Improving the Home Health Acute-Care Hospitalization Quality Measure

Charles P. Schade and John G. Brehm

Objectives. (1) To demonstrate average length of service (ALOS) bias in the currently used acute-care hospitalization (ACH) home health quality measure, limiting comparability across agencies, and (2) to propose alternative ACH measures.

Data Sources/Study Setting. Secondary analysis of Medicare home health service data 2004–2007; convenience sample of Medicare fee-for-service hospital discharges.

Study Design. Cross-sectional analysis and patient-level simulation.

Data Collection/Extraction Methods. We aggregated outcome and ALOS data from 2,347 larger Medicare-certified home health agencies (HHAs) in the United States between 2004 and 2007, and calculated risk-adjusted monthly ACH rates. We used multiple regression to identify agency characteristics associated with ACH. We simulated ACH during and immediately after home health care using patient and agency characteristics similar to those in the actual data, comparing the existing measure with alternative fixed-interval measures.

Principal Findings. Of agency characteristics studied, ALOS had by far the highest partial correlation with the current ACH measure ($r^2 = 0.218$, $p < .0001$). We replicated the correlation between ACH and ALOS in the patient-level simulation. We found no correlation between ALOS and the alternative measures.

Conclusions. Alternative measures do not exhibit ALOS bias and would be appropriate for comparing HHA ACH rates with one another or over time.

Key Words. Quality of health care, home care services, computer simulation, regression analysis

The Centers for Medicare & Medicaid Services (CMS) considers acute-care hospitalization (ACH) during home health to be one of the key quality measures for care given to homebound Medicare beneficiaries. Defined as the percentage of patients who had to be admitted to the hospital while receiving services of a home health agency (HHA) (Centers for Medicare & Medicaid Services 2002), the measure is one of 11 currently listed on CMS' Home Health Compare website (Centers for Medicare & Medicaid Services 2007). CMS recently completed a year-long national campaign to reduce ACH rates

(Quality Insights of Pennsylvania 2008). Preventing unnecessary readmissions to the hospital from HHAs and other community providers is a key objective of the current work of CMS-funded Quality Improvement Organizations (Centers for Medicare & Medicaid Services 2008).

The stated rationale for the ACH measure includes the following: "... some inpatient hospital care may be avoided if the home health clinical staff is doing a good job at checking the health condition of patients at each visit to detect problems early, including monitoring nutritional status, taking medicines correctly, and home safety" (Centers for Medicare & Medicaid Services 2002). This rationale is based on the work of Shaughnessy et al. (2002), who observed modest reductions in risk-adjusted ACH rates in HHAs given performance feedback and training in continuous quality improvement methods.

It is unclear whether the ACH rate as calculated can reliably represent *avoidable* inpatient care. The measure is subject to reporting errors and one major bias. Reporting errors include intentional or unintentional failure to code hospital admission on the CMS Outcomes and Assessment Information Set (OASIS) form used for reporting, and failure to count a hospital admission occurring immediately after discharge from home health care. The bias is due to variation in length of service (LOS—the number of days between the beginning and the end of an episode of home health care), because the probability of hospital admission increases with increasing time following hospital discharge *whether or not* there is intercurrent home health care. As a consequence, differences in LOS over time or among agencies may confound comparisons of ACH rates.

At present, there is substantial interest in improving how patients are supported through transitions of care, for example, from hospital to long-term care (Parry et al. 2003; Coleman et al. 2004; Naylor et al. 2004). Experts believe that patient health and well-being suffer when useful information related to the patient is lost between care settings, or patients are excessively transferred. CMS has made care transitions an important component of the work assigned to Medicare Quality Improvement Organizations between 2008 and 2011 (Centers for Medicare & Medicaid Services 2008).

