Explaining Direct Care Resource Use of Nursing Home Residents: Findings from Time Studies in Four States

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Objective. To explain variation in direct care resource use (RU) of nursing home residents based on the Resource Utilization Groups III (RUG-III) classification system and other resident- and unit-level explanatory variables.

Data Sources/Study Setting. Primary data were collected on 5,314 nursing home residents in 156 nursing units in 105 facilities from four states (CO, IN, MN, MS) from 1998 to 2004.

Study Design. Nurses and other direct care staff recorded resident-specific and other time caring for all residents on sampled nursing units. Care time was linked to resident data from the Minimum Data Set assessment instrument. Major variables were: RUG-III group (34-group), other health and functional conditions, licensed and other professional minutes per day, unlicensed minutes per day, and direct care RU (wage-weighted minutes). Resident- and unit-level relationships were examined through hierarchical linear modeling.

Data Collection/Extraction Methods. Time study data were recorded with hand-held computers, verified for accuracy by project staff at the data collection sites and then merged into resident and unit-level data sets.

Principal Findings. Resident care time and RU varied between and within nursing units. RUG-III group was related to RU; variables such as length of stay and unit percentage of high acuity residents also were significantly related. Case-mix indices (CMIs) constructed from study data displayed much less variation across RUG-III groups than CMIs from earlier time studies.

Conclusions. Results from earlier time studies may not be representative of care patterns of Medicaid and private pay residents. New RUG-III CMIs should be developed to better reflect the relative costs of caring for these residents.

Key Words. Nursing home, reimbursement, payment, case mix, hierarchical linear model

The Resource Utilization Groups III (RUG-III) case-mix system has become the standard for case-mix nursing home reimbursement. Medicare and 26 state Medicaid programs have adopted some variation of the RUG-III since its

development in 1993 (Job et al. 2002). The Medicare RUG-III payment methodology has been criticized for its alleged failure to deal adequately with combinations of rehabilitation and special nursing needs. As a result, Medicare RUG-III groups have been expanded from 44 to 53 (Department of Health and Human Services 2005). The Medicare RUG-III will probably evolve to further take into account care for complex, postacute cases, making it less applicable to longer stay Medicaid and private pay residents. Limited research has been conducted into the effects of Medicaid case-mix reimbursement. Implementation of RUG-III-based Medicaid payment during the 1990s appeared to increase access for more dependent residents, while leading to no significant change in care quality (Arling and Daneman 2002; Grabowski 2002). Nyman and Connor (1994) found that the Minnesota Medicaid case-mix payments may have overestimated costs for some case-mix groups and underestimated costs for other groups, leading to the selective admission of residents in more profitable groups.

The RUG-III uses resident assessment data from the Minimum Data Set (MDS) on health, functional status, cognition, and service use to classify nursing home residents into mutually exclusive groups. Each group has a case-mix index (CMI) score representing the direct care resource use (RU) of that group relative to other groups. The RUG-III CMIs were estimated from time and motion studies sponsored by the Centers for Medicare and Medicaid Services (CMS) in 1990 and 1995–1997 (Fries et al. 1994; White, Pizer, and White 2002). These studies pooled data from long- and short-stay residents. Medicare and all state Medicaid programs employing the RUG-III have based their CMIs on results from these studies (Job et al. 2002).

The CMIs have a major impact on nursing home payment because with case-mix reimbursement the direct care payment rate for residents in each RUG-III group is proportional to its CMI. If CMIs correspond to cost of care, then providers have incentives to admit and care for all types of residents. Alternatively, if the CMIs over- or underestimate the cost of care for certain

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case-mix groups, then providers may have an incentive to admit residents in certain groups and not others. They also might find it difficult to provide adequate staffing or other resources for residents whose payment falls short of costs.

Believing that results from earlier RUG-III time studies may not accurately represent the relative RU of Medicaid and private pay residents, we analyzed data from a large, four-state nursing home time study. We identify weaknesses of earlier CMS time studies, present findings from our study, and discuss the implications of our findings for Medicaid reimbursement policy.

