	0.10	0.12	-0.09	0.03	0.07	-0.06
ODC	0.13	0.11	0.02	-0.01	0.17	0.12	0.11	0.21	0.13	0.15
Pool_Nurse	-0.06	0.03	-0.07	-0.10	-0.03	-0.01	-0.11	-0.08	-0.03	-0.08
Private room	0.11	0.16	0.00	-0.01	0.24	0.24	0.08	0.25	0.29	0.06
Occupancy	-0.04	-0.01	-0.11	-0.06	0.21	0.20	-0.11	0.12	0.12	0.03

Notes: QI: quality indicator; QOL: quality of life; MDH score: five-star rating health inspection; HOSP_HRP: adjusted 30-day hospitalization rate; HOSP_LRP: hospitalization rate for 30+ days per 1000 resident days; CD30: adjusted 3-30 day community discharge rate; CD90: adjusted 30-90 day community discharge rate; HRD: hours per resident per day; NA: nurse administrator; RN: Registered Nurse; LPN: Licensed Practical Nurse; CNA: Certified Nursing Assistant; TMA: trained medication aides; ACT: activity staff; MHW: mental health worker; SW: social worker; ODC: other direct care staff; Pool_Nurse: percentage of temporary/pool nursing staff hours. Bolded numbers indicate correlation coefficients 0.3 or higher.

4.5 VBR New Score

4.5.1 Number of short-stay quality indicators

We presented a detailed critique of the QIs in the Clinical Quality Indicators report. Having only two short-stay QIs presents a problem in attempting to represent the clinical care quality for this population. We recommended 2 additional short-stay resident QIs: Prevalence of Antipsychotic Medications without a Diagnosis of Psychosis and Prevalence of Any Falls, which are used in the CMS Nursing Home Compare (NHC) system and, thus, should be familiar to providers.

4.5.2 Missing data and its effect on rescaled quality total scores

Significant missing data for components of the short-stay quality score presents a problem in calculating both the short-stay and total VBR quality scores. A facility's actual quality score is calculated based on the number of non-missing quality components. For facilities with one or more missing components, the quality score is then rescaled to 90 total, in order to have a fair comparison with facilities that have all the components. If the number of facilities with missing quality components were small, there would be no major concerns about the rescale method. As a result, the correlation coefficient between actual score and their "rescaled to 90" score (rescaled score) should be 1 or close to 1. There is not a problem of missing quality components for long-stay facilities. Almost all facilities have all the components for the long-stay total quality score, so their rescaled score equals their actual score in almost all cases. This situation is confirmed in our analysis; the correlation coefficient between actual and rescaled scores is as high as 0.99 (Table 10).

In contrast, the short-stay quality score has many facilities with missing quality components. Only 47% of facilities (n = 166) have all the components for the short-stay total quality score and more than half of facilities (53%, n = 190) are missing 1+ short-stay quality components. For facilities having missing information on one or more components, their total score does not offer a complete picture; instead it reflects quality for only those measures where data are present. The short stay resident satisfaction survey is measure most likely to have missing data. In those facilities with a missing survey, resident satisfaction plays no role in the final score; it is dependent on the other measures that are present. As a consequence, the correlation coefficient between actual and rescaled short-stay quality scores is only 0.58 (Table 10), much less than 1.

On the positive side, the method of blending short and long stay quality scores minimizes the bias that can be introduced by missing data on the short stay measure. The contributions of the short and along stay measures are weighted by the number of short stay resident days as a proportion of long-stay resident days. Facilities with missing data on their short stay residents typically have few short stay resident days. If so, their total VBR score will be largely dependent on the long stay score; the problem of missing data in the short stay score will be minimized.

