Modeling Skilled Nursing Facility (SNF) Therapy Costs per Stay

A memo by staff from the Urban Institute for the Medicare Payment Advisory Commission

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MEMORANDUM

TO: Carol Carter, Mark Miller (MedPAC)

FROM: Doug Wissoker

DATE: September 28, 2012

SUBJ: Modeling Skilled Nursing Facility (SNF) Therapy Costs per Stay

RE: Alternative Component Designs for the SNF PPS Design
(UI # 08434-003-00 - MedPAC #MED11P0051)

This memo documents our work to model the therapy costs of stays in Skilled Nursing Facilities (SNFs) using Medicare claims and assessment data from 2007. The work grew out of an interest to consider paying SNFs for each stay, rather than continuing the current practice of paying for each covered day. The payment for therapy would be a pre-determined amount, adjusted for case mix to account for the patient condition and functionality. Paying for therapy by stay is thought to hold providers responsible for increases in the length of stay. A shift to payment for entire stays could also help move toward more comparable payment systems across post-acute settings.

Currently, SNFs are paid for therapy for each covered day of a stay. The therapy component of the payment is case-mix adjusted for patients that qualify as "rehabilitation cases" to account for the amounts and types of therapy provided and patient functionality. The case-mix adjustment is determined by the Resource Utilization Group (RUG) classification category to which the beneficiary is assigned.

Our previous work, summarized in Carter, Garrett and Wissoker, focused on the fact that Medicare's SNF payment depends on the amounts and types of therapy provided – and therefore is not fully prospective. To address this problem, we developed and evaluated a payment model in which the payments are based on patient and stay characteristics.

In the current project, we address the issue that facilities are paid for all covered days – that is, the number of days of payment is set retrospectively. As a result of being paid for all covered days, facilities have an incentive to extend the length of profitable stays and shorten the length of unprofitable stays. To better understand the feasibility of paying for therapy by stay, we have evaluated the extent to which three alternative models can predict therapy costs per stay, alone or in combination, and provide a credible basis for setting relative therapy payments. Of particular

interest is whether models perform adequately without including length of stay itself as a predictor.

We compare the ability to predict therapy costs per stay of three alternative models:

1) A model based on the previous work of the Urban Institute (UI) that predicts therapy costs per day using patient and stay characteristics.

2) A model based on the elements incorporated into the case-mix system Medicare uses to pay inpatient rehabilitation facilities (IRFs). IRFs specialize in furnishing therapy services to beneficiaries.

3) A model based on the therapy component used in the Post-Acute Care Payment Reform Demonstration (PAC-PRD). The demonstration measured the resources used by beneficiaries treated in SNFS, IRFs, long-term care hospitals, and home health agencies.

Our analysis of these alternative model specifications finds that the models of costs per stay perform reasonably well without length of stay as a predictor, explaining 17.7 to 20.7 percent of the variation in therapy costs per stay:

- The predictors from the UI model of therapy costs per day explain 17.7 percent of variation in therapy costs per stay;
- Adding predictors used in either the IRF case mix groups or the PAC-PRD model of the therapy costs increases the share of the variance of therapy costs explained to 20.7 percent.

These results show that it is possible to predict therapy costs per stay without including the length of stay as a predictor. The ability of predictions and implied payments to track costs without length of stay in the model is, however, dramatically less than obtained by extending the model to include length of stay as a predictor or is implicit in the current system of paying for all covered days.

Models of therapy costs per stay that include length of stay and whether the patient qualified for a rehabilitation RUG group explain a very high share of the variation across stays, with measures describing patient condition adding little to the models. A model including only measures of length of stay, whether the patient qualified for a rehabilitation payment group under the previous RUG-III payment system, and age explains 53.6 percent of the variance of therapy costs per stay. Adding 114 measures of diagnoses, procedures, measures of cognitive ability and functionality to the model lifts the percent of variance explained to 55.5 percent.

