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Accuracy of Pressure Ulcer Events in US Nursing Home Ratings

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Background: The US government relies on nursing home-reported data to create quality of care measures and star ratings for Nursing Home Compare (NHC). These data are not systematically validated, and some evidence indicates NHC's patient safety measures may not be reliable.

Objective: The objective of this study was to assess the accuracy of NHC's pressure ulcer measures, which are chief indicators of nursing home patient safety.

Research Design: For Medicare fee-for-service beneficiaries who were nursing home residents between 2011 and 2017, we identified hospital admissions for pressure ulcers and linked these to the nursing home-reported data at the patient level. We then calculated the percentages of pressure ulcers that were appropriately reported by stage, long-stay versus short-stay status, and race. After developing an alternative claims-based measure of pressure ulcer events, we estimated the correlation between this indicator and NHC-reported ratings.

Subjects: Medicare nursing home residents with hospitalizations for pressure ulcers.

Measures: Pressure ulcer reporting rates; nursing home–level claims-based measure of pressure ulcer events.

Results: Reporting rates were low for both short-stay (70.2% of 173,043 stage 2–4 pressure ulcer hospitalizations) and long-stay (59.7% of 137,315 stage 2–4 pressure ulcer hospitalizations) residents. Black residents experienced more severe pressure ulcers than White residents, however, this translated into having slightly higher reporting rates because higher staged pressure ulcers were more likely to be reported. Correlations between our claims-based measure and NHC ratings were poor.

Conclusions: Pressure ulcers were substantially underreported in data used by NHC to measure patient safety. Alternative approaches are needed to improve surveillance of health care quality in nursing homes.

Key Words: nursing homes, nursing home compare, pressure ulcers, public reporting, self-reporting, health care quality

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Patient safety in nursing homes, which can be achieved through the prevention of adverse events such as infections, falls, and pressure ulcers, has been a longstanding concern, evidenced by government reports,[1–4] state lawsuits,[5–9] academic articles,[10] and media publications.[11,12] However, the recent deaths of over 130,000 nursing home residents due to coronavirus disease 2019 (COVID-19) infection[13] has heightened concerns about the quality of care and whether ratings by the federal government can discriminate between higher quality and lower quality facilities.[12]

To monitor patient safety in nursing homes and help consumers make informed decisions, the Centers for Medicare and Medicaid Services (CMS) created Nursing Home Compare (NHC) in the 1990s, a Web site that publicly reports patient safety indicators for each nursing home and summarizes these via a user-friendly Five-Star Quality Rating System.[14] However, CMS relies on nursing homes to self-report the data that is then used by NHC to rate nursing homes. Given this apparent disincentive and the potential administrative challenge of reporting, it is imperative to ask: how accurate and informative are NHC measures?

The self-reported data from nursing homes are collectively referred to as the Minimum Data Set (MDS) and consist of patient-level assessments that are conducted at least every 92 days.[15] Inconsistencies between the MDS or MDS-based measures and other sources like medical records have been reported by academic and government studies, but these have largely been suggestive due to small sample sizes or aggregate data.[16–29] One analysis, however, directly compared resident level MDS assessments of all Medicare beneficiaries to a high-quality independent data source, the beneficiaries' hospital claims, to assess reporting accuracy of major injury falls.[30] It found only 57.5% of hospitalized major injury falls were reported by nursing homes and further concluded that NHC measures could not differentiate between facilities that had more or less fall-related injuries.

In this study, we assessed nursing home reporting of pressure ulcers, which are key markers of patient safety because they can be prevented and managed with vigilant

care[31,32] but otherwise may lead to serious morbidity and mortality.[33–35] We performed a national analysis of pressure ulcer reporting accuracy by linking MDS data to Medicare claims at the patient level. We also examined differences in reporting by pressure ulcer severity and resident race, given the vast literature on racial disparities in long-term care settings and pressure ulcer care.[36,37] Last, we assessed how well NHC ratings differentiate between nursing homes with varying pressure ulcer rates.

METHODS

Study Overview

Our strategy was to assess whether pressure ulcers identified as present-on-admission (POA) in Medicare hospitalization claims for nursing home residents were reported by nursing homes on assessments used by CMS to create patient safety measures. We created tightly linked episodes of care between claims and assessments by linking beneficiary identification numbers and discharge and admission dates within 1 day. By combining several datasets, using statistical modeling, and assessing the robustness of our findings to alternative specifications, we examined how accurately nursing homes reported pressure ulcers to CMS, the roles of pressure ulcer severity and race in reporting, and the extent to which CMS public ratings are informative indicators of pressure ulcer risk in a nursing home.

