



Abt Associates Inc.

**Variation in Prescribed  
Medication and Other  
Non-therapy Ancillary  
Costs in Skilled Nursing  
Facilities: Potential  
RUG-III Refinements**

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# Contents

<b>Executive Summary .....</b>	<b>ii</b>
<b>1.0 Overview .....</b>	<b>1</b>
1.1. Background.....	1
1.2 Purpose and Approach of Study .....	2
1.3 Overview of Recommended Refinements .....	3
1.4 Structure of this Report.....	3
<b>2.0 Data Sources and Descriptive Results .....</b>	<b>5</b>
2.1 Data Sources .....	5
2.1.1 Minimum Data Set (MDS) (including Section U).....	5
2.1.2 Health Care Financing Administration (HCFA) Claims Data .....	6
2.1.3 Exclusions and Creation of Analytic Sample .....	7
2.2 Descriptive Results .....	10
2.2.1 Characteristics of the sample .....	11
2.2.2 Contrasting Hospital-based and Freestanding SNF Drug Costs .....	18
<b>3.0 Conceptual Approach to Developing Potential RUG Refinements .....</b>	<b>22</b>
3.1 Principles for Development of Potential Refinements .....	22
3.2 Methods: Creation of Cost Measures .....	22
3.3 Methods: Developing Potential RUG Refinements.....	24
3.4 Criteria for Evaluating Potential Refinements.....	27
3.5 Clinical and Technical Review .....	30
<b>4.0 Analytic Results and Potential RUG-III Refinements.....</b>	<b>32</b>
4.1 Relationship Between RUG-III and Costs.....	32
4.2 Ability of RUG-III to Predict Ancillary Charges and Total Costs .....	41
4.3 Costs for Residents Who Qualify for Both Extensive Services and Rehabilitation .....	42
4.4 MDS Items Associated With Differences in Ancillary Charges .....	49
4.5 Clinical Review and Modification.....	49
4.6 Description of Potential RUG-III Refinements .....	51
<b>5.0 Conclusions and Recommendations .....</b>	<b>73</b>
<b>References .....</b>	<b>76</b>

## Appendices

A. The RUG-III Classification System	
B. Minimum Data Set (MDS) Version 2.0	
C. Staff Time Measurement (STM) Study Data	
D. Drug Charge Imputation Analyses	
E. Detailed Specifications for Cost to Charge Multipliers	
F. Technical Expert Panel Participants	
G. Descriptive Tables	
H. Short Stay Analyses	
I. Descriptive Analysis of the Use of Cancer Therapy in Skilled Nursing Facilities	
J. Description of Proposed RUG-III Model Refinements	

# Executive Summary

The Medicare skilled nursing facility (SNF) prospective payment system (PPS), implemented by the Health Care Financing Administration (HCFA) under Congressional mandate in July 1998, is intended to cover all costs for services provided to residents while in a Part A stay, including routine services, ancillary, and capital-related costs. Payment is casemix-adjusted based on the Resource Utilization Groups, Version 3 (RUG-III) resident classification system. The primary purpose of this study was to evaluate potential refinements to RUG-III to improve the ability of the system to predict variance in non-therapy ancillary charges. Data on non-therapy ancillary charges were measured using Medicare claims data.

Despite general agreement that casemix-adjusted prospective payment systems furnish desirable incentives for efficiency and reduce administrative burden for both providers of services and for payers, concern has been expressed about the ability of this particular payment system - the Medicare SNF PPS - to adequately capture variance in certain types of costs. RUG-III, modeled and tested during the HCFA-sponsored Nursing Home Casemix and Quality demonstration, more accurately captures variance in the *staff and therapy* resources used to care for SNF residents than any other patient classification system developed to date. However, the classification system by design did not take into consideration other types of resources that contribute to care of the SNF resident, such as prescription medications, oxygen and other non-therapy ancillary supplies and services. Analyses conducted for the current study showed that RUG-III accounted for only about four percent of the variance in *per diem* ancillary charges. These costs now comprise about 25 percent of the daily costs of care for Medicare SNF residents, and there is concern that access to quality SNF care may become restricted under the current system for Medicare beneficiaries that have high non-therapy ancillary costs.

## Guiding Principles for This Study

HCFA awarded this contract to Abt Associates, Brown University Center for Gerontology and Health Care Research and the University of Michigan Institute of Gerontology to evaluate potential improvements to the RUG-III system. The guiding principle of the study was to augment but not replace the RUG-III system, which has been proven in a large number of studies, both in the U.S. and abroad, to be effective in explaining nursing and therapy staff costs. The project team sought to maintain not only the basic “tree-based” RUG-III structure, but also accepted as given the underlying casemix weights (derived from HCFA’s Staff Time Measurement studies) associated with each of the RUG-III categories. As a result, potential modifications were designed as splits of the RUG-III groups or new groups that could be added to the current system.

## Data Sources

Data used to develop casemix refinements came from SNF residents from in several states (Kansas, Maine, Mississippi, New York, Ohio, South Dakota, and Texas) who had Medicare-covered nursing home stays between 1995-1997. Data from the Nursing Home Minimum Data Set (MDS) were matched to Medicare SNF claims, which were used to create a measure of *per diem* non-therapy ancillary charges. Note that because it is not possible to measure nursing and therapy staff time costs from Medicare claims data, the focus of the study was on non-therapy ancillary charges, rather than on staff time or total costs. Because little interaction among and relatively low predictability of some

of the individual components of non-therapy ancillary charges were discovered, the predictors of each component were used in unified regressions of total ancillary costs.

### **Approach to RUG-III Refinements**

In developing a refined RUG-based casemix model to predict non-therapy ancillary charges, a variety of approaches were considered. Analytic results pointed to the use of regression-derived index models of multiple MDS variables rather than tree-based models (i.e., from CART or PC-Group) that partition a data set into discrete subgroups based on individual MDS items that are predictive of costs. The use of index models based on multiple variables has a disadvantage of adding complexity to the system, but the advantage that increased payment is likely linked to more than one single resident characteristic or service.

Development of index model-based refinements began with a search for variables associated with large differences in costs for residents, either overall or within RUG-III categories. Through an iterative process, a group of MDS items that were associated with differences in prescription drug, respiratory therapy, or other non-therapy ancillary charges were identified. This search was not limited only to those variables already utilized in the RUG-III classification system. Each refinement was evaluated using statistical, clinical, incentive, and administrative considerations. A Clinical Workgroup was convened in November 1999 to assist the project team in selecting those MDS variables considered appropriate for inclusion in any modified casemix system.

### **Findings in Brief**

RUG-III modifications based on interactions between existing RUG-III categories were also examined. The most promising of these was based on a new category for residents who qualified for both the Rehabilitation and Extensive Services RUG categories. The RUG-III Rehabilitation category included some residents who also qualify for Extensive Services. Mean ancillary costs for residents who qualified for both categories were much higher (\$119 per day) than for residents who qualified only for Rehabilitation (\$37 per day). The addition of a new Extensive Services and Rehabilitation category is, therefore, recommended.

Performance of the proposed models was evaluated through a variety of measures, including statistical performance (R-squared, sensitivity and specificity), clinical coherence, and administrative complexity (i.e., number of groups). R-squared is a statistic that measures how much of the variance in costs observed in the data can be explained or predicted by the alternate RUG-III model.

### **Recommendations**

The refinements discussed in this report increase the predictive power of the classification system, but also increase the complexity of the system. The index model refinements differ based on the weights given to the index model items and on the RUG-III categories to which the index is applied. RUG-III refinements recommended for consideration by HCFA include:

- ***Addition of a new RUG domain.*** It is recommended that a new 'Extensive Services and Rehabilitation' category be added to the RUG classification system. The structure of this new category would be similar to the RUG-III Rehabilitation category, but would include residents who also qualify for the Extensive Services category. This new category would go at the "top" of

the casemix system (i.e., residents would be considered first for inclusion in these categories); the Extensive Services and the existing Rehabilitation categories would now include only one type of resident or the other. The ADL splits for these five new “Extensive Services and Rehabilitation” categories would be the same as for the corresponding RUG-III Rehabilitation category. This proposed refinement has been termed the “RUG-III+” model.

- ***The Weighted Index Model 2 (WIM2)*** would apply a weighted index model to Extensive Services residents (including residents in the new Extensive Services and Rehabilitation category), and to Rehabilitation, Special Care, and Clinically Complex residents.

Model WIM2 was the most statistically powerful refinement examined. This model accounted for 15 percent of the validation sample variance in ancillary charges and 21 percent of the variance in total costs. Using WIM2, 32 percent of residents in the top 10 percent in terms of actual ancillary charges were also in the top 10 percent in terms of predicted ancillary charges. The model applies a six-group ancillary index to 40 RUG-III+ groups (14 Rehabilitation/Extensive Services groups, three Extensive Services groups, 14 Rehabilitation groups, three Special Care and six Clinically Complex groups), and results in a large number of groups (258) if it is implemented as part of an integrated classification system. Alternatively, as with the other index model-based refinements, WIM2 could be thought of as a six-group ancillary add-on that works alongside RUG-III to determine total payment. Statistically, the two systems are identical.

- ***The Unweighted Index Model (UWIM)*** would apply an unweighted index model to Extensive Services residents (including residents in the new Extensive Services and Rehabilitation category), and to Rehabilitation, Special Care, and Clinically Complex residents. In this model, there would be up to 178 groups if implemented as new terminal splits; alternatively, UWIM could be considered as a four-group ancillary add-on system for the above-mentioned categories.

This model is the unweighted counterpart to WIM2. While this model performed better than the RUG-III and RUG-III+ models, it did not perform as well as WIM2. UWIM accounted for about 12 percent of the validation sample variance in ancillary charges and 19 percent of the variance in total costs. The range of payments for UWIM was quite similar to that of the weighted index models. The sensitivity and specificity of the model were slightly less than for WIM2.

### **Policy Implications Associated with Proposed Refinements and Other Changes to the Nursing Home Payment System**

Several issues have arisen in the eighteen months since prospective payment was broadly implemented by SNFs around the country. The long term care industry has voiced complaints regarding the adequacy of the *per diem* payment rates, and the perceived failure of the rates to account for non-therapy ancillary service costs. In 1999, through the Balanced Budget Refinement Act (BBRA), a temporary increase in payment for certain high cost residents was authorized by Congress (DHHS, 2000). The BBRA provided for a temporary, 20 percent increase in 15 specific RUGs in the Rehabilitation, Extensive Services, Special Care, and Clinically Complex categories. This rate adjustment will be eliminated once HCFA implements casemix refinements.

These issues together, along with concern that access to SNF care for high-cost residents would be restricted, highlight the importance and applicability of this RUG-III refinement research to HCFA's ongoing efforts to improve the Medicare SNF payment system.

# 1.0 Overview

## 1.1. Background

Among the payment reforms mandated by the Balanced Budget Act (BBA) of 1997 (H.R. 2035) was the requirement that the Department of Health and Human Services implement a prospective payment system (PPS) for Medicare skilled nursing facility (SNF) care. Implementation of this system began on July 1, 1998. The PPS is based on an all-inclusive, prospectively set *per diem* payment rate that covers all Medicare-covered services (routine, ancillary, and capital-related) provided to residents while in a Part A SNF stay, including services such as nursing care, rehabilitation therapy, pharmaceuticals, and laboratory services.

The prospective payment is casemix-adjusted based on the Resource Utilization Group, Version 3 (RUG-III) resident classification system that is based on data from the Minimum Data Set (MDS) (see Appendices A and B). RUG-III, developed as part of the multi-state Nursing Home Casemix and Quality demonstration, is a 44-group casemix classification system designed to capture the resource use (staff time) of nursing home residents (Fries et al., 1994). This classification system measures the intensity of care and services required for different types of SNF residents and translates this into a payment rate.

Despite agreement that PPS furnishes desirable incentives for efficiency, there is concern that payment rates may not be suitably adjusted to the care needs of all residents. RUG-III more accurately captures variance in the staff time resources used to care for SNF residents than any other classification system developed to date; however, but RUG-III was developed based on nursing and therapy time and may not reflect differences in medical conditions or other resident characteristics associated with higher ancillary charges (e.g., prescription drugs, medical equipment and supplies, IV therapy). In the current study, it was found that the system accounted for four percent of the variance in *per diem* ancillary charges and 10 percent of the variance in total costs (including a simulated staff time cost measure). This finding was consistent with an earlier study which found that RUG-III accounted for only nine percent of the variance in total costs and seven percent of the variance in ancillary charges (Abt Associates, 1999, unpublished). These figures differ substantially from those which reflect RUG-III performance in predicting staff time costs alone. When staff time only costs are considered, RUG-III has been found to predict approximately 40 percent of the variance in staff time costs. (See Appendix A.)

Although the casemix system cannot directly affect prescribing patterns, a system that is sensitive to the wide variations in cost associated with drug treatment may be a necessary condition for optimal drug therapy treatment to occur. If the casemix system does not offer an adequate payment rate for some types of residents, for example those who require more medically complex care or expensive prescription medications, then Medicare PPS may have implications for access to or quality of SNF care. Nursing facilities have some discretion over which residents to admit, and residents for whom the expected costs of care are greater than the prospective payment rate may have difficulties obtaining access to SNF services or may not receive all of the services that they need as facilities attempt to provide care within the payment amount.

Given the potential for inappropriate drug prescribing patterns and other potentially adverse outcomes to occur under national PPS, further research is needed to ensure that the payment system adequately reimburses SNFs for costs incurred for necessary resident care.

## 1.2 Purpose and Approach of Study

The purpose of this study was to review the RUG-III classification system, study the pattern of medication use in skilled nursing facilities, and propose potential refinements that may help explain the variation in non-therapy ancillary cost (including prescription drugs) within RUG-III categories.

To deepen the understanding of prescribing patterns in SNFs, detailed prescription drug information from Section U of the MDS was explored. Although these data suffer from incompleteness, they provide unique information regarding specific drugs and dosages used. When linked to drug pricing data, analysis of Section U identifies the most expensive and most heavily prescribed medications that drive trends in prescription drug costs in the SNF setting.

Unfortunately, no comparable data exists for other non-therapy ancillaries (like supplies, oxygen, and IV). For this reason, and because of incompleteness in Section U, the variation in non-therapy ancillary cost was measured by linking charges from SNF claims to MDS resident assessments. To account for the difference between charges reported on claims and actual cost incurred by facilities, charges were adjusted using a cost to charge ratio computed from SNF cost reports. Once adjusted, claims provide a comprehensive and complete measure of cost for all non-therapy ancillary services.

Since the focus of this work was on non-therapy ancillaries, with a guiding principle to leave the basic structure of RUG-III intact to explain the variance of staff time cost, analyses were not restricted to the small samples typical of staff time measurement studies (Fries et.al. 1994, Kramer et. al. 1999). The relatively large sample size used here permits a confident estimation of parameter values even for relatively uncommon individual characteristics and reduces the bias that may result from selection of atypical facilities or individuals in smaller studies.

The task of designing potential refinements involved several analytic steps.

- Examination of potential refinements based on internal changes to RUG-III (e.g., interactions between existing categories). The most promising of these potential modifications was to create new categories for residents who qualified for both Extensive Services and a Rehabilitation category.
- Examination of potential refinements using other MDS items associated with higher costs. The process of identifying clinically appropriate items associated with cost differences that could be used in potential refinements involved several steps:
  - The subset of MDS items that are associated with differences in prescription drug, respiratory therapy, or other non-therapy ancillary charges were identified. These items were selected by testing a large number of variables to identify the subset with a significant relationship to costs.

- Using MDS items associated with significant differences in prescription drug, respiratory therapy, and other non-therapy ancillary charges, items that were associated with differences in total ancillary charges were identified.
- Some items, despite their ability to identify high cost residents, were rejected outright due to potential negative incentive effects. Others were found acceptable, with modification, and the remainder were recommended as is for inclusion in a potential model. Clinical input for the study was obtained from Abt nursing staff, from the Clinical Work Group that was assembled to review the variables underlying the index models, and from the Technical Expert Panel convened to review the study's preliminary results.

### 1.3 Overview of Recommended Refinements

A number of potential types of refinements were considered, the most promising of which fell into two general categories:

- **Changes to the casemix system for residents who qualify for both Extensive Services and a Rehabilitation category.** Ancillary charges for residents in the Extensive Services category were much higher than for other residents, including those in the RUG-III Rehabilitation categories. Costs were much higher for residents who qualified for both Extensive Services and Rehabilitation than for those who qualified for Rehabilitation only. These high costs suggest that, at a minimum, the payment rate for Extensive Services should be increased. Increasing the payment rate without further adjustments, however, could reduce provider incentives to provide therapy to Extensive Services residents. A new category for residents who qualify for Extensive Services and Rehabilitation would alleviate these concerns.
- **Refinements to the casemix system based on index models.** Specific options for incorporating the MDS items that survived clinical review were developed. Analytic results pointed to the use of regression-derived index models of multiple MDS variables rather than AID-derived interactive tree structures based on “indicator variables.” The use of multiple variables has a disadvantage of complexity, but the advantage that increased payment is likely linked to more than a single resident characteristic or facility service. Refinements based on index models achieve potentially important improvements in statistical performance and allow for much higher payment rates for residents with characteristics associated with high ancillary charges, including most Extensive Services residents.

### 1.4 Structure of this Report

In addition to the RUG-III refinement analyses completed during this project, two special studies were performed to further inform HCFA regarding 1) the ancillary costs associated with "short stay" nursing facility residents; and 2) the use and cost of chemotherapy rendered in SNFs. These analyses may be found in Appendices H and I respectively. Neither study produced findings to suggest that the prospective payment system should be altered in any way.

Section 2.0 provides an overview of data sources utilized in these analyses, the final analytic sample for RUG-III refinements, and descriptive statistics on prescription drug use by RUG-III category. Section 3.0 describes the methods and criteria utilized to evaluate potential RUG-III refinements. Section 4.0 presents findings, and Section 5.0 provides conclusions and recommendations for potential modifications to the Medicare SNF prospective payment system.

## 2.0 Data Sources and Descriptive Results

### 2.1 Data Sources

Working in conjunction with the University of Michigan Assessment Archive Project (UMAAP), the *Systematic Assessment of Geriatric Drug Use via Epidemiology (SAGE)* study group at Brown University assembled a large cross-linked data set. The data include nursing home resident assessments collected using the federally-mandated Minimum Data Set (MDS), drug information, HCFA claims data, and organizational data on nursing home providers. Each of the data sets used to derive the analytic files is briefly described below.

The study database was comprised of residents with a Medicare covered stay using computerized Nursing Home Minimum Data Set (MDS) assessments from seven states (Kansas, Maine, Mississippi, New York, Ohio, South Dakota, and Texas) linked to Medicare SNF claims. All of these states except for Ohio participated in the HCFA-sponsored multi-state Nursing Home Casemix and Quality (NHCMQ) demonstration.

#### 2.1.1 Minimum Data Set (MDS) (including Section U)

All SNFs that are certified to participate in the Medicare or Medicaid programs are required to complete a Resident Assessment Instrument (RAI). The MDS component of the RAI is a core set of more than 300 screening and assessment elements. The RAI is required for residents covered under Medicare at the following frequency: 5, 14, 30, and 60 days following admission. It is to be completed by trained clinical nursing and other staff responsible for resident care.

Topics covered in the MDS include cognitive function, communication/hearing problems, physical functioning, continence, psychosocial well-being, mood state, activity and recreation, disease diagnoses, health conditions, nutritional status, oral/dental status, skin condition, special treatments, and medication use. The tool has been extensively tested for reliability and has high interrater agreement on almost all MDS items (Hawes, et.al., 1995).

For the current project, MDS assessments from seven states were included: Kansas, Maine, Mississippi, New York, Ohio, South Dakota, and Texas. Unless limited by data availability (e.g., Texas 1997 only), MDS data from 1995 through 1997 were utilized.

The sample included assessments from three different MDS versions—the MDS+ (90b), the MDS+ (92), and the MDS 2.0. MDS 2.0 data were available only for Kansas (1996), Mississippi (some 1996 and 1997), and Texas (1996-1997). Maine, Mississippi (1995 and some 1996), Ohio and South Dakota used the MDS + (90b), while Kansas (1995 and 1996) used the MDS + (92).

Some items have differing definitions or response categories across the three MDS versions. In order to utilize a uniform set of MDS items for developing and testing potential refinements, items that did not use identical definitions across the three MDS versions were replaced with a new set of variables based on information that was common across the three different MDS versions. For example, the variables indicating the provision of “Surgical Wound or Ulcer Care” differ across the three versions of the MDS. The MDS+ (90b) groups each type of care into a single variable while the MDS+ (92) and MDS 2.0 separate surgical wound care and ulcer care into two variables. A single variable was

created to indicate the provision of surgical wound and ulcer care if such care was coded as being provided according to either the MDS+ (90b), the MDS+ (92), or the MDS 2.0. The goal was to ensure that variable definitions were independent of the MDS version that was used. New variables were created for the following MDS items:

- Use of beds or mattresses or bed pads or chair pads
- Surgical wound or ulcer care
- Preventative care: Foot or nails
- Abnormal lab values in last 90 days
- Cognitive patterns ('easily distracted', 'altered awareness', 'incoherent speech', 'restlessness/lethargy', 'cognitive function varies')
- Speech clarity
- Vision impairment
- Mood and behavior patterns (Section E of MDS)
- Lifted manually or mechanically
- Use of transfer aide or trapeze
- Disease diagnoses: Emphysema, COPD, or asthma
- Health conditions: Presence of hallucinations or delusions

The MDS 2.0 contains a number of items that are not available in either the MDS+(90b) or MDS+(92). Because the sample included only a small number of MDS 2.0 assessments, the majority of which were from Texas, we generally excluded items that were not available in all three MDS versions. In recognition of the fact that the MDS 2.0 is currently being used in all states, we did consider some MDS 2.0 items that were recommended by our clinical experts for illustrative purposes, using only assessments from the three states from which these data were available. The coefficients from this three-state model should be considered unreliable, because the sample size was neither large nor representative enough to produce reliable estimates.

**Section U data:** In completing the MDS in each of the states included in this study, nursing facility staff coded up to eighteen drugs taken within the seven days preceding the assessment. Each drug was coded according to the National Drug Coding (NDC) system using either the 10,000 NDCs included in the MDS+ manual or the Physicians' Desk Reference Book. NDCs are unique 10-digit codes that identify drug products. Project staff matched NDC codes to codes in the MediSpan™ software system. This system includes over 150,000 generic drug products, products from regional manufacturers, and information on over 90,000 inactive drugs. The overall match rate between the NDC and the MediSpan™ was greater than 90 percent with only 5.4 percent of the original NDC codes recorded on the MDS Section U in the NHCMQ demonstration states found to be incomplete or incorrect. Gambassi et al (1997) have previously shown that the MDS drug data are consistent and reliable.