Table 10. Correlation between 2019 VBR quality components

	Long-Stay Quality Components					Short-Stay Quality Components						MDH Inspection	VBR Total Score
	QI	QOL	Family Satisfaction	Total90 (rescaled)	Total (actual)	Resident Survey	Hospital	QI pain	QI pressure ulcer	Total90 (rescaled)	Total (actual)		
LS_QI	1												
LS_QOL	0.18	1											
LS_Family	0.16	**0.60**	1										
LS_Total90	**0.95**	**0.46**	**0.40**	1									
LS_Total	**0.94**	**0.46**	**0.40**	**0.99**	1								
SS_Resident	0.22	**0.50**	**0.65**	**0.39**	**0.39**	1							
SS_Hospital	0.13	0.14	0.28	0.18	0.18	**0.34**	1						
SS_QIpain	**0.36**	-0.04	-0.01	**0.31**	**0.31**	-0.02	0.02	1					
SS_QIulcer	0.12	0.10	0.08	0.14	0.14	0.01	-0.01	0.15	1				
SS_Total90	0.23	0.12	0.25	0.26	0.26	**0.55**	**0.86**	0.23	0.17	1			
SS_Total	0.14	0.03	0.00	0.13	0.14	**0.55**	**0.34**	0.11	0.00	**0.58**	1		
MDH Inspection	0.24	0.27	**0.31**	**0.32**	**0.31**	0.26	0.23	-0.01	0.16	0.24	0.03	1	
VBR Total Score	**0.81**	**0.47**	**0.46**	**0.89**	**0.88**	**0.43**	**0.37**	0.23	0.19	**0.41**	0.18	**0.67**	1

Notes: LS: long-stay; SS; short-stay; QI: quality indicator; QOL: quality of life; MDH: Minnesota Department of Health; VBR: value based reimbursement; LS_QI: long-stay clinical quality indicator score; LS_QOL: long-stay quality of life score; LS_Family: long-stay residents' family satisfaction score; LS_Total: the actual long-stay total quality score; LS_Total90: the rescaled long-stay total quality score; SS_Resident: short-stay resident survey score; SS_Hospital: 30-day hospitalization score; SS_QIpain: short-stay QI "prevalence of moderate to serious pain" score; and SS_QIulcer: short-stay QI "prevalence of new or worsening pressure ulcers" score; SS_Total: the actual short-stay total quality score; SS_Total90: the rescaled short-stay total quality score. Bolded values indicate correlation coefficients ≥ 0.3.

4.5.3 Correlations between VBR and CMS NHC quality measures

We examined the correlations between the VBR quality score components and comparable measures from the CMS Nursing Home Compare system. Because of the concerns described above with the short-stay total quality score, we did not expect the short-stay quality score to be highly correlated with any of the other measures.

Regarding the health inspection survey, the correlation between the two data sources (MDH VBR and CMS NHC) is 0.37 (Table 11). This correlation is surprisingly low given that both the MDH and CMS measures are attempting to measure the same construct. Our previous findings also indicate that the CMS inspection measure appears to better represent the dimension of care quality. With regard to other scores, we found as expected that the CMS NHC five-star overall quality rating and clinical quality indicator rating were positively correlated with the VBR long-stay total quality score (0.44 and 0.51, respectively).

Surprisingly, we found weak correlations between the CMS staffing measures and the VBR total score. This weak correlation could be because the CMS staffing measure is only moderately related to the VBR measure. Also, the VBR total score includes multiple measures, some of which may be related to staffing and others not. As a result, other unrelated measures will have a greater influence on the VBR score, which will lower the correlation between the CMS NHC staffing score and the total VBR score.

Table 11. Correlations between VBR quality components and CMS NHC quality measures

CMS NHC quality measures	Long-Stay Total Quality Score		Short-Stay Total Quality Score		MDH Inspection	VBR Total Score
	Total90 (rescaled)	Total (actual)	Total90 (rescaled)	Total (actual)		
Overall quality (five-star rating)	**0.43**	**0.44**	0.27	0.17	**0.37**	**0.50**
Clinical quality indicators (five-star rating)	**0.51**	**0.51**	**0.30**	0.17	0.24	**0.52**
Health inspection						
Health inspection survey (five-star rating)	**0.38**	**0.39**	0.24	0.12	**0.37**	**0.44**
Total health inspection score (the lower score, the better facility performance)	**-0.30**	**-0.32**	-0.29	-0.14	**-0.38**	**-0.40**
Number of substantiated complaints	-0.23	-0.24	-0.18	0.03	**-0.30**	**-0.32**
Number of facility-reported incidents	-0.18	-0.18	-0.13	0.10	-0.26	-0.26
Number of fines	-0.20	-0.19	-0.21	-0.02	-0.16	-0.24
Total amount of fines in dollars	-0.19	-0.19	-0.24	-0.07	-0.22	-0.26