Data

For a 100% sample of 2011–2017 Medicare fee-for-service beneficiaries, we used hospital admission data and skilled nursing facility (SNF) claims from the Medicare Provider Analysis and Review (MedPAR) file. The last 3 months of 2015 were excluded to allow for a washout period during the transition from *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) to the *10th Revision* (ICD-10-CM). Information on beneficiary demographics and chronic conditions was obtained from the Master Beneficiary Summary File (MBSF).

We used MDS 3.0 assessments from the same time period, with resident identifiers mapped to Medicare beneficiary identifiers. The assessment instrument includes sections for clinical, functional, and psychological outcomes; we focused on Section M Skin Conditions, which is mostly devoted to pressure ulcers. We assessed reporting on the M0300 items which ask about any unhealed pressure ulcers at each stage in the 7 days before the assessment date (Table 1).[15] These items are used by NHC to directly create a quality measure for long-stay high-risk residents and as prerequisites for a short-stay quality measure; both measures are used to calculate the NHC Five-Star Quality Ratings.

Facility information was extracted from the Certification and Survey Provider Enhanced Reporting (CASPER) dataset and LTCFocus at Brown University. NHC quality measures and star ratings were obtained from CMS.[14]

Identification of Pressure Ulcers in Claims Data

The MDS instrument and ICD-9-CM and ICD-10-CM follow the National Pressure Ulcer Advisory Panel's (NPUAP) pressure ulcer definitions, which identify 6 stages based on skin color and tissue loss[15,38] (Appendix A, Appendix Table S1, Supplemental Digital Content 1, http://links.lww.com/MLR/C498). Higher numbered stages indicate greater severity; unstageable pressure ulcers may be as severe as stage 3 or 4 but cannot be staged because of eschar or slough covering.

Pressure ulcer locations and stages are coded as 707.00–707.09 and 707.20–707.25, respectively in ICD-9-CM; a single ICD-10-CM code (L89.000–L89.96) records both location and stage. We identified all hospital admission data with these codes in any diagnosis field and required the condition to be flagged as POA to minimize inclusion of hospital-acquired pressure ulcers. We created 2 categories of claims to reflect different clinical scenarios: (1) primary pressure ulcer diagnosis claims, which had pressure ulcer codes in the admitting, first, or second diagnosis field, for cases with a pressure ulcer as a leading reason for hospitalization, and (2) secondary pressure ulcer diagnosis claims, which had pressure ulcer codes in any diagnosis field after the second, for patients who had pressure ulcers as comorbid conditions. In addition, we identified SNF claims with pressure ulcer codes in the admitting, primary, or second diagnosis field. We used the primary pressure ulcer diagnosis hospital claims as our main analytical sample.

Linkage of Claims and Minimum Data Set Assessments

Pressure ulcer claims were linked with MDS assessments at the resident level based on 2 criteria. First, nursing homes are required by CMS to complete discharge assessments, including pressure ulcer-related items, when a patient has been admitted to a hospital. Therefore, we linked hospital claims to MDS discharge assessments with discharge dates within 1 day of hospital admission. Since pressure ulcers in our sample are marked as POA on the hospital claim, we expected the discharge assessment from the nursing home to report the pressure ulcer, and especially so in cases with a primary hospital diagnosis of pressure ulcer. Second, we required residents to be readmitted to the same nursing home within 1 day of hospital discharge (Appendix C, Appendix Fig. S1, Supplemental Digital Content 1, http://links.lww.com/MLR/C498). This is not a CMS reporting requirement. Rather, we imposed it on our analysis to assess reporting in a more conservative scenario—that is, when a facility should be more familiar with a patient.

We used SNF claims to assess reporting in cases where the same facility that completed the MDS assessment also billed Medicare for postacute care and noted a pressure ulcer diagnosis on the claim. SNF reimbursements are based on the Medicare Prospective Payment System (PPS) and determined by Resource Utilization Groups (RUGs). RUGs are assigned based on the MDS, not the submitted diagnosis codes on the claim. CMS checks for consistency of qualifying clinical conditions between the RUG and MDS assessments.[15] If this check has a spillover effect on claim diagnosis codes, it may be reasonable to expect consistency between the MDS and claim diagnosis codes too. However, cases in which a

TABLE 1. Minimum Data Set 3.0 Items on Current Number of Unhealed Pressure Ulcers at Each Stage*