### **2.1.2 Health Care Financing Administration (HCFA) Claims Data**

Part A Claims were merged to the MDS files using the Health Insurance Claim (HIC) number of Medicare beneficiaries. Gender and date of birth were also used in the matching process. To ensure confidentiality, these identifiers were replaced with unique identifiers using the HIC number as a seed. SNF services are a Part A (hospital insurance) benefit under Medicare and are available only to patients who require continued skilled nursing care and/or skilled rehabilitation services on a daily basis following a hospital stay of at least three days. All SNF claims spanning the years 1995 through

1997 were downloaded from the HCFA Data Center and matched to MDS files. The files were constructed so that there are multiple observations per SNF stay if multiple MDS assessments were performed. Some individuals have multiple SNF stays.

Under cost reimbursement, most ancillary services were billed under Medicare Part A, but some services not directly provided by the SNF could be reimbursed under Medicare Part B. For research purposes, however, extraction and analysis of Part B claims is unjustifiably time-consuming. In previous unpublished research (Abt Associates, 1999, unpublished), Part B claims processing consumed more time than processing of Part A claims, but more than 93 percent of total ancillary costs for nursing home residents were billed under Medicare Part A. In view of this fact, Medicare Part B data were not analyzed for this study and the portion of ancillary charges that were billed under Part B were not captured in the study's measure of ancillary costs.

### ***Skilled Nursing Facility Cost Report Data***

Because HCFA claims contain data on what the facility charged for SNF services (“charges”) and what HCFA paid, rather than on what it actually cost the facility to provide these services, claims were matched to SNF cost reports in order to calculate an appropriate facility-specific adjustment factor (additional detail is provided in Section 3.2 and Appendix E). This is necessary because the ratio of charges to cost for some facilities is systematically larger than for others. Using this cost to charge ratio to adjust the claims prior to analysis removes a facility-specific source of variation in the charges that is unrelated to casemix.

### ***Staff Time Measurement (STM) Study Data***

The HCFA STM study data (1995 and 1997) measure the amount of time required to care for nursing home residents. Over a period of 48 hours, all unit nursing staff recorded direct resident care time. Therapy time, which includes physical therapy, occupational therapy, and speech therapy was collected over the span of a week. For these analyses STM data were employed as the foundation of imputed staff time cost to be added to adjusted non-therapy ancillary charges to obtain estimates of total cost for each resident. A complete description of the STM study data and the wage and benefit adjustments required to convert it from hours to dollars is presented in Appendix C.

Development of the RUG-III classification system for nursing facility residents was based on HCFA's STM data. The initial STM study included data from 6,333 sampled residents in selected nursing units of 176 nursing homes in six states (Kansas, Maine, Mississippi, Nebraska, South Dakota, and Texas), and included detailed staffing information as well as MDS assessments. The 1995 STM data were collected in 77 Medicare units across seven states (Kansas, Maine, Mississippi, Ohio, South Dakota, Texas, and Washington), and included 1,896 residents. The 1997 data included 2,037 residents from 73 units in five states (California, Colorado, Florida, Maryland, and New York).

### **2.1.3 Exclusions and Creation of Analytic Sample**

Creation of the analytic sample used to develop and test potential RUG-III refinements was balanced by a desire to have a large, representative sample and the need to exclude assessments likely to contain reporting errors. The original sample included 733,300 MDS assessments, representing the years 1995-1997. That sample was then reduced through implementation of the following exclusion criteria:

1. *Exclude all assessments from New York.* All assessments from New York were excluded from analyses that used Medicare claims data because many facilities in the state billed SNF stays using an all-inclusive rate. Because these facilities did not use the revenue codes that were used to measure prescription drug, respiratory therapy or other non-therapy ancillary charges, measured ancillary charges for most New York residents were zero in some or all of the revenue codes analyzed for this study. The exclusion of New York results in the removal of 525,215 of the 733,300 total MDS assessments from the analytic sample.

2. *Exclude all assessments for which a cost-to-charge ratio could not be calculated.* Medicare cost report data were used to calculate the facility-specific ratio of Total Part A allowed cost to total Part A charges for each facility in each year. Facilities missing Medicare cost reports for at least two years between 1995 and 1997 were excluded. This resulted in the exclusion of 93,314 additional assessments.

3. *Exclude all facilities for which the correlation between a measure of drug costs calculated from Section U and one calculated from Medicare claims data was less than zero.* Drug charge data derived from Medicare claims were used in the refinement analyses, but Section U data enabled the identification of facilities with unreliable drug cost data. For facilities that have a negative correlation between the two drug cost measures, there is a concern about inaccurate reporting on either claims or MDS assessments at the facility level; thus, these facilities were excluded. This step resulted in the exclusion of 10,915 MDS assessments.

4. *Exclude all residents with per diem ancillary charges greater than \$1,000.* Two hundred fifty-three (253) observations with *per diem* total ancillary charges greater than \$1,000 were excluded from the refinement analyses. This was done because the accuracy of these extreme values was judged by the project team to be questionable and such values have disproportionate leverage in the design of potential refinements (because summary measures of statistical performance like R-squared are typically sensitive to outliers). It should be noted that the exclusion of extreme outliers in refinement analysis does not imply that they should be excluded when payment rates are determined. On the contrary, extreme values are generally included in rate-setting calculations.

The resulting analytic sample included 103,856 assessments, which were assigned randomly to either the test or validation samples. Sixty percent of this sample (61,929 assessments) was assigned to the test sample that was used to develop and test potential refinements. The remaining 41,927 assessments comprised the validation sample and were used to independently test refinements developed with the test sample. The entire analytic sample included 59,342 unique individuals from 1,578 facilities.

The large sample size, combined with the information on ancillary costs, were the main strengths of the analytic file used for this study. Limitations of the data included the lack of staff time cost data, the lack of MDS 2.0 assessments, which limited our ability to use items that were added in this version, and the non-representative selection of states included in the analytic sample. The limitations of the ancillary cost measure created using Medicare claims data are discussed in Section 3.0. There also appeared to be significant limitations in the Section U data on drug utilization and in the Medicare-claims based measure of ancillary costs. These issues are further discussed below.

To evaluate the representativeness of the analytic sample, data from the Health Care Financing Administration's Online Survey Certification and Reporting System (OSCAR) database were used.

OSCAR contains information on every nursing home in the United States that is certified by Medicare and/or Medicaid. The data are collected by the state survey and certification agencies at the time of the facility's survey (performed at least annually). Note that it was not possible to link the OSCAR data to the analytic sample. It was only possible to compare facilities in the states included in the analyses to facilities in other states, rather than to base comparisons on the actual facilities that were used to develop and test refinements.

OSCAR assessments for 1997 were used to compare facilities in the six states included in the refinement analyses (excluding New York) to the states (including New York) that were not part of the analytic sample. Facilities in the states included in our analyses tended to be somewhat smaller than facilities in other states. These facilities had an average of 79 residents and 107 beds, compared to 99 residents and 116 beds for facilities in other states (Table 2.1). The analytic sample included a higher proportion of for-profit facilities, a higher proportion of Medicare residents, and a slightly higher proportion of hospital-based facilities. The sample also appeared to include a somewhat higher proportion of residents who required extensive services. The proportion of rehabilitation residents was essentially identical across the two groups of states.

**Table 2.1**  
**Comparison of facility characteristics for facilities in states included in analytic sample and other states, 1997**

Item	Facilities in states included in analytic sample (n=2,105)	Facilities in states excluded from analytic sample (n=10,098)
Total residents	78.61	99.47
Total beds	107.30	116.04
Percentage of hospital-based facilities	14.6%	13.8%
Percentage of for-profit facilities	75.3%	65.6%
Percentage of Medicare residents	20.4%	17.3%
Ratio of extensive services required to residents <sup>+</sup>	0.148	0.133
Percentage of rehabilitation residents	21.4%	21.5%

Note: Analysis includes only facilities reporting one or more Medicare resident during the two week period reported in OSCAR. To exclude facilities with OSCAR data of questionable reliability, facilities reporting less than 0.5 or more than 12 total nursing hours per resident day were excluded from this analysis.

<sup>+</sup>: This is defined as the sum of residents who required tube feeding, ventilator, tracheostomy, suctioning, or IV therapy divided by the total number of residents at the facility. (Note that because it is not possible to determine how many residents require two or more extensive services, it is not possible to estimate the proportion of extensive services residents in OSCAR, only the number of extensive services required).

Sources: OSCAR, 1997

## 2.2 Descriptive Results

Although the MDS Section U data were not considered appropriate to use in the development of potential casemix refinements, the data do offer insights about the study population, and the variation in drug utilization by RUG-III category. This section discusses how drug costs were measured using the Section U data and also presents descriptive findings derived from MDS Section U.

### *Estimating Drug Costs*

The average wholesale price (AWP) as included in the MediSpan™ software for medication costs was used to determine the price for drugs listed in Section U. There were several reasons for using the AWP. First, the AWP is a national figure and not subject to regional influences resulting from purchasing contracts and other local market factors. This helps to account for the cost of dispensing. Second, using AWP is conservative when the price of a medication is relatively low or high as the AWP is not subject to institutional cost-shifting. Differences between the pricing options for a subset of representative and frequently used medications were also evaluated. Additionally, owing to the amount of completeness with each pricing option, the AWP was used because it also yielded the lowest amount of missing cost data. While we were successful in mapping NDC codes to drug names (nested within therapeutic classes and sub-classes), more information was required to match NDC codes to a drug cost. Specifically, to assign an AWP to a drug, both the strength of the drug administered and complete information regarding the frequency or dosage with which the medication was administered was required. Unfortunately, many of the codes included in the MDS training manual itself did not include information regarding strength. For example, it was often possible to know from the NDC code that a resident received aspirin, but not to ascertain if it was 80 mg, 325 mg, or some other strength. Without the drug frequency information, it was not possible to determine cost, and, as a result, there were substantial missing cost data.

For cases where drug costs could not be assigned due to missing frequency or dosage, costs were imputed. Analyses of the extent of missing data revealed that the missing data did not vary by RUG, state, year, or type of medication. Nonetheless, by imputing missing drug costs, random variations have been introduced in the data that were not generated by the underlying process being modeled. Consequently, variables that explain variance in non-missing data will have no explanatory power for imputed data. As a result, the coefficients on these variables will be biased toward zero. This bias will be small if the proportion of total variance attributable to imputation is small. However, variables explicitly or implicitly used in the imputation process may have explanatory power with regard to the imputed values. For example, if the RUG category is implicitly used as part of the imputation process, it theoretically could, as a result, explain more of the variance in the dependent variable simply because the RUG was used as part of the imputation algorithm. The coefficients of the variables used to impute cost data may be amplified relative to other coefficients in the explanatory models. Depending on the correlation between the RUG categories and other variables, these coefficients will also be biased in unpredictable ways. This problem could be small if the between-group variance is small (overall variance can be decomposed into between-group and within-group components). Given the potential for introducing bias in the models, two imputation algorithms were created. The values imputed from each method were remarkably similar and did not alter any of the findings. Therefore, only one of the imputation methods is described here. The analyses using this method may be found in Appendix D.

## *Computation Based on Time and Place*

Because of concerns regarding bias, an algorithm was implemented to estimate the drug costs based on data contained in Section U of the MDS. It was thought that missing data might vary systematically by state, owing to differing data collection procedures (and software) used by states. Furthermore, coding of drugs might have improved through time. If both assumptions were true, the pattern of missing drug data would vary systematically through time and place. It follows that an imputation method based on time and place would be reasonable. If the NDC code was not listed among the 150,000 Medispan™ codes, but the exact name of the generic drug was listed, pricing was calculated as follows. If only one cost was associated with the drug within a given state and year, it was used. If multiple costs were associated, a cost was chosen probabilistically based on the distribution of observed costs among residents. If the exact generic name could not be matched, a match for the leading words in the generic name was made, and if a match the same approach was applied (i.e., opting to a probabilistically selected drug cost using the state and year). In cases where no reasonable match could be found, no price was assigned to the medication. As with the RUG-based imputation measure, this algorithm was iterative over the observed distribution among residents.

### **2.2.1 Characteristics of the sample**

Note that the results described in this section include all residents for whom MDS assessments were available, including residents from New York. The exclusion criteria described above, which were used for the RUG refinement analyses, were not used for the descriptive results included in Tables 2.1- 2.5 and Figures 2.1 and 2.2.

*Demographic characteristics.* The majority of residents were female (65 percent), with little variation in the proportion across RUG categories (Table 2.2). Only 30 percent of residents in the Reduced Physical Functioning category were male. Reflecting the demographic characteristics of the states included in this sample, the majority of residents were white, of non-Hispanic origin (84 percent). Approximately nine percent of residents were black and two percent were Hispanic.

*Cognitive and functional status.* Overall, nearly one quarter of residents was severely cognitively impaired. Among residents classified in a Rehabilitation category, 35 percent were moderately impaired and 14 percent were severely cognitively impaired. The distribution of cognitive impairment among those classified as Physical Function Reduced was similar to that of the Rehabilitation category. Residents classified as Extensive Services or Special Care also had a similar distribution of cognitive impairment. Approximately one third of each were moderately impaired. Thirty-nine percent of residents were classified as dependent in activities of daily living and only seven percent showed no limitations. Residents categorized as Behavior Only were most likely to have only minimal limitations in physical functioning (28 percent). Residents classified as Clinically Complex (14 percent), Cognitively Impaired (13 percent), or Reduced Physical Functioning (14 percent) were also more likely to have minimal limitations relative to the other RUG categories. Residents in the Extensive Services (58 percent) and Special Care (56 percent) categories were most likely to be classified as dependent in activities of daily living.

*Clinical diagnoses.* The active clinical diagnoses documented for residents in the sample are shown stratified by RUG category in Table 2.3. Cardiovascular diseases were common. Overall, 20 percent of residents had coronary artery disease. Cardiac arrhythmia was present in 14 percent of residents.

Nearly one-quarter of residents had congestive heart failure and nine percent had peripheral vascular diseases. On average, 43 percent of residents had documented hypertension. While the distribution of residents with coronary artery disease appeared similar across RUGs, congestive heart failure and arrhythmia were more common in the Extensive Services, Special Care, and Clinically Complex categories. Residents in the Impaired Cognition category were less likely to have cardiovascular conditions compared to other RUG categories. A similar pattern was noted for residents in the Behavior Only category.

Neurological diseases were also common. Overall, nine percent of residents had Alzheimer's disease, while 28 percent had other dementia documented. Nearly one-quarter of residents had an active clinical diagnosis of stroke and six percent had Parkinson's disease. While the proportion of residents with Parkinson's disease did not vary by RUG group, the proportion with other neurological conditions varied substantially by RUG group. Residents in the Impaired Cognition group were more likely to have Alzheimer's disease (22 percent) and other dementia (54 percent) documented and less likely to have had a stroke (15 percent) compared to other RUGs. Similar to the Impaired Cognition group, residents in the Behavior Only category were more likely to have other dementia (41 percent) and less likely to have had a stroke (12 percent) compared to other RUG groups, but had a similar proportion of residents with Alzheimer's disease. The distribution of neurological conditions among residents classified as Extensive Services, Special Care, and Clinically Complex were similar to distributions of the former two. A third of residents classified as Extensive Services and Special Care had non-Alzheimer's dementia and one-quarter had suffered a stroke.

Only five percent of residents had anxiety and 16 percent had depression documented as a diagnosis on the MDS. Across RUG categories, the proportion of residents with anxiety and depression was similar. However, the prevalence of anxiety (eight percent) and depression (22 percent) was higher in the Behavior Only RUG category. Twelve percent of residents had cataract and seven percent glaucoma. These conditions did not vary substantially by RUG. Overall, septicemia was rare (one percent), only eight percent of residents had pneumonia and 17 percent had urinary tract infections. Residents in the Extensive Services categories were more likely to have septicemia (two percent), pneumonia (17 percent), and urinary tract infections (24 percent) compared to other RUG categories. Other diagnoses and conditions were common. Twenty-one percent of residents had allergies, 19 percent anemia, 22 percent had arthritis, 22 percent had diabetes, and 12 percent had cancer. Residents in the Rehabilitation, Extensive Services, Special Care, and Clinically Complex categories were more likely to have these conditions compared to the Impaired Cognition and Behavior Only RUG categories. The prevalence of hypothyroidism (10 percent) did not vary by RUG category.

*Drug costs based on Section U.* Pooling across all states and the three years, there is little variation by RUG in total daily drug cost as measured by Section U. Median costs within the Rehabilitation RUG categories ranged from ~\$6.50 (Low Rehab groups) to ~\$9.00 (Ultra-high Rehab groups) whereas the lowest costs of medications was experienced by the Impaired Cognition groups (~\$3.00).<sup>1</sup> The groups with the higher interquartile range (~\$13) were the Extensive Services

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<sup>1</sup> Note that mean drug costs based on Section U were considerably lower than those based on Medicare claims, suggesting that the Section U data did not capture all medications received by residents. Mean per diem drug costs were \$25 according to the SNF claims data, more than four times higher than mean costs based on Section U. It was because of the apparent underreporting of drug utilization in Section U that it was decided to base the RUG-III refinement analyses on costs derived from SNF claims. The Section U

categories and some of the Rehabilitation RUG categories (e.g., RVC ~\$12). The Impaired Cognition groups also demonstrated the least variation in costs of medications with an interquartile range of ~\$5.

To better understand which classes of drugs contributed to cost differences, drugs were classified according to fourteen major therapeutic classes. The most expensive therapeutic drug classes were anti-infective agents (Median: \$6.53) and biologics (Median: \$9.73). The least expensive therapeutic drug classes are analgesics (Median: \$0.10) and nutritional products (Median: \$0.18). While RUG-III accounted for little of the variance in drug costs, there was variation across RUG categories for many medication classes, reflecting the differences in active clinical diagnoses for residents in different categories (see Table 2.3). Below are some of the highlights of this analysis of drug use patterns by therapeutic class:

- Residents were least likely to be on biologics (one percent) and anti-neoplastics (two percent), regardless of RUG class (Table 2.4).
- The majority of residents were on at least one cardiovascular medication, with substantial variation across RUGs.
- Residents in the Rehabilitation RUG categories (67 percent) and in the Clinically Complex group (64 percent) were the most likely to be receiving at least one cardiovascular medication. Residents in the Impaired Cognition (47 percent) and Behavior Only groups (53 percent) were the least likely to be receiving cardiovascular medications. A similar pattern was observed for gastrointestinal agents.
- Over one-third of residents in Rehabilitation, Extensive Services, Special Care, and Clinically Complex RUGs received endocrine and metabolic agents, compared to less than 25 percent for residents in the other categories.
- More than 25 percent of residents in the Rehabilitation, Special Care, and Clinically Complex categories received anti-infective agents, compared to less than 15 percent of residents in other categories. Nearly 40 percent of Extensive Services residents used anti-infective agents.
- Overall, 47 percent of residents received at least one analgesic. Impaired Cognition residents (32 percent) and Behavior Only residents (39 percent) were less likely to receive analgesics than those in the Rehabilitation category (60 percent). Similar trends were apparent with hematological agents and topical agents.
- Conversely, residents in the Impaired Cognition (~46 percent) and Behavior Only (over 50 percent) RUG categories were more likely to receive CNS drugs relative to the other RUG categories (~33 percent).
- Use of biologics was relatively infrequent (~1.2 percent) and the proportion of drug costs due to these agents was highly variable amongst the users, regardless of RUG.

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data are still useful, however, for analyzing the types of drugs taken by nursing home residents, as this information cannot be determined from SNF claims.

The proportion of total drug costs due to particular therapeutic classes was also analyzed:

- The highest proportion of total costs due to anti-infective use was found in the Extensive Services and Clinically Complex RUG categories, with ~ 50 percent of drug costs attributable to the anti-infective agents.
- Among people receiving anti-neoplastic medications (~2.2 percent of residents), these agents accounted for one-quarter of their total daily drug cost (Median: 27 percent; 25<sup>th</sup> percentile: 13 percent; 75<sup>th</sup> percentile: 49 percent).
- While nearly one third of all residents received an endocrine medication, these agents only accounted for eight percent of the total daily drug costs amongst users. Cardiovascular medications accounted for 18 percent of the total daily drug cost, which varies slightly across RUG category (+/- ~ four percent).
- Among the 19 percent of residents using respiratory medications, 12 percent of their drug costs were due to these agents. Higher median proportions and greater variability occurred at the end-splits within the aggregate RUG categories. A similar pattern is observed among users of gastrointestinal agents. These medications accounted for only 13 percent (Median) of the total daily costs.
- Only five percent of residents had used a genitourinary medication, accounting for only 13 percent of total drug costs (Median value). This measure varied slightly across RUG category.

**Table 2.2**  
**Sociodemographic Characteristics of Residents of SNF Stays by RUG-III Group**

	All n=179825	Rehabilitation n=33527	Extensive Services n=24747	Special Care n=53618	Clinically Complex n=34101	Impaired Cognition n=7556	Behaviors only n=592	Physical Function Reduced n=25684
Male	35%	37%	36%	34%	36%	35%	37%	30%
Race/Ethnicity								
White	84	90	83	83	82	80	84	83
Hispanic	2	1	2	2	2	3	3	2
Black	9	6	9	9	9	11	8	9
Asian/Pacific Islander	0.5	0.2	0.7	0.5	0.6	0.7	0.7	0.6
American Indian	1	0.7	2	2	2	1	1	1
Missing=	3	.9	3	4	4	3	3	3
Cognitive Impairment:≡								
Mild (CPS: 0-1)	41	51	33	35	47	0	50	53
Moderate (CPS: 2-4)	35	35	31	34	35	67	50	32
Severe (CPS: 5-6)	23	14	34	31	17	33	0	14
Physical Functioning:								
Minimal limitations	7	6	0	3	14	13	28	14
Moderate limitations	44	53	37	36	51	58	49	47
Dependent	39	18	58	56	31	20	7	26
Missing=	9	23	6	4	4	9	16	12

Note: = indicates percent missing MDS data.

Source: Medicare Matched MDS Data 1995-1997, Section U.