RUG-III CLASSIFICATION AND CMIs

The RUG-III's hierarchical structure uses resident characteristics and services received to assign residents to mutually exclusive case-mix groups. The RUG-III 44-group version is used by Medicare; however, most Medicaid programs employ a 34-group version that does not distinguish residents according to their intensity of licensed therapies. States remove therapies from the Medicaid RUG-III CMIs because Medicare is the primary payer for these services. Figure 1 shows the RUG-III 34-group model which is the subject of this study. Residents are first classified into one of seven major categories: Special Extensive, defined by intravenous (IV) medication, ventilator/respirator, tracheostomy care, suctioning, and parenteral/IV feeding; Rehabilitation, based on receipt of licensed therapies; Special Care, defined by conditions such as coma, quadriplegia, stages III and IV pressure sores, burns, and septicemia; Clinically Complex, defined by conditions such as hemiplegia, stasis ulcer, surgical wounds, aphasia, and terminal illness; Impaired Cognition, defined by moderate to very severe cognitive impairment; Behavioral Problems, defined by one or more daily behavioral problems; and Reduced Physical Function, consisting of residents not meeting conditions for other categories.

Other variables in the RUG-III hierarchy are: activities of daily living (ADL) dependency score—bed mobility, transferring, toileting, and eating; Depressed Mood—three or more symptoms such as anger, crying, and tearfulness; and Restorative Nursing—two or more restorative programs such as toileting plan, range of motion, and ADL skill training for at least 15 minutes/day. These variables form branches off major categories: Special Extensive has three groups based primarily on number of SE services; Rehabilitation has four groups defined by ADL dependency; Special Care has three groups

Figure 1: RUG-III Case-Mix Model (34-Group)

defined by ADL dependency; Clinically Complex has six groups defined by ADL dependency and depressed mood; Impaired Cognition and Behavioral each have four groups defined by level of ADL dependency and restorative nursing; and Physical Functioning has 10 groups defined by ADL dependency and restorative nursing.

The 1990 and 1995–1997 CMS time studies employed large multistate samples with oversampling of postacute and Medicare units. The 1990 study had 7,658 residents in 202 nursing units in seven states, including 83 Medicare-certified units, 35 hospital-based units, and three ventilator/respirator and three rehabilitation units (Fries et al. 1994). The 1995–1997 study targeted Medicare facilities and units with 3,933 residents (34 percent Medicare stays) in 150 nursing units in 12 states (White et al. 2002). The RUG-III explained 55 percent of the variance in direct care staff time cost in the original 1990 CMS time study (Fries et al. 1994), while it accounted for 40 percent of the variance in staff time cost of all residents and 21 percent of the variance for residents with Medicare stays in the 1995–1997 CMS time study (White et al. 2002). RUG-III studies conducted in other countries have yielded comparable results (Ikegami et al. 1994; Carpenter et al. 1997; Brizioli et al. 2003; Bjorkgren et al. 2004).

The RUG-III CMIs were constructed from resident care times (minutes/day) recorded by nurses on sampled units. Minutes of care per resident day were weighted by staff wage levels and converted into a resident RU score. The CMIs were calculated from the mean RU score for residents in each RUG-III group, standardized to a sample average of 1.00. The CMIs from the 1990 study ranged from 0.39 to 3.68 (Fries et al. 1994), whereas the CMIs from the 1995 to 1997 studies ranged from 0.46 to 2.25 (Department of Health and Human Services 1998).

PROBLEMS WITH RUG-III STAFF TIME DATA AND CMIS

There are serious problems in generalizing from the CMS time studies to general nursing home populations. First, the study results were heavily influenced by care patterns on high acuity Medicare nursing units, which were oversampled in the CMS studies. Results generalized to non-Medicare nursing home populations probably overestimate average care times and the relative difference in care between high and low acuity groups. Second, variation in RU across RUG-III groups was likely inflated in the CMS studies because of the way time for nonresident-specific tasks (e.g., staff meetings, documenta-

tion, administration, and maintenance) was assigned to residents. Staff members were supposed to record their time for specific residents (resident-specific time, or RST); time not attributable to specific residents was to be recorded in a residual category, nonresident-specific time (NRST). The amount of NRST in the CMS studies was substantial: it accounted for 53 percent of licensed and 33 percent of unlicensed nurse time in the 1990 study, and 41 percent of licensed and 39 percent of unlicensed staff time in the 1995–1997 study. In constructing the CMS CMIs, researchers decided to allocate about 40 percent of licensed staff NRST and 20 percent of unlicensed staff NRST to specific residents in direct proportion to their RST. These percentages were based on staff time spent in meetings and documentation, tasks that researchers assumed would vary directly with each resident's RST. The mean RST and NRST minutes for RUG-III groups in the CMS time studies were highly correlated, with a Pearson's r of 0.93–0.95 for licensed RST $\times$ NRST and 0.47–0.78 for unlicensed RST $\times$ NRST. This NRST allocation method may be appropriate for short-stay Medicare residents who typically require a great deal of documentation; however, when applied to Medicaid CMIs it may artificially inflate the variability in relative RU between high and low acuity groups.