Staffing						
Overall staffing (five-star rating)	0.19	0.22	0.10	0.20	0.11	0.20
RN (five-star rating)	0.16	0.18	0.06	0.17	0.13	0.18
Hours per resident per day						
RN	0.08	0.09	0.04	0.28	0.10	0.07
Adjusted RN	0.15	0.17	0.11	0.22	0.17	0.18
LPN	-0.01	0.00	0.02	0.16	-0.08	-0.03
Adjusted LPN	0.00	0.01	0.04	0.07	-0.06	-0.01
CNA	0.21	0.24	0.11	0.11	0.06	0.19
Adjusted CNA	0.20	0.23	0.08	0.00	0.04	0.17
RN+LPN	0.05	0.07	0.05	**0.33**	0.04	0.04
Total nurse	0.18	0.21	0.11	0.27	0.06	0.15
Adjusted total nurse	0.21	0.22	0.12	0.13	0.14	0.20
Physical therapy	0.08	0.09	0.10	**0.37**	0.04	0.15

Notes: Total: the actual total quality score; Total90: the rescaled total quality score. Bolded values indicate correlation coefficients ≥ 0.3.

4.5.4 Weights assigned to VBR quality components

A total of 29 respondents completed the survey regarding the weights of VBR score components. Respondents were provided with the current VBR equation and asked to create what they perceived to be an ideal weighting of components for the VBR equation based upon their experiences (described in the Qualitative Components Report). Average responses somewhat mirrored the actual VBR equation for the long-stay residents with a lesser emphasis on QOL measures and increased emphasis on family satisfaction than is currently used (Table 12). Responses addressing the short-stay quality equation differed from the current equation with respondents placing less emphasis on hospitalization and more emphasis on pressure ulcers and pain. It should be noted that the standard deviation for these averages is wide, indicating variability or lack of consensus among responses, and that averages are impacted by scores at the outside of the range such as zero.

Table 12. Weights assigned to VBR quality components

	DHS Score	Weights Assigned by Respondents		
		Mean	Standard Deviation	Range
VBR Long-Stay Quality Components				
Resident Quality of Life Ratings	40	34.1	13.8	0-55
Clinical Quality Indicator Score	40	40.7	16.9	10-90
Family Satisfaction Ratings	10	13.8	8.3	0-30
State Inspection Results	10	11.4	5.2	5-30
VBR Short-Stay Quality Components				
Resident Experience Ratings	50	49.7	12.7	20-80
Percent of Hospitalizations	30	22.2	7.5	0-30
Prevalence of Residents who Report Moderate to Severe Pain	5	7.8	5.6	0-20
Prevalence of New or Worsening Pressure Ulcers	5	10.2	6.3	0-25
State Inspection Results	10	10.4	5.0	0-25

5. Summary

5.1 Resident and Family Experiences as Key Indicators of Facility Care Quality and Performance

One theme that emerged from the qualitative findings based on discussions with nursing home clinical leaders, quality experts, and administrators was a desire for person-centered and comprehensive measures (described in the Qualitative Component Report). However, they expressed some frustration with the quality of life measure in particular. The survey may not represent the resident's true quality of life. For example, they were concerned that the survey was only a 'snap shot' of one point in time and it could be heavily influenced by immediate events. In addition, the sample includes residents with cognitive impairment who may not have been able to respond to questions in a valid manner.

Despite these concerns, we found evidence for the construct validity of the resident and family experience measures. Resident and family experience measures were correlated with several of the other quality measures. Residents and families tended to give higher satisfaction scores for facilities with better performance on multiple indicators: health inspections and clinical quality

indicators, lower hospitalization rates, higher community discharge rates, more nurse staffing hours, higher retention rates, and higher proportion of single rooms. In addition, facilities with higher scores on these resident and family experience measures had higher occupancy rates. Better resident and family experience is likely a pivotal factor in attracting residents to the facility.

For these reasons, the state should continue to invest in resident and family surveys, and they should be essential components of the quality measurement system.

5.2 The Hospitalization Rate for 30+ Days per 1000 Resident Days

Correlational findings suggest that more licensed nurse and social worker hours is positively correlated with higher hospitalization rate for 30+ days per 1000 resident days. One possible reason for this unexpected relationship is that the hospitalization rate does not adjust for the acuity of residents in the facility. Facilities with higher resident acuity may have more licensed nurses and more residents at risk of entering the hospital. We recommend to adjust the 30 days or more hospitalization rate by case mix acuity in the same manner as the acuity adjustment is applied to rates of hospitalization for short-stay residents (less than 30 days).