**Table 2.3**  
**Active Clinical Diagnoses of Residents of SNF Stays by RUG-III Group**

	All n=179825	Rehabilitation n=33527	Extensive Services n=24747	Special Care n=53618	Clinically Complex n=34101	Impaired Cognition n=7556	Behaviors only n=592	Physical Function Reduced n=25684
<b>Heart/Circulation</b>								
Coronary artery disease	20%	14%	22%	22%	22%	21%	19%	21%
Cardiac arrhythmia	14	15	16	15	14	11	8	12
Congestive heart failure	24	22	27	25	27	16	20	21
Hypertension	43	44	42	42	44	37	40	42
Peripheral vascular diseases	9	8	10	12	9	6	7	7
Other cardiovascular diseases	20	20	21	21	21	16	16	17
<b>Neurological</b>								
Alzheimer's disease	9	5	9	9	8	22	11	8
Other dementia	28	18	30	30	27	54	41	28
Cerebrovascular disease	23	26	24	25	25	15	12	16
Parkinson's disease	6	5	6	6	5	6	5	6
<b>Psychiatric</b>								
Anxiety	5	6	5	5	6	5	8	5
Depression	16	17	15	17	18	15	22	15
<b>Sensory</b>								
Cataract	12	6	14	14	14	14	13	13
Glaucoma	7	5	7	7	7	6	8	7
<b>Infections</b>								
Septicemia	1	1	2	1	1	0	0	0
Pneumonia	8	8	17	8	10	0	0	0
Urinary tract infection	17	16	24	19	13	10	9	12
<b>Other</b>								
Allergies	21	23	22	22	21	14	19	17
Anemia	19	16	23	22	19	15	14	17
Arthritis	22	22	23	22	21	17	19	24
Cancer	12	11	14	13	13	7	8	9
Emphysema/COPD	15	14	17	15	19	10	14	10
Diabetes mellitus	22	22	22	23	24	15	19	18
Hypothyroidism	10	10	10	10	10	9	9	9
Osteoporosis	8	9	8	8	8	6	6	9

Source: Medicare Matched MDS Data 1995-1997, Section U.

**Table 2.4**  
**Active Clinical Diagnoses of Residents of SNF Stays by RUG-III Group**

	All n=179825	Rehabilitation n=33527	Extensive Services n=24747	Special Care n=53618	Clinically Complex n=34101	Impaired Cognition n=7556	Behaviors only n=592	Physical Function Reduced n=25684
<b>Anti-infectives</b>	26%	29%	39%	28%	23%	12%	12%	16%
<b>Biologics</b>	1	0.3	1	2	1	1	1	1
<b>Anti-neoplastics</b>	2	2	2	2	3	1	2	1
<b>Endocrine</b>	31	36	30	30	33	22	26	26
<b>Cardiovascular</b>	61	67	59	59	64	51	55	58
<b>Respiratory</b>	19	23	21	18	23	9	17	13
<b>Gastrointestinal</b>	61	67	60	62	62	47	53	58
<b>Genitourinary</b>	5	6	5	5	5	4	3	5
<b>CNS</b>	36	43	32	33	38	46	55	34
<b>Analgesics</b>	47	60	43	45	44	32	39	44
<b>Neuromuscular</b>	13	13	13	13	12	14	18	12
<b>Hematological</b>	30	35	30	31	29	20	19	26
<b>Topical</b>	30	26	34	37	28	20	20	23

*Source: Medicare Matched MDS Data 1995-1997, Section U.*

*High cost residents.* Table 2.5 contrasts the proportion of residents using drugs by specific drug classes among all residents to the same proportion among residents with high drug costs (defined using the Section U data as per diem costs greater than \$30). In each case, the proportion of each drug class was higher among residents with high drug costs, although the extent to which the proportions differed varied by drug class. For example, among all residents, only 26 percent received anti-infective agents, whereas among residents with high drug costs, 61 percent received anti-infective agents. Similarly, the disparities were extreme with respiratory agents. Nineteen percent of all residents received respiratory drugs, whereas 37 percent of residents with high drug costs received at least one of these drugs.

<b>Drug Class</b>	<b>All residents</b>	<b>High cost residents (&gt;\$30 / day)</b>
	<i>Percentage</i>	
Gastrointestinal	61%	71%
Cardiovascular	61	70
Anti-infective	26	61
Analgesic	47	55
CNS	36	46
Endocrine Drug	31	46
Respiratory	19	37
Biologics	1	9
Antineoplastic	2	4

*Source: Medicare Matched MDS Data 1995-1997, Section U.*

### **2.2.2 Drug costs for hospital-based and freestanding facilities**

Historically, SNF care in hospital-based nursing facilities has been reimbursed at a higher rate than care provided in freestanding skilled nursing facilities. Part of this cost difference has been attributed to the mix of patients both in terms of their nursing and therapy needs. Presumably, risk adjustment using RUGs grouping should at least partially account for this difference. Residual differences that persist are attributed to the fact that hospital-based SNF patients present with more complex medical care needs. One component of that complexity is the array of drugs (and their associated costs) administered to patients in hospital-based facilities versus freestanding facilities. Since PPS reimbursement does not differentiate between facility types, it is pertinent to examine the extent to which there are differences in the estimated drug costs of patients in these two kinds of facilities. Since all drug "costs" have been standardized to the Average Wholesale Price, the existence of systematic differences in pricing between the two types of facilities have been removed and the only

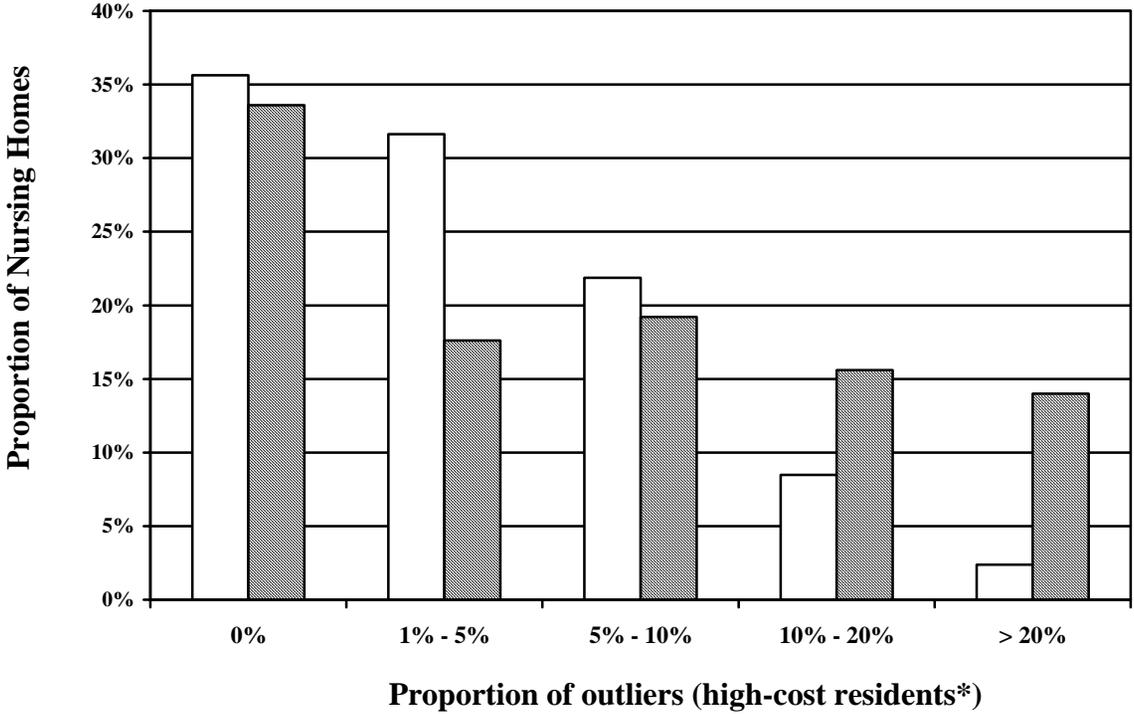
differences should be related to the relative costliness of the drugs used by similar patients in the two types of facilities.

Among freestanding hospitals, there was little variation in total daily drug cost by RUG (Figure 2.1). Median costs were lowest for residents in the Behavioral Only category (median between \$8 and \$12 for the groups in this category). Average drug costs for all three Extensive Services groups and Clinically Complex groups CA1 and CA2 were about twice as high. Among hospital-based facilities, there tended to be more variability in drug costs than for freestanding facilities. Costs for residents in most of the Extensive Services, Special Care and Clinically Complex groups were higher for residents in hospital-based facilities than for residents in freestanding facilities. There were a number of Extensive Services and Clinically Complex residents who had daily average wholesale drug costs greater than \$25 and some with costs in excess of \$50. Since these differences are not attributable to different pricing patterns across the two types of facilities, it is clear that patients in hospital-based facilities tended to be treated with a more expensive profile of medications than were their freestanding counter-parts.

Figure 2.2 shows the proportion of residents with high drug costs (i.e., > \$30 per day) for freestanding and hospital-based facilities. While there was little difference between the proportion of freestanding and hospital-based facilities that did not have any high cost residents (about 35 percent of both facility types), differences were apparent in other stratifications. Thirty-two percent of freestanding facilities have between one and five percent of residents with high drug costs, compared to 17 percent of hospital-based facilities. Sixteen and fourteen percent of hospital-based facilities had between 10-20 percent and over 20 percent of residents with high drug costs little variation in total daily drug cost by RUG group.. Only 6 and 2 percent of freestanding facilities fell within these categories, respectively. These data suggest that, to some extent, residents with the highest drug costs are clustered within facilities. It was not clear the extent to which this reflects actual clustering of high cost residents or clustering of more complete Section U data.

## Figure 2.1

**Figure 2.2**  
**Proportion of high-cost drug residents by type of facility**



\*High-cost resident defined as a resident with \$30 or more in drug costs per day.  
 Source: Medicare MDS and OSCAR Data, 1995-1997.

□ Free standing    ■ Hospital based

## 3.0 Conceptual Approach to Developing Potential RUG Refinements

### 3.1 Principles for Development of Potential Refinements

The goal of this analysis was to improve the predictive power of the RUG-III system while incorporating clinical and other factors. Regardless of the type of potential refinement being considered, the process involved an iterative search for variables associated with large differences in costs for residents (either overall or within RUG-III categories). For purposes of developing casemix refinements, the ideal type of variable is one that meets all of the following criteria: (1) has a significant impact on costs; (2) makes clinical and administrative sense; and (3) is observed in a large number of residents.

Once such variables were identified, a variety of refinements were designed that applied these variables to redefine existing RUG groups, add new terminal end-splits, and create new “add-on” groups that could be added to the current 44-group system. Several alternative refinements were developed, all based on the same MDS variables, and then evaluated with reference to statistical, clinical, incentive, and administrative considerations (described further in Section 3.4).

As stated earlier, claims-based cost measures were used, although they did not correspond to the MDS assessment period (claims typically cover a one month period). This measure of drug costs was created by converting the charges that appear on the claims to a best guess of actual costs using an adjustment that is based on the total charges and total costs reported on the facility’s cost report.

### 3.2 Methods: Creation of Cost Measures

Because the measurement of cost is both difficult and central to the analysis of potential casemix refinements, it was approached on two levels. First, following approaches used in previous studies, measures of non-therapy ancillary cost were built from Medicare SNF claims. Second, to provide an additional perspective on the performance of potential refinements, HCFA’s Staff Time Measurement data were used to impute staff time costs for each observation. It should be emphasized that, because they were not used to develop refinements, staff time costs were used only as a component of one measure of statistical performance.

As described in Section 2.2, MDS Section U data were utilized in this project to provide a more detailed review of drug therapy utilization amongst nursing facility residents. During the course of the project, it was determined that these data were incomplete; thus, RUG-III refinement analyses relied exclusively on claims data for prescription drug and other ancillary cost measures.

#### *Creation of Measure of Non-therapy Ancillary Charges from SNF Claims*

Medicare Part A SNF claims were used to measure per-diem non-therapy ancillary charges that corresponded to each MDS assessment. Non-therapy ancillary services include diagnostic services, pharmaceuticals and medical supplies and equipment. Because each MDS assessment occurred on a particular day and referred to the period immediately preceding that day, and because Part A SNF claims typically cover 30 days, it was not generally possible to match ancillary charges recorded on

the claim to the specific period covered by the assessment. Instead, Medicare claims with a covered date including the assessment date were matched to the assessment and all charges on the claims were converted to a *per diem* basis. Operationally, *per diem* charges are derived by the sum of the charges for ancillary therapies divided by the number of days covered by the claim. Since this procedure does not account for the fact that true reimbursable costs are generally lower than charges reported on claims, further adjustments were made in the cost calculation (see Cost to Charge Multiplier below).

Charges for non-therapy ancillaries were identified using revenue codes determined by Abt Associates for another project and extracted from the claims data. These revenue codes were organized into conceptually meaningful categories that form the basis for the analytic cost variables. The categories and their related revenue codes included the following: prescription drugs/pharmacy (250-259); drugs requiring ID (630-639); IV therapy (260-269); medical and surgical supplies (270, 620-622); respiratory services (410-419); laboratory (300-309); oxygen (600-604); and dialysis (820-829, 830-839, 880-889).

### ***Cost to Charge Multiplier***

It is important to note that the actual ancillary *costs* for residents in the sample are not observed. The covered charges reported in claims are routinely discounted on the basis of audited reasonable cost by the fiscal intermediary responsible for claims processing. Inclusion of ancillary charges without further adjustment in the measure of *per diem* ancillary charges would overstate the true level of reimbursable costs since these charges are routinely discounted before payment.

Discount rates are computed by cost center in the process of “settling” the annual SNF cost report and then applied throughout the year. Unfortunately, these calculations were not exactly reproducible because of missing data in the SNF Cost Report Minimum Data Set. To be as consistent as possible with this practice, one average discount factor (the ratio of total Part A allowed cost to total Part A charges) was calculated for each facility in each year. Since some facilities did not have cost reports on file for every year, facilities lacking cost reports in two or more years were excluded from the sample. An average ratio across years was calculated for all remaining facilities to improve precision and fill-in any missing years. This average discount factor was applied to all of the facility’s non-therapy ancillary charges (matched by provider number) before analysis.

This method adjusts ancillary charges downward for most residents (i.e., those residents at facilities where the total Part A allowed cost was less than the total Part A charges), so that the contribution of non-therapy ancillaries to total costs is not overstated. A variety of limitations precludes the creation of an actual measure of resident-specific cost due to available data sources. Cost report data are facility-specific, while claims data reflect charges to the Medicare program per SNF resident. Although the method employed for these analyses uses all of the information that is available for converting ancillary charges into a measure of ancillary costs (i.e., cost report and SNF claims data), it relies on a facility-specific adjustment factor, as again, there are no data for creating a resident-specific adjustment. To emphasize the fact that true costs are not observable in this data, the term “ancillary charges” is used throughout this document to refer to the adjusted estimate of non-therapy ancillary charges. Additional detail on the construction of cost to charge multipliers is provided in Appendix E.

### *Limitations to Cost Measurement*

There are several limitations to the cost measures created, including problems with the relationship between the MDS assessment observation period, the usual claim covered period, and the derivation of the cost to charge ratio. As with any study reliant upon claims data from cost reimbursed providers, it is possible that variation between claims submitted and eventually reimbursed exists. Similarly, costs recognized upon cost report settlement will vary from charges billed. These factors mean that an exact assignment of Medicare costs per sampled resident is not possible. The resulting measurement error in the calculation of non-therapy ancillary charges reduces the ability to model the sources of variance in non-therapy ancillary charges, and affects the measured accuracy of all casemix systems. Specifically, the imprecision with which non-therapy ancillary charges were measured introduces a source of variation in costs that cannot be captured by either RUG-III or the potential refinements, and almost certainly results in an underestimate of the predictive power of all of the models discussed in this report, including RUG-III. It is not possible to calculate the size of this underestimate.

As with any study reliant upon claims data from cost-reimbursed providers, it is possible that variation between claims submitted and eventually reimbursed exists. Similarly, costs recognized upon cost report settlement will vary from charges billed.

## **3.3 Methods: Developing Potential RUG Refinements**

### **Tree-based systems and Index Models**

There are two fundamental approaches to categorizing residents for the purpose of casemix adjustment: tree-based systems and index models. Tree-based approaches categorize residents into mutually exclusive groups defined by sets of shared resident characteristics. For example, residents receiving IV therapy may be categorized into the same group, and residents suffering from cognitive impairment are (mostly) categorized into a different group. The term “tree-based” is used because these systems can be depicted simply and meaningfully by a tree diagram. By contrast, the term “index model” refers to a system best described in four steps. First, each resident is assessed with respect to a list of MDS items. Second, each item that applies to the resident is assigned a weight (this weight can be thought of as a certain number of points). Third, the sum of these weights comprises the resident’s “index score,” and, fourth, residents are classified into casemix groups based on their index scores.

Index models have the advantage of accounting for all MDS items that apply to each resident, regardless of the casemix group into which the resident is classified. For this reason, index models often have more statistical power than casemix systems based on mutually exclusive categories (tree-based systems). However, for the same reason, index models can be perceived to be more complex. As will be discussed below, tree-based systems (like RUG-III) and index models can be combined to form a hybrid casemix model that preserves the clinical value of the tree structure while enhancing its statistical power.

The first step in the process of RUG-III casemix refinement is the identification of variables that are associated with differences in non-therapy ancillary charges. Once identified, these variables can be used to refine the definitions of tree-based groups or as components of an index model. The choice of

which approach to take is informed by the presence or absence of interaction effects (i.e. the effect on cost of one variable is determined by another variable).

### **Identification of Variables and Exploration of Interactions**

The current RUG-III system was based only on staff time costs and accounts for a relatively small proportion of the variance in non-therapy ancillary charges. In an attempt to incorporate those costs, potential RUG-III refinements based on MDS items that are associated with higher non-therapy ancillary charges were examined. These MDS items were identified by a broad and systematic search of all items in the MDS. The identified items included a variety of measures of resident acuity and treatments received, including items related to functional status (Sections G and H of the MDS+ and MDS, respectively), disease diagnoses (Section I), health conditions (Section J), nutritional status (Section K), skin conditions (Section M), and special treatments and procedures (Section P of the MDS).

Having assembled a list of variables that were associated with differences in non-therapy ancillary charges, the utility of Automatic Interaction Detection (AID) based branching models (using PC-Group) was explored; this is a method similar to that used to develop the current RUG-III system. Although the details are not reported here, models were considered both for the full population and for subsets including those classified into the Extensive Services category and in combined Rehabilitation and Extensive Services categories. The latter were considered because of early results (see Table 4.1) suggesting that these RUG-III categories contain many of the high-cost residents.

Tree-based splitting as described above has a tactical advantage when there are strong statistical interactions present, that is, when one characteristic is important in explaining the dependent variable of interest only in the presence of a second (or more) characteristic(s). A hypothetical example would be that diabetes was only predictive of ancillary costs when there were pressure ulcers present. Perhaps for those without ulcers, a measure of physical functioning would be predictive. Following this example, if diabetes was found to be a useful splitting variable in both branches (i.e., regardless whether the resident had pressure ulcers) then these two variables would not be considered interactive.

In the analysis of ancillary costs, the AID-based results did not indicate strong interaction effects. This implied that the variables' effects were principally additive; thus, from a statistical point of view, the appropriate approach was to use regression analysis to form indices, rather than PC-Group to identify tree models. (It should be noted that PC-Group still has some unique capabilities, employed later, to help identify optimal thresholds for an index.)

One way an index model could be used is as an "add-on" component to the casemix system, specifically for predicting non-therapy ancillary charges. For example, RUG-III could be used for predicting staff time costs, and a non-therapy ancillary index would be "added-on" to determine the total payment rate for residents with given characteristics. The motivation for this approach is that RUG-III has been well tested and validated for predicting staff time costs, but does not perform as well in capturing variance in non-therapy ancillary charges. Although such a system can be described as consisting of two components, it could easily be implemented as an integrated system, as though the non-therapy ancillary component defined a new set of end-splits to RUG-III.

### ***Creation of Test and Validation Samples***

The recursive strategies employed by stepwise regression, AID, and other fitting techniques may produce over-optimistic measures of variance explanation. For that reason, assessment of the explanatory power of alternative models required use of data that were not used in forming the models themselves. To this end, the sample was divided into test and validation samples. The test sample (three-fifths of the data) was used for exploratory analysis and to develop refinements. The validation sample (the remaining two-fifths of data) was reserved to be used exclusively in testing the refinements after development was complete. Since aberrations in the test sample that may have influenced the design of refinements were absent in the validation sample, any unsupported features of the proposed models should be exposed by this approach.

### **Index Model Construction**

The index model approach allowed for a large number of items to be considered simultaneously in determining payment rates, including additional measures of severity that are not reflected in RUG-III. Both weighted and unweighted versions of a non-therapy ancillary index were designed. Both versions resulted in large improvements in the proportion of the variance predicted by the casemix system and some improvement in the system's ability to identify high-cost residents. The weighted version allowed items that predict much higher costs (such as pneumonia) to have more impact on predicted costs than less-influential items (e.g., pressure ulcer). Consequently, the weighted index model exhibited enhanced explanatory power, but at the cost of additional complexity.

The steps used to identify MDS items and create the index models are as follows:

1. Examining each MDS variable independently, all MDS items that had a significant positive relationship (at the five percent level) with *per diem* non-therapy ancillary charges were identified using t-tests for binary variables and bivariate regression analyses for continuous measures.
2. For variables that were found to be significantly related to *per diem* costs in the first step, a backward stepwise regression was estimated to identify the subset of items that in a multivariate context were still related to costs at the five percent level.
3. The surviving variables were reviewed to evaluate their clinical validity and potential incentive effects if included in the payment rate. For example, indwelling catheters and other MDS items that may be quality-of-care indicators were removed from consideration as casemix adjustors due to the potential incentive factors introduced. Establishing a higher payment rate for residents with these types of treatments or conditions might result in a casemix system that induces nursing facilities to admit more residents with these conditions.
4. Once variables were identified, a weighted non-therapy ancillary charge index score was calculated for each resident. The index score was based on how many of the selected variables apply to the resident, weighted by the importance of the variable in predicting ancillary charges. These weights were obtained as coefficients estimated from an ordinary least squares (OLS) regression of non-therapy ancillary charges on the list of selected variables, conducted on the test sample. For the unweighted model, each variable was used with a constant weight of 1.

5. Finally, residents were grouped according to their weighted or unweighted index score. For both versions, splits were defined based on analysis of the test sample and applied to the validation sample for evaluation.