A third criticism of earlier studies is the possible overestimation of RU for residents in the Special Extensive category, particularly residents coded as receiving IV medication (the most common SE classifier). The MDS item for IV medication requires a 14-day "look-back" period which covers services provided in the hospital before nursing home admission. As the CMS time study oversampled hospital-based or postacute units, many residents may have been receiving IV medications on the nursing unit. When applied to Medicare reimbursement, the receipt of IV medication may be an appropriate classifier. However, anecdotal reports from state Medicaid staff and our survey of Minnesota nursing facilities suggest that few residents in the SE groups received IV medications in the nursing home. As a consequence, RU of Medicaid and private pay residents in the SE groups may be overestimated by the CMS CMIs.

Finally, analysis of CMS time study data failed to deal systematically with the nesting of residents in nursing units or the effect those unit characteristics might have on RU scores or CMIs. Although prior research has examined RU in Alzheimer's special care units (SCUs) (Mehr and Fries 1995; Arling and Williams 2003), other unit characteristics have received little attention. For example, analysis reported from CMS time studies did not systematically compare units with high and low acuity or with heavy and light staffing. Providers probably staff their units in relation to acuity of residents,

thus leading to possible endogeneity between the amount of care available on a unit and its allocation among residents. Focusing solely on resident-level analysis buries this problem in the data.

Our study analyzed data from more recent nursing home staff time measurement (STM) studies we conducted in Colorado (1998), Indiana (1999), Mississippi (2001), and Minnesota (2004). These studies were sponsored individually by state Medicaid programs. We were particularly concerned with developing a method that accurately reflected the relative direct care RU of long-stay residents, who comprise the majority of Medicaid nursing home expenditures. We examined the direct care RU with a multilevel modeling approach, which allowed us to separate RU variance at the unit and resident levels, and to estimate the effects of the RUG-III groupings simultaneously with other resident and unit characteristics. In addition, we looked for systematic differences in CMIs by comparing CMIs generated from our analysis with the current RUG-III CMIs.

DESIGN AND METHODS

Sample

The combined four-state study sample consisted of 105 facilities, 156 nursing units, and 5,314 residents. The samples were drawn independently in each state, although similar procedures were used. In the Indiana, Minnesota, and Mississippi studies, Alzheimer's SCUs were oversampled to allow for separate analysis of residents. About 10 percent of facilities in each state were excluded from the sample frame due to serious quality of care deficiencies, low staffing, or recent ownership change. A random sample of remaining facilities was invited to participate. The final sample was chosen according to a facility's willingness to participate, scheduling, and location. Approximately one-half of invited facilities actually participated. Table 1 shows the characteristics of study facilities with intrastate and national comparisons (Jones 2002). Study facilities were more likely than nonstudy facilities to be nonprofit (CO and IN), nonchain affiliated (CO and IN), and to have a high occupancy rate (MN, CO, IN), high proportion private pay (IN), or Alzheimer's SCUs (MN, IN, MS). Study and nonstudy facilities did not differ significantly in average nursing hours per resident except for aide hours in Mississippi. The only major difference between state and national figures was the high percentage of nonprofit facilities in Minnesota. When study and nonstudy facilities in each state were compared according to a quality score calculated from 22 MDS-based

Table 1: Facility Characteristics

	Minnesota		Colorado		Indiana		Mississippi		Four-State Combined		U.S. [†]
	Study	State	Study	State	Study	State	Study	State	Study	State	
Number of facilities	43	385	18	185	30	468	14	184	105	1,222	18,000
For-profit ownership (%)	22	28	47*	64*	48*	69*	60	73	39*	56*	67
Government ownership (%)	9	14	11	10	7	4	13	14	9	9	6
Nonprofit ownership (%)	65	58	42*	26*	45*	28*	27	13	50*	35*	27
Chain affiliation (%)	51	51	37*	62*	45*	65*	27	55	44*	58*	60
Hospital based (%)	12	15	5	8	7	6	13	12	10	10	—
Alzheimer's SCU (%)	37*	23*	11*	35*	62*	20*	40*	5*	40*	21*	—
Total residents (mean)	103	86	83	80	95	85	103	86	97*	85*	105
Occupancy rate (mean) (%)	96*	93*	88*	82*	89*	84*	91	90	92	87	87
Percent Medicaid (mean) (%)	58	60	63	62	55*	66*	84	81	62	66	59
Percent Medicare (mean) (%)	9	10	7	8	9	12	9	8	9	10	15
Percent private pay (mean) (%)	33	29	30	30	36*	22*	7	11	30	24	27
Licensed hours/resident day (mean)	1.15	1.23	1.39	1.37	1.20	1.27	1.17	1.27	1.21	1.27	—
Aide hours/resident day (mean)	2.29	2.20	2.29	2.20	2.18	2.01	2.49*	2.24*	2.29	2.13	—
Total hours/resident day (mean)	3.44	3.43	3.68	3.56	3.39	3.27	3.66	3.51	3.49	3.40	—

* $p < .05$ (t -test or χ^2) for difference between study and state facilities.[†] Source: 1999 National Nursing Home Survey.