5.3 CMS Nursing Home Compare Staffing and Inspection Measures

The CMS staffing and inspection measures offer more comprehensive and timely composite scores than comparable Minnesota measures. The CMS staffing measure is well designed and it relies on more timely data than the Minnesota measure, which is subject to an 18 month or more lag between data collection and reporting. The CMS ratings on the staffing domain are based on two measures: 1) registered nurse (RN) hours per resident per day; and 2) total nurse staffing (the sum of RN, licensed practical nurse (LPN), and nurse aide) hours per resident per day. The staffing measures are derived from data submitted each quarter through the Payroll-Based Journal (PBJ) System, along with daily resident census derived from Minimum Data Set assessments, and are case-mix adjusted based on the distribution of MDS assessments by Resource Utilization Groups, version IV (RUG-IV group). In addition to the overall staffing rating, a separate rating for RN staffing is also reported.

The CMS health inspections composite measure is also well designed. It provides a more comprehensive rating of inspection results than does the current Minnesota measure. The CMS composite is based on the number, scope, and severity of deficiencies identified during the three most recent annual inspection surveys, as well as substantiated findings from the most recent 36 months of complaint investigations. All deficiency findings are weighted by scope and severity. This measure also takes into account the number of revisits required to ensure that deficiencies identified during the health inspection survey have been corrected.

Adopting the CMS measures offers an advantage to facilities that would have to track only one measure and to the state which could download the measure from the CASPER system rather than having to collect and process separate data.

5.4 New Short-Stay Quality Indicators

In the Clinical Quality Indicators Report, we recommended adding two short-stay quality indicators (falls and antipsychotics without a diagnosis of psychosis). Expanding the number and range of short-stay quality indicators would improve reliability of short-stay VBR score.

5.5 New VBR Quality Scores

Besides the substitution of CMS staffing and inspection scores for MN measures, we recommended changes in the short- and long-stay QIs (described in the Clinical Quality Indicators Report) and quality of life measures (describe in the Long Stay Resident Quality of Life Survey Report). After deciding on these recommended changes and any other changes to the quality measurement system, the next step would be to construct corresponding new VBR quality scores for long- and short-stay residents.

5.6 Extensive Evaluation of the VBR Quality Components

We recommend systematic and extensive input from key stakeholders in evaluating the VBR quality scoring and in determining the weights assigned to different components. Due to the COVID-19 pandemic, we obtained viewpoints about the quality measures from only a small proportion of the nursing home industry. We recommend that DHS conduct an extensive evaluation of quality measures by convening focus groups and conducting surveys on this topic in the coming months after the COVID-19 pandemic has subsided. Also, participation in this process should be expanded to include not only quality experts from the industry but also consumer/advocacy groups.

Appendix

Table 1. Individual quality indicator: variable name and description

Variable Name	Description
21 QIs	
CNTA	Adjusted I of Worsening or Serious Bowel Incontinence (LS)
CNTB	Adjusted I of Worsening or Serious Bladder Incontinence (LS)
CNTE	Adjusted P of Occasional to Full Bladder Incontinence w/o a Toileting Plan (LS)
CNTF	Adjusted P of Occasional to Full Bowel Incontinence w/o a Toileting Plan (LS)
PAI3	Adjusted P of Moderate to Severe Pain (LS)
PAI2	Adjusted P of Moderate to Severe Pain (SS)
WALX	Adjusted I of Walking as Well or Better than on Previous Assessment (LS)
ADLA	Adjusted I of Worsening or Serious Functional Dependence (LS)
MOBA	Adjusted I of Worsening or Serious Mobility Dependence (LS)
FAL1	Adjusted P of Falls with Injury (LS)
ROMA	Adjusted I of Worsening or Serious Range of Motion Limitation (LS)
BEHA	Adjusted I of Worsening or Serious Resident Behavior Problems (LS)
MOD1	Adjusted P of Depressive Symptoms (LS)
RES1	Adjusted P of Physical Restraints (LS)
DRG1	Adjusted P of Antipsychotic Medications Without a Diagnosis of Psychosis (LS)
INFX	Adjusted P of Infections (LS)
PRUA	Adjusted P of New or Worsening Pressure Sores (SS)
PRUB	Adjusted P of Pressure Sores in High Risk Residents (LS)
WGT1	Adjusted P of Unexplained Weight Loss (LS)
CAT2	Adjusted P of Indwelling Catheters (LS)
CNT4	Adjusted P of Urinary Tract Infections (LS)

Notes: QI: quality indicator; LS: long-stay; SS: short stay; I: incidence; P: prevalence.