### 3.4 Criteria for Evaluating Potential Refinements

The primary purpose of the resident classification system is to predict costs accurately, while providing incentives to furnish appropriate care and to classify residents into groups that make clinical sense. Evaluation of potential refinements to RUG-III is a complicated process that often involves tradeoffs between the statistical, clinical, incentive-related and administrative factors. For example, statistical performance (in terms of the percentage variance explanation) is often maximized by the use of measures based on the *provision* of rather than the *need for* services. Such measures, however, are often subject to gaming or upcoding, and may give providers the incentive to alter their practice patterns. The tradeoff between statistical performance and the avoidance of unwanted incentives is an inescapable outcome of the limited ability of any assessment measures yet developed to predict residents' needs based solely on health conditions.

The criteria used to evaluate potential refinements to RUG-III are described below. The potential refinements discussed in this report increased the statistical performance of the casemix system and met with the approval of clinical consultants and project team members. However, this increased statistical performance in general was achieved at the cost of greater complexity to the system.

#### *Statistical Factors*

If one were to graph each resident's costs with total cost on one axis and casemix categories on the other, a perfect classification system would look like a straight line with a positive slope, reflecting greater resource use for residents in higher categories. In practice, such a relationship will never be observed due to both the intrinsic variability in resource use even by residents with the same observable characteristics, and the complex relationships among staffing, payment, resident needs, and the provision of services. In addition, measurement error and unobservable resident characteristics reduce the ability of any classification system to produce such a relationship.

Despite these limitations, a casemix system that accounts for a substantial proportion of the underlying variance in expected costs reduces the financial risk to providers and also reduces the incentives for skimming of financially attractive residents (i.e., those for whom the prospective payment is much greater than the expected costs of providing care). The fairness of the casemix system (to providers, beneficiaries, and the government) is enhanced by maximizing the variation in expected costs captured by the system.

R-squared is a statistic that measures how close a particular classification system comes to the ideal. This statistic is estimated routinely and reported by most statistical software as part of ordinary least squares (OLS) regression output. In the context of the models examined here, R-squared is a measure of how much of the variance in resource use observed in the data can be explained or predicted by the model. It gives the percentage of the variation of the dependent variable (cost) explained linearly by variation in independent variables (casemix groups). Formally, this equals the sum of squared deviations of the predicted values of the dependent variables about their mean (i.e., the explained

variation from the OLS regression) divided by the total variation of the dependent variable about its mean (the total sum of squares).

Since the classification system could have a relatively high variance explanation, but still fail to account for some high cost residents, potential refinements were also evaluated based on reductions in the proportions of residents whose costs of care were much higher than the payment rate. These outlier analyses were intended to measure the extent to which the overall R-squared of the model was disproportionately affected by residents with outlier costs, and to allow for the measurement of the proportion of residents who may experience difficulties under PPS in obtaining access to SNF services or in receiving all needed services.

Using a constructed measure of total costs (which includes *per diem* imputed staff time costs and charges for non-therapy ancillaries), each potential refinement to RUG-III was evaluated using several measures of statistical performance:

- **R-squared on the test and validation samples:** The R-squared on the validation sample is a realistic measure of how well the model would perform in the real world. It is expected that the R-squared on the validation sample will be somewhat lower than the R-squared on the test sample. A significant drop from the test sample to the validation sample indicates one of several possibilities: the validation sample, even though chosen by chance, may contain more outliers or more extreme outliers than the test sample; or the coefficients generated using the test sample may be unreliable. This could be caused by the observations being divided into too many categories, by inadequate sample size or because coefficients are being estimated based on outlier values.
- **Maximum/minimum group costs:** This measure provided the highest and lowest mean ancillary cost across all the payment groups. A system with a greater range is more likely to be acceptable to the industry as it will provide situations where high levels of payment will be authorized.
- **Specificity and sensitivity in identifying high-cost residents:** An alternative way to evaluate how a casemix system accounts for the needs of heavy care residents is to think of the system like a diagnostic test. With what probability will the casemix system predict that a resident has costs above the 90th percentile when their actual costs are above the 90th percentile? This probability is known as “sensitivity”. A very sensitive system, however, may be likely to classify too many residents as high cost. Hence we also ask with what probability will the system predict that a resident has costs below the 90th percentile when their actual costs are below the 90th percentile. This probability is known as “specificity”. A good system will exhibit both high sensitivity and high specificity.

### *Clinical Factors*

In addition to adjusting for differences in costs associated with the expected resource requirements imposed by residents with different needs, the classification system needs to make sense clinically. The clinical relevance of the system is enhanced if the definitions used to classify casemix groups include residents who are similar not only in terms of costs, but also in terms of medical conditions, physical and functional status.

The categories in the RUG-III system were defined to ensure that residents within each category had clinical affinity (see Fries et al., 1994, Schneider et al., 1991, Cornelius et al., 1994), based on input from a broad-based clinical panel.

Because the potential casemix refinements evaluated for this study took as given the general structure of the RUG-III system, the clinical input that went into the original design of the system was reflected in the potential refinements described in this report. In addition, input on the clinical appropriateness of the MDS items that qualified for the index models was also considered. Items that had a relationship with costs that did not also contribute to the clinical meaningfulness of the system were excluded from further consideration.

It must be recognized that the clinical and statistical factors used to evaluate possible casemix refinements occasionally conflict. For example, the statistical performance of measures based on the presence of specific types of disease diagnoses used to define casemix categories or end splits has been disappointing, as most of the diagnoses have little relation to observed costs. Diagnosis-based measures may, however, improve the clinical meaningfulness of the casemix system by increasing the clinical affinity between patients in given categories. A strong case can be made for incorporating diagnosis-based measures regardless of the effects of their inclusion on the statistical performance of the system based on such clinical criteria.

In the design of possible refinements to RUG-III, measures that do not make sense from a clinical viewpoint have been avoided. Clinical input for the study has come both from Abt nursing staff and from the Clinical Work Group that was assembled to review the MDS variables underlying the index models. A description of the Clinical Work Group, as well as the Technical Expert Panel which commented on these analyses, may be found in Section 3.5.

### ***Incentive-related Factors***

The casemix system may create incentives for providers to alter their practice patterns, or their assessment of resident needs, in a manner that will produce increased payment. These incentive-factors must be considered in evaluating possible refinements to RUG-III.

The classification system should not give facilities the opportunity to manipulate the system by developing (or upcoding) a characteristic at little cost to the facility that results in increased payment. To minimize upcoding, categories should be as broad and inclusive as possible, subject to the statistical and clinical criteria described above. An exception to this general rule can be made for variables that, while subject to manipulation, provide appropriate incentives, such as the provision of rehabilitation therapies.

Subtleties in the data elements that make up the classification system can send strong incentives to providers. For example, making the casemix payment contingent on the types of services received can lead to much higher utilization of those services. As a result, wherever possible, measures used in the classification system should be based on measures of the *need* for the service rather than the *provision* of the service itself. Casemix systems that are based on the *receipt* of services tend to be more accurate than those relying on measures of the *need* for services, so there is often a tradeoff between improving the statistical performance of the classification system and the potentially adverse incentive effects introduced by the use of service-based measures.

There are elements both in RUG-III, and in some of the potential refinements to RUG-III, that are based on the actual utilization of services. The RUG-III Rehabilitation categories are defined based on the amount and types of therapy received by residents. Several of the variables that were most strongly related to *per diem* ancillary charges and included in the index models are based on special treatments and procedures received by the resident (from Section P of the MDS 2.0).

Following Schneider et al. (1991), service-based variables should be avoided unless they meet at least some of the following criteria:

- The cost of providing a procedure or set of services offsets a significant portion of the increased payment.
- The service requires medical authorization and there is the potential of negative consequences to the resident if it is inappropriately provided.
- There are no measures available in the MDS which predict the need for the service.

In order to mitigate any inappropriate incentives created by the inclusion of service-based variables, several of these items were linked to specific diagnoses or conditions. The requirement that a service variable be linked with a clinical variable should help to limit the provision of these services to the subset of residents for whom such services are clinically appropriate.

### ***Administrative Criteria***

Any change to the RUG-III system will introduce some administrative costs to providers and to the government, and these costs need to be weighed against the benefits (in terms of statistical, clinical, and incentive-related criteria) in evaluating the overall desirability of potential changes to RUG-III.

Possible refinements to RUG-III may increase the predictive power of the classification system, but may also increase the complexity of the system. Taking the general structure of RUG-III as given, improvements in statistical performance will be achieved by adding new categories and end splits to the system, and adding a new index system for predicting non-therapy ancillary charges. Adoption of any of these possible refinements would add additional groups to the casemix system, thereby increasing its complexity. This may introduce some confusion for providers, who would have to become familiar with and design implementation and support systems for the new system.

Incorporation of changes to the casemix system will also result in some administrative burden for HCFA, which must incorporate the resulting changes to payment rates in a way that ensures budget neutrality and maintains the continuity of the PPS. Some of the potential changes may also increase the number of “inversions”<sup>2</sup> required in the casemix system. Under an index-maximization approach, this need not affect payment rates, but it does increase the complexity of the model and also underlies the hierarchical nature of the classification system.

## **3.5 Clinical and Technical Review**

In order to assist the project team in evaluating the clinical, incentive and operational impacts of possible RUG refinements, a Clinical Workgroup was convened in November 1999. The work group

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<sup>2</sup> Inversions refer to situations where the casemix system does not progress consistently from low to high in terms of costs as one advances through the hierarchy.

consisted of clinicians and pharmacists with experience in nursing home operations, familiarity with pharmaceutical prescribing patterns and expertise in administrative and clinical issues in skilled nursing facility, rehabilitation and subacute care settings. Group members were recruited from recommendations by the American Society of Consultant Pharmacists and through contacts with SNF administrators who have participated in previous long-term care studies with HCFA, Abt Associates, the Brown University Center for Gerontology and Health Care Research, and the University of Michigan.

Members of the Workgroup included:

- Karen Burton, RPh, FASCP, Regional Clinical Director for Omnicare Inc.
- Steve Feldman, RPh, FASCP, President and CEO, The ICPS Group; Board of Directors, American Society of Consultant Pharmacists
- Judy Girouard, RN, Director of Clinical Resources, Genesis Eldercare, Andover, MA.
- Barbara Johanson, RN, Nursing Rehabilitation and MDS Coordinator, Winchester Nursing Center, Winchester, MA.
- Susan Poirier, RN, Director of Clinical Services and Program Development, Steere House Nursing and Rehabilitation, Providence, RI.
- Eric G. Tangalos, M.D., C.M.D., Professor of Medicine, Mayo Clinic School of Medicine; Chair, Division of Community Internal Medicine; Medical Director, Bethany Heights Nursing Home, Rochester, MN.

The Workgroup convened for an all-day meeting at Abt Associates' Cambridge office on November 17, 1999. One week prior to the meeting, members were provided with briefing materials describing the history of the RUG-III system, a list of variables under consideration as candidates for inclusion in the system, a description of the methods by which they were derived, and potential changes to the structure of the system.

In addition to the Clinical Workgroup, additional clinical and incentive review was provided by the Technical Expert Panel (TEP), convened at HCFA on February 28, 2000. A complete list of TEP participants is included in this report in Appendix F. After reviewing briefing materials provided prior to the meeting and listening to a presentation of preliminary results, TEP members discussed the findings and their opinions on clinical, incentive, and administrative concerns with HCFA staff and members of the project team. Areas in which comments from the TEP affected the development of potential refinements have been noted throughout the Results section of this report (Section 4.0).

## 4.0 Analytic Results and Potential RUG-III Refinements

The primary goal of the RUG refinement analyses was to develop potential refinements that improved the ability of the casemix system to account for variation in ancillary charges, while incorporating clinical criteria and other concerns. Development of potential refinements began with a set of analyses that evaluated the relationship between ancillary charges and the categories in the current RUG-III system. These analyses indicated that RUG-III accounted for a relatively small proportion of the variance in ancillary charges and suggested that the predictive power of the casemix system could be improved if new categories for residents who qualified for both Extensive Services and a Rehabilitation category were added.

Also examined were potential refinements using other MDS items that were associated with higher costs. These analyses were performed using the methods described in Section 3.0. The analyses involved identifying a subset of clinically appropriate MDS items associated with differences in ancillary charges, reviewing the resulting list of variables for clinical appropriateness, and considering alternative ways of incorporating these items into a refined casemix system.

### 4.1 Relationship Between RUG-III and Costs

Ancillary charges were much higher for Extensive Services residents than for residents in other RUG-III categories. Across the other categories, ancillary charges were higher for the Rehabilitation, Special Care, and Clinically Complex categories than for the Impaired Cognition, Behavior Only, and Reduced Physical Functioning categories. Highlights of these findings are presented below, and the distribution of ancillary charges by RUG-III category may be found in Table 4.1. In addition, further descriptive statistics may be found in Exhibits 4.1 - 4.6.

- Mean prescription drug charges were nearly \$24 per day. They were more than twice as high for Extensive Services residents (\$46) as for any other category. There were relatively small differences in mean drug charges across the other categories, which ranged from \$16 for Impaired Cognition to \$23 for Ultra-high Rehabilitation (Table 4.1, Figure 4.1). In addition to examining mean drug costs, we examined the distribution of high cost residents by RUG-III category. Among those with drug charges higher than \$150 per day (about 1.6 percent of all residents), 33 percent were in the Extensive Services category (Figure 4.2).
- Respiratory therapy charges were highest for Extensive Services and Ultra-high Rehabilitation residents, although the difference was not as large as for prescription drugs. Mean respiratory therapy charges were \$25 for Extensive Services residents, \$25 for Ultra-high Rehabilitation, \$9 for Special Care, and \$14 for those in the Clinically Complex category (Table 4.1, Figure 4.3). Among Rehabilitation residents, there was a strong relationship between respiratory therapy charges and the Rehabilitation group for which residents qualified. The distribution of respiratory therapy charges was highly skewed. Less than 13 percent of the sample had any respiratory therapy charges. Among those with non-zero charges, the mean of costs was \$108 and the standard deviation was \$103. Residents with high respiratory therapy charges were more common in the Ultra-high Rehabilitation and Extensive Services categories (Figure 4.4).

§ Charges for “other” non-therapy ancillary charges (which include medical and surgical supplies, IV therapy, laboratory, blood, and other miscellaneous ancillary charges) for Extensive Services residents were \$24, nearly three times higher than for any other category. Furthermore, a disproportionate share of residents with high “other” ancillary charges were in the Extensive Services category. Among those with “other” ancillary charges of \$100 or higher (the top 1.3 percent of the sample), 37 percent were in Extensive Services.

- While the Extensive Services category contained a disproportionate share of residents with high ancillary charges, there was considerable within-category variation in ancillary charges. The standard deviation of ancillary charges for Extensive Services residents was \$152, more than 1.5 times higher than the mean. One goal in developing potential refinements was to reduce the within-category variance of these ancillary charges.

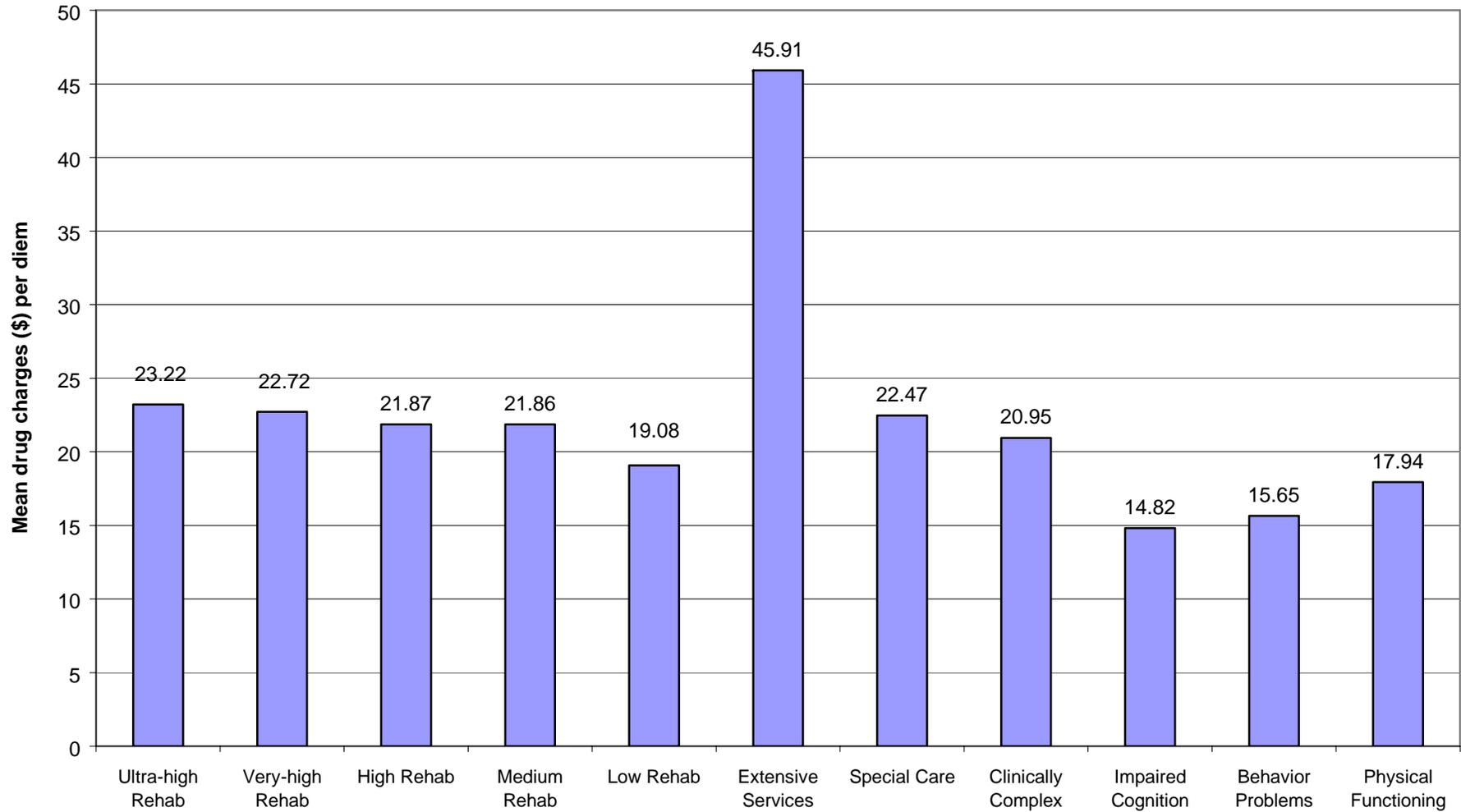
**Table 4.1**  
**Distribution of Ancillary Charges by RUG-III Category**

<b>RUG-III category</b>	<b>N</b>	<b>Mean total ancillary charges (std. dev.)</b>	<b>Mean respiratory therapy charges (std. dev.)</b>	<b>Mean drug charges (std. dev.)</b>	<b>Mean other ancillary charges (std. dev.)</b>
All	61,872	\$45.80 (89.74)	\$14.27 (52.42)	\$23.78 (49.90)	\$8.12 (36.42)
Ultra-high rehabilitation	5,321	\$56.42 (103.92)	\$24.58 (66.46)	\$23.22 (51.91)	\$8.62 (36.68)
Very-high rehabilitation	5,121	\$49.29 (93.75)	\$19.14 (60.23)	\$22.72 (47.56)	\$7.43 (37.73)
High rehabilitation	4,548	\$40.56 (84.26)	\$13.32 (52.18)	\$21.87 (47.39)	\$5.38 (26.29)
Medium rehabilitation	13,523	\$41.36 (80.56)	\$13.20 (50.02)	\$21.86 (41.41)	\$6.29 (29.73)
Low rehabilitation	1,112	\$29.73 (60.50)	\$6.62 (39.30)	\$19.08 (33.81)	\$4.02 (14.17)
Extensive Services	5,525	\$95.49 (152.07)	\$25.19 (73.50)	\$45.91 (90.93)	\$24.40 (79.67)
Special Care	13,508	\$38.95 (71.25)	\$9.35 (39.03)	\$22.47 (45.83)	\$7.12 (26.98)
Clinically complex	8,086	\$38.65 (71.80)	\$13.39 (51.42)	\$20.95 (37.08)	\$4.31 (19.46)
Impaired Cognition	1,016	\$22.14 (44.91)	\$5.54 (31.38)	\$14.82 (26.33)	\$1.78 (9.15)
Behavior Only	126	\$27.86 (60.17)	\$10.68 (48.58)	\$15.65 (18.00)	\$1.53 (5.43)
Reduced Physical Functioning	3,986	\$28.11 (57.93)	\$6.79 (34.92)	\$17.94 (33.43)	\$3.38 (24.05)

Notes: N=61,872 (Based on test sample only)