Item	Pressure Ulcer Severity	Pressure Ulcer Description	Possible Responses
M0300A	Stage 1	Intact skin with nonblanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may not have a visible blanching; in dark skin tones only it may appear with persistent blue or purple hues	Enter number of stage 1 pressure ulcers
M0300B1[†]	Stage 2	Partial thickness loss of dermis presenting as a shallow open ulcer with a red or pink wound bed, without slough. May also present as an intact or open/ruptured blister	Enter number of stage 2 pressure ulcers
M0300C1[†]	Stage 3	Full-thickness tissue loss. Subcutaneous fat may be visible but bone, tendon, or muscle is not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling	Enter number of stage 3 pressure ulcers
M0300D1[†]	Stage 4	Full-thickness tissue loss with exposed bone, tendon, or muscle. Slough or eschar may be present on some parts of the wound bed. Often includes undermining and tunneling	Enter number of stage 4 pressure ulcers
M0300E1	Unstageable	Nonremovable dressing: Known but not stageable due to nonremovable dressing/device	Enter number of unstageable pressure ulcers
M0300F1	Unstageable	Slough and/or eschar: Known but not stageable due to coverage of wound bed by slough and/or eschar	Enter number of unstageable pressure ulcers
M0300G1	Unstageable	Deep tissue injury: Suspected deep tissue injury in evolution[‡]	Enter number of unstageable pressure ulcers

*Only pressure ulcer-related items in Minimum Data Set 3.0 that were assessed in this study are listed here. Coding for these items should include any pressure ulcer within 7 days before the assessment reference date for assessment records. For a complete list of items in section M, please see Appendix Table S2.

[†]Items M0300B1, M0300C1, and M0300D1 are used by Nursing Home Compare to create quality measures and assign 5-star ratings.

[‡]ICD-9-CM and ICD-10-CM do not include a diagnosis code for this stage from 2011 to 2017 and therefore this type of pressure ulcer was not separately identified in this study. ICD-9-CM indicates *International Classification of Diseases, Ninth Revision, Clinical Modification*; ICD-10-CM, *International Classification of Diseases, 10th Revision, Clinical Modification*.

pressure ulcer is noted by the SNF on a claim but not reported on the MDS may indicate underreporting.

For SNF claims, we linked pressure ulcer hospital claims to all MDS assessments (except for entry and death tracking records) within the resident's stay at the facility as it is not possible to know when the pressure ulcer occurred during the billing cycle (Appendix D, Appendix Fig. S2, Supplemental Digital Content 1, http://links.lww.com/MLR/C498).[15] This allowance only made our estimation more conservative since we counted reporting of a pressure ulcer on any assessment during the stay rather than a single assessment that falls within the window of expected reporting.

Outcome Variables

Our primary outcome was a binary variable indicating that at least 1 pressure ulcer was reported in any of the M0300 items on the assessments linked with each claim, without any requirements of the stage at which a pressure ulcer was reported. As a secondary outcome, we created a binary indicator of whether the assessment reported a pressure ulcer at a stage within 1 level of the highest-staged pressure ulcer on the claim.

We also constructed a claims-based nursing home–level pressure ulcer rate defined as the number of primary pressure ulcer diagnosis claims per 100 Medicare fee-for-service residents. We created this measure for 2014 and 2017, the most recent complete years of data under ICD-9-CM and ICD-10-CM.

Covariates

At the resident level, we obtained from the MBSF age, sex, race, dual status (a binary indicator of whether the

resident was dually eligible for Medicare and Medicaid in the month of their hospital admission), and disability status (a binary indicator of whether disability was the current reason for Medicare entitlement). We flagged residents as short stay if they had a PPS 5-day assessment within 100 days before nursing home discharge, and as long stay otherwise. To adjust for health status, we created indicators for each of 27 chronic conditions, and Charlson/Elixhauser comorbidity scores using diagnosis codes from the hospital admission claim.[39] Pressure ulcer severity was assigned by the highest-staged pressure ulcer recorded on the claim.

At the nursing home level, we categorized nursing homes by size based on tertials of their resident population distributions, Census region, and ownership. We also created nursing home–level measures of race, dual status, and pressure ulcer severity.[40,41] Quarterly NHC measures were averaged within each year for each nursing home. Please see Supplement for further detail (Appendix B, Supplemental Digital Content 1, http://links.lww.com/MLR/C498).

Statistical Analysis

We assessed the accuracy of pressure ulcer reporting on the MDS by calculating national reporting rates overall and by stage, stratified by claim type, short-stay versus long-stay resident, and pressure ulcer severity.

We studied disparities in reporting rates associated with resident-level and nursing home–level characteristics by fitting a multilevel logistic regression model with nursing home random intercepts. In this model, we used our main analytical sample and adjusted for all covariates described above. We disaggregated the individual-level and nursing home–level effects of race, dual status, and pressure ulcer severity by

including these variables at both levels.[40,41] After noting a strong association between race and severity, we included interactions of these variables at both individual level and nursing home levels (Appendix B). For easier interpretation, we predicted reporting rates for hypothetical patients by using fitted parameters from the model, fixing key variables at different and reasonable values, and keeping other variables at their sample means.