Table 2. Correlations between CMS NHC quality measures and individual QIs

	CMS NHC: Five Star Rating					CMS NHC: Health Inspection				
	Overall quality	Health inspection	Clinical QIs	Overall staffing	RN	Inspection	Incidents	Complaints	Fine Number	Fine Dollar
CNTA	-0.29	-0.26	-0.22	-0.08	0.00	0.26	0.12	0.21	0.10	0.10
CNTB	-0.24	-0.22	-0.19	-0.09	0.01	0.22	0.12	0.19	0.09	0.09
CNTE	-0.14	-0.15	-0.10	-0.01	-0.02	0.13	0.11	0.11	0.06	0.07
CNTF	-0.02	-0.04	-0.02	0.04	-0.01	0.02	0.05	0.03	0.03	0.03
PAI3	-0.10	-0.02	**-0.32**	0.00	-0.03	0.01	0.00	-0.04	0.01	0.00
PAI2	-0.11	-0.03	**-0.31**	-0.01	-0.05	0.04	-0.04	-0.05	0.00	-0.01
WALX	0.21	0.20	0.23	0.00	-0.06	-0.18	-0.13	-0.19	-0.12	-0.13
ADLA	-0.21	-0.16	**-0.30**	-0.03	-0.04	0.17	0.03	0.08	0.10	0.09
MOBA	-0.12	-0.09	-0.22	0.05	0.00	0.11	0.00	-0.04	0.08	0.07
FAL1	0.00	0.02	-0.08	0.00	-0.01	-0.03	0.00	-0.04	0.00	0.00
ROMA	-0.06	-0.03	-0.12	-0.02	-0.06	0.04	-0.01	-0.01	0.03	0.03
BEHA	-0.06	-0.02	-0.06	-0.10	-0.07	0.02	-0.01	-0.03	0.02	0.01
MOD1	-0.07	-0.04	-0.10	-0.06	-0.08	0.04	-0.05	-0.01	0.00	-0.01
RES1	-0.01	0.02	-0.11	-0.05	-0.07	-0.02	-0.15	-0.20	0.01	0.00
DRG1	-0.22	-0.16	-0.23	-0.13	-0.13	0.18	0.01	0.03	0.05	0.04
INFX	-0.09	-0.06	-0.12	-0.08	-0.03	0.07	0.00	0.07	0.01	0.00

PRUA	-0.15	-0.06	-0.20	-0.14	-0.15	0.08	-0.10	-0.11	0.04	0.02
PRUB	-0.22	-0.17	**-0.30**	-0.03	-0.03	0.17	0.06	0.08	0.09	0.09
WGT1	-0.13	-0.10	-0.17	-0.01	-0.01	0.12	0.04	0.06	0.05	0.05
CAT2	-0.09	-0.02	-0.28	0.04	0.04	0.04	0.00	-0.04	0.05	0.04
CNT4	-0.02	0.04	-0.23	0.02	-0.07	-0.03	-0.08	-0.18	-0.02	-0.03

Notes: Bolded numbers indicate correlation coefficients 0.3 or higher.

Table 3. Correlations between CMS NHC staffing quality measures and individual QIs