Data Source: Medicare MDS and SNF Claims Data 1995-1997

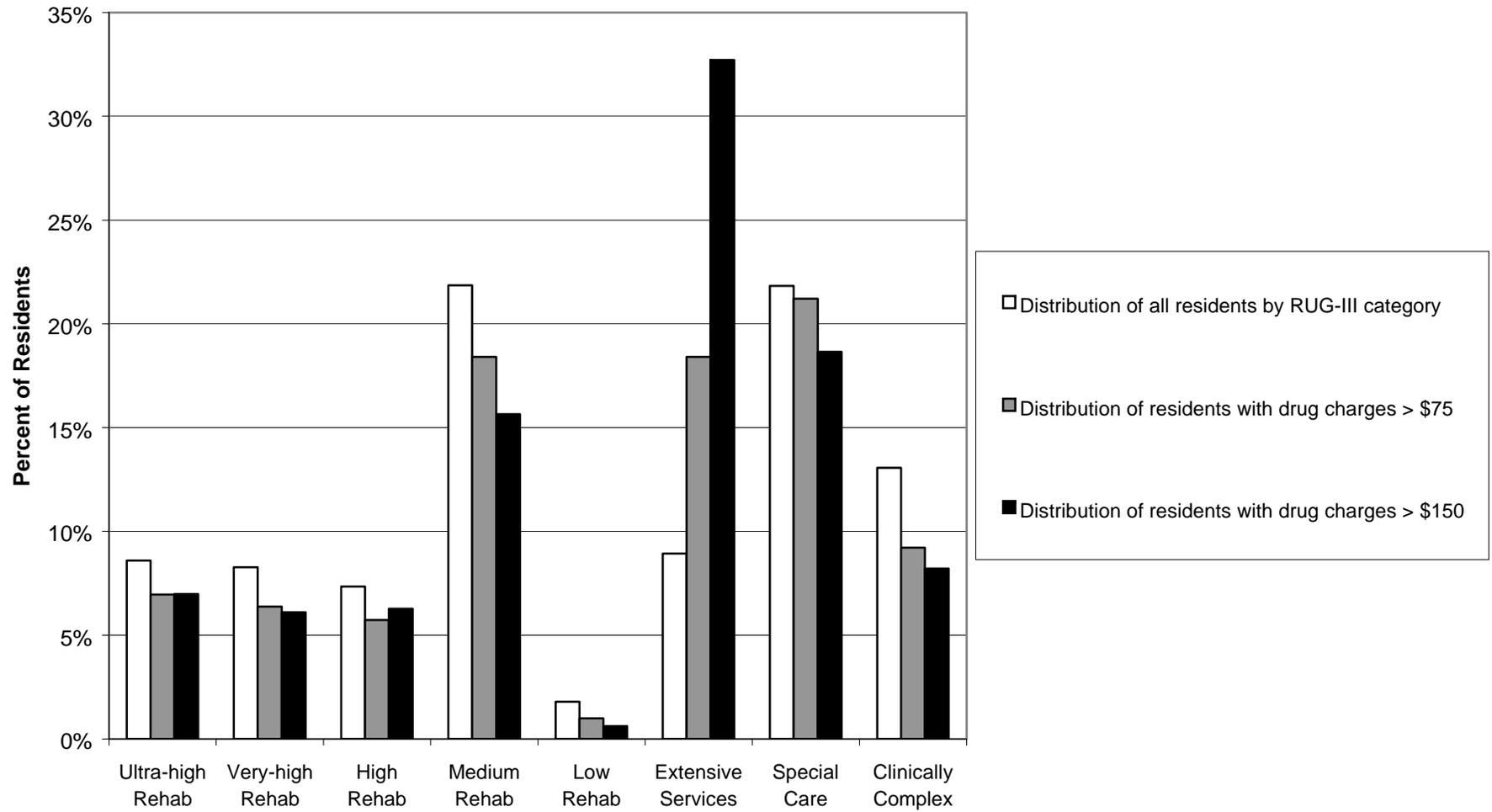
**Exhibit 4.1: Comparison of Drug Charges by RUG-III Category**



N=61,872 (Based on test sample only)

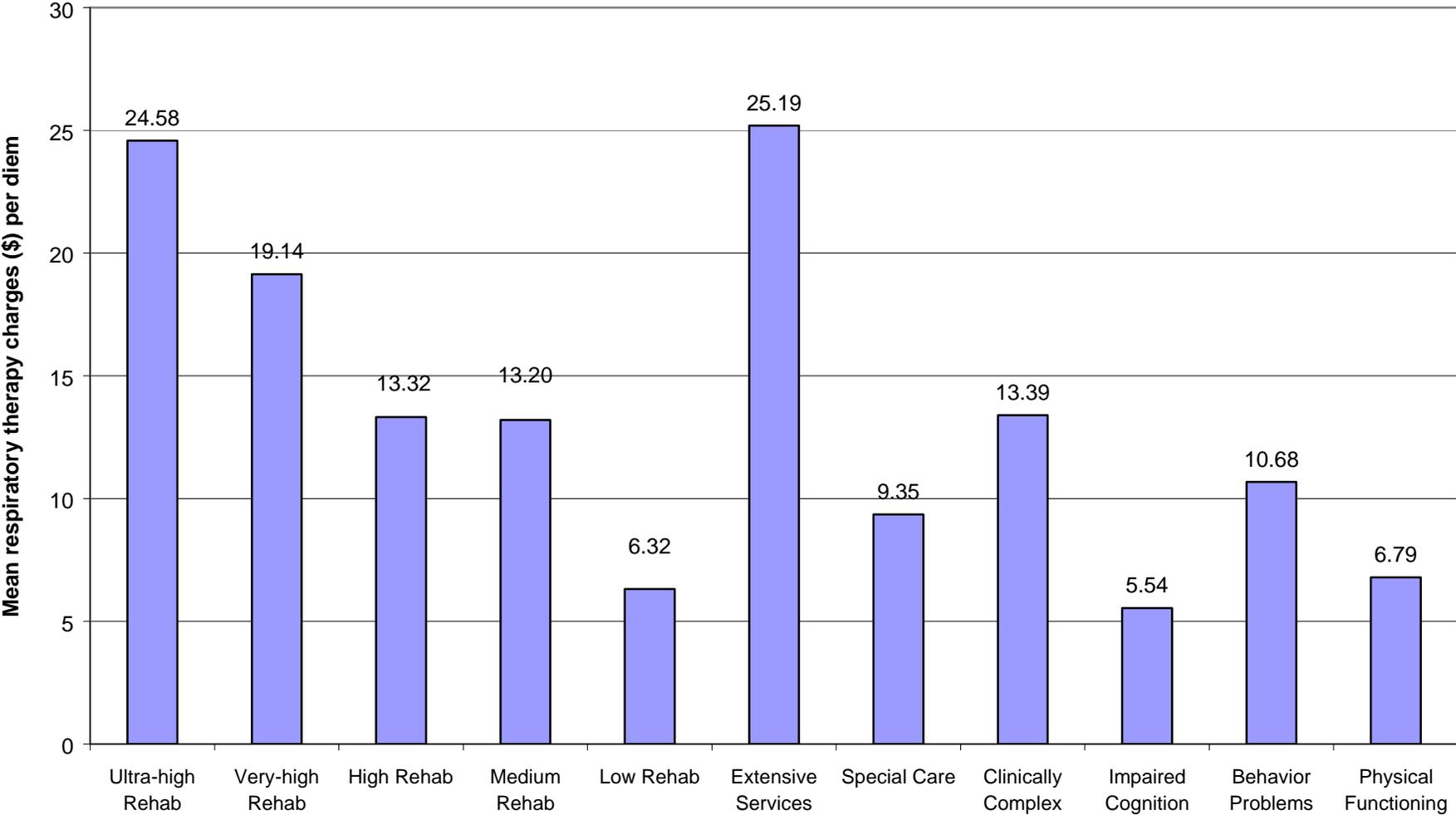
Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.2: Distribution of High Drug Charge Residents by RUG-III Category**



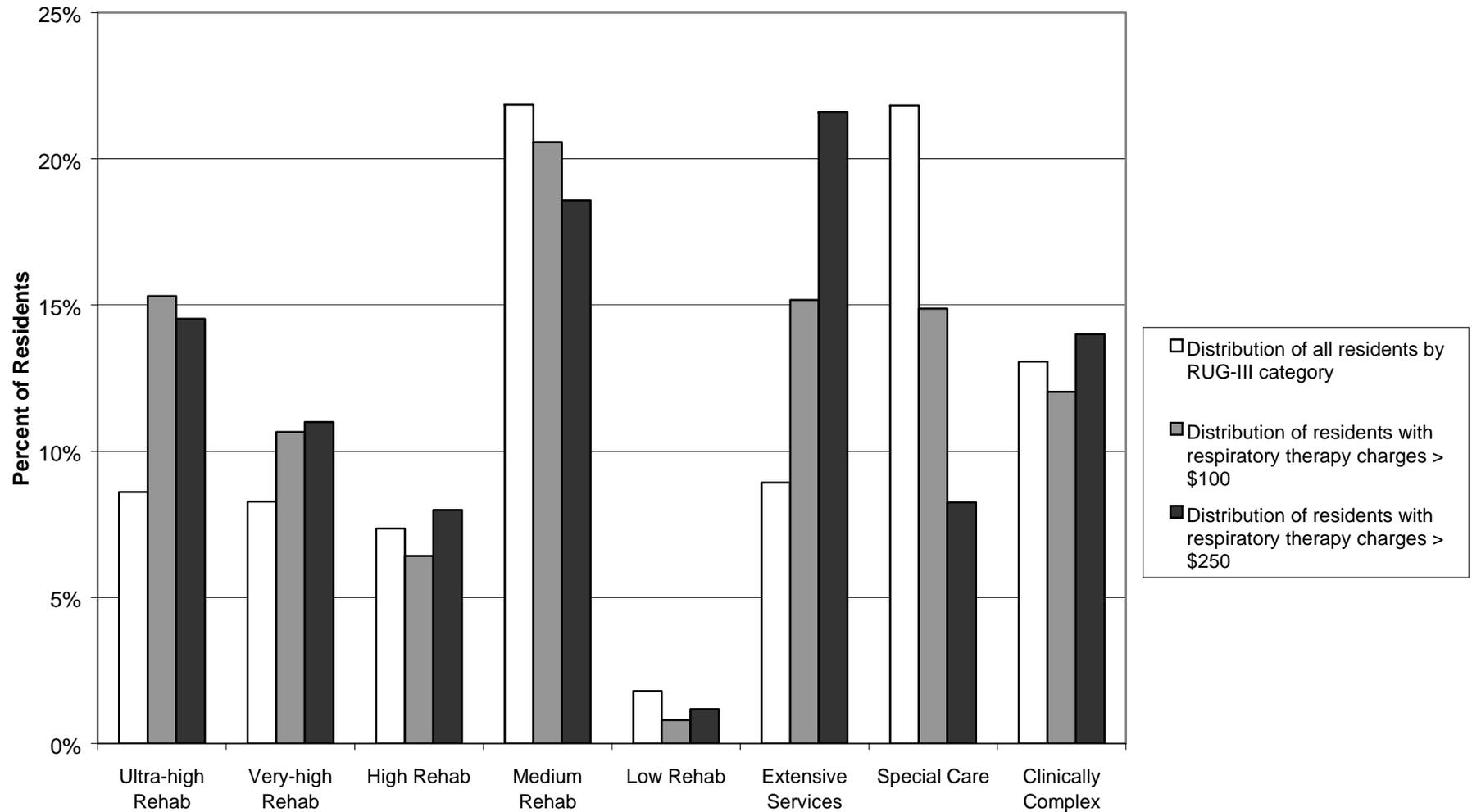
N=61,872 (Based on test sample only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.3: Comparison of Respiratory Therapy Charges by RUG-III Category**



N=61,872 (Based on test sample only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

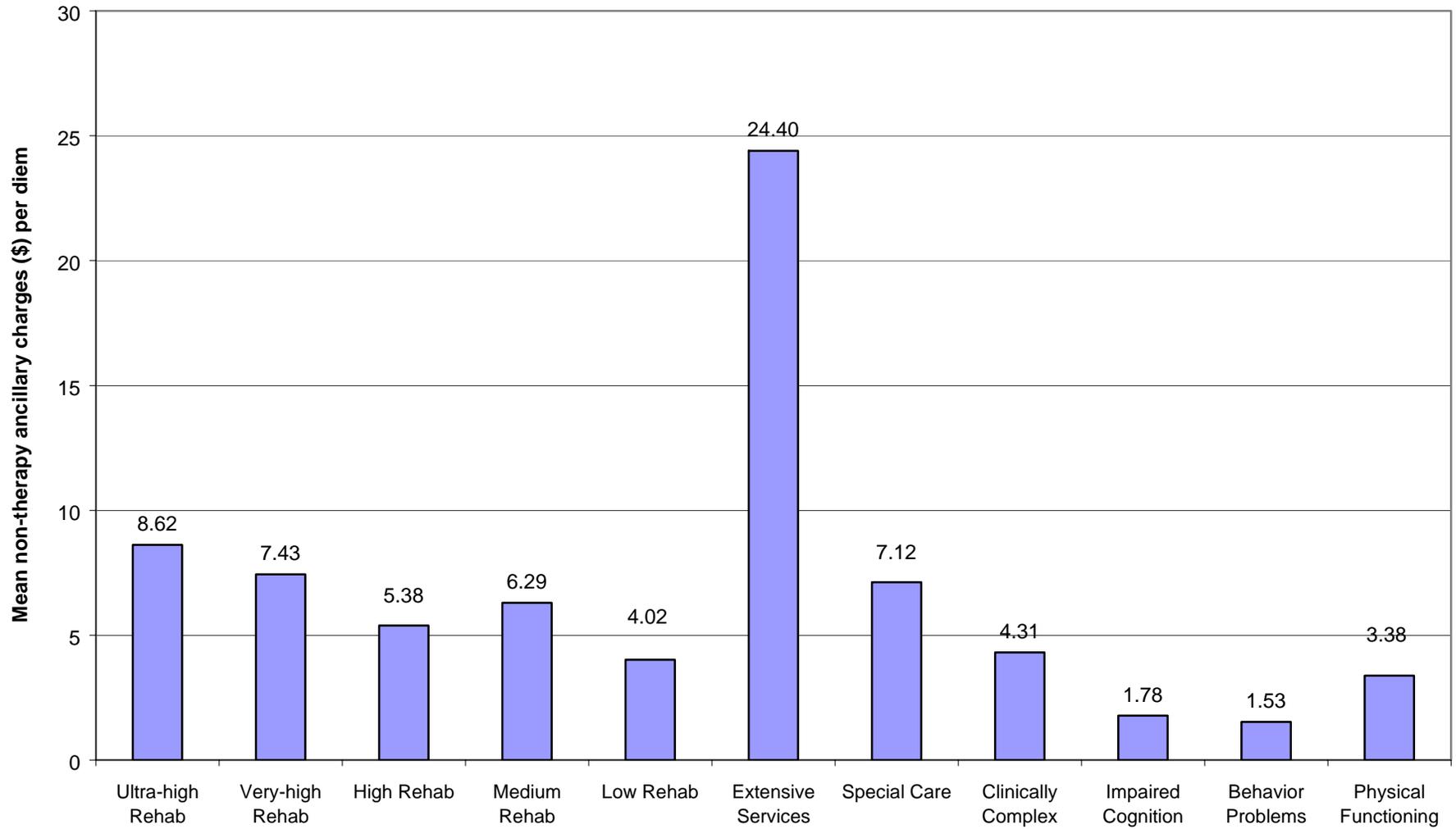
**Exhibit 4.4: Distribution of High Respiratory Therapy Charge Residents by RUG-III Category**



N=61,872 (Based on test sample only)

Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

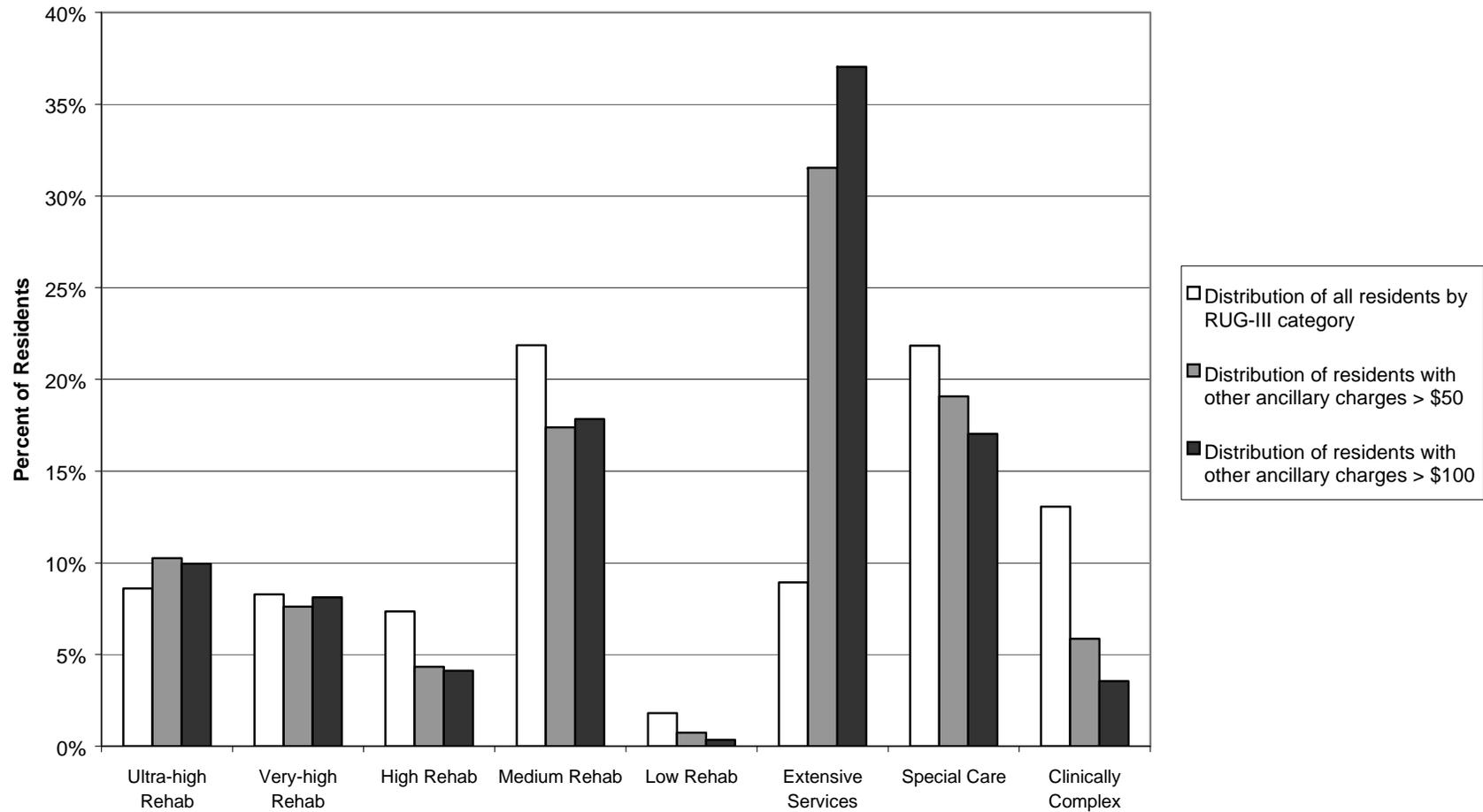
**Exhibit 4.5: Comparison of Other Non-therapy Ancillary Charges by RUG-III Category**



N=61,872 (Based on test sample only)

Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.6: Distribution of High Other Ancillary Charge Residents by RUG-III Category**



N=61,872 (Based on test sample only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

## 4.2 Ability of RUG-III to Predict Ancillary Charges and Total Costs

To test the ability of RUG-III to predict ancillary charges and a measure of total costs, a regression of total ancillary charges on a set of binary indicator variables was estimated for each RUG-III group (with a single group omitted to serve as the reference category). This model was estimated using only the test sample. Two types of models were tested: one using all 44 RUG-III groups; and the second using the first 26 groups (i.e., from Rehabilitation through Clinically Complex), which include most Medicare-covered SNF residents.

As stated previously, R-squared is a statistic that measures how close a particular classification system comes to the ideal. In the context of our models, R-squared is a measure of how much of the variance in costs observed in the data can be explained or predicted by the model. RUG-III accounted for only 10 percent of the variance in (simulated) total costs and four percent of the variance in total ancillary charges (Table 4.2). The statistical performance was slightly lower in the model that included only residents through Clinically Complex. Examining ancillary costs separately by type, RUG-III accounted for two percent of the variance in prescription drug charges, about one percent of the variance in respiratory therapy charges, and less than one percent of the variance in other non-therapy ancillary charges. Even considering the limitations in the measure of ancillary charges (see Section 3.0), these findings raise concerns about the adequacy of RUG-III in reflecting variance in non-therapy ancillary charges.

*Sensitivity of Statistical Performance to Outliers.* Depending on how costs are distributed, it is possible that small numbers of outliers can cause a large decrease in the R-squared of a regression of costs on casemix groups. For most analyses, extreme outliers (defined as those with total ancillary charges of \$1,000 or higher) were excluded. To test how model results were affected by outliers, the regression models described above were estimated, excluding all residents with ancillary charges of \$100 or more (roughly the top 10 percent). With this group excluded, RUG-III predicted 18 percent of the variance in total costs (including simulated staff time costs).<sup>3</sup> The R-squared of total ancillary charges fell from four to one percent. The decrease in statistical performance for ancillary charges was due to the disproportionate share of high cost residents in the Extensive Services category.

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<sup>3</sup> Note that this model was estimated using residents in all RUG-III categories, including those in categories below Clinically Complex.

**Table 4.2**  
**Predictive Power of RUG-III Classification System**

	R-squared		
	All RUG-III Categories	All RUG-III Categories through Clinically Complex	Exclude high cost residents (> \$100)
Total cost (includes simulated staff time costs)	10.0%	7.8%	18.3%
Total ancillary charges	4.1%	3.8%	1.4%
Drug charges	2.2%	2.3%	0.007%
Respiratory therapy charges	1.3%	1.2%	0.004%
Other non-therapy ancillary charges	0.007%	0.007%	0.01%

Sample size: 61,788 for “All RUG-III Categories”, 56,672 for “All RUG-III Categories through Clinically Complex”; 54,578 for model that excludes high cost residents. Note that this sample size differs slightly from that of Figures 4.1 4.6 due to the exclusion of 84 observations with outlier (negative or greater than \$500) values of simulated staff time costs.

Sources: Medicare MDS and SNF claims data 1995-1997

### 4.3 Costs for Residents Who Qualify for Both Extensive Services and Rehabilitation

Under the current PPS system, the payment rate is the same for residents who qualify for both Extensive Services and one of the top three Rehabilitation categories (Ultra-high, Very High and High Rehabilitation) as for residents who qualify only for one of the top three Rehabilitation categories.<sup>4</sup>

Ancillary charges were much higher for residents who qualified for both Extensive Services and a Rehabilitation category than for those who qualified only for a Rehabilitation category. Across all Rehabilitation categories, mean ancillary charges were \$119 for those who also qualified for the Extensive Services category and \$37 for those who qualified only for Rehabilitation (Table 4.3). Large differences in ancillary charges for those who qualified for both Extensive Services and a Rehabilitation category were observed across all five Rehabilitation categories (see Figures 4.7 – 4.10).

These cost differences suggest a potential type of refinement for residents who qualify for both Extensive Services and Rehabilitation. Such a refinement could be implemented by making fairly minor changes to the structure of RUG-III. For example, a new category could be added for these residents. If the structure

<sup>4</sup> Under an index maximization approach, residents who qualify for multiple RUG-III groups are paid according to the group with the highest payment rate, even if it is lower on the RUG-III hierarchy. The payment rate for Extensive Services is higher than that for the Medium and Low Rehabilitation groups.

of these categories were identical to that of the current RUG-III Rehabilitation categories, the resulting casemix system would have 14 additional Extensive Services and Rehabilitation Groups. This new category could use the same Rehabilitation categories and ADL splits as the current Rehabilitation categories.<sup>5</sup> This refinement is referred to as the RUG-III+ model.