Finally, we grouped nursing homes into quintiles of their claims-based pressure ulcer rates. For each quintile, we computed means of NHC 5-star ratings and pressure ulcer measures, and the percentages of 4-star or 5-star rated nursing homes. We estimated the Pearson and Spearman correlation coefficients between our claims-based pressure ulcer rates and these NHC measures. Please see Appendices E–G for further sensitivity analysis and modeling detail (Supplemental Digital Content 1, http://links.lww.com/MLR/C498).

The descriptions of programming code for the analysis were in Appendix H and code can be accessed through https://github.com/sanghavi-lab/nhc_pressure_ulcer.

RESULTS

Resident Characteristics

Overall, we identified 114,729 and 293,617 hospital admission claims with primary and secondary pressure ulcer diagnoses, respectively; we identified 60,203 SNF claims with primary diagnosis of pressure ulcer. On average, short-stay residents were sicker, less likely to have a disability, and less likely to be dually eligible individuals than long-stay residents (Table 2). The distribution of pressure ulcer severity among individuals who were not White was statistically different from that of White residents. Importantly, White residents had substantially lower percentages of stage 4 pressure ulcers than Black residents (short stay: 40.8% vs. 50.4%; long stay: 45.6% vs. 54.2%) and Hispanic residents (short stay: 40.8% vs. 46.1%; long stay: 45.6% vs. 48.9%).

National Pressure Ulcer Reporting Rates

Here, we focus on pressure ulcers in stages 2 through 4, as these are used by NHC. Among long-stay residents, about 74.7% of primary pressure ulcers were reported at all, with 70.2% reported within 1 stage of the hospital diagnosis; 52.1% of secondary pressure ulcers were reported at all, with 46.1% reported within a stage of the hospital diagnosis (Table 3). Most of the reporting difference between primary and secondary pressure ulcers is explained by differences in the distributions of pressure ulcer severity between the 2 groups; primary pressure ulcer diagnoses were more severe (90.6% in stages 3 and 4) than secondary diagnoses (42.2% in stages 3 and 4) and reporting substantially increased with higher stage.

Among short-stay residents with stage 2–4 pressure ulcers, about 82.2% of primary pressure ulcers were reported at all, with 76.6% reported within 1 stage of the hospital diagnosis; 64.6% of secondary pressure ulcers were reported at all, with 55.9% reported within 1 stage of the hospital diagnosis. As with long-stay residents, primary pressure

ulcers were on average more severe (90.5% vs. 39.8% at stages 3–4) and reporting improved with severity.

For short-stay residents, we found 42,467 SNF claims at stage 2–4. In 7.3% of these cases, the same facility recorded a pressure ulcer on its Medicare claim but did not report the pressure ulcer to CMS for NHC's patient safety ratings. Please see Appendix Figure S3 and Tables S3–S5 for sensitivity analyses (Supplemental Digital Content 1, http://links.lww.com/MLR/C498).

Disparities in Reporting Rates

Table 4 shows predicted reporting rates by nursing home race mix, individual race, and pressure ulcer severity, adjusted for individual and nursing home–level characteristics using a multilevel model as described in the methods (Appendix Tables S6, S7, Supplemental Digital Content 1, http://links.lww.com/MLR/C498). Among long-stay residents, differences between White and Black residents were similar in nursing homes with 10% and 70% Black residents. Reporting improved similarly for both races with pressure ulcer severity. Reporting differences between the 2 races were not statistically significant at stage 2, but residents who are Black had significantly higher reporting rates at stages 3 and 4 by about 2.5 (*P* = 0.042) and 2.9 (*P* < 0.001) percentage points, respectively. Results were similar for short-stay residents.

Claims-based Pressure Ulcer Rates Versus Nursing Home Compare Measures

In 2014, nursing homes with the fewest hospitalizations for a primary diagnosis of pressure ulcer (the lowest quintile) had 0.4 pressure ulcers per 100 residents on average; the highest quintile had 3.2 pressure ulcers per 100 residents on average (Table 5). About 46.8% of the lowest quintile nursing homes had a 4-star or 5-star overall rating and 75.8% had a 4-star or 5-star quality rating. About 28.5% of highest quintile nursing homes had a 4-star or 5-star overall rating and 65.7% had a 4-star or 5-star quality rating. The correlation coefficients between the claims-based pressure ulcer rates and NHC 5-star ratings were exceedingly low (−0.151 and −0.029 for the overall and quality ratings, respectively), as were the correlations with the MDS-based pressure ulcer quality measures (0.319 and 0.040 for the long-stay and short-stay measures, respectively). Correlation coefficients improved in 2017 (−0.152 and −0.092 for the overall and quality ratings, respectively) but were still quite low. All correlation coefficients were statistically significant at an α level of 0.05.