SCU, special care units.

national nursing home quality indicators, there were no significant differences in mean quality scores between study and nonstudy facilities or across states.

Data Collection

The same data collection procedures were used in each state. Units were selected randomly from within participating facilities. In facilities with an Alzheimer's SCU, the SCU and at least one other unit was selected. In facilities without SCUs, one to three conventional units were selected. A project team spent a week on-site in each nursing home preparing nursing home staff, monitoring data collection, and ensuring accuracy of reported times. All direct care staff on the unit participated in the study: registered nurses, licensed practical nurses, and nursing assistants; physical (PT), occupational (OT), speech, and respiratory therapists; restorative, PT, and OT aides; activity directors and aides; and social workers and social services aides. The staff members entered their times into hand-held computers while they were delivering care. Time was recorded by nursing staff over a 48-hour period and by ancillary staff over 7 days. All residents on sampled units participated in the time study and all staff time was accounted for, including breaks and meals. Staff time associated with a specific resident was recorded as RST; time that could not be associated with a resident was recorded as NRST. The STM data were subjected to extensive error testing after being entered into the project database. Residents' health and functional status information came from the MDS assessment occurring closest to the STM date. Nursing home staff was instructed to update the MDS if the resident had undergone a change in status. There was mean of 16 and a median of 14 days between the MDS assessment date and the STM date. An MDS was successfully matched to the time study data for 98 percent of STM participants.

Major Variables

The amount of care provided to each resident was converted into a composite measure of direct care RU, where direct care time (minutes/day) was weighted for the care provider's relative hourly wages. The RU measure approximates relative cost because it assigns higher wage-weights to the minutes of care provided by more "costly" staff types. Wage-weighted times were assigned to residents in each state based on the wages of direct care staff participating in the STM study. The 34-group RUG-III (Version 5.12) with hierarchical classification was employed in the main analysis. Other RUG-III variables were ADL dependency score (range = 4–18, independent—totally dependent) and

dummy variables (yes/no) for behavior problem, depressed mood, and restorative nursing. Impaired cognition was measured with the Cognitive Performance Scale with a range of 0 (intact) to 6 (very severely impaired) (Morris et al. 1994). Unit-level variables were constructed by taking the mean or percentage of residents on the unit having a condition, e.g., mean ADL or percentage with behavioral problems.

Analysis

The dependent variables were resident-specific licensed and professional staff minutes, unlicensed staff minutes, and RU score. The RUG-III group and resident- and unit-level covariates served as independent variables. To control for potential differences between states we treated state as a resident-level fixed effect (yes/no dummy variables). Also, we included a variable for the day gap (absolute value of number of days) between the resident's MDS assessment and the STM date.

Analysis objectives were to: (1) determine the amount of variance in RST and RU that was between and within nursing units; (2) estimate effects of RUG-III group, resident-level covariates, and average NRST and other unit-level variables on resident RU and RST. Several of the RUG-III groups defined by presence of restorative nursing services had very few cases. Therefore, we collapsed the restorative nursing groups and coded restorative nursing (yes/no) as a dummy variable.

The analysis was conducted with hierarchical linear modeling (HLM) using *HLM* 6.0 (Raudenbush, Bryk, and Congdon 2004). This approach deals explicitly with nesting of residents within nursing units and it provides estimates of level 1 (resident) and level 2 (nursing unit) effects, residual variance at each level, and unbiased standard errors based on appropriate degrees of freedom (Raudenbush and Bryk 2002). We tested intercepts-as-outcomes models with full maximum likelihood estimation. None of the slopes had large enough variance to warrant slopes-as-outcomes models. All independent variables were grand mean centered on their respective sample means. Model fit was assessed with the deviance statistic and by change in levels 1 and 2 residual variance between the unconditional model and models containing independent variables at levels 1 and 2 (Snijders and Bosker 1994; Luke 2004).