The ACH rate is a potential measure of HHAs' contribution to effective care during transitions, as reduced readmissions might result from better

Address correspondence to Charles P. Schade, M.D., M.P.H., West Virginia Medical Institute, 3001 Chesterfield Ave., Charleston, WV 25304; e-mail: cschade@wvmi.org. John G. Brehm, M.D., F.A.C.P., is with the West Virginia Medical Institute, 3001 Chesterfield Ave., Charleston, WV.

patient management in the home care setting, improved communication between agency and other providers, or more effective patient/caregiver self-management training. Higher quality home care might require longer LOS. Alternatively agencies might reduce risk of early hospitalization through more intensive services early in care (“front loading” services), allowing shorter LOS for the same outcome. In either instance, an LOS-biased quality measure might yield incorrect conclusions about the benefits of high-quality home care. Comparisons among agencies based on such a measure are problematic, as shown in Figure 1, which illustrates a dramatic impact of average length of service (ALOS) on ACH rates measured in two agencies caring for identical patients.

In this paper, we present evidence supporting an alternative to the current ACH measure.

1. We demonstrate that agency ALOS is by far the most important of the provider characteristics predicting agency ACH rates;
2. We replicate the effect of ALOS on ACH rates in a patient-level simulation of a system of HHAs similar to Medicare agencies; and
3. We use the simulation to show that measuring ACH against a fixed time interval following hospital discharge is not ALOS biased.

Such an alternative measure might better reflect agencies’ impacts on readmission rates when ALOS varies over time, as some changes in the reported ACH measure might only reflect changes in ALOS. It would also support fair comparison of rehospitalization rates among HHAs with differing ALOS. An agency-specific hospital readmission rate would be consistent with measures CMS currently uses in assessing management of care transitions in other settings.

METHODS

Observed Predictors of ACH

We used data derived from the CMS OASIS submissions from HHAs in the United States between January 1, 2004 and December 31, 2007 prepared by a CMS contractor (the Iowa Foundation for Medical Care). We received linked records by patient that defined home health episodes of care, and we calculated LOS in home health for each episode. We counted the number of episodes of care by agency with end dates within each calendar month. We included records from agencies having at least 10 episodes. We calculated the crude

Figure 1: Time Course of Home Care and Hospital Readmissions for Five Hypothetical Patients in Two Home Health Agencies with Differing Average Length of Service (ALOS)

Note. The gray timelines represent the intervals during which each hypothetical patient receives home health services. Patients are identified by letters A–E, and length of service, in days, is shown in parentheses. The triangles represent readmission to the hospital, black if during a period of home health care and gray otherwise. The patients are assumed to have the same readmission dates in both agencies, but the agency crude acute-care hospitalization (ACH) rates (calculated as number of patients discharged to the hospital divided by total discharges) differ because more of the readmissions occur during home health care in Agency 2 compared with Agency 1.

ACH rate and risk-adjusted it using the method of Shaughnessy and Hittle (2002) for every agency and month. We calculated ALOS as the sum of the LOS for all patients divided by the number of patients for each HHA and month.

From preliminary studies, we knew that ACH was strongly correlated with ALOS. We wanted to determine if there were other factors that had a significant influence on ACH. We built a linear regression model to predict monthly ACH rates from agency characteristics available in published cost reports (urban–rural status and ownership), ALOS, $(\text{ALOS})^2$, and geographic region. Preliminary work suggested both seasonal and systematic month-to-month variation in ACH, as well as similar long-term trends. We included

terms to account for possible secular trends, the proportion of days each month that were weekdays, and seasonality.

Observed Readmissions in Hospital Patients Discharged to Home Health

We planned to simulate hospital readmissions among persons receiving home health care, because national home health care data available to us did not include information on hospitalizations occurring after home health discharge, which would be needed for testing alternative measures. We did not have access to national hospital claims data or permission to link individual beneficiary claims, preventing a direct comparison under current conditions. (However, we did have access to hospital claims data for the three states for which we are the Quality Improvement Organizations, as described in the following paragraph.) By using simulation, we could model current conditions as well as test the effect of changes in HHA behavior on ALOS and ACH.