	CMS NHC: Staffing (Hours per Resident per Day)									
	RN	Adjusted RN	LPN	Adjusted LPN	CNA	Adjusted CNA	RN+LPN	Total Nurse	Adjusted Total Nurse	Physical Therapy
CNTA	0.10	0.03	0.08	0.02	-0.18	-0.19	0.12	-0.08	-0.10	0.13
CNTB	0.11	0.02	0.06	0.00	-0.21	-0.21	0.12	-0.10	-0.13	0.17
CNTE	-0.03	0.05	0.01	-0.01	-0.08	-0.07	-0.01	-0.06	0.01	0.04
CNTF	-0.02	0.01	0.00	0.01	0.06	0.05	-0.02	0.05	0.09	0.03
PAI3	-0.01	-0.07	0.02	0.04	0.01	0.02	0.01	0.02	0.02	0.03
PAI2	-0.03	-0.09	0.07	0.11	0.00	0.02	0.03	0.02	0.01	0.00
WALX	-0.17	-0.11	-0.02	0.08	0.01	0.06	-0.15	-0.06	0.02	-0.25
ADLA	0.01	-0.07	0.08	0.08	-0.06	-0.06	0.05	-0.03	-0.03	0.01
MOBA	-0.03	-0.02	0.09	0.10	0.03	0.03	0.03	0.04	0.07	-0.09
FAL1	-0.01	0.00	-0.01	-0.01	0.02	0.02	-0.02	0.02	0.03	0.03
ROMA	-0.02	-0.08	0.08	0.06	0.03	-0.01	0.05	0.05	-0.01	0.03
BEHA	-0.10	-0.10	-0.01	0.05	-0.08	-0.08	-0.08	-0.09	-0.09	-0.13
MOD1	-0.07	-0.11	0.04	0.07	-0.09	-0.09	-0.02	-0.08	-0.08	-0.07
RES1	-0.06	-0.06	-0.02	0.01	-0.02	-0.01	-0.06	-0.06	-0.03	-0.09
DRG1	-0.14	-0.16	0.03	0.07	-0.11	-0.11	-0.07	-0.13	-0.10	-0.11

INFX	0.01	-0.11	-0.01	0.00	-0.07	-0.06	0.00	-0.05	-0.10	-0.03
PRUA	-0.13	-0.24	0.09	0.16	-0.07	-0.04	-0.03	-0.07	-0.09	-0.08
PRUB	-0.01	-0.03	0.05	0.02	-0.06	-0.05	0.02	-0.03	-0.05	0.01
WGT1	0.01	-0.04	0.05	0.05	-0.04	-0.03	0.02	-0.03	-0.05	0.02
CAT2	0.08	-0.01	0.08	0.07	0.04	0.01	0.13	0.09	0.03	0.08
CNT4	-0.06	-0.16	0.05	0.11	0.10	0.10	-0.01	0.08	0.06	-0.06

Notes: NA: nurse administrator; RN: Registered Nurse; LPN: Licensed Practical Nurse; CNA: Certified Nursing Assistant.

Table 4. Correlations between MN quality measures

	QI	QOL	MDH Score	VBR Score	HOSP HRP	HOSP LRP	CD30	CD90	Pool_Nurse	Private Room	Occupancy
CNTA	-0.26	**-0.31**	-0.18	**-0.33**	0.15	0.27	-0.11	-0.11	0.07	-0.02	-0.22
CNTB	-0.22	-0.22	-0.16	-0.28	0.13	0.19	-0.04	-0.06	0.00	-0.05	-0.16
CNTE	-0.25	-0.12	-0.13	-0.27	0.03	0.04	0.04	0.01	0.11	0.03	-0.10
CNTF	-0.18	-0.04	-0.08	-0.19	0.00	-0.06	0.06	0.02	0.05	0.02	0.02
PAI3	**-0.36**	0.06	0.01	-0.27	-0.04	0.00	0.03	-0.02	0.00	0.01	0.02
PAI2	**-0.31**	0.07	0.01	-0.22	-0.08	0.01	0.01	-0.06	-0.02	0.00	0.03
WALX	0.19	0.19	0.14	0.25	-0.14	-0.27	0.01	-0.04	-0.05	-0.09	0.18
ADLA	-0.27	-0.14	-0.06	-0.26	0.09	0.14	-0.06	-0.06	0.03	0.06	-0.15
MOBA	-0.27	-0.02	-0.04	-0.24	0.01	-0.04	-0.03	-0.04	0.04	0.11	-0.11
FAL1	-0.13	0.04	-0.02	-0.10	0.02	0.03	0.00	0.04	0.06	0.04	-0.05
ROMA	-0.19	0.01	0.01	-0.15	0.00	0.04	0.07	0.05	0.03	0.04	-0.02
BEHA	-0.20	0.00	0.04	-0.14	-0.06	-0.07	-0.03	-0.02	0.00	-0.13	0.08
MOD1	-0.23	0.00	0.03	-0.16	-0.07	-0.03	0.00	-0.03	-0.03	-0.02	0.05
RES1	-0.23	0.02	0.03	-0.17	-0.05	-0.01	-0.05	0.00	-0.02	0.00	-0.03
DRG1	**-0.40**	-0.07	-0.04	**-0.35**	0.06	0.03	-0.15	-0.09	0.01	-0.08	-0.04
INFX	-0.14	-0.03	-0.06	-0.14	0.05	0.13	-0.13	-0.08	-0.03	-0.07	-0.02
PRUA	-0.12	0.07	0.03	-0.07	-0.03	0.00	-0.06	-0.05	-0.02	-0.01	0.01