DISCUSSION

Nursing homes substantially underreported pressure ulcers between 2011 and 2017, making CMS patient safety measures based on these data highly inaccurate. We assessed reporting by focusing on patients who were hospitalized with a primary diagnosis of pressure ulcer and resided in the same nursing home before and after hospitalization. Of these, 22.4% of pressure ulcers were not reported by nursing homes. When we relaxed our requirements to hospitalizations with a secondary diagnosis of pressure ulcer, 45.0% of pressure ulcers were not reported by nursing homes. This is the first

TABLE 2. Characteristics of Medicare Fee-for-Service Beneficiaries With Primary Pressure Ulcer Diagnosis Claims[†] by Long Stay Versus Short Stay and Pressure Ulcer Severity

Pressure Ulcer Severity[‡]	Age (y)	Female (%)	Dually Eligible for Medicare and Medicaid (%)	Comorbidity Score	Disability (%)	No. Chronic Conditions	n (%)				
							White	Black	Hispanic	Asian	Other[§]
Long-stay residents											
Stage 1 (N = 1539)	80.94	63.7	82.5	2.64	8.4	12.37	1247 (4.0)	161 (1.1)	90 (2.5)	28 (3.2)	13 (2.0)
Stage 2 (N = 4325)	79.15	61.4	84.6	2.79	10.8	12.29	2900 (9.2)	994 (6.5)	266 (7.5)	107 (12.1)	58 (8.7)
Stage 3 (N = 16,842)	76.61	59.1	86.7	3.39	17.2	12.34	10,610 (33.6)	4550 (29.9)	1170 (33.0)	317 (35.7)	195 (29.3)
Stage 4 (N = 25,088)	72.79	56.3	87.5	3.25	25.2	11.96	14,382 (45.6)	8246 (54.2)	1735 (48.9)	378 (42.6)	347 (52.2)
Unstageable (N = 4075)	76.34	55.1	86.8	3.43	17.6	12.30	2416 (7.7)	1266 (8.3)	284 (8.0)	57 (6.4)	52 (7.8)
Weighted mean	75.08	57.7	86.8	3.25	20.3	12.15	Total 31,555 (100.0)	15,217*** (100.0)	3545*** (100.0)	887* (100.0)	665*** (100.0)
Short-stay residents											
Stage 1 (N = 1713)	80.64	60.2	49.9	3.04	7.1	12.46	1433 (3.5)	148 (0.9)	74 (1.9)	40 (4.4)	18 (2.5)
Stage 2 (N = 5215)	79.16	58.3	51.6	3.27	8.6	12.21	3827 (9.3)	982 (6.0)	271 (6.8)	85 (9.5)	50 (6.9)
Stage 3 (N = 22,167)	77.39	54.3	57.9	3.79	12.3	12.20	15,166 (37.0)	5055 (31.1)	1383 (34.7)	333 (37.0)	230 (31.6)
Stage 4 (N = 27,498)	73.66	54.7	65.4	3.64	20.4	11.73	16,725 (40.8)	8211 (50.4)	1835 (46.1)	357 (39.7)	370 (50.8)
Unstageable (N = 6267)	77.03	50.3	61.3	3.79	12.2	12.13	3825 (9.3)	1881 (11.6)	417 (10.5)	84 (9.3)	60 (8.2)
Weighted mean	75.96	54.6	60.8	3.66	15.4	12.00	Total 40,976 (100.0)	16,277*** (100.0)	3980*** (100.0)	899** (100.0)	728** (100.0)

[†]Primary pressure ulcer diagnosis claims were hospital admission claims where the admitting, the first or second diagnosis code was for a pressure ulcer.
[‡]Severity for a claim was assigned based on the stage of the highest-staged pressure ulcer on the claims.
[§]"Other" is the combination of race category "Other" and "American Indian" in RACE_RTI and was created to satisfy the Centers for Medicare and Medicaid Services (CMS) data use agreement cell suppression policy.
*Based on a χ^2 test, the distribution of pressure ulcer severity in this race category is statistically different from the distribution of pressure ulcer severity among those who are White, with $P < 0.05$.
**Based on a χ^2 test, the distribution of pressure ulcer severity in this race category is statistically different from the distribution of pressure ulcer severity among those who are White, with $P < 0.01$.
***Based on a χ^2 test, the distribution of pressure ulcer severity in this race category is statistically different from the distribution of pressure ulcer severity among those who are White, with $P < 0.001$.