From Medicare fee-for-service hospitalization data available to us in three states (Delaware, Pennsylvania, and West Virginia), we measured cumulative probability of hospital readmission among patients reportedly discharged to home health service. Most, but not all, home health patients initiate care after hospital discharge. CMS contractors audit the discharge status codes, because they use them in determining payment for hospital care. We believe they are reasonably reliable. We fitted the hospitalization data to a log-logistic equation so that we had a continuous function for estimating time to next hospital admission for each patient in the simulation of the form:

$$t = t_{1/2}(p/(1 - p))^r \quad (1)$$

where t is the time (in days) from hospital discharge, p is the cumulative probability of hospital readmission at time t , and $t_{1/2}$ and r are constants. $t_{1/2}$ represents the time at which one-half of the beneficiaries in the population group would have been readmitted to the hospital. By using a uniform random variate as p , we could simulate a random individual's time to rehospitalization, which might be greater or less than the person's planned LOS in home health.

Simulation Model of ACH under Alternative Assumptions about the Impact of Home Care

The simulation tracked the posthospital course of a large number of patients within different HHAs. It allowed us to model patient rehospitalization before and after discharge from home health so that we could compare an alternative rehospitalization measure to the current approach. In the simulation, we assigned each patient a planned length of stay based on an assumed LOS target

for each agency. We calculated time to readmission as above, and we considered the patient to have had an ACH while in home care whenever the time to readmission was less than the planned length of stay. Simulation assumptions are summarized in Table 1.

In the base case, we assumed that the hospital readmission probability followed the same cumulative distribution function regardless of whether the patient had been discharged from home health. We studied three alternative scenarios: (1) improvement in home care that resulted in increased time to

Table 1: Simulation Assumptions for Patient-Level Model of Readmissions to Hospital from Home Health Care

<i>Model Feature</i>	<i>Assumption</i>	<i>Authority/Rationale</i>
Patient admission source	Hospital on same day as discharge	The most prevalent form of Medicare home health admission. Necessary for estimating interval-specific readmission rate
Patient admission frequency	Daily admissions	
Number of admissions per day	Poisson random variate with expected value equal to average agency daily admissions	Admissions are infrequently occurring events suited to this model
Agency average daily admissions	Random exponential variate eliminating agencies with fewer than 10 expected admissions per month	Regression fit to the distribution of U.S. agencies by mean number of Medicare episodes ended in a month 2004–2007
Patient length of service	The shorter of the length of time to hospital admission or planned length of service	
Patient time to hospital admission	Random variate from the cumulative distribution function for probability of hospital readmission of Medicare patients discharged to home health	We used three states' fee for service Medicare hospital discharge claims from 2006, as described in the text
Planned length of service	Random normal lognormal variate with mean equal to the facility's average length of service (ALOS) and standard deviation equal to 15 percent of the mean	The shape of this distribution is unknown. Based on the facility-level distribution, lognormal is reasonable
Planned ALOS for facility	Random variate from a lognormal distribution	The observed distribution of ALOS in the agencies between 2004 and 2007 was approximately lognormal

hospital readmission while the patient was in home care, reverting to the asymptotically to the baseline curve thereafter (implying an impact of home care on hospital readmission that dissipates over time); (2) improvement in home care, resulting in increased time to readmission throughout a patient's posthospitalization experience (implying a persistent improvement in a patient's ability to manage after home care); and (3) reduction in ALOS without change in the readmission probability function, which might result from conscious policy in agencies attempting to meet patient needs more quickly, thereby controlling cost, or from an effort to "game" the current measure.

The simulations produced *SAS* datasets representing a hypothetical population of 1,000 HHAs of varying sizes consistent with national Medicare claims, having monthly ALOS values similar to those actually seen in agencies. We modeled daily admissions and subsequent discharges for 30 days after a run-in period to allow the number of discharges to reach a steady state. The run-in time was equal to the 97th percentile of ALOS in the national HHA population.