There are fairness and consistency-related reasons for considering changes to the casemix system for residents who qualify for both Extensive Services and Rehabilitation. Given that the payment for other types of residents is tied to the amount of therapy received, the inconsistency of having payment for Extensive Services invariant to the amount of therapy received (which would be the case if the Extensive Services payment rate were adjusted to reflect the non-therapy ancillary charges observed for the category) raises concerns about the appropriateness of treating Extensive Services residents differently than other types of residents. The structure of the RUG-III Rehabilitation categories serves as encouragement to SNFs to provide therapy (by having the payment rate tied to the amount of therapy received) and it would be inconsistent to treat residents in the Extensive Services category differently.

**Table 4.3**  
**Comparison of Total Ancillary Charges for Those in Rehabilitation Categories Based on Whether Resident Also Qualifies for Extensive Services**

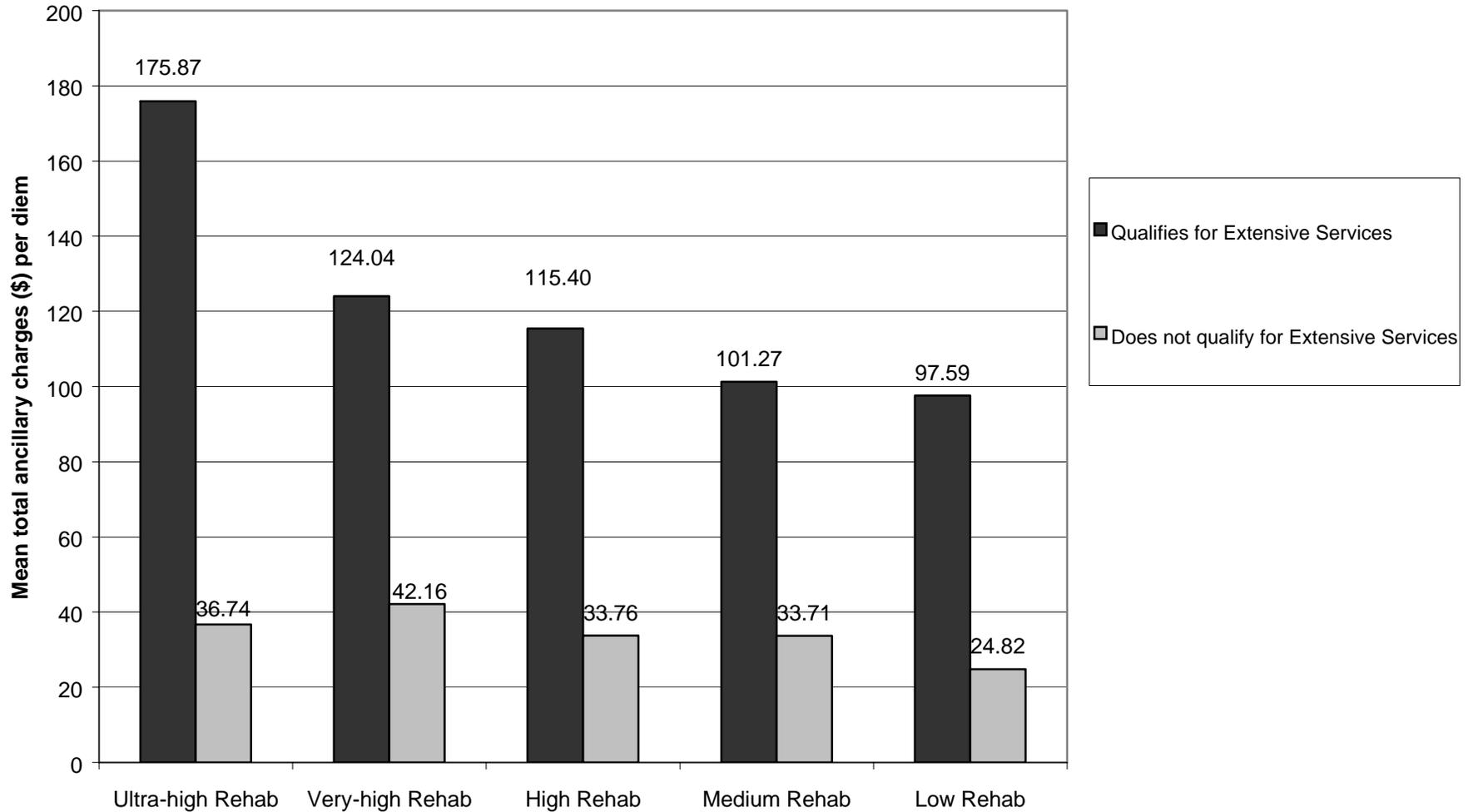
RUG-III category	Qualifies for Extensive Services		Does not qualify for Extensive Services	
	N	Mean ancillary charges (std. dev.)	N	Mean ancillary charges (std. dev.)
All Rehabilitation categories	2,926	\$119.13 (172.65)	26,699	\$36.74 (67.82)
Ultra-high Rehabilitation	496	\$175.87 (207.21)	4,825	\$44.14 (76.74)
Very-high Rehabilitation	446	\$124.06 (177.40)	4,675	\$42.16 (77.76)
High Rehabilitation	379	\$115.40 (175.08)	4,169	\$33.76 (66.41)
Medium Rehabilitation	1,530	\$101.27 (153.86)	11,993	\$33.71 (61.51)
Low Rehabilitation	75	\$97.59 (164.73)	1,037	\$24.82 (40.36)

Notes: N=29, 625 (Based on test sample residents in a RUG-III Rehabilitation category only)

*Data Source: Medicare MDS and SNF Claims Data 1995-1997*

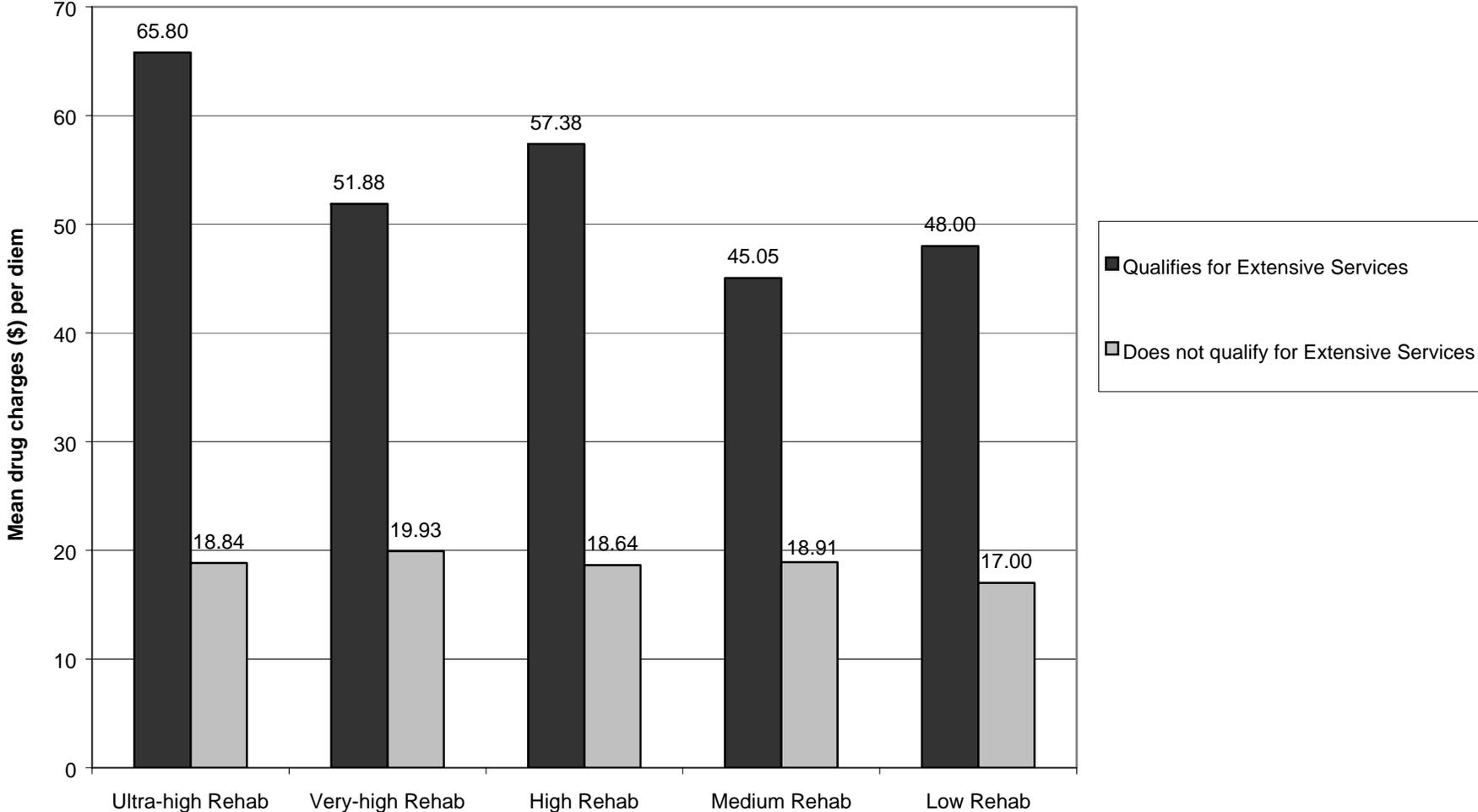
<sup>5</sup> It should be noted that RUG-III+ could also be implemented as a new terminal split within the existing Rehabilitation categories based on whether the resident also qualified for Extensive Services. Statistically, the two systems are identical.

**Exhibit 4.7: Comparison of Total Ancillary Charges for Rehabilitation Residents Based on Whether the Resident also Qualifies for Extensive Services**



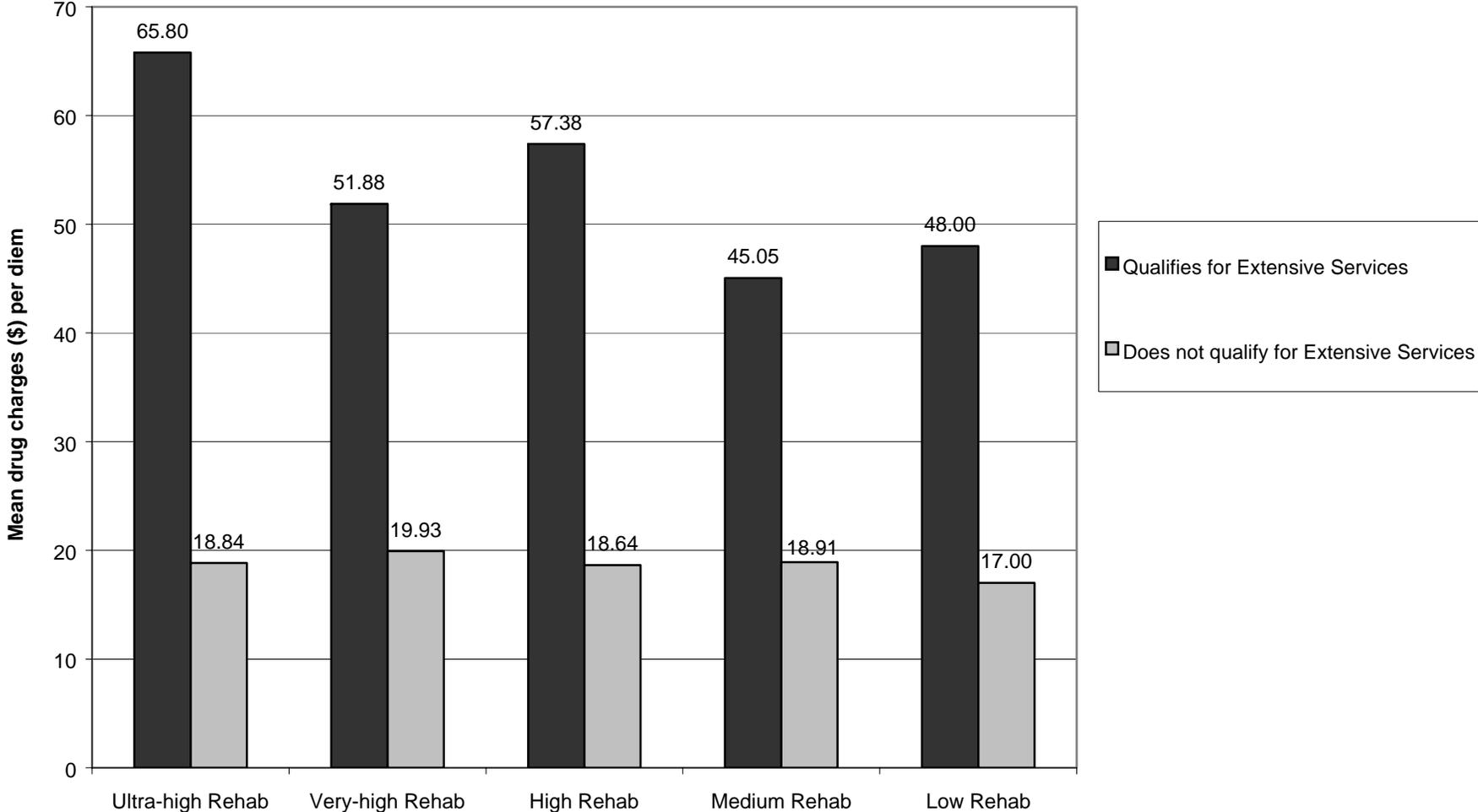
N=29,625 (Based on test sample residents in a RUG-III Rehabilitation category only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.8: Comparison of Drug Charges for Rehabilitation Residents Based on Whether the Resident also Qualifies for Extensive Services**



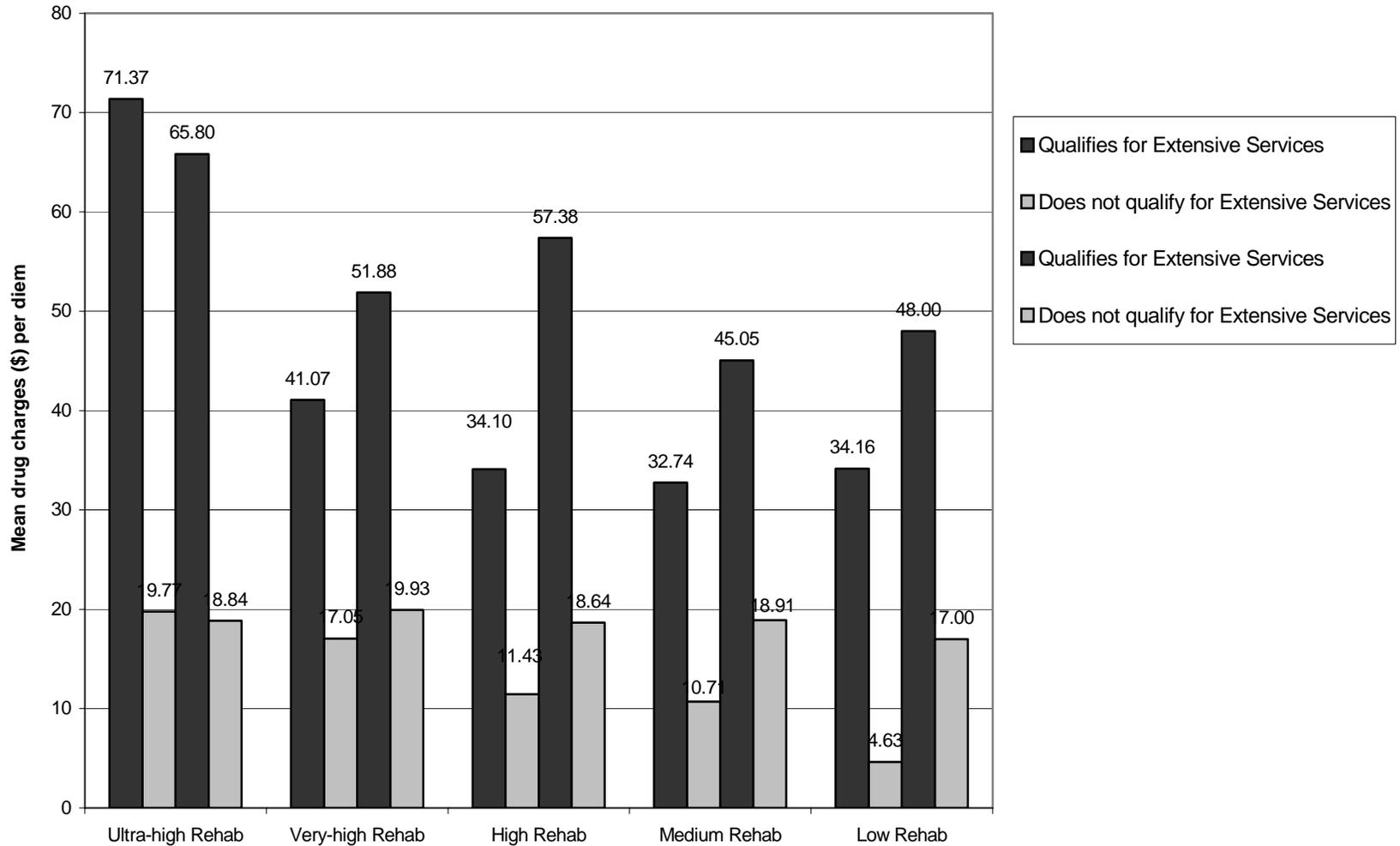
N=29,625 (Based on test sample residents in a RUG-III Rehabilitation category only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.8: Comparison of Drug Charges for Rehabilitation Residents Based on Whether the Resident also Qualifies for Extensive Services**



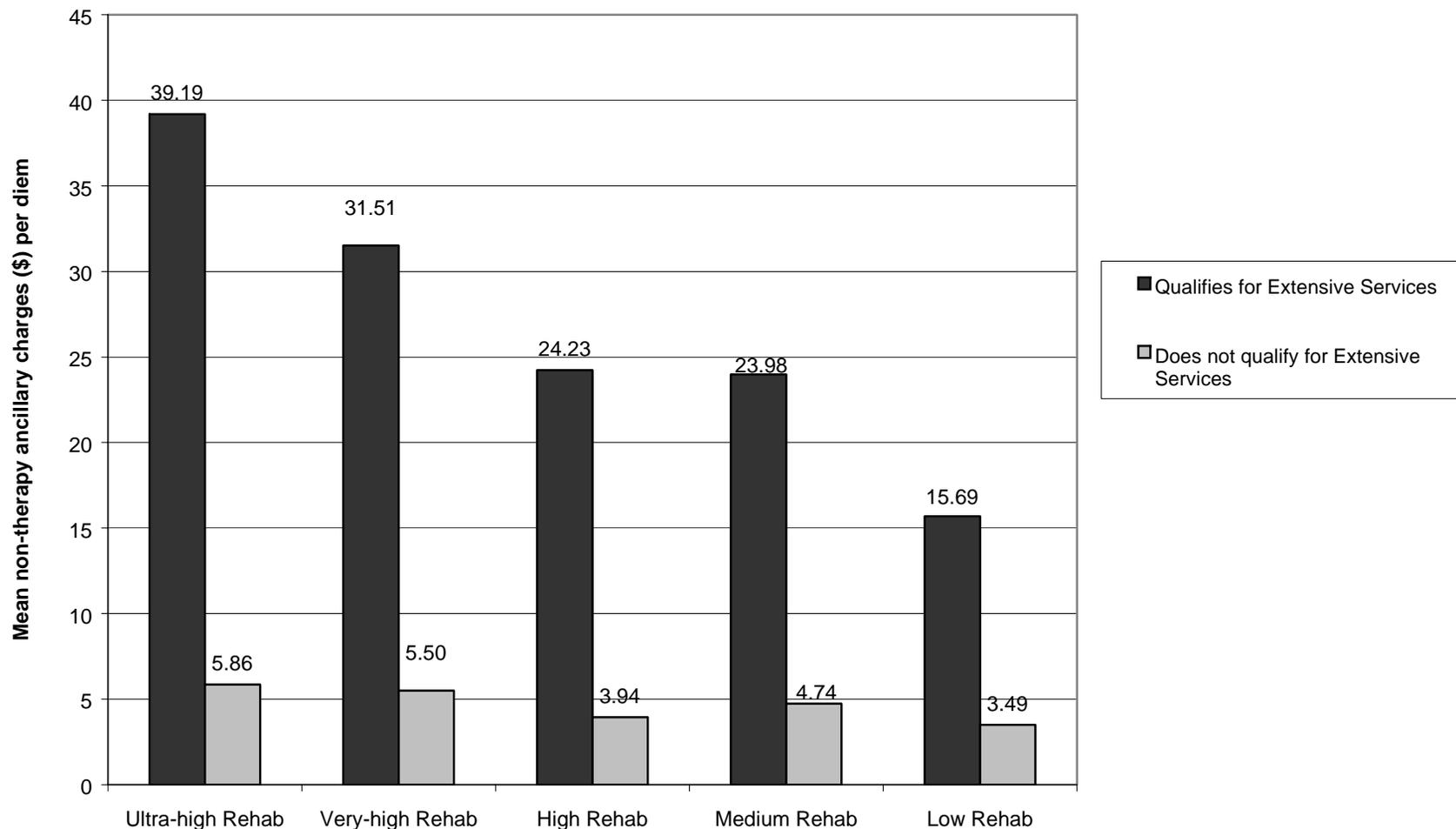
N=29,625 (Based on test sample residents in a RUG-III Rehabilitation category only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.9: Comparison of Drug Charges for Rehabilitation Residents Based on Whether the Resident also Qualifies for Extensive Services**



N=29,625 (Based on test sample residents in a RUG-III Rehabilitation category only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

**Exhibit 4.10: Comparison of Other Ancillary Charges for Rehabilitation Residents Based on Whether the Resident also Qualifies for Extensive Services**



N=N=29,625 (Based on test sample residents in a RUG-III Rehabilitation category only)  
 Data Source: Medicare SNF claims, 1995-1997 and Minimum Data Set

## 4.4 MDS Items Associated With Differences in Ancillary Charges

Given the large within-category variance in ancillary charges, the next phase of the refinement analyses was dedicated to identifying MDS items associated with differences in prescription drug, respiratory therapy, or other non-therapy ancillary charges. First, MDS items associated with either higher drug charges, respiratory therapy charges, or higher other ancillary charges were identified. These items were identified based on a broad and systematic search of MDS items (see Appendix G). This work suggested that refinements based on individual MDS items produced only very small improvements in statistical performance relative to the original RUG-III classification system. Efforts were instead focused on refinements based on combinations of MDS items (i.e., index models). Refinement efforts also focused on predicting total ancillary charges. Some of the variables that were associated with differences in either drug, respiratory therapy, or other ancillary charges were not associated with differences in *total* ancillary charges, and these variables were dropped from the index model.