TABLE 3. National Pressure Ulcer Reporting Rates by Long Stay Versus Short Stay and Pressure Ulcer Severity in 2011–2017

Claims Type (N)	Pressure Ulcer Severity on Claim*	Long Stay			Short Stay		
		N	Percent of Claims With Any Pressure Ulcer Reported on MDS (25th, 75th percentile)[†]	Percent of Claims With Any Pressure Ulcer Reported on MDS Within 1 Stage of Claim Severity (25th, 75th Percentile)[†]	N	Percent of Claims With Any Pressure Ulcer Reported on MDS (25th, 75th Percentile)[†]	Percent of Claims With Any Pressure Ulcer Reported on MDS Within 1 Stage of Claim Severity (25th, 75th Percentile)[†]
Primary pressure ulcer diagnosis[‡] hospital admission claims (N = 114,729)	Stage 1	1539	12.9 (0.0, 0.0)	7.0 (0.0, 0.0)	1713	28.1 (0.0, 50.0)	18.0 (0.0, 0.0)
	Stage 2	4325	33.3 (0.0, 66.7)	25.4 (0.0, 50.0)	5215	52.8 (0.0, 100.0)	41.0 (0.0, 100.0)
	Stage 3	16,842	66.8 (50.0, 100.0)	64.1 (50.0, 100.0)	22,167	77.7 (66.7, 100.0)	73.8 (58.3, 100.0)
	Stage 4	25,088	87.2 (81.0, 100.0)	81.9 (75.0, 100.0)	27,498	91.5 (88.9, 100.0)	85.6 (78.0, 100.0)
	Unstageable	4075	77.9 (66.7, 100.0)	70.0 (50.0, 100.0)	6267	86.7 (100.0, 100.0)	79.2 (66.7, 100.0)
Secondary pressure ulcer diagnosis[‡] hospital admission claims (N = 293,617)	Stage 1	19,314	14.0 (0.0, 20.9)	7.8 (0.0, 5.6)	22,100	27.8 (0.0, 50.0)	17.9 (0.0, 28.6)
	Stage 2	52,647	33.6 (16.7, 50.0)	25.9 (7.7, 38.5)	71,187	52.1 (37.8, 66.7)	41.0 (25.0, 54.5)
	Stage 3	17,775	65.2 (50.0, 100.0)	62.8 (44.4, 100.0)	24,945	75.9 (62.5, 100.0)	72.0 (53.8, 100.0)
	Stage 4	20,638	88.0 (83.3, 100.0)	83.3 (76.7, 100.0)	22,031	92.1 (91.7, 100.0)	86.1 (80.0, 100.0)
	Unstageable	16,066	56.7 (33.3, 87.5)	46.4 (16.7, 71.4)	26,914	73.0 (57.1, 100.0)	60.5 (42.9, 83.3)
Primary pressure ulcer diagnosis[‡] SNF claims[§] (N = 60,203)	Stage 1				1222	74.6 (50.0, 100.0)	67.8 (50.0, 100.0)
	Stage 2				7846	86.1 (66.7, 100.0)	81.0 (66.7, 100.0)
	Stage 3				11,172	93.9 (100.0, 100.0)	92.6 (100.0, 100.0)
	Stage 4				23,449	94.4 (100.0, 100.0)	92.1 (91.7, 100.0)
	Unstageable				16,514	95.3 (100.0, 100.0)	92.5 (94.4, 100.0)

*Severity for a claim was assigned based on the stage of the highest-staged pressure ulcer on the claims.
[†]The 25th and 75th percentile were weighted by the number of pressure ulcer claims identified for each nursing home.
[‡]Primary pressure ulcer diagnosis claims had a pressure ulcer in the admitting, first or second diagnosis code. Secondary pressure ulcer diagnosis claims had a pressure ulcer in a field after the second diagnosis.
[§]Since Medicare only covers 100-day postacute care in nursing homes, all residents with a SNF claim should be short-stay residents during the stay billed by the claim.
MDS indicates Minimum Data Set; SNF, skilled nursing facility.