For comparison, we calculated the predictive power of Medicare's 2012 Prospective Payment System (PPS) therapy payments for all covered days. To obtain a payment rate over the stay, we multiplied the therapy daily payment rates by the observed length of stay. For the current PPS therapy payment rates, the payment per stay explains 59.5 percent of the variation in therapy costs per stay. For the model-based rates, the payment per stay explains 55.5 percent of variation

in therapy costs per stay.
In this memo, we briefly describe the SNF payment system and the data used for this analysis, and then report on the results of the modeling effort.

Background

The Medicare SNF benefit pays a daily rate for care in a skilled nursing facility. The daily rate is the sum of payments for three components: nursing, therapy, and room and board. The nursing component is case-mix adjusted to account for variation across cases in the costs of nursing. The therapy component is case-mix adjusted using a separate set of relative weights for patients that qualify as "rehabilitation cases" to account for the amounts and types of therapy provided and patient functionality.

The payments are adjusted for case mix using a classification system known as Resource Utilization Groups (RUGs). Patients are grouped into RUG categories using information gathered in an assessment conducted on or about days 5, 14, 30, 60, and 90 of a stay. The assessment instrument is the minimum data set (MDS). Assignment to a RUG category depends on the number of minutes and types of therapy, indicators of expected need for services, patient diagnoses, and ability to perform activities of daily living (such as walking or dressing).

The most recent version of the RUG classification system is called RUG-IV. The RUG-IV categories can be grouped into the following major categories: rehabilitation only, rehabilitation and extensive services, extensive services only, special care, clinically complex, behavior symptoms and cognitive performance. Assignment to a rehabilitation case-mix group requires that the beneficiary receive at least forty-five minutes of physical occupation or speech therapy per week. In the first quarter of 2012, over 90 percent of SNF stays were in a rehabilitation or rehabilitation and extensive services RUG category.

In our previous work, we described two problems with the SNF PPS. First, the system does not accurately pay for nontherapy ancillary (NTA) services. Instead, it pays for them as part of the payment for nursing services. Second, it encourages facilities to provide therapy services for financial, not clinical, reasons.

To address these problems, Bo Garrett, Steve Zuckerman, and I worked with Dr. Carol Carter at MedPAC to develop a separate model-based NTA payment component to add to the SNF PPS, and a predictive model of therapy costs to replace the therapy payment component. Payments for NTA services would be carved out of the existing system's nursing daily payment and then adjusted for case mix using predicted NTA costs. The existing system's case-mix weights for therapy services would be replaced with weights based on predicted therapy costs.

To simulate the model-based payments, we developed multivariate models of both non-therapy ancillary costs and therapy costs in which the average cost per day depends on a limited number of SNF diagnoses and treatments, measures of physical and motor functioning, a proxy for length of stay, and an indicator that the beneficiary qualified for a rehabilitation RUG category under the previous payment classification system. The models were developed in line with CMS preference that the models be based on administrative data easily available to SNFs and include only measures that do not promote undesirable incentives. The revised system increased

payments to facilities with a low share of rehabilitation therapy patients, high shares of patients with extensive services and to both non-profit and hospital-based facilities.

Data

Our analysis of therapy costs per stay uses a sample of 2007 SNF stays provided to us by CMS staff for our earlier work. The data files combine information from three sources:

- Medicare SNF claims. The SNF claims are the primary source of data on periods of services, types of procedures furnished, patient diagnoses, and the facility's charges for services.

- Assessments of patient condition. The assessments of patient condition in the SNF are conducting using the MDS 2.0, which was used at the time. For each claim, CMS attached information from as many MDS assessment records as cover the dates of the claim. The MDS assessments are the source of information on the patients' cognitive and functional status, use of specific services, and assigned case-mix group. In addition, the assessments provide information on diagnoses and services such as therapy furnished to SNF patients during the past 14 days (the so called "look-back" period). Recall that the MDS is administered to patients on a specified schedule approximately 5, 14, 30, 60, and 90 days from the start of the Medicare-covered SNF stay.

- Facility cost-to-charge ratios from Medicare cost reports. CMS used the cost report data that Medicare-participating SNFs submit annually to the fiscal intermediaries to create ancillary service cost-to-charge ratios (CCRs), which they used to convert claims data on ancillary service charges to estimated costs for those services.