To illustrate the impact of our findings we calculated alternative CMIs and payment rates for study residents. The CMS CMIs were calculated from the reported RU (RST and NRST) from the 1995–1997 time study (Department of Health and Human Services 1998). The CMIs from our study were

based on the mean total RU scores for each RUG-III group. Each resident's RST RU was added to NRST RU, which was assigned uniformly across all residents on a nursing unit. We applied design weights to compensate for oversampling of Alzheimer's SCUs in our study; otherwise CMI's were calculated directly from the time study data. Both sets of CMI's were calibrated so that the study sample average CMI was 1.00. Residents were assigned to the same RUG-III groups in both scenarios. To assess the financial impact, we calculated per diem direct care payment rates for each RUG-III group based on the CMS CMI's and the CMI's from our study. The base rate for the simulation was \$75 which is 60 percent of the average total estimated Medicaid payment rate for the four states in 2006. The direct care rate for each RUG-III group was determined by multiplying the base rate (\$75) by the group's CMI. A detailed description of the methodology and CMI tables can be obtained from the authors on request.

RESULTS

Characteristics of the study sample overall and by state are displayed in Table 2. The Minnesota study contributed the most cases to the data set followed by Indiana, Mississippi, and Colorado. Indiana had the largest proportion of the sample from Alzheimer's SCU units. Because the samples were cross-sectional, each state had only a small percentage of residents (10 percent) with stays < 45 days. Also, small percentages of residents were in the highest acuity RUG-III categories: 4 percent in Special Extensive, 9 percent in Rehabilitation, and 8 percent in Special Care. A sizable percentage of residents had behavioral problems (28 percent), depressed mood (28 percent), and restorative nursing (19 percent). The average RST was 32 minutes for licensed and professional staff and 77 minutes for unlicensed staff. The average NRST was 26 minutes for licensed and professional staff and 46 minutes for unlicensed staff. The average RU score (wage-weighted time) was 102 for NRST and 145 for RST. The only significant difference in service use between states was for restorative nursing where Indiana had a high percentage (28 percent) and Mississippi a low percentage (1 percent). Colorado had the highest ratio of NRST to RST (128/135), while Mississippi had the highest combined NRST and RST RU score (284).

HLM

We tested HLM models initially with the RUG-III groups as the only independent variables; we then added resident- and unit-level covariates. Results for the full models (with covariates) are shown in Table 3. As expected, a

Table 2: Characteristics of the Study Sample

	<i>Minnesota</i>	<i>Colorado</i>	<i>Indiana</i>	<i>Mississippi</i>	<i>Total</i>
Facilities	43	18	30	14	105
Nursing units	62	18	50	26	156
Alzheimer's SCUs	18	2	18	7	45
Residents	2,506	513	1,418	877	5,314
Alzheimer's SCU residents	446	73	409	113	1,041
Age (mean)	83.3	80.8	83.1	83.4	80.3
Female (%)	74	73	77	82	76
Length of stay < 45 days (%)	13	7	8	5	10
RUG-III variables					
Special extensive category (%)	5	2	4	2	4
Special extensive (IV medications only) (%)	3	1	1	1	2
Rehabilitation category (%)	7	14	8	11	9
Special care category (%)	8	8	8	7	8
Clinically complex category (%)	17	20	15	17	17
Impaired cognition category (%)	15	19	23	18	18
Behavioral problem category (%)	1	1	1	2	1
Physical category (%)	48	37	42	44	45
ADL dependency (mean)	11.64	10.64	11.45	11.43	11
Cognitive performance scale (mean)	2.93	3.27	2.91	2.99	3
Behavioral problem (%)	29	33	35	34	28
Depressed mood (%)	33	27	20	16	28
Restorative nursing services (%)	6	28	12	1	19
Nonresident-specific care time (mean minute/resident day)					
Licensed and professional NRST	21.8	39.0	26.6	30.8	26.2
Unlicensed NRST	39.5	52.6	45.0	60.5	45.7
Resident-specific care time (mean minute/resident day)					
Licensed and professional RST	30.2	32.6	34.7	30.7	31.7
Unlicensed RST	81.4	71.0	65.3	88.6	77.3
Resource use score RST	144.7	134.5	141.1	157.6	144.9
Resource use score NRST	88.8	128.4	100.6	126.0	101.9
Resource use score total	233.5	262.8	241.6	283.5	246.8

SCU, special care units; RUG-III, resource utilization groups III; RST, resident-specific time; NRST, nonresident-specific time; ADL, activities of daily living.

sizable proportion of variance in resident-specific care times and RU was between nursing units. The intraclass correlations were 0.312, 0.374, and 0.285 indicating that 29–37 percent of the variance in resident RU and care time was between nursing units. The RUG-III groups entered as resident-level fixed effects reduced level 1 (resident) residual variances by 20–23 percent and level 2 (nursing unit) residual variances by 16–41 percent. When covariates were added to the model, level 1 residual variances were reduced by