Each *SAS* dataset contained one observation for every agency and included the number of discharges from home health care during the month, the number of hospital admissions from home health care, ALOS, ACH, as well as 30-, 60-, and 90-day hospital readmission rate for the simulated patients in each agency, regardless of whether the admission occurred before or after discharge from home health. We computed descriptive statistics on each simulated month and repeated the procedure 100 times without changing the simulation parameters. We chose three fixed-interval hospital readmission rates to test the effects of alternative scenarios. Thirty days is shorter than most home health stays, which currently average about 45 days. For most patients and facilities, 30-day rates would capture the impact of being in home health care on risk of readmission. The longer intervals would capture increasing proportions of time post home health and might be expected to respond to persistent effects of home health care on readmission risk past the end of care.

We used *SAS* version 9.1 for all statistical analyses.

RESULTS

Characteristics of the Data

The dataset consisted of 48 monthly totals of episodes of care concluded among 2,347 Medicare HHAs in the United States between January 1, 2004 and December 31, 2007, reflecting outcomes of 12,453,669 episodes. The

median number of providers per state was 31.5 (10th percentile 7.5; 90th percentile 114.5). The state median number of episodes per HHA per month was 95.4 (10th percentile 65; 90th percentile 140). Both ACH and ALOS showed marked state-to-state variation, with higher rates in the South.

Examination of state-level summary data showed an obvious geographical pattern. Southern states, except for Florida, tended to have greater ACH rates than others. We divided the states into two groups (southern = TX, AR, LA, MI, AL, TN, KY, WV, VA, NC, SC, GA; and nonsouthern = the remainder of the states), with Florida considered nonsouthern based on the demographics of its Medicare population. Each group was approximately normally distributed; however, their means differed significantly (southern = 0.312, nonsouthern = 0.281, $p = .0009$). Accordingly, we included a dummy variable set to 1 for agencies in southern states and 0 otherwise to account for the effect of geographic location in the predictive model.

Inspection of time trends of mean agency ACH and ALOS (graph available from authors) reflecting 2,347 agencies with at least 10 discharges every month suggested an increasing trend in ALOS over the 4-year period, with annual midwinter peaks. ACH appeared to have a slight negative trend over time and showed similar peaks in midwinter, along with a pronounced fluctuation from month to month that was not present in ALOS trends. Therefore, we included sinusoidal terms for seasonal trends in the predictive model. Correlated fluctuations appeared in most subsets of ACH time trends, for example, ACH in urban versus rural agencies, or for-profit and not for-profit ownership. The fluctuations were several times greater than expected random fluctuation in a population of 2,347 and proved to be related to the number of weekdays in each month. Therefore, we included the proportion of weekdays each month in the final regression model.

Predictors of ACH

Pairwise correlation analysis of ACH with other variables of interest showed significant negative correlation with time and positive correlation with ALOS. ALOS was by far the strongest correlation ($r = 0.467$), explaining almost one-fourth of the variance in ACH. The dummy variables for rural location, proprietary ownership, and seasonality showed significant positive correlation with ACH, whereas weekday percent was negatively correlated.

ALOS, $(\text{ALOS})^2$, and the other covariates identified above except for agency ownership were significant in the stepwise regression model, with ALOS and $(\text{ALOS})^2$ most important in terms of variance explained (Table 2).