To model costs per stay, we averaged the within-stay measures over claims and assessments to obtain stay-level data. Predictors (e.g., SNF care, diagnoses) are calculated as the day-weighted average across all the claims for each stay.[1] The variables from the claims (e.g., diagnoses) are averaged over all claims for the stay, while those from the MDS (e.g., RUG categories and measures of functionality) are averaged over those claims with matched MDS data. Some chronic diagnoses (or groups of diagnoses) are recoded to indicate that the diagnosis (or group of diagnoses) ever occurs during the stay. The process of averaging the measures from the claims and MDS level to obtain an analysis file with one record per stay is described in detail in our previous reports (Wissoker and Garrett 2010; Wissoker and Zuckerman, 2012; and Carter, Garrett and Wissoker 2012).

[1]For example, consider a stay that consists of a 10 day and 30 day claim and the beneficiary is recorded as having an infectious disease on only the 30 day claim. We would construct the weighted share of time with the infection by applying a weight of one-fourth to the diagnosis indicator from the first claim (equal to zero) and three-fourths to the indicator from the second claim (equal to one). The result would be 0.75 – indicating that the patient had an infection for three-fourths of the stay.

Stays with a per diem NTA cost over $1500 – accounting for less than a tenth of a percent of stays – are excluded from our analyses as are stays that are missing data for any variable in any model. Our final sample size is 626,435 stays in 9,857 facilities.

Analytic Approach

Sources of explanatory variables. The models of estimated therapy costs per stay use three sources of case-mix variables describing the beneficiary, the stay, and services furnished:

- The model of therapy costs per day developed by Urban Institute staff for MedPAC. The predictors include age, diagnoses (especially those relevant for therapy such as hip fracture, difficulty swallowing), SNF procedures (e.g., IV medication, oxygen linked to conditions or tracheostomy or ventilator), ability to perform activities of daily living, the cognitive performance score, eligibility for a rehabilitation RUG category (defined using RUG-53); nursing case mix index under the RUG-53 payment system, the number of MDS assessments covered by the stay (a proxy for length of stay);

- Patient and service characteristics used by the case mix groupings used by Medicare to pay IRFs. Beneficiary stays are assigned to a case-mix group based on age; 21 Rehabilitation Impairment Codes (RICs) indicating diagnoses; 4 tiers of comorbidities; measures of motor functioning based on 10 activities of daily living, and measures of bladder and bowel control; treatments (tracheostomy care, respirator dependent, dialysis, and amputee status); a cognitive score based on elements that describe patient comprehension, expression, social interaction, problem solving and memory;

- The SNF therapy cost model developed in the Post-Acute Care Payment Reform Demonstration (PAC-PRD): Predictors of therapy include 10 groups of diagnoses and comorbidities (e.g., kidney and urinary, medical); treatments (central line management, hemodialysis, total parenteral nutrition); functional status (bowel and sitting endurance); and length of stay indicators (days 1 – 3, 4 – 7, 8 – 15, and day 60 or more).

The IRF case mix and the PAC-PRD model cannot be directly replicated using data from the SNF claims and the MDS. The IRF case mix is based on data from the IRF Patient Assessment Instrument, while the PAC-PRD model is based on data collected from the CARE tool. Both systems include elements that describe the prior inpatient hospital stay (such as the surgical procedure), which are not indicated on the SNF claims. The IRF case mix groups depend on functionality measures not reported on the MDS: ability to transfer into a tub, transfer into a shower, and to use stairs. In addition, the case mix groups depend upon splits in the motor score that both differ by RIC category and cannot be reproduced using the SNF data. The PAC-PRD is based on sitting endurance, which is not available in the MDS.

Our approach was to define the variables from each source as best we could. Dr. Carol Carter reviewed the IRF case mix case mix groups and the PAC-PRD model to find ICD-9 codes and

MDS assessment responses that would reasonably mimic the underlying elements of each system. Although we did not replicate either the IRF case mix groups or PAC-PRD model perfectly, we believe that our regression model approximates – though perhaps understates somewhat – the share of variance that would be explained using a fully specified version of either system. No attempt was made to remove variables that are part of a given system even if they have unanticipated effects.