Table 3: HLM Results for Resident Resource Use Score, and Licensed and Professional and Unlicensed Minute/Day

	<i>Resource Use Score—RST</i>		<i>Licensed and Professional RST</i>		<i>Unlicensed RST</i>	
	<i>Coefficient</i>	<i>p</i>	<i>Coefficient</i>	<i>p</i>	<i>Coefficient</i>	<i>p</i>
Intercept	149.50	.000	32.69	.000	79.47	.000
Unit variables						
Alzheimer's unit	21.12	.022	5.50	.073	9.51	.057
Proportion SE, R, or SS residents	60.12	.002	29.91	.000	−9.58	.351
Unit size	0.04	.879	0.02	.764	0.03	.822
NRST licensed and professional minutes	0.28	.305	0.41	.000	−0.53	.001
NRST unlicensed minutes	0.70	.000	−0.06	.253	0.81	.000
Resident-level covariates						
Indiana	2.88	.716	5.53	.037	−12.65	.004
Mississippi	14.83	.146	0.96	.777	7.29	.188
Colorado	−13.63	.254	−2.96	.459	−2.39	.713
Receiving restorative nursing	6.79	.008	−1.25	.204	8.48	.000
Length of stay <45 days	27.47	.000	11.28	.000	0.53	.782
Day gap between STM and MDS	−0.44	.000	−0.10	.001	−0.119	.004
RUG-III groups						
SE group with IV medications only	−41.06	.000	−28.11	.000	4.90	.352
SE3	97.10	.000	50.34	.000	9.81	.074
SE2	96.95	.000	53.89	.000	0.09	.851
SE1	48.22	.000	28.22	.000	−0.66	.918
RAD	91.82	.000	31.20	.000	33.87	.000
RAC	53.66	.000	16.42	.000	20.29	.000
RAB	25.59	.000	13.35	.000	−4.48	.149
RAA	−10.97	.060	5.98	.009	−29.01	.000
SSC	74.36	.000	22.43	.000	36.24	.000
SSB	47.06	.000	15.70	.000	18.37	.000
SSA	9.72	.050	12.54	.000	−15.11	.000
CC2	61.81	.000	14.95	.000	38.71	.000
CC1	38.66	.000	11.12	.000	23.71	.000
CB2	19.98	.001	6.28	.005	9.26	.005
CB1	14.75	.000	5.70	.000	4.97	.024
CA2	−9.35	.162	9.77	.000	−28.17	.000
CA1	−24.89	.000	5.69	.000	−36.36	.000
IB1&2	−30.42	.000	−4.34	.000	−23.32	.000
IA1&2	−59.54	.000	−5.17	.000	−51.44	.000
BB1&2	−31.60	.010	2.99	.526	−36.25	.000
BA1&2	−69.61	.000	−4.08	.274	−65.11	.000
PE1&2	29.12	.000	0.96	.379	29.51	.000
PD1&2 (reference category)						
PC1&2	−22.03	.001	−1.41	.578	−20.84	.000
PB1&2	−47.22	.000	−4.31	.044	−39.29	.000
PA1&2	−65.02	.000	−5.64	.000	−57.16	.004

Continued

Table 3: *Continued*

	<i>Resource Use Score—RST</i>	<i>Licensed and Professional RST</i>	<i>Unlicensed RST</i>
Unconditional model variance			
Level 1 variance	4,622	572	1,794
Level 2 variance	2,099	342	716
Intraclass correlation	0.312	0.374	0.285
Residual variance for models			
Level 1 RUG only model	3,185	481	1,040
Level 2 RUG only model	1,967	251	894
Level 1 full model	3,073	466	1,021
Level 2 full model	1,412	153	413
% change in residual variance			
Level 1 unconditional—RUG only (%)	23	20	23
Level 2 unconditional—RUG only (%)	31	16	41
Level 1 unconditional—full (%)	33	32	43
Level 2 unconditional—full (%)	33	19	43
Deviance statistics			
Unconditional model	60,338	49,280	55,293
RUG only model	58,262	48,239	52,391
Significance: RUG—unconditional (df = 33)	0.000	0.000	0.000
Full model	57,970	47,974	52,138
Significance: full—RUG (df = 11)	0.000	0.000	0.000

STM, staff time measurement; MDS, minimum data set; RUG-III, resource utilization groups III; NRST, nonresident-specific time; RST, resident-specific time; HLM, hierarchical linear modeling.