TABLE 4. Adjusted Differences in Reporting Rates by Pressure Ulcer Severity, Race, and Nursing Home Race Mix for Long-stay and Short-stay Residents

Percentage of Black Residents	Pressure Ulcer Severity‡	Adjusted Mean*,†		Difference (*P*)
		White	Black	White−Black
Long stay (N = 51,869)				
10%	Stage 2	33.6	33.8	−0.1 (0.960)
	Stage 3	65.6	68.2	−2.6 (0.037)
	Stage 4	85.1	88.0	−2.9 (<0.001)
70%	Stage 2	37.1	37.2	−0.1 (0.960)
	Stage 3	67.5	70.0	−2.5 (0.042)
	Stage 4	85.2	88.1	−2.9 (<0.001)
Short stay (N = 62,860)				
10%	Stage 2	52.1	55.3	−3.2 (0.167)
	Stage 3	76.6	79.1	−2.4 (0.015)
	Stage 4	90.5	92.8	−2.3 (<0.001)
70%	Stage 2	52.9	56.2	−3.2 (0.170)
	Stage 3	77.1	79.5	−2.4 (0.021)
	Stage 4	90.0	92.3	−2.4 (<0.001)

*The reporting rates for long-stay and short-stay residents were separately modeled using logistic multilevel models with nursing home random intercepts. The model adjusted for individual-level variables of age, sex, race, pressure ulcer severity, comorbidity score, disability status, and chronic conditions, nursing home–level variables of size, region, ownership type, and both individual-level and nursing home–level variables of Medicaid-Medicare dual status, pressure ulcer severity, and race. Interactions for pressure ulcer severity and race were also included at both levels. Only primary pressure ulcer diagnosis claims were used.

†The adjusted reporting rates were predicted using the fitted parameters of the logistic multilevel model with fixed values for the percentage of stage 1 pressure ulcer (5%), the percentage of stage 2 pressure ulcer (10%), the percentage of stage 3 pressure ulcer (20%), the percentage of stage 4 pressure ulcer (60%), and the percentage of Unstageable pressure ulcer (5%). The percentage of Hispanic residents was set to 1. The percentage of White residents was 1 minus the percentage of Black and Hispanic residents. All other variables were set at the sample mean.

‡Severity for a claim was assigned based on the stage of the highest-staged pressure ulcer on the claims.

national assessment of the accuracy of nursing home-reported data on pressure ulcers to CMS and coupled with previous findings on underreporting of falls,[30] indicates an urgent need for an alternative approach to measuring patient safety in nursing homes.

Comparisons of nursing homes based on reported measures might still be possible if nursing homes similarly underreport. To assess this, we created an alternative claims-based measure of pressure ulcers for each nursing home. If nursing home-reported pressure ulcer indicators tracked with this measure, it would indicate that despite being inaccurate, they still contain useful information. However, we found poor correlation between our claims-based measure and NHC ratings and measures. Though the overall 5-star ratings are based on much more than pressure ulcers, including staffing and inspections, the lack of correlation still indicates that a high star rating did not inform the risk of developing a pressure ulcer in a nursing home that was subsequently diagnosed by a hospital. The other correlations compare our claims-based measure with NHC measures that are even more closely related to pressure ulcers, and these too indicate that one's risk of developing serious pressure ulcers in a nursing home could not be gleaned from publicly reported ratings.

These findings are consistent with other studies that have also found poor correlations between the NHC pressure

ulcer measure and other aggregate measures of quality of care, such as indicators for negligence litigation, pressure ulcer care processes, complaints, hospital readmission, and rehabilitation outcomes.[23–26,28,29] For example, in an analysis of hospital readmission risk and death, researchers found little meaningful difference between facilities that had publicly reported rates of pressure ulcers at the 25th and 75th percentiles.[24] More generally, a 2020 systematic review article by Tamara Konetzka et al[42] found most validation exercises of NHC measures and ratings, including for staffing, resulted in only weak or no associations with other quality metrics. Using less direct methods than validation exercises, several studies have also indicated evidence of gaming, that is measurable effort by nursing homes to inflate ratings.[42]

Black and Hispanic residents were much more likely to have stage 4 pressure ulcers than White residents, which is consistent with past literature.[36,37] However, this did not translate into racial disparities in reporting rates, in large part because the relationship between race and reporting was confounded by pressure ulcer severity. That is, Black and Hispanic populations had more severe pressure ulcers, but more severe pressure ulcers were much more likely to be reported, perhaps because they are more visibly apparent.

Our results echo previous government reports that aimed to validate MDS records with medical records, albeit on a much smaller scale.[16–20] A CMS audit of 218 assessments in 2014 found 8.3% incorrectly reported the number of pressure ulcers and 18.3% with inaccurate ulcer stage.[20] An OIG report assessing an earlier version of MDS found 15% of assessments had inconsistencies between pressure ulcer-related items and medical records.[18] However, these analyses relied on the MDS rather than an alternative data source and thus would have missed any pressure ulcer that was altogether not reported.