Approximating the IRF case mix elements. To approximate the IRF case mix system using the claims and MDS data, we defined a stay as qualifying for a RIC category if at least one primary or secondary ICD-9 diagnosis or procedure code reported on the SNF claims or one MDS assessment indicated a condition in the relevant RIC category. By relying on both primary and secondary diagnoses, individuals can be coded as qualifying for more than one RIC category (that is, up to one per reported diagnosis code). Indicators for the RIC categories then have additive effects in our regression model.

Since the IRF motor score could not be fully replicated using the MDS, we approximated the motor score with an index that is the sum of the following ten ADL scores: eating, grooming, bathing, dressing, transfer (bed/chair/wheelchair), toileting, bladder management, bowel management, walking in corridor, and locomotion off unit. The IRF case mix groups are primarily defined by splitting RIC groups according to an individual's motor score. For example, case mix groups for stroke are separated into 10 groups with the initial division based on motor score. Rather than base the model on groups of the functional score that would need to be defined for each RIC, we included a quadratic function of the score in the model directly and interacted with the indicator for each RIC group. This simpler approach allows us to avoid defining groupings of functional score for each RIC category, but still look at the effect of functional score by RIC group.

We also included measures of cognitive ability and tiers of comorbidities. The cognitive score used in the case mix groups is approximated by indicators of the high impairment values of the SNF Cognitive Performance Scale, along with several indicators of ability to understand and problems in social interactions that are used in the IRF system. For simplicity, we created indicators of the two relatively intensive comorbidity tiers (tiers one and two).

Approximating the PAC-PRD elements. To approximate the PAC-PRD variables, we defined hierarchical condition categories (HCCs) of diagnoses and comorbidities using both primary and secondary diagnoses reported on the SNF claims. The diagnostic category assignment is assumed to apply to the entire beneficiary stay. Treatments for central line management, hemodialysis, and total parenteral nutrition, as well as the ADL for toileting were taken from the MDS.

Estimation. We estimated models of the therapy cost per stay using variables from the UI, IRF, and PAC-PRD approaches in turn, followed by combinations of variables from all three approaches. The models are estimated using Poisson regression, following the approach in our previous work. We first estimate models excluding length of stay or its proxies and then add length of stay in each model to make clear how the predictive value would change with its inclusion. We evaluate each model by first calculating the predicted cost from the Poisson

model and then estimating the share of the variance in cost explained by the model prediction.

Findings

The current (2012) PPS payments for therapy services and the payments estimated by the UI model both explain a large share of the variation in therapy costs for the stay (see Table 1). A per stay payment weight obtained by applying the RUG-IV therapy payment weight to all the days of the stay explains nearly 60 percent of the variance in therapy costs per stay. The UI therapy model developed for the MedPAC refinement project explains roughly 56 percent of the variance in therapy costs per stay.

Table 1: Ability to Predict SNF Therapy Costs per Stay with Per-day Case Mix Weights Applied to Length of Stay

Case Mix	R-squared
RUG-IV 2012 PPS therapy weights times length of stay	0.595
UI model per diem therapy prediction times length of stay	0.555

Source: Urban Institute analysis of 2007 SNF claims, cost reports and MDS records.

Notes: N=626,435 stays in 9,857 facilities; Skilled Nursing Facility (SNF); RUG (Resource Utilization Group); MDS (Minimum Data Set); Prospective Payment System (PPS); Urban Institute (UI); UI model of therapy costs per day is reported in Wissoker and Zuckerman (2012) and includes age, diagnoses (especially those relevant for therapy such as hip fracture, difficulty swallowing), SNF procedures (e.g., IV medication, oxygen linked to conditions or tracheostomy or ventilator), ability to perform activities of daily living, the cognitive performance score, eligibility for a rehabilitation RUG category (defined using RUG-III); nursing case mix index under the RUG-53 payment system, the share of covered days associated with each MDS assessment (a proxy for length of stay).