The MDS items that were associated with differences in total ancillary charges are reported in Table 4.4. This table reports both means and regression coefficients associated with each variable. The means indicate how prevalent each treatment or condition was in the data; for example, 19 percent of the sample were receiving oxygen therapy. The regression coefficients measure each variable's contribution to total ancillary charges, holding other variables constant. For example, receipt of oxygen therapy was associated with \$21 in additional charges.

Based on this search, a subset of items from the MDS that had a significant relationship with ancillary charges was identified. These items include a variety of measures of resident acuity and treatments received, including functional status (bedfast), nutritional status (parenteral/IV feeding, tube feeding), disease diagnoses (COPD, terminal prognosis, pneumonia, respiratory infection), health conditions (use of indwelling catheter, shortness of breath), skin conditions and treatments (Stage 4 pressure ulcers, surgical wound/ulcer care, application of dressing with/without topical medication), and special treatments and procedures (IV medications, tracheostomy, suctioning).

**Table 4.4**  
**MDS Items Associated With Higher Total Ancillary Charges**

MDS Item	Mean	Regression Coefficient (std. error)	Implications
Parenteral /IV	0.025	84.61 (2.41)	IV Hydration presents some opportunity for manipulation; however, one safeguard is to pair with amount of parenteral nutrition provided via IV so that costs captured are those related to identified nutritional need.
Suctioning	0.022	71.70 (2.86)	Labor- and supply-intensive item, not likely to be manipulated.
Tracheostomy Care	0.015	48.44 (3.29)	No apparent negative incentive.
IV Medication	0.118	42.68 (1.18)	Currently included in Extensive Services; potentially provides incentive to administer medication generally available in oral or injectable form as an IV.
Oxygen	0.190	21.22 (1.45)	Failure to link oxygen use to a diagnosis/condition and/or symptoms indicative of need could lead to inappropriate and overuse of oxygen.
COPD	0.214	20.98 (0.96)	Due to prevalence of this diagnosis, potential for manipulation as a stand-alone variable. Needs to be linked to treatment (oxygen) and/or symptoms of acuity (SOB).
Shortness of breath (SOB)	0.176	15.90 (1.15)	Subjective with probable high prevalence. Highly gameable. Not appropriate for use in potential refinements.
Pneumonia	0.104	15.87 (1.27)	Less likely to be manipulated; could be linked to oxygen use, fever and/or SOB if gaming a concern.
Tube Feeding	0.095	15.57 (1.36)	Item currently included in Clinically Complex. Needs to be linked to percentage of calories and fluids received via the tube to avoid potential negative incentive.
Respiratory Infection	0.075	12.32 (1.46)	Not likely to be manipulated. Appropriate for use in potential refinements.
Bedfast	0.138	11.19 (1.19)	Negative incentive to quality of life/quality of care. Not appropriate for use in potential refinements, although other MDS items that proxy for bedfast might be appropriate.
Indwelling Catheter	0.177	10.71 (1.04)	May create facility incentives for negative clinical outcomes. Would only consider the variable if linked to certain diagnoses/conditions.
Terminal prognosis	0.021	10.61 (2.57)	Eliminated from RUG-III and considered inappropriate for use in potential refinements.
Application of dressing (to feet) with/without topical medication	0.056	8.68 (1.63)	Includes wide variety of dressings/bandages, not all of which are high cost. Should be paired with indication of wound requiring dressing. Currently included in Special Care.
Surgical Wound/Ulcer Care	0.282	4.08 (0.85)	Item is included in Special Care and is appropriate for use in potential refinements.
Number of Stage 4 Pressure Ulcers	0.041	2.15 (0.54)	Item included in Special Care, and contributes to a Quality Indicator. Unlikely to provide negative incentives and is suitable for use in refinements.

Notes: N = 52,328 (Test sample only). This sample size differs from that in other tables because of missing data in the MDS assessments. Observations missing data for any of the variables included in the regression models were excluded.

*Data Sources: Medicare MDS and SNF Claims Data 1995-1997*

## 4.5 Clinical Review and Modification

The items listed in Table 4.4 were identified using statistical techniques, and some of the items associated with significant cost differences may be inappropriate for use in the casemix system due to clinical or incentive-related concerns. Based on input from the Clinical Workgroup assembled for this project and the clinical expertise of project staff, the list of items to include in the index model were modified. Some items, despite their ability to identify high cost residents, were rejected outright due to potential negative incentive effects. Others were found acceptable with modification, and the remainder were recommended as is for inclusion in a potential model. A further description of this review follows.

### MDS Items Considered Unacceptable

The MDS item indicating that a resident is “bedfast” is not considered appropriate for inclusion in a casemix classification system. Though the index model shows that sampled residents who are bedfast have \$12 higher *per diem* non-therapy ancillary charges than those residents who are not bedfast, this item could be conceived as encouraging facilities to allow residents to spend excessive time in bed or in their room and thus have a negative impact on facility staffing, resident quality of life and quality of care.

Clinical Workgroup members agreed that it was not appropriate to include bedfast in the index model, but asked that a proxy for bedfast be examined, using other MDS items. A number of options were evaluated, the most promising of which is a proxy based on how the resident walks around the unit and the level of staff assistance received while doing so (locomotion support). Residents who were totally dependent in locomotion and who required a 2+ person assist for this activity (or the activity did not occur) qualified for this bedfast proxy, regardless of the value recorded for the bedfast item itself. This bedfast proxy is recommended for inclusion in the RUG-III refinement models, as sampled residents who meet this criterion have \$25 per diem non-therapy ancillary charges than those resident who don’t.

Indwelling urinary catheters are best excluded from the classification system in order to avoid their inappropriate use. Only by linking to medication profiles and diagnoses would these items be considered appropriate for inclusion in any casemix classification system. The Terminal Prognosis variable was removed from RUG-III prior to national PPS implementation, due to its lack of predictive power and incompatibility with the Medicare SNF benefit. That variable was, therefore, not pursued in these refinement analyses.

### MDS Items Found to be Acceptable if Linked to Other MDS Items

Several of the most powerful MDS variables identified by the index model indicate either treatment or symptoms/conditions which are highly prevalent in the nursing home population. Such variables, when considered independently, are of some concern, as they have the potential to create perverse incentives. In order to make use of these variables while maintaining some assurance that the modified classification system will not promote negative clinical outcomes, the following combinations of variables were proposed by the Clinical Workgroup.

**Parenteral/IV:** This item includes intermittent fluid administration for hydration and its inclusion could lead to unnecessary invasive practices. If utilized in the classification system, the item should focus on parenteral nutritional fluids administered either via central or peripheral lines. The item

could be refined by linking it to the percentage of calories received via parenteral IV, without the presence of a feeding tube.

**Oxygen:** Because oxygen administered for any brief period in the last 14 days generates coding on this item, there is concern that *absent a link to an acute condition* there could be inappropriate overuse of oxygen. It is, therefore, proposed that oxygen use be linked to the following diagnoses and symptoms:

<u>Diagnosis</u>	<u>Symptoms</u>
Respiratory Infection and Shortness of Breath (SOB)	Fever
Pneumonia and SOB	Fever
COPD	SOB
CHF and Inability to lie flat	SOB
CAD and Inability to lie flat	SOB
Terminal Prognosis	SOB
Cancer and Terminal Prognosis	SOB

**COPD/Emphysema:** Because of the widespread prevalence of these conditions, the item should focus on acute exacerbations. Combining these diagnoses with MDS items that reflect treatment of an acute condition would minimize potential manipulation. A link to oxygen use and SOB would further refine this item.

**Feeding tube:** This item is included in the Clinically Complex RUG category and by definition is linked to percentage of calories and fluids received via the tube. (Such a linkage is recommended in further RUG refinement).

**Dressing application with/without topical medications:** This item may include a wide array of dressing types, not all of which represent the need for unusually high amounts of supplies or medications. Linking to specific clinical conditions would better define this item in terms of non-therapy ancillary charges. The suggestion was made to evaluate this item in combination with MDS variables indicating the need for treatment with dressings, i.e. presence of ulcers or other wounds or lesions.

Based upon suggestions from the project team's clinical members (and from the earlier Clinical Workgroup), several MDS variables were examined to determine their interactions. Specifically, the index models were re-run with four re-defined variables:

- § Parenteral IV with the majority of caloric intake (greater than 75 percent) being administered via parenteral IV;
- § Oxygen administration and either pneumonia or respiratory infection with fever; or oxygen with pneumonia, respiratory infection, COPD, CHF, or CAD — all with shortness of breath;
- § Feeding tube with the majority of caloric intake (greater than 75 percent) being administered via feeding tube; and
- § Application of dressing with presence of either ulcers or other skin lesions/wounds.

## **MDS Items Acceptable “As-Is”**

In general, the following MDS items by themselves do not appear to provide negative care incentives nor would they be considered “manipulable”: IV Medications; Suctioning; Respiratory Infection; Pneumonia; Tracheostomy Care; and Stage 4 Pressure Ulcers.

## **Suggestions for MDS Form Modification**

In order to better capture the types of treatments and corresponding conditions that seem to contribute to the higher non-therapy ancillary charges associated with the items described above, several modifications to the MDS assessment form in future revisions may be warranted. These proposed modifications were generated through discussion with the Clinical Workgroup and through internal clinical review of potential RUG-III refinements.

- § A clear distinction between types of IV access (e.g., central v. peripheral line) and reason for IV (e.g., antibiotics, medication including IV push medication, hydration, nutrition (TPN or PPN));
- § Re-evaluation of the time frames for measurement of diagnoses and infections and occurrence of symptoms. For example, when attempting to link treatment to clinical conditions and symptoms, it is possible that MDS assessments could be incorporating data from three different time periods, thereby raising the possibility that the same condition may not be measured across the various time periods, but rather three separate conditions (or exacerbations of conditions). Also regarding time frames, all of the items in Special Treatments (P1a Special Care) refer to treatments that were provided within the past 14 days, not necessarily treatments provided at the nursing facility. A distinction between treatments provided prior to admission from those provided at the facility would provide a more accurate description of care/cost associated with the nursing facility.
- § A clearer definition of pressure relieving bed and chair, as this item is believed to be over-utilized and is one of several skin treatments that, when present, allow a resident to meet the requirement for a Special Care category.
- § Finally, the Clinical Workgroup noted that inclusion of information on the location of skin ulcers (i.e., trunk vs. extremity) would enable differentiation between appropriate/necessary means of treatment vs. unnecessary and/or costly methods.

## **Results of Refined Index Model**

The items in the refined index model performed reasonably well, accounting for 23 percent of the variance in ancillary charges for the assessments for which the item was available. The models were run using two separate analytic samples: the six-state version, and the three-state version. The six-state version contained variables which could be commonly defined across multiple MDS form versions. The three-state version included Mississippi, South Dakota and Texas, for which MDS 2.0 data were available. Because of serious concerns about how representative the cost estimates from the three state model were, refinements were evaluated using the six-state model. For example, the three state sample included only 14 non-Texas residents with the parenteral/IV feeding- caloric intake variable present (there were 92 Texas residents with this item present). The addition of clinical conditions to oxygen administration and of calories to parenteral/IV did not substantially undermine

the predictive power of the model. A six-state version of the index model that did not use the interaction between caloric intake and parenteral/IV or tube feeding predicted 16 percent of the variance in ancillary charges. Regression coefficients for both the three- and six-state versions of the model are reported in Table 4.5.

Only 46 percent of residents who received parenteral/IV feeding met the caloric intake threshold recommended by the Clinical Workgroup. Average ancillary charges for these residents were \$551, compared to \$345 for the 46 percent of those who were reported as receiving parenteral/IV feeding but zero percent of calories from parenteral/tube feedings. Nearly 96 percent of those who used a feeding tube met the caloric intake threshold.

**Table 4.5**  
**MDS Items Associated with Differences in Ancillary Charges: Refined Variable List**  
**Following Clinical Input**

MDS Item	Six-state version of model <sup>^</sup>		Three-state version of model <sup>^</sup>	
	Mean	Regression coefficient (std. error)	Mean	Regression coefficient (std. error)
Intercept	----	23.44 (0.44)	----	44.34 (1.60)
Parenteral /IV with > 76% total calories <sup>^</sup>	0.026	75.78 (2.13)	0.010	179.48 (12.41)
Suctioning	0.022	73.71 (2.55)	0.026	102.71 (8.42)
Tracheostomy Care	0.016	52.07 (2.86)	0.008	141.79 (14.13)
IV Medication	0.117	43.83 (1.07)	0.131	96.78 (3.61)
Oxygen and either pneumonia or resp. inf. with fever, or pneumonia or resp. infection, COPD, CHF, CAD with SOB	0.101	43.54 (1.15)	0.092	91.94 (4.26)
Bedfast proxy (Totally dependent and require 2+ person assist for walking/ locomotion)	0.066	25.30 (1.38)	0.116	22.04 (3.85)
Pneumonia	0.107	17.76 (1.14)	0.113	39.49 (3.86)
Tube Feeding with > 76% total calories <sup>^</sup>	0.101	15.45 (1.16)	0.113	6.77 (3.96)
Respiratory Infection	0.079	13.73 (1.31)	0.063	43.53 (4.95)
Application of dressing with/without topical medication and presence of ulcers or other skin lesions/wounds	0.052	10.60 (1.55)	0.276	-3.12 (3.18)
Skin Wound/Ulcer Care	0.284	4.58 (0.77)	0.283	9.68 (3.15)
Stage 4 Pressure Ulcer	0.042	1.29 (0.39)	0.088	9.87 (2.53)

Notes: N: 60,394 for six state model, 11,024 for three state model (Both models based on test sample only). This sample size differs from that from tables that are not based on regression results because of missing data in the MDS assessments. Observations missing data for any of the variables included in the regression models were excluded. Due the unavailability of the MDS 2.0 item that reports the percentage of total calories from parenteral or tube feedings for assessments from 1995 as well as assessments from Kansas, Maine, and Ohio, a version of the model was also estimated that did not use the interaction variables for parenteral/IV and tube feeding with the percentage of calories from parenteral or tube feedings. Instead, the six state version of the model used only indicators for whether the residents received parenteral/IV feeding or tube feeding.

*Data Source: Medicare MDS and SNF Claims Data 1995-1997.*

## 4.6 Description of Potential RUG-III Refinements

Given the high ancillary charges for residents who qualified for both Rehabilitation and Extensive Services, refinements were evaluated based on the creation of a new category for residents who qualify for both Extensive Services and a Rehabilitation category. This refinement produces some improvement in the ability of the casemix system to account for variance in ancillary charges using “internal changes” that are based on the existing RUG-III categories. In addition, the statistical

performance of the casemix system is improved through the use of the index model either to create new groups for selected RUG-III categories or as a separate “ancillary add-on”. The choice of which of the potential refinements to use is largely a policy decision based on a trade-off between improved statistical performance and increased casemix system complexity. There are a number of ways that index model-based refinements can be implemented, several of which are described below.

### **Development of index model-based refinements**

All of the index model-based refinements incorporate new categories for residents who qualify for both Extensive Services and a Rehabilitation category. There are a number of ways that index model-based refinements can be implemented:

- § The models can be based on an unweighted count of the number of index model variables present or on a weighted index that uses the index model variables to estimate predicted ancillary charges.
- § The index models can differ with respect to the RUG-III categories to which the model is applied. The two best options seemed to be to apply the index model only to Extensive Services residents (including Rehabilitation residents who qualify for Extensive Services) or to apply it to all residents in Clinically Complex or above RUG categories.
- § The index models can differ with respect to the number of index groups that are used. For the weighted index models described below, residents were put into one of six groups based on their predicted ancillary charges. For the unweighted model, four groups were used. The number of index groups can be changed, but there are trade-offs (in terms of decreased statistical performance) that result from decreasing the number of groups.
- § The index models can also vary based on the thresholds used to define groups. For the weighted index model, residents were classified based on whether their predicted costs were at the 50<sup>th</sup> percentile or below (group 1), the 51<sup>st</sup> - 75<sup>th</sup> percentile (group 2), the 76<sup>th</sup>-90<sup>th</sup> percentile (group 3), the 90<sup>th</sup> - 95<sup>th</sup> percentile (group 4), the 96<sup>th</sup> - 98<sup>th</sup> percentile (group 5) and the 99<sup>th</sup> percentile (group 6). For the unweighted index model, groups were defined based on whether zero, 1-2, 3-5, or 6 or more index model variables applied to the resident.
- § For the index model alternatives described below, the same index was used across all RUG-III categories, but it is also possible to apply category-specific index models. A number of potential refinements were tested, but focus on the models described below. Since several types of refinements were explored in depth, only the most powerful alternative from each type were selected for presentation here. These were:
  - § *Model RUG-III+*: This is the RUG-III model with new categories for residents who qualify for Extensive Services and one of the Rehabilitation categories, as described above. The resulting casemix system would have 14 additional Extensive Services and Rehabilitation groups, and would use the same Rehabilitation categories and ADL splits as the current Rehabilitation categories.<sup>6</sup>

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<sup>6</sup> It should be noted that RUG-III+ could also be implemented as a new terminal split within the existing Rehabilitation categories based on whether the resident also qualified for Extensive Services. Statistically, the two systems are identical.

- § *Model WIM 1:* Applies the weighted index model to Extensive Services residents (including residents in the new Extensive Services and Rehabilitation category). A disproportionate share of high cost residents qualify for Extensive Services, so it may make sense to apply the index model only to those residents. Using this refinement, the casemix system would have up to 143 groups if the index model were incorporated within RUG-III as new terminal splits. Alternatively, the system could be implemented as a six-group ancillary add-on system.
- § *Model WIM 2:* Applies the weighted index model to Extensive Services residents (including residents in the Extensive Services and Rehabilitation category), and to Rehabilitation, Special Care, and Clinically Complex residents. In this model, there would be up to 258 groups if it were implemented as new terminal splits rather than as a six -group ancillary add-on system.
- § *Model UWIM:* Applies the unweighted index model to Extensive Services residents (including residents in the Extensive Services and Rehabilitation category), and to Rehabilitation, Special Care, and Clinically Complex residents. In this model, there would be up to 178 groups if it were implemented as new terminal splits rather than as a 4-group ancillary add-on system.

(Note that for comparison purposes, the baseline RUG-III model was also evaluated.)

Although the proposed index model variables include interactions for parenteral/IV feeding and feeding tubes based on the proportion of calories that the resident obtained through parenteral feeding or feeding tubes, *this interaction was not included in analysis of the statistical performance of potential refinements.* The MDS item that reports proportion of calories from IV/feeding tube was available only for residents in Mississippi, South Dakota, and Texas. (Note that New York was excluded from the analysis for the reasons described in Section 2.0.) This analysis suggested that the statistical performance of the two models was comparable. *Although the interaction variables were not included in the potential refinements evaluated, it is recommend that they be included the refined casemix system.* The interaction variables are important for reducing the extent to which providers might inappropriately use parenteral/IV feeding or feeding tubes solely for the purpose of receiving a higher payment. Further research using a larger sample of MDS 2.0 assessments is needed, however, to calculate reliable estimates of the cost differences associated with these interaction items.

### **Model performance**

***RUG-III:*** RUG-III accounted for about four percent of the validation sample variance in ancillary charges and 9 percent of the variance in total costs (Table 4.6). Using the validation sample, predicted total costs for the 44 RUG-III groups ranged from \$127 (excluding a Behavior Only group which had very few residents and an imprecise predicted cost estimate) to \$247 (for SE3). Using RUG-III, 22 percent of residents in the top 10 percent in terms of actual ancillary charges were also in the top 10 percent in terms of predicted ancillary charges.

***RUG-III+:*** This model adds the new Extensive Services and Rehabilitation categories which resulted in small improvements in statistical performance. The validation sample R-squared increased to seven percent for ancillary charges (an increase of about three percent points relative to RUG-III), and to 13 percent for total costs. Predicted costs for the 58 groups in the RUG-III+ model ranged

from \$128 to \$357 (for one of the new Extensive Services and Ultra-high Rehabilitation groups). Ancillary costs were considerably higher for residents in the Rehabilitation and Extensive Services groups than for the Rehabilitation (only) groups (Table 4.7).

RUG-III+ was statistically less powerful than the other refinements examined, all of which incorporated RUG-III+ and index model-based refinements. The RUG-III+ refinement, however, adds less complexity than the index model-based refinements. It performs somewhat better than RUG-III in identifying high cost residents, a disproportionate share of whom qualify for both Extensive Services and Rehabilitation.

**WIM1:** Application of WIM1 resulted in some statistical improvement relative to RUG-III+. For the validation sample, the model accounted for 10 percent of the variance in ancillary charges and nearly 17 percent of the variance in total costs. For WIM1, 32 percent of residents in the top 10 percent of ancillary charges were also in the top 10 percent in terms of predicted costs.

WIM1 was dominated statistically by the WIM2 model, which also applied the index model to Rehabilitation (only), Special Care, and Clinically Complex residents. The only reason for favoring WIM1 over WIM2 is the somewhat greater simplicity of WIM1, which has fewer casemix groups.

**WIM2:** The WIM2 model accounted for 15 percent of the validation sample variance in ancillary charges and 21 percent of the validation sample variance in total costs. The range of payments was similar to that of WIM1. Using WIM2, 32 percent of residents in the top 10 percent in terms of actual ancillary charges were also in the top 10 percent in terms of predicted ancillary charges, a substantial improvement relative to RUG-III.

Model WIM2 was the most statistically powerful refinement that was examined. Because the model applies a six-group ancillary index to 40 RUG-III+ groups (14 Rehabilitation/Extensive Services groups, three Extensive Services groups, 14 Rehabilitation groups, three Special Care and six Clinically Complex groups), it results in a large number of groups (up to 258) if it is implemented as part of an integrated classification system. Alternatively, as with the other index model-based refinements, WIM2 could be thought of as a six group ancillary add-on that works alongside RUG-III to determine total payment.

Under WIM2, residents in Clinically Complex or above (including those in the new Extensive Services and Rehabilitation categories) would receive an ancillary “add-on” based on the index model variables applicable to the resident. There would be no additional ancillary “add-on” for residents whose predicted ancillary costs are below the 50<sup>th</sup> percentile. If the validation sample were used to set rates, the “add-on” would be as follows:

- \$11 for those between the 50<sup>th</sup> and 74<sup>th</sup> percentile
- \$51 for those in the 75<sup>th</sup>-89<sup>th</sup> percentile
- \$75 for those in the 90<sup>th</sup>-94<sup>th</sup> percentile
- \$126 for those in the 95<sup>th</sup>-98<sup>th</sup> percentile
- \$205 for those in the top 1 percent in terms of predicted ancillary charges.