PRUB	-0.26	-0.12	-0.10	-0.27	0.06	0.15	-0.04	0.00	0.02	-0.05	-0.12
WGT1	**-0.39**	-0.11	-0.05	**-0.35**	0.05	0.12	-0.08	-0.07	0.01	-0.04	-0.08
CAT2	-0.14	0.04	-0.01	-0.11	0.00	0.02	0.05	0.05	-0.02	0.01	0.01
CNT4	-0.18	0.15	0.07	-0.09	-0.03	0.00	0.04	0.04	-0.04	0.14	0.05

Notes: QI: quality indicator; QOL: quality of life; MDH score: five-star rating health inspection; HOSP_HRP: adjusted 30-day hospitalization rate; HOSP_LRP: hospitalization rate for 30+ days per 1000 resident days; CD30: adjusted 3-30 day community discharge rate; CD90: adjusted 30-90 day community discharge rate; Pool_Nurse: percentage of temporary/pool nursing staff hours. Bolded numbers indicate correlation coefficients 0.3 or higher.

Table 5. Correlations between MN staffing (hours per resident per day) and quality indicators

| | Staffing (hours per resident per day) | | | | | | | | | | |
	Staffing	NA	RN	LPN	RN+ LPN	CAN	TMA	ACT	MHW	SW	ODC	Total
CNTA	-0.08	0.06	0.12	0.12	0.18	0.05	-0.05	-0.16	-0.17	0.05	-0.02	0.08
CNTB	-0.08	0.05	0.11	0.10	0.16	-0.02	-0.12	-0.19	-0.09	0.09	0.00	0.00
CNTE	0.10	0.04	0.01	0.05	0.04	-0.08	0.07	-0.08	-0.10	0.05	0.05	0.00
CNTF	0.08	0.01	0.02	0.02	0.03	-0.04	0.07	-0.05	-0.06	0.03	0.04	0.02
PAI3	0.11	0.05	-0.03	0.08	0.04	-0.01	0.02	-0.01	0.02	0.02	0.06	0.03
PAI2	0.09	0.00	0.02	0.10	0.08	0.00	0.00	-0.03	0.00	0.01	0.01	0.03
WALX	0.06	-0.24	-0.16	-0.04	-0.15	-0.20	0.01	0.04	0.15	-0.10	-0.02	-0.25
ADLA	-0.03	0.04	0.01	0.12	0.10	0.17	-0.08	0.03	-0.17	-0.05	0.00	0.13
MOBA	0.06	0.06	-0.01	0.10	0.07	0.23	-0.05	0.05	-0.15	-0.14	0.03	0.18
FAL1	0.05	0.06	0.00	0.02	0.01	0.01	0.04	0.06	-0.02	0.00	-0.01	0.05
ROMA	-0.05	0.00	0.00	0.06	0.04	0.12	-0.07	0.05	-0.08	-0.08	0.05	0.08
BEHA	-0.04	-0.03	-0.15	-0.01	-0.12	-0.27	0.08	-0.03	0.21	0.03	-0.03	-0.21
MOD1	-0.05	-0.05	-0.07	0.05	-0.02	-0.11	-0.04	-0.05	0.05	-0.03	0.04	-0.12
RES1	-0.06	0.01	-0.09	0.03	-0.05	0.01	-0.02	0.02	-0.02	-0.10	0.00	-0.03
DRG1	-0.06	-0.03	-0.14	-0.02	-0.12	-0.20	0.00	-0.08	0.25	-0.01	-0.03	-0.21
INFX	-0.15	-0.09	-0.02	0.01	-0.01	-0.14	-0.02	-0.10	0.00	-0.05	-0.01	-0.15