Our study is limited. First, claims data may contain diagnosis errors, in which case we may have incorrectly identified some pressure ulcer cases, though this is less likely in our main sample based on primary diagnosis codes. Second, hospitals may have a financial incentive to code stage 3 and 4 pressure ulcers as secondary diagnoses that were POA, as this could increase their reimbursement under the Medicare Severity Diagnosis Related Groups coding system. In a CMS investigation that compared hospital claims to medical records, about 9.5% of stage 3 and 4 secondary pressure ulcers were incorrectly coded as being POA.[43] Based on this, it is possible that we overidentified some stage 3 and 4 secondary pressure ulcers in the hospital claims. However, the vast majority (90.5% based on the CMS report) of stage 3 and 4 pressure ulcers that were secondary diagnoses, all stage 3 and 4 cases identified by the primary diagnosis code, and all stage 1, 2, and unstageable pressure ulcer diagnoses would not be affected by this financial incentive.

Third, since we imposed additional requirements (eg, return to the same nursing home after hospitalization) or allowed flexibility (eg, multiple assessment opportunities to report in SNF-identified cases) to be more conservative in our estimation of reporting, that is more forgiving to nursing homes, we may have overestimated reporting rates. Further,

TABLE 5. Correlations Between Claims-based Pressure Ulcer Rates[†] and Nursing Home Compare Measures in 2014 and 2017

Year	The Number of NHs	Quintiles[‡] of Claims-based Pressure Ulcer Rates [Means, 10th, 90th Percentiles]	Percent of NHs With 4-star or 5-star Ratings		NH Average Ratings			
			Overall Rating	Quality Measure Rating	Overall Rating	Quality Measure Rating	MDS Long-stay Pressure Ulcer Measure	MDS Short-stay Pressure Ulcer Measure
2014	4438	0	45.0	69.9	3.43	4.13	5.09	0.90
	1212	0.4 (0.2, 0.5)	46.8	75.8	3.51	4.25	5.47	0.71
	1188	0.6 (0.5, 0.7)	37.9	72.6	3.23	4.15	5.93	0.78
	1209	0.9 (0.8, 1.1)	33.6	68.3	3.09	4.08	6.44	0.84
	1192	1.5 (1.2, 1.8)	33.9	69.0	3.08	4.11	6.98	0.89
	1214	3.2 (2.0, 4.9)	28.5	65.7	2.90	4.02	8.43	0.95
Correlation coefficients between claims-based pressure ulcer rates and measure[§]					−0.151***	−0.029**	0.319***	0.040***
2017	5094	0	41.9	52.5	3.30	3.74	4.84	0.77
	1091	0.4 (0.2, 0.5)	50.2	62.3	3.55	3.99	5.22	0.62
	1092	0.7 (0.5, 0.8)	36.9	51.6	3.17	3.71	5.66	0.73
	1099	1.0 (0.8, 1.1)	34.3	49.0	3.02	3.61	5.92	0.74
	1089	1.5 (1.2, 1.8)	27.5	43.4	2.88	3.53	6.66	0.76
	1099	3.1 (2.0, 4.7)	21.6	39.9	2.67	3.35	7.90	0.82
Correlation coefficients between claims-based pressure ulcer rates and measure[§]					−0.152***	−0.092***	0.299***	0.025**

[†]The claims-based pressure ulcer rate was calculated as the total number of primary pressure ulcer diagnosis claims identified for a NH within a year divided by the number of Medicare fee-for-service residents in the NH, multiplied by 100.

[‡]Quintiles were assigned based on the distribution of claims-based pressure ulcer rates for NHs with at least 1 primary pressure ulcer hospital claim in 2014 or 2017.

[§]Spearman rank correlation coefficients were calculated for correlations between claims-based pressure ulcer rates and Nursing Home Compare ratings, and Pearson correlation coefficients were calculated for correlations between claims-based and MDS-based pressure ulcer rates.

MDS indicates Minimum Data Set; NH, nursing home.

*$P < 0.05$.

**$P < 0.01$.

***$P < 0.001$.

our analysis did not include pressure ulcers that occurred among residents who were not hospitalized. Given the cases in our analysis were under more surveillance due to hospitalization, it is possible that reporting of pressure ulcers more generally is poorer. Finally, pressure ulcers can develop within hours, including in outpatient settings; however, we would not expect a higher staged pressure ulcer to develop so quickly and be POA.

Our study calls for policy action. Individuals use quality of care information provided by the federal government to inform their nursing home choices and residents rely on public monitoring for their safety. The current system that relies on nursing home-reported data to assess patient safety neither incentivizes accurate reporting nor adequately penalizes inaccurate reporting. It may be possible for future research and policy to improve nursing home-reported data, but more immediate solutions are needed to properly surveil nursing home safety. CMS could develop alternative quality measures based on objective, readily available data sources like Medicare and Medicaid claims, to supplement or replace MDS-based measures. It is also imperative to assess the accuracy of other MDS items to better grasp our understanding of the past and current states of nursing home safety in the United States.

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