In Table 2, we report the shares of variance explained by variables from each of the three alternative approaches. The results are reported by model. For each model, we first present the results for a simple specification in which length of stay is excluded. We then add predictors in stages, leading to a model that includes both an indicator of qualification for a rehabilitation payment group and measures of length of stay. Each model shows a similar pattern of improvement in predictive power as the rehabilitation indicator and measures of length of stay are included.

Without any controls for length of stay, the UI therapy model explains 17.7 percent of the variance of costs; the IRF case mix group replication explains 6 percent of the variance of costs; and the PAC-PRD model explains 3 percent of the variance of costs. Adding an indicator that a stay qualifies for a RUG-III rehabilitation category to the IRF and PAC-PRD models increases the variance explained by the respective models to 10.4 percent for the IRF model and 8.2 percent for the PAC-PRD model. (This rehabilitation indicator is already included in the basic UI model.)

Adding length of stay and length of stay squared to the models dramatically increases the percent of variance explained and nearly equalizes the predictive ability of the models. The UI model

explains 55.2 percent of variance of therapy costs; the IRF model explains 54.4 percent; and the PAC-PRD model explains 53.9 percent. As can be seen in the UI model, inclusion of length of stay directly improves the fit relative to including the number of assessments (43.9 percent explained) and indicators of length of stays of a given length (48.6 percent explained).

Table 2: Ability to Predict SNF Therapy Costs per Stay With and Without Length of Stay as a Predictor UI Model, PAC-PRD Model, and IRF Case Mix Groups

Source of Predictors / notes on variables included	R-squared	# of predictors
UI model		
Basic model without length of stay (LOS) or LOS indicator	0.177	50
Basic model with LOS indicator (3 versions)		
Indicators for number of assessments during stay	0.439	55
Indicators for days 1-3, 4-7, 8-15, and 60+	0.486	54
Actual LOS and LOS squared	0.552	52
Inpatient Rehabilitation Facilities Case Mix Group Elements		
Basic model (no LOS or LOS indicator)	0.059	33
+ Interactions between RIC group and functionality score	0.060	59
+ RUG-III rehabilitation indicator	0.104	60
+ Actual LOS and LOS squared	0.544	62
PAC-PRD model elements		
Basic model without length of stay	0.030	19
+ RUG-III rehabilitation indicator	0.082	20
+ Indicator for length of stay (2 versions)		
Indicators for days 1-3, 4-7, 8-15, and 60+	0.469	24
Actual LOS and LOS squared	0.539	22

Source: Urban Institute analysis of 2007 SNF claims, cost reports and MDS records. Notes: N=626,435 stays in 9,857 facilities. Skilled Nursing Facility (SNF); RUG (Resource Utilization Group); MDS (Minimum Data Set); Urban Institute (UI); Inpatient Rehabilitation Facility (IRF); Post-Acute Care Payment Reform Demonstration (PAC-PRD); The UI model is as reported in Wissoker and Zuckerman (2012) and in the notes to Table 1; IRF elements include age, age squared, indicators of high cognitive impairment (Cognitive Performance Score=4, =5, =6), behavioral problems, and difficulty understanding others; treatments of tracheostomy care, respirator/ventilator, dialysis, and missing limb; functional score summing scores for eating, grooming, bathing, dressing, toileting, transfer to bed/chair/wheelchair, bladder management, bowel management, walking in corridor, locomotion off unit; rehabilitation impairment categories (RICs) for stroke, traumatic brain injury, non-traumatic brain injury, spinal cord injury, neurological, hip fracture, other orthopedic problem, amputation lower extremity, osteoarthritis, rheumatoid, cardiac, pulmonary, pain syndrome, Guillain-Barre, burns; indicators for comorbidities tiers 1 and 2; PAC-PRD model includes age, age squared; indicators for morbid obesity, orthopedic disorders, liver and other gastro-intestinal conditions, urinary tract infection, respiratory chronic obstructive pulmonary disease, kidney, hematological, and stroke; indicators for toileting assistance needed; total parenteral nutrition, dialysis, intravenous medication, and transfusions.