Table 2: Linear Regression Model of Monthly Risk-Adjusted Acute-Care Hospitalization Rate on Time, Average Length of Service (ALOS), and Agency Characteristics U.S. Medicare Home Health Agencies, 2004–2007

<i>Description</i>	<i>Variable Name</i>	<i>Parameter Estimate</i>	<i>Standard Error</i>	<i>Partial R²</i>
	Intercept	0.2237	0.0067	
ALOS, in months	m1	0.1634	0.0018	0.2178
Square of ALOS	m2	−0.0252	0.0005	0.0200
Month since December 2003	Mon	−0.0003	0.0000	0.0021
Rural agency location	Rural	0.0120	0.0005	0.0034
Proportion weekdays in month	Weekday_pct	−0.1559	0.0091	0.0021
Seasonal forcing function with period of 1 year	sin_term	0.0029	0.0003	0.0006
	cos_term	0.0050	0.0003	0.0017
Southern agency location	South	0.0129	0.0005	0.0059

On average, a 1 day increase in ALOS increased the ACH rate by 0.16 percent. This effect diminished with increasing ALOS; nevertheless, a positive change in ALOS predicted a proportional change in ACH for ALOS values up to 3 months, encompassing 99 percent of the observations.

The negative weekday coefficient implies that weekends posed a higher risk of readmission than weekdays. There was a significant negative trend in ACH over time, after accounting for other model variables. Patients in rural and southern agencies were more likely to experience ACH. There was a small but significant increase in ACH in early months of the year. After adjusting for other variables, agency ownership was not significantly associated with ACH. Other factors such as specifics of a patient's disease state not captured in risk adjustment, agency-level policies, treatment choices, and random error would explain the majority of the variance in ACH rate.

Readmission after Transfer to Home Health

The log-logit model explained more than 99 percent of the variance in readmissions among the three states for which we had Medicare claims data. The average half time to readmission ($t_{1/2}$) was 187.9 days. During the first 7 days posthospital discharge, the model systematically underestimated hospital readmissions, but the model residuals were approximately normally distributed for greater values of time since discharge.

Simulation Results

One hundred runs of the baseline case simulation yielded median ALOS 42.6 ± 14.3 days (mean $\pm$ standard deviation) with an average of 67.7 ± 38.8 discharges per month. The simulated ACH rate was 28.9 ± 10 percent. Monthly discharges, ALOS, and ACH rates varied widely among the simulated agencies as suggested by the large standard deviations. ACH was significantly correlated with ALOS, and regression parameters were similar in magnitude and sign to those determined in the actual population of HHAs. The average change in ACH rate per day of ALOS was 0.173 percent, and the model r^2 was 0.289. As noted in the methods, other agency characteristics and variations over time were not included in the simulation. The fixed-interval hospital readmission rates increased as observation period increased, from 21.7 ± 6.0 percent for 30-day readmissions through 37.8 ± 7.5 percent at 90 days.

Table 3 compares the model scenarios. Reducing target length of stay had the expected effect on ALOS. For example, a 10 percent relative reduction in planned LOS produced an 8.6 percent reduction in actual ALOS and

Table 3: Impact of Different Simulation Scenarios on Average Length of Service, Acute-Care Hospitalization, and 30-, 60-, and 90-Day Hospital Readmission Rates in 1,000 Home Health Agencies of Varying Sizes

Description	Change from Baseline	Measures				
		ALOS	ACH	R-30	R-60	R-90
Base case*	—	42.6	0.289	0.217	0.312	0.378
Increased median time to readmission	5	0.9	-2.5	-2.8	-2.4	-2.3
during home health; converge to	10	1.4	-4.5	-5.2	-4.6	-4.2
baseline rate postdischarge (%)	20	2.4	-8.6	-9.4	-8.4	-7.8
Increased median time to readmission	5	1.1	-2.7	-2.7	-2.4	-2.3
across the board (%)	10	1.4	-4.9	-5.5	-4.9	-4.5
	20	2.7	-9.1	-10.3	-9.4	-8.5
Change planned length of service (%)	-10	-8.6	-5.2	-0.1	0.0	-0.1
	-5	-4.4	-2.8	-0.2	-0.1	-0.1
	5	4.3	2.6	0.1	0.1	0.0
	10	8.5	4.7	0.0	0.1	0.1

*Table shows relative percentage changes in specified measure compared with a baseline similar to actual conditions, except for the "base case" line, which shows the actual results for that scenario. In this table, ALOS, average length of service; ACH, acute-care hospitalization rate defined as the proportion of home health patients who were admitted to the hospital while receiving home health services; R-30, R-60, and R-90, the percent of home health patients readmitted to the hospital within 30, 60, or 90 days of hospital discharge, respectively.