32–43 percent, and level 2 residual variances were reduced by 19–43 percent. The covariates significantly improved the model fit (F -test of deviance statistic difference) when compared with the RUG groups model alone ($p < .000$).

Nearly all RUG-III group coefficients were significant for the model with resident-specific RU. The reference group for the RUG-III dummy variables was the PD1&2 group (P with ADL score of 11–15), which was near the sample mean in their RU scores. Because all independent variables were grand mean centered, the intercepts (RU = 149.50, licensed/professional minutes = 32.69, and unlicensed minutes = 79.47) can be interpreted as the care time or RU estimate for a PD1&2 resident having a mean value on each of the covariates. Some of the lower acuity RUG-III groups (e.g., Impaired Cognition, Behavioral, and Physical) coefficients were not significant in the model for licensed/professional staff time, suggesting that licensed/professional staff did not vary in the amount of time they spend with lower acuity residents (i.e., those with-

out specialized services or complex medical conditions). The use of restorative nursing services had a significant positive effect on unlicensed staff time and RU, but it was not significantly related to licensed/professional staff time. Evidently, unlicensed staff took primary responsibility for delivery of these services. Residents with shorter length of stay (<45 days) received more licensed/professional staff time and had higher RU scores. Also, the day gap between the MDS assessment and STM was negatively related to RU; the closer the MDS to STM, the higher the RU. One reason for having an assessment close to the STM date was a recent change in health status that triggered an updated assessment. Changes in health are likely to be associated with higher RU.

Finally, IV medications as the only Special Extensive group classifier had significant negative effects in the licensed/professional staff time and RU models. As indicated by regression coefficients, residents with IV medications had 28.11 minutes less of licensed/professional staff time and 41.06 points less of RU when compared with the average resident (PE1&2). Corresponding coefficients for the Special Extensive groups as a whole were very large and positive (RU = 48.22–97.10 and licensed/professional minutes = 28.22–50.34). This finding offers strong evidence that residents with IV medications as their only classifier had much less licensed/professional care time and overall RU than residents with other Special Extensive classifiers.

Among unit-level covariates, average licensed/professional and unlicensed NRST had significant effects on RST. Residents on units with higher licensed/professional NRST received more licensed/professional RST yet they received less unlicensed RST, which suggests substitution of care between staff types. Residents on units with higher unlicensed NRST received greater unlicensed RST; however, there was no significant relationship between unlicensed NRST and licensed/professional RST. Only unlicensed NRST was related to overall RU. Thus, the relationships between NRST and RST appear to be quite complex. As expected, the unit's percentage of residents in the Special Extensive, Rehabilitation, and Special Care categories, a proxy for unit acuity and presence of Medicare residents, had a strong positive effect on licensed staff time and RU. Finally, Alzheimer's SCUs had significantly higher RU than conventional units.

Comparison of CMIs and Payment Rates

To illustrate the impact of our study results, we compared CMIs and per diem direct care payment rates derived from published CMS data and from our

Table 4: Comparison of Mean CMIs by RUG-III Categories

<i>RUG-III Category</i>	<i>Number of Study Residents</i>	<i>CMS CMI</i>	<i>Study CMI</i>	<i>Study CMI-CMS CMI</i>	<i>CMS Direct Care Rate</i>	<i>Study Direct Care Rate</i>	<i>Study Rate— CMS Rate</i>
Special Extensive	193	1.828	1.383	-0.445	\$137.10	\$103.75	\$(33.35)
Rehabilitation	453	1.343	1.292	-0.051	\$100.69	\$96.88	\$(3.81)
Special Care	403	1.364	1.190	-0.174	\$102.30	\$89.22	\$(13.08)
Clinically Complex	882	1.098	1.028	-0.070	\$82.38	\$77.13	\$(5.25)
Impaired Cognition	945	0.796	0.809	0.013	\$59.70	\$60.68	\$0.98
Behavioral Problems	59	0.702	0.769	0.067	\$52.65	\$57.69	\$5.04
Physical	2,379	0.858	0.952	0.094	\$64.34	\$71.42	\$7.08
Total	5,314	1.000	1.000	0.000	\$75.00	\$75.00	\$—

CMI, case-mix index; CMS, Centers for Medicare and Medicaid Services; RUG-III, resource-utilization groups III.

study. Table 4 shows average CMIs and rates by major RUG-III categories. Study CMIs are substantially lower than the CMS CMIs in the higher acuity categories of Special Extensive, Rehabilitation, Special Care, and Clinically Complex where most Medicare residents would fall, and higher in Impaired Cognition, Behavioral, and Physical where most Medicaid and private pay residents would fall. The differences in projected daily payment rates were quite striking. Rates derived from our study CMIs were \$33.35 lower for Special Extensive groups and \$13.08 lower for Special Care groups; in contrast, rates were \$7.08 higher for groups in the Physical category, which is heavily populated by Medicaid and private pay residents. We should caution that our CMI and payment simulations are simply for illustration; many factors go into the setting of state Medicaid rates and we could not hope to model all of them.