In sum, without length of stay, the alternative approaches explain quite different shares of the variance in costs per stay, with the UI model explaining substantially more variation in therapy

costs. However, once indicators of length of stay and qualification for a rehabilitation RUG category are included in the model, other patient and stay characteristics (including diagnoses, measures of functionality, and special treatments such as tracheostomy care) appear to add very little, with roughly equal shares of variance explained across all three models.

Table 3 shows the effect of combining various elements of the predictive models without including a measure of length of stay in the model. Altogether, combining all variables from the three models explains 20.8 percent of variance of stay therapy costs. Given the number of variables in the model, this is a relatively modest increase beyond what can be explained by using the UI model alone. The 20.8 percent probably gives a good estimate of the share of variance that one can hope to explain in a stay-based model without adding either length of stay or predictors from sources not used in this model. For example, one might improve the predictive power by adding measures of therapy use, diagnoses, or procedures from the prior hospital stay.

Table 3: Ability to Predict SNF Therapy Costs per Stay without Length of Stay as a Predictor Combining Elements of the UI Model, PAC-PRD Model, and IRF Case Mix Groups

Starting model/ notes on variables included	R-squared	# predictors
UI model		
Basic model (without length of stay proxy)	0.177	50
+IRF elements	0.202	78
+quadratic functionality score interacted with RIC categories	0.202	102
+PAC-PRD variables	0.208	119
Inpatient Rehabilitation Facilities Case Mix Group Elements		
Basic model	0.059	33
+interactions between RIC group and quadratic of functionality score	0.060	59
+RUG-III rehabilitation indicator	0.104	60
+PAC-PRD variables	0.116	76
+select UI model variables (transfer adl, nursing case mix index, hip fracture, swallowing, post-fracture care)	0.197	85
+rest of UI model variables (excluding assessment number)	0.208	119
PAC-PRD model elements		
Basic model (without length of stay indicators)	0.030	19
+RUG-III rehabilitation indicator	0.082	20
+Basic IRF variables	0.114	50
+interactions between RIC group and quadratic of functionality score	0.116	76
+select UI model variables (transfer adl, nursing case mix index, hip fracture, swallowing, post-fracture care)	0.197	85
+rest of UI model variables (excluding assessment number)	0.208	119

Source: Urban Institute analysis of 2007 skilled nursing facility claims, cost reports and MDS (Minimum Data Set) records. Notes: N=626,435 stays in 9,857 facilities; Skilled Nursing Facility (SNF); RUG (Resource Utilization Group); MDS (Minimum Data Set); Urban Institute (UI); Inpatient Rehabilitation Facility (IRF); Post-Acute Care Payment Reform Demonstration (PAC-PRD); UI model is as reported in Wissoker and Zuckerman (2012) and in the notes to

Table 1; IRF and PAC-PRD elements are listed in the notes to Table 2.

Table 4 shows the strong role of length of stay and qualification for a rehabilitation RUG category in predicting therapy costs. A model with only five predictors – length of stay, length of stay squared, age, age squared, and qualification for a rehabilitation RUG category explains 53.6 percent of the variance of costs. A model with all of the length of stay and length of stay squared and all of the predictors from the three alternative models explains 55.6 percent of the variance in costs. This is consistent with the findings from Table 2 that after controlling for length of stay, the effects of the variables describing the patient's condition are muted.

Table 4: Ability to Predict SNF Therapy Costs per Stay with Length of Stay as a Predictor

Variables included	R-squared	# predictors
Length of stay, length of stay squared	0.386	2
+RUG-III rehabilitation indicator, age, age squared	0.536	5
+UI model variables	0.553	52
+IRF elements +interactions between RIC group and quadratic of functionality score	0.555	106
+PAC-PRD variables	0.556	121

Source: Urban Institute analysis of 2007 SNF claims, cost reports and MDS records.
Notes: N=626,435 stays in 9,857 facilities; Skilled Nursing Facility (SNF); RUG (Resource Utilization Group); MDS (Minimum Data Set); Urban Institute (UI); Inpatient Rehabilitation Facility (IRF); Post-Acute Care Payment Reform Demonstration (PAC-PRD); the UI model is as reported in Wissoker and Zuckerman (2012) and in the notes to Table 1; IRF and PAC-PRD elements are listed in the notes to Table 2.

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