5.2 percent relative decline in ACH. However, reductions or increases in planned and observed LOS had no apparent impact on the fixed-interval readmission measures. In the two scenarios that modeled agency-level changes in risk of hospitalization (when the actual underlying probability of hospitalization was varied during the home care episode or across the entire observation period, including some post home health time), both the ACH measure and all the fixed-interval measures changed, decreasing as $t_{1/2}$ increased. Shorter readmission timeframes showed greater relative decreases for a given change in underlying hospitalization risk than longer ones. In both of these scenarios, reducing hospital admissions was associated with a proportional increase in ALOS.

DISCUSSION

We could not find published studies of the relationship between LOS and ACH in home health patients. Concerning LOS, Peters (1999) found important regional differences and noted that chain-associated agencies had shorter ALOS, controlling for patient characteristics. Our results showed that proprietary agencies had longer ALOS; whether this agrees with Peters' findings depends on the relationship of "chain" and "proprietary" ownership. Peters did not report linkage between ALOS and ACH. Murkofsky et al. (2003) demonstrated that ALOS in home health declined sharply in 1,053 HHAs after the adoption of the 1997 Balanced Budget Act amendments, which implemented prospective payment for home health services. For-profit agencies experienced a greater reduction in ALOS than not for-profit, but they continued to have longer ALOS than other HHAs, consistent with our more recent findings. However, these investigators did not study association between ALOS and ACH.

Wray et al. (1988) noted that living in the South is a risk factor for recurrent hospitalization among male veterans. Philbin and DiSalvo (1999) found that rural hospital location and discharge to skilled nursing facilities predicted reduced readmission rates in New York State heart failure patients, but their study did not report impacts of home health care. In our model, region was correlated strongly with both ALOS and ACH; omitting it from the model reduced the r^2 by 0.0042, suggesting a small independent effect on ACH.

Studies of impact of home health care on hospitalization are not common. An older systematic review showed limited evidence of impact of

substituting home care services on hospitalization costs, but they focused on early hospital discharge, rather than rehospitalization (Soderstrom, Tousignant, and Kaufman 1999). Shipton (1996) found that length of *hospital* stay was a risk factor for readmission. Using hospital discharge data, Rich and Freedland (1988) observed that decreased hospital LOS associated with adoption of diagnosis-related groups (DRGs) had not resulted in increased rehospitalization among congestive heart failure patients in a single hospital.

In the face of increasing hospital discharge rates to home health care, these authors speculated that such care might have reduced readmission rates; they did not study utilization of home health itself. Li, Morrow-Howell, and Proctor (2004) studied postacute care for heart failure (CHF) patients and found no evidence of service impact on ACH. In contrast, a review by Konetzka, Spector, and Limcangco (2008) found weak evidence that home health services substituted for hospital care might reduce readmissions in CHF patients. Neither Li's nor Konetzka's studies addressed ALOS.

As recently as 2001 one researcher, noting the overall poor quality of evidence, had this to say about using readmissions as a quality indicator: "While some studies have demonstrated a process-outcome link between substandard care and the likelihood of readmission, the association is not strong enough to be a valid and useful quality indicator" (Hasan 2001). Nonetheless, a measure of rehospitalization may well be appropriate for home health outcome, provided that the measure tracks desirable results of home health interventions in reducing unnecessary hospital care and does not merely reflect the cumulative probability of hospital readmission related to patient age, sex, and health status.