DISCUSSION

Our study suggests that results from the 1990 and 1995–1997 CMS time studies do not accurately represent relative RU of Medicaid or private pay residents. We discovered much less variation in RU across RUG-III groups in our sample made up primarily of Medicaid and private pay residents. The CMS study likely had greater RU variation because of sampling bias toward postacute Medicare residents and units, combined with the way care time was allocated across residents. States using CMIs derived from CMS time study data may be setting too high a Medicaid payment rate for residents in the

higher acuity RUG-III groups and too low a rate for residents in the low acuity groups. A differential between Medicaid payment and the facility's cost may be desirable as an incentive to admit heavier care residents and discourage admission of lighter care residents; however, states can make this payment policy explicit with rate adjustments or add-ons rather than relying on incentives derived implicitly from inaccurate CMIs.

Our findings also suggest that results from the CMS study overstate considerably the RU of residents in Special Extensive groups when IV medications use is their only Special Extensive classifier. In a state such as Minnesota, which sets a payment rate at admission and typically retains it for 180 days, inflated CMIs for the Special Extensive groups have large payment implications. Not only are Medicaid funds affected, but numerous complaints have arisen from private pay residents as to why they must pay the Special Extensive rate when they did not even receive this Special Extensive service (IV medications) in the nursing home. In June 2005, CMS clarified the definition of IV medication use on the MDS by excluding cases where IV medications were given in the hospital in conjunction with a surgical or diagnostic procedure, including the postoperative or postprocedure recovery period, or with chemotherapy or dialysis. This may reduce the proportion of residents with IV medications as their only SE category classifier.

Finally, the failure of the CMS studies to consider nesting of residents within nursing units obscured important sources of RU variation. Using a multilevel model we found that about one-third of resident RU was between units, even after taking into account resident-level characteristics. Some of this variation may be essentially random or due to unique patterns of work assignment and provider-specific beliefs about appropriate and affordable practice. Other sources of inter-unit variation are systemic and policy-relevant. For example, RU was strongly associated with the percentage of unit residents in higher acuity RUG-III categories. Also, residents in Alzheimer's SCUs had significantly greater RU than residents on conventional units. Medicaid programs must consider how to deal with possible RU differences between conventional and specialized units. Should unit characteristics be factored into the CMIs, should rates be set separately for specialty units, or should they simply be placed in the mix with conventional units?

Limitations of our study as well as those of previous CMS time studies must be acknowledged. First, our facility sample may not be nationally representative as it was drawn from only four states which were not purposively sampled; each study was individually sponsored with its own objectives. Nonetheless, the states included in this study represent different regions with

variation in facility characteristics. Second, our sample relied heavily on facilities' willingness to participate. Some selection bias is inevitable in studies demanding so much data collection effort. Although study facilities differed from other facilities on some key characteristics, such as ownership, there was no difference in reported staffing levels or quality indicators. Third, the time sampling period for nursing staff (48 hours) was brief; a longer observation period would have produced more reliable estimates. Fourth, the analysis approach was empirically based. At best, the CMIs reflect current practice; they do not necessarily reflect the best standards of care. Finally, we classified residents based on MDS assessments which may have varied in their timeliness and accuracy. Facilities in different states, or facilities in the same state, may vary in the directionality of errors in assessing ADL or other MDS items (Roy and Mor 2005). Ascertainment or other forms of bias may affect study results, particularly if residents end up being classified into the wrong RUG-III groups.

The CMS is in the early stages of a new, multistate nursing home time study intended to update the Medicaid RUG-III CMIs. Findings from our study are instructive. The new CMS study should have adequate sampling of Medicaid and private pay residents across a range of unit and facility types. The study should give careful attention to the tasks involved in NRST as they relate to care which can be linked directly to residents. The study also should explicitly model unit-level variation in delivery of care, using techniques like HLM to account for facility and state effects, so that cost variation owing to resident case mix can be clearly distinguished from unit-level factors. Finally, the study should carefully document the actual delivery in the nursing home of potentially high cost services, such as IV medications, to ensure that high acuity groups are properly defined.

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