PRUA	-0.03	-0.11	-0.09	0.04	-0.05	-0.12	-0.05	0.01	0.07	-0.04	0.00	-0.14
PRUB	0.00	0.00	0.02	0.05	0.05	0.00	-0.04	-0.05	-0.06	-0.01	0.02	0.00
WGT1	-0.03	-0.02	-0.01	0.05	0.03	0.02	-0.06	-0.03	-0.05	0.00	-0.07	-0.02
CAT2	0.00	0.07	0.05	0.08	0.10	0.12	-0.09	-0.03	-0.06	-0.01	0.06	0.10
CNT4	0.07	-0.04	-0.12	0.11	0.00	0.10	-0.02	0.10	-0.03	-0.09	0.05	0.06

Notes: NA: nurse administrator; RN: Registered Nurse; LPN: Licensed Practical Nurse; CNA: Certified Nursing Assistant; TMA: trained medication aides; ACT: activity staff; MHW: mental health worker; SW: social worker; ODC: other direct care staff

Table 6. Correlations between MN retention and quality indicators

	Retention										
	Retention	NA	RN	LPN	CAN	TMA	CAN/TMA	ACT	MHW	SW	ODC
CNTA	-0.21	-0.15	-0.13	-0.12	-0.05	-0.08	-0.13	-0.09	-0.14	-0.12	-0.02
CNTB	-0.13	-0.16	-0.12	-0.09	-0.01	-0.10	-0.06	-0.06	-0.08	-0.12	0.02
CNTE	-0.04	-0.09	-0.06	-0.04	0.03	0.01	0.01	-0.03	-0.11	-0.07	-0.02
CNTF	-0.03	-0.03	-0.03	-0.02	0.00	0.05	0.01	-0.02	-0.06	-0.05	0.00
PAI3	-0.07	-0.02	-0.07	-0.03	-0.06	-0.03	-0.07	0.02	0.03	0.01	0.02
PAI2	-0.03	0.02	-0.03	-0.01	-0.04	-0.02	-0.04	0.02	-0.01	0.00	-0.02
WALX	0.22	0.11	0.15	0.12	0.07	0.01	0.17	0.08	0.13	0.08	-0.07
ADLA	-0.18	-0.08	-0.10	-0.10	-0.02	-0.08	-0.13	-0.05	-0.15	-0.04	-0.06
MOBA	-0.09	-0.03	-0.01	-0.08	0.01	-0.07	-0.07	-0.03	-0.14	0.00	0.01
FAL1	-0.03	-0.03	-0.02	-0.07	-0.05	-0.03	-0.03	0.01	-0.01	0.01	-0.01
ROMA	-0.06	-0.02	-0.04	-0.08	-0.02	-0.02	-0.05	0.03	-0.06	-0.01	-0.01
BEHA	0.02	-0.03	-0.03	0.00	-0.11	0.01	0.00	0.04	0.15	-0.01	-0.09
MOD1	0.00	-0.01	-0.01	-0.03	-0.08	-0.07	-0.04	0.02	0.02	-0.06	-0.01
RES1	-0.01	-0.01	0.01	0.03	0.00	-0.03	-0.01	0.00	-0.02	-0.03	-0.06
DRG1	-0.05	-0.08	-0.05	-0.03	-0.06	-0.04	-0.03	-0.04	0.17	-0.07	-0.07
INFX	-0.06	-0.09	-0.05	-0.07	-0.10	-0.04	-0.06	-0.02	-0.01	-0.08	-0.05
PRUA	-0.03	-0.02	-0.03	-0.02	-0.02	0.01	-0.01	0.01	0.03	0.02	-0.05

PRUB	-0.09	-0.10	-0.04	-0.05	-0.07	-0.03	-0.07	-0.06	-0.06	-0.09	-0.02
WGT1	-0.07	-0.10	-0.07	-0.05	-0.02	-0.04	-0.06	-0.05	-0.05	-0.03	-0.07
CAT2	-0.02	0.00	-0.02	-0.03	0.02	-0.03	-0.01	0.04	-0.07	0.01	0.09
CNT4	0.00	0.06	0.00	0.01	0.01	-0.01	-0.01	0.02	-0.04	0.04	0.04

Notes: NA: nurse administrator; RN: Registered Nurse; LPN: Licensed Practical Nurse; CNA: Certified Nursing Assistant; TMA: trained medication aides; ACT: activity staff; MHW: mental health worker; SW: social worker; ODC: other direct care staff