The current measure, risk-adjusted ACH, does not meet this requirement. ALOS bias makes it unsuitable for fair comparison of agency performance. The easiest way for a provider to reduce ACH is to reduce LOS, as illustrated in the fourth simulation scenario. In the post-Balanced Budget Act environment, where the financial incentive might be to reduce LOS to increase profit, this may be a perverse incentive. We have no reason to believe agencies are generally using this as a strategy; recently, ALOS has increased substantially nationwide along with a slight reduction in ACH. Our simulation suggests this could be due to a combination of better care and patients requiring longer LOS for reasons that might include a sicker population.

Could the apparent bias be due to inadequate risk adjustment? Risk adjustment of ACH rates is intended to compensate for variation in patient condition, as documented in OASIS, allowing fair comparison of agencies with dissimilar populations. Iezzoni and colleagues have documented the

imperfect ability of risk adjustment methods to separate patient-level risk from institutional sources of variation, at least in the hospital setting (Iezzoni et al. 1996; Iezzoni 1997). There is no reason to expect the home care environment to be different. The effect of LOS was recognized in the risk-adjustment methods used for the national quality measure during the period of this study (Shaughnessy and Hittle 2002). In fact, the dichotomous variable “length of stay less than 31 days” used in the risk-adjustment model was the strongest protective factor against hospital readmission among the covariates included in the published model.

In our preliminary studies, we found that correlating $\log(\text{ALOS})$ with the square root of risk-adjusted ACH instead of unadjusted ACH resulted in a change in correlation coefficient from 0.495 to 0.472 (transformations were performed so that the variables of interest had distributions that were approximately normal). The risk-adjustment model currently in use makes no reference to LOS and would therefore not correct for ALOS bias at all (Hittle, Goodrich, and Nuccio 2008).

The risk adjustment model in effect at the time of our work did not include adjustment for age. Because of widely differing hospital readmission rates among Medicare beneficiaries discharged to home health, we tested the simulation using age stratification and saw little difference in results. This is most likely due to the age distribution of beneficiaries receiving home health care, which is dominated those age 85 and older. The interaction between ALOS and ACH, in which increased ALOS “causes” increased ACH, whereas hospital admissions during home care act to reduce ALOS, makes it doubtful that a logistic regression model would fully adjust for ALOS’ effect on the current measure.

A fixed-interval hospital readmission rate avoids this problem. Moreover, it is not subject to reporting errors to the same extent as OASIS-derived measures, as it only depends on accurate reporting dates of admission on home health and hospital claims, which are audited by the fiscal intermediaries who pay Medicare claims. Longer fixed intervals have the additional theoretical advantage of capturing postdischarge impact of home health services, for example, improved self-management or better hand-offs to community care, leading to an overall suppression of hospital readmissions. However, comparing the change in readmission rates after across-the-board increases in $t_{1/2}$ with those following increases that dissipate after the end of service in the simulation suggests such effects would be small. The 30-day readmission rate is currently used to monitor quality during care transitions, and the other two fixed-interval rates are consistent with it.

A disadvantage of the alternative measures is the required linking of two data streams (hospital discharges and home health claims). This is not difficult in Medicare fee-for-service cases, but it would be arduous if an all-payer measure were desired. However, an offsetting advantage would be the availability of hospital discharge information to improve the precision of risk adjustment. Linking home health to hospital data could verify that a fixed-interval measure is feasible in practice, and it could test whether improved comparability of the measure across HHAs was worth the additional time and expense to produce it.

CONCLUSIONS

In the United States between 2004 and 2007, ALOS was the principal determinant of risk-adjusted ACH rate in HHA patients. This limits the usefulness of the ACH rate for comparison of quality performance of HHAs, or for tracking performance changes over time. An alternative fixed-interval measure would be free of this influence and might be used to compare agency performance in quality of care during patient transitions across settings. Simulation of home health care episodes with a stochastic model may be useful for testing the likely impact of policy changes affecting utilization on rehospitalization.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

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