The cutoff points for the index models are weighted towards high cost residents since those residents account for much of the variance in ancillary charges. Because of the emphasis on very high cost residents, the top payment rate (based on predicted costs) is \$467 (for residents in one of the Extensive Services and Ultra high Rehabilitation groups who are also in the highest index group (i.e., in the top one percent in terms of predicted ancillary charges). This was more than \$200 higher than the top predicted cost under RUG-III, showing the improved potential of the index model-based refinements to capture costs for residents with high resource needs. Table 4.8 shows (actual) ancillary costs and number of residents for each of the casemix groups that are created using WIM-2.

**UWIM:** This model is the unweighted counterpart to WIM2 and is based on a count of the number of index model items present rather than the cost difference associated with each item. While this model performed better than the RUG-III and RUG-III+ models, it did not perform as well as WIM2. The model would be favored over WIM2 if there were concerns about the complexity of the weighted index models or other concerns about the weighted models, perhaps because the cost data covered a period before implementation of PPS.

UWIM accounted for about 11 percent of the validation sample variance in ancillary charges and 19 percent of the variance in total costs. The range of payments for UWIM was quite similar to that of the weighted index models. The sensitivity and specificity of the model were slightly less than for WIM2.

Using UWIM, residents would be split into four groups based on the *number* of index model variables applicable to each resident. The splits used were 0 (44 percent of test sample observations), 1-2 (45 percent), 3-5 (10 percent) and 6 or more (one percent). Residents with no index model items present would receive no additional ancillary payment. Residents with one to two items present would receive \$20 (based on predicted ancillary charges for the test sample), those with three to five items would receive \$66 and those with six or more would receive \$128 (based on parameter estimates for the validation sample). Table 4.9 contains sample count and ancillary cost information for the UWIM groups.

**Table 4.6**  
**Statistical Performance of Potential RUG-III Refinements**

Model description	Number of groups	R-squared Test sample (Validation sample)		Min/Max $\sigma$	Specificity and sensitivity analyses Validation sample	
		Ancillary charges	Total Simulated costs		Specificity <sup>H</sup>	Sensitivity <sup>=</sup>
<b>RUG-III</b>	44	4.1% (3.5%)	10.0% (9.3%)	\$127/247	91.3%	22.2%
<b>RUG-III+</b> <i>RUG-III with new category "Extensive Services and Rehabilitation"</i>	58	8.0% (7.0%)	14.3% (13.4%)	\$128/357	91.6%	29.4%
<b>WIM 1</b> <i>Weighted index model applied to Extensive Services residents (includes new category "Extensive Services and Rehabilitation")</i>	58 plus a six-group ancillary add-on system	12.9% (10.5%)	19.1% (16.8%)	\$120/467	92.4%	32.3%
<b>WIM 2</b> <i>Weighted index model applied to Extensive Services residents (includes new category "Extensive Services and Rehabilitation") and to Rehabilitation, Special Care, and Clinically Complex residents</i>	58 plus a six-group ancillary add-on system	16.5% (14.8%)	22.8% (21.1%)	\$120/467	92.4%	32.3%
<b>UWIM</b> <i>Unweighted index model applied to Extensive Services residents (includes new category "Extensive Services and Rehabilitation") and to Rehabilitation, Special Care, and Clinically Complex residents</i>	58 plus a four-group ancillary add-on system	13.7% (11.7%)	20.6% (18.8%)	\$126/451	92.4%	32.3%

*Notes:* Sample sizes: Test sample: 61,789 for RUG-III and RUG-III+, 60,276 for WIM-1, WIM-2 and UWIM. Validation sample: 41,599 for RUG-III and RUG-III+, 40,637 for WIM-1, WIM-2 and UWIM. (Difference due to missing data in index model MDS items.)  
 $\sigma$ : Predicted total costs for the lowest (assumed to be PA1) and highest reimbursed groups in the refined casemix system (uses simulated staff time costs derived from HCFA's Staff Time Measurement Studies) based on validation sample.  
<sup>H</sup>: Specificity is measured as the proportion of residents who are not in the top 10 percent of predicted ancillary charges and also not in the top 10 percent in terms of actual ancillary charges.  
<sup>=</sup>: Sensitivity is measured as the proportion of residents in the top 10 percent in terms of both predicted and actual ancillary charges.

*Data sources: Medicare MDS and SNF Claims Data, 1995-1997*

**Table 4.7**  
**Count by Group and Mean Ancillary Charges for the RUG-III+ Model**

RUG-III+ Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
<b>REHABILITATION AND EXTENSIVE SERVICES</b>					
<b>Ultra-high Rehabilitation and Extensive Services</b>	RUC+SE	184	\$195.70	130	\$171.29
	RUB+SE	285	\$169.28	177	\$149.86
	RVA+SE	27	\$110.33	13	\$78.02
<b>Very-high Rehabilitation and Extensive Services</b>	RVC+SE	160	\$133.24	105	\$154.72
	RVB+SE	254	\$117.65	158	\$139.11
	RVA+SE	32	\$129.01	21	\$104.82
<b>High Rehabilitation and Extensive Services</b>	RHC+SE	248	\$112.39	169	\$106.56
	RHB+SE	130	\$121.76	73	\$118.42
	RHA+SE	1	\$34.66	2	\$196.40
<b>Medium Rehabilitation and Extensive Services</b>	RMC+SE	755	\$121.80	502	\$114.40
	RMB+SE	759	\$80.51	492	\$89.96
	RMA+SE	15	\$89.02	3	\$109.21
<b>Low Rehabilitation and Extensive Services</b>	RLB+SE	40	\$119.60	36	\$84.46
	RLA+SE	34	\$72.68	24	\$81.04
<b>REHABILITATION (only)</b>					
<b>Ultra-high rehabilitation</b>	RUC	793	\$44.11	599	\$47.90
	RUB	2822	\$42.20	2009	\$45.58
<b>Very high rehabilitation</b>	RVA	1207	\$48.78	896	\$40.67
	RVC	697	\$43.80	456	\$41.06
	RVB	2604	\$39.29	1725	\$39.76
	RVA	1368	\$46.72	976	\$43.74
<b>High rehabilitation</b>	RHC	1577	\$32.94	1104	\$33.13
	RHB	1684	\$31.36	1138	\$33.45
	RHA	906	\$39.66	662	\$38.67
<b>Medium rehabilitation</b>	RMC	3104	\$35.89	2050	\$36.36
	RMB	6443	\$31.55	4426	\$33.80
	RMA	2432	\$36.68	1625	\$36.21
<b>Low rehabilitation</b>	RLB	367	\$26.43	284	\$24.16
	RLA	667	\$24.03	394	\$26.51
<b>EXTENSIVE SERVICES</b>					
	SE3	2079	\$112.07	1294	\$108.21
	SE2	3124	\$88.35	2088	\$82.90
	SE1	302	\$55.04	208	\$51.06
<b>SPECIAL CARE</b>					
	SSC	3214	\$38.71	2111	\$40.81
	SSB	3708	\$36.26	2541	\$37.41
	SSA	6533	\$40.60	4399	\$42.99
<b>CLINICALLY COMPLEX</b>					
	CC2	58	\$57.56	37	\$27.49
	CC1	317	\$54.39	229	\$46.87
	CB2	272	\$34.24	176	\$28.87
	CB1	1475	\$42.93	1005	\$37.72
	CA2	822	\$40.17	558	\$37.01
	CA1	5117	\$36.24	3332	\$37.33

**Table 4.7**  
**Count by Group and Mean Ancillary Charges for the RUG-III+ Model**

RUG-III+ Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
<b>IMPAIRED COGNITION</b>	IB2	60	\$16.47	29	\$18.68
	IB1	562	\$21.46	379	\$18.75
	IA2	12	\$18.15	6	\$14.46
	IA1	377	\$23.82	272	\$19.95
<b>BEHAVIORAL ONLY</b>	BB2	1	\$0.03	3	\$10.05
	BB1	51	\$30.27	36	\$32.07
	BA2	2	\$22.05	0	N/A
	BA1	71	\$27.08	37	\$43.44
<b>REDUCED PHYSICAL FUNCTIONING</b>	PE2	41	\$15.13	10	\$9.48
	PE1	401	\$33.64	253	\$30.36
	PD2	119	\$16.64	52	\$24.93
	PD1	1183	\$29.97	800	\$29.11
	PC2	33	\$15.72	16	\$18.82
	PC1	341	\$21.38	246	\$27.49
	PB2	39	\$10.80	27	\$19.11
	PB1	602	\$28.32	387	\$27.58
	PA2	40	\$19.34	24	\$14.66
	PA1	1181	\$29.09	756	\$29.00

Notes: The 'A' suffix corresponds to group A of the WIM-2 model (predicted ancillary charges in the highest 1 percent), B indicates predicted ancillary charges in the 95-99<sup>th</sup> percentile, C is the 90-95<sup>th</sup> percentile, D is the 75<sup>th</sup>-90<sup>th</sup> percentile, E is the 50<sup>th</sup>-75<sup>th</sup> percentile, and F is for residents with predicted ancillary costs below the 50<sup>th</sup> percentile

Sources: Medicare MDS and SNF claims data, 1995-1997

**Table 4.8**  
**Count by Group and Mean Ancillary Charges for the WIM-2 Model**

WIM-2 Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
<b>REHABILITATION AND EXTENSIVE SERVICES</b>					
<b>Ultra-high Rehabilitation and Extensive Services</b>	RUC+SE-A	24	\$439.69	17	\$299.56
	RUC+SE-B	63	\$217.70	45	\$188.39
	RUC+SE-C	44	\$147.73	31	\$137.98
	RUC+SE-D	52	\$96.65	37	\$119.45
	RUB+SE-A	20	\$343.85	10	\$417.96
	RUB+SE-B	58	\$308.79	52	\$199.57
	RUB+SE-C	47	\$213.73	28	\$95.99
	RUB+SE-D	156	\$85.56	85	\$105.95
	RUA+SE-B	5	\$159.76	1	\$302.63
	RUA+SE-C	4	\$106.87	1	\$4.79
	RUA+SE-D	18	\$97.36	11	\$64.26
<b>Very-high Rehabilitation and Extensive Services</b>	RVC+SE-A	12	\$309.69	9	\$318.22
	RVC+SE-B	60	\$186.79	31	\$229.05
	RVC+SE-C	38	\$91.38	34	\$113.53
	RVC+SE-D	50	\$58.43	27	\$85.14
	RVC+SE-F	0		1	\$20.94
	RVB+SE-A	6	\$361.34	10	\$371.75
	RVB+SE-B	63	\$205.50	33	\$171.66
	RVB+SE-C	45	\$80.64	24	\$120.14
	RVB+SE-D	134	\$78.62	88	\$109.99
	RVC+SE-B	9	\$176.26	3	\$130.28
	RVC+SE-C	3	\$286.58	7	\$91.38
	RVC+SE-D	19	\$87.81	11	\$106.42
	<b>High Rehabilitation and Extensive Services</b>	RHC+SE-A	18	\$238.17	10
RHC+SE-B		77	\$173.27	47	\$146.91
RHC+SE-C		52	\$101.06	35	\$70.41
RHC+SE-D		96	\$48.26	75	\$72.68
RHC+SE-E		1	\$33.52	1	\$166.85
RHB+SE-A		3	\$259.25	3	\$284.51
RHB+SE-B		29	\$224.88	17	\$211.16
RHB+SE-C		20	\$90.13	8	\$105.25
RHB+SE-D		76	\$84.86	41	\$76.41
RHB+SE-E		1	\$122.40	2	\$88.88
RHA+SE-B		0		1	\$362.65
RHA+SE-D	1	\$34.66	1	\$30.15	
<b>Medium Rehabilitation and Extensive Services</b>	RMC+SE-A	80	\$286.04	54	\$276.97
	RMC+SE-B	238	\$159.52	141	\$143.55
	RMC+SE-C	170	\$90.02	119	\$89.22
	RMC+SE-D	261	\$58.78	184	\$59.83
	RMB+SE-A	18	\$190.67	7	\$191.28

**Table 4.8**  
**Count by Group and Mean Ancillary Charges for the WIM-2 Model**

WIM-2 Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
	RMB+SE-B	109	\$149.02	72	\$169.34
	RMB+SE-C	129	\$91.08	92	\$100.26
	RMB+SE-D	492	\$59.32	317	\$67.13
	RMB+SE-E	3	\$26.54	0	N/A
	RMB+SE-F	2	\$15.52	1	\$175.67
	RMA+SE-B	1	\$394.81	1	\$0.00
	RMA+SE-D	14	\$67.18	2	\$163.82
<b>Low Rehabilitation and Extensive Services</b>	RLB+SE-A	1	\$272.71	2	\$438.92
	RLB+SE-B	10	\$253.82	8	\$40.57
	RLB+SE-C	11	\$66.35	12	\$75.16
	RLB+SE-D	18	\$69.07	14	\$66.86
	RLA+SE-A	1	\$165.37	1	\$51.42
	RLA+SE-B	1	\$13.59	1	\$250.55
	RLA+SE-C	7	\$31.59	2	\$90.98
	RLA+SE-D	25	\$82.85	20	\$73.05
<b>REHABILITATION (ONLY)</b>					
<b>Ultra-high rehabilitation</b>	RUC-B	1	\$161.44	2	\$218.73
	RUC-C	17	\$170.45	13	\$142.57
	RUC-D	83	\$69.58	56	\$93.94
	RUC-E	416	\$45.15	328	\$46.60
	RUC-F	269	\$27.04	195	\$29.05
	RUB-B	2	\$65.76	3	\$165.32
	RUB-C	34	\$137.16	24	\$172.23
	RUB-D	158	\$100.18	124	\$95.65
	RUB-E	1036	\$49.26	707	\$50.80
	RUB-F	1560	\$29.75	1136	\$33.77
	RUA-A	3	\$226.29	1	\$401.30
	RUA-B	6	\$373.77	5	\$124.07
	RUA-C	15	\$113.59	6	\$61.75
	RUA-D	109	\$131.89	77	\$105.28
	RUA-E	248	\$46.37	226	\$42.38
	RUA-F	814	\$34.06	568	\$30.11
<b>Very-high Rehabilitation</b>	RVC-B	3	\$135.82	0	N/A
	RVC-C	16	\$102.73	10	\$144.83
	RVC-D	70	\$87.20	48	\$68.46
	RVC-E	350	\$39.44	218	\$43.94
	RVC-F	253	\$31.73	177	\$22.57
	RVB-B	2	\$98.41	0	N/A
	RVB-C	31	\$139.19	25	\$142.15
	RVB-D	189	\$114.63	117	\$100.36
	RVB-E	965	\$38.80	590	\$41.67
	RVB-F	1376	\$25.96	971	\$29.00

**Table 4.8**  
**Count by Group and Mean Ancillary Charges for the WIM-2 Model**

WIM-2 Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
	RVA-B	5	\$370.82	8	\$167.62
	RVA-C	29	\$144.36	14	\$112.56
	RVA-D	142	\$104.16	99	\$121.86
	RVA-E	336	\$47.85	234	\$42.29
	RVA-F	838	\$30.48	612	\$27.03
	<b>High rehabilitation</b>	RHC-B	1	\$165.58	3
RHC-C		25	\$79.13	14	\$111.91
RHC-D		117	\$78.89	85	\$58.68
RHC-E		702	\$34.26	518	\$35.78
RHC-F		718	\$22.12	476	\$22.32
RHB-C		22	\$83.48	14	\$119.71
RHB-D		140	\$93.59	94	\$91.64
RHB-E		481	\$29.07	314	\$33.14
RHB-F		1022	\$22.47	700	\$24.22
RHA-B		12	\$236.55	12	\$166.90
RHA-C		22	\$87.41	14	\$132.13
RHA-D		117	\$97.65	82	\$81.08
RHA-E		183	\$41.39	117	\$33.93
<b>Medium rehabilitation</b>		RHA-F	566	\$21.20	435
	RMC-B	11	\$84.84	5	\$124.72
	RMC-C	79	\$109.16	54	\$112.08
	RMC-D	286	\$70.39	177	\$73.37
	RMC-E	1527	\$35.48	1007	\$35.29
	RMC-F	1178	\$22.41	798	\$23.76
	RMB-B	3	\$237.08	3	\$115.30
	RMB-C	85	\$117.15	64	\$119.18
	RMB-D	500	\$68.30	385	\$83.10
	RMB-E	2101	\$35.12	1422	\$32.91
	RMB-F	3689	\$22.35	2519	\$24.31
	RMA-A	1	\$804.80	2	\$62.52
	RMA-B	23	\$165.66	18	\$161.64
	RMA-C	43	\$126.37	35	\$110.95
	RMA-D	317	\$75.88	252	\$76.44
	RMA-E	486	\$35.66	344	\$33.61
RMA-F	1538	\$23.83	965	\$21.72	
<b>Low rehabilitation</b>	RLB-B	2	\$109.15	0	N/A
	RLB-C	5	\$121.92	7	\$86.32
	RLB-D	33	\$41.70	26	\$35.85
	RLB-E	174	\$26.16	118	\$21.03
	RLB-F	150	\$19.42	133	\$21.39
	RLA-A	1	\$119.11	0	N/A
	RLA-B	1	\$222.55	0	N/A

**Table 4.8**  
**Count by Group and Mean Ancillary Charges for the WIM-2 Model**

WIM-2 Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
	RLA-C	13	\$55.98	14	\$69.99
	RLA-D	75	\$51.84	32	\$68.23
	RLA-E	177	\$22.42	98	\$22.31
	RLA-F	397	\$17.77	250	\$20.38
<b>EXTENSIVE SERVICES</b>	SE3-A	240	\$255.40	163	\$190.43
	SE3-B	787	\$128.40	493	\$130.62
	SE3-C	503	\$78.47	319	\$72.85
	SE3-D	519	\$54.96	300	\$64.55
	SE2-A	162	\$211.30	104	\$169.58
	SE2-B	638	\$120.38	436	\$122.69
	SE2-C	722	\$83.15	500	\$72.22
	SE2-D	1300	\$69.75	850	\$65.73
	SE2-E	82	\$41.07	61	\$32.09
	SE2-F	30	\$45.89	17	\$45.95
	SE1-A	6	\$218.53	1	\$264.77
	SE1-B	21	\$91.01	14	\$149.94
	SE1-C	71	\$43.39	51	\$44.50
	SE1-D	151	\$53.81	93	\$51.24
	SE1-E	10	\$44.85	5	\$120.03
	SE1-F	11	\$33.82	15	\$17.44
<b>SPECIAL CARE</b>	SSC-B	23	\$107.18	18	\$195.96
	SSC-C	150	\$69.23	96	\$101.98
	SSC-D	527	\$53.98	357	\$56.05
	SSC-E	1738	\$33.12	1106	\$34.77
	SSC-F	679	\$27.78	467	\$24.00
	SSB-B	18	\$60.76	10	\$123.91
	SSB-C	130	\$89.66	94	\$112.84
	SSB-D	452	\$54.82	321	\$58.81
	SSB-E	2024	\$34.32	1341	\$32.71
	SSB-F	963	\$22.95	703	\$23.77
	SSA-A	6	\$86.91	7	\$169.76
	SSA-B	130	\$125.56	64	\$134.53
	SSA-C	270	\$63.76	196	\$100.32
	SSA-D	1143	\$70.32	765	\$71.01
	SSA-E	2585	\$31.54	1790	\$31.06
	SSA-F	2090	\$25.91	1387	\$27.63
<b>CLINICALLY COMPLEX</b>	CC2-C	3	\$96.41	1	\$88.30
	CC2-D	5	\$120.05	3	\$18.58
	CC2-E	26	\$70.78	11	\$21.02
	CC2-F	23	\$25.58	21	\$21.27
	CC1-B	2	\$325.29	0	N/A
	CC1-C	19	\$104.79	10	\$195.05
	CC1-D	64	\$70.37	52	\$70.51
	CC1-E	120	\$47.28	83	\$31.23

**Table 4.8**  
**Count by Group and Mean Ancillary Charges for the WIM-2 Model**

WIM-2 Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
	CC1-F	103	\$27.59	76	\$25.46
	CB2-B	0	N/A	1	\$0.00
	CB2-C	9	\$29.43	4	\$153.83
	CB2-D	41	\$95.82	26	\$36.29
	CB2-E	69	\$28.59	36	\$26.44
	CB2-F	142	\$18.53	105	\$23.79
	CB1-B	2	\$234.11	2	\$38.03
	CB1-C	50	\$114.05	25	\$60.19
	CB1-D	199	\$63.54	141	\$74.99
	CB1-E	442	\$51.35	329	\$42.76
	CB1-F	728	\$27.07	478	\$22.05
	CA2-C	20	\$103.42	9	\$97.71
	CA2-D	155	\$64.68	96	\$58.53
	CA2-E	158	\$33.71	109	\$36.67
	CA2-F	463	\$29.75	325	\$27.65
	CA1-B	1	\$268.43	2	\$30.87
	CA1-C	75	\$87.13	65	\$116.38
	CA1-D	789	\$71.21	493	\$68.16
	CA1-E	1311	\$36.99	863	\$39.96
	CA1-F	2780	\$24.06	1797	\$23.76
<b>IMPAIRED COGNITION</b>	IB2	59	\$16.58	28	\$18.83
	IB1	555	\$21.28	378	\$18.80
	IA2	12	\$18.15	4	\$16.74
	IA1	373	\$23.94	267	\$19.90
<b>BEHAVIORAL ONLY</b>	BB2	1	\$0.03	2	\$13.25
	BB1	51	\$30.27	35	\$32.73
	BA2	2	\$22.05	0	N/A
	BA1	70	\$27.46	37	\$43.44
<b>REDUCED PHYSICAL FUNCTIONING</b>	PE2	41	\$15.13	9	\$9.90
	PE1	395	\$33.48	251	\$30.49
	PD2	117	\$16.89	51	\$24.96
	PD1	1167	\$29.98	792	\$29.03
	PC2	33	\$15.72	15	\$19.88
	PC1	333	\$21.27	239	\$26.53
	PB2	38	\$9.90	26	\$19.51
	PB1	595	\$27.44	377	\$26.38
	PA2	39	\$13.98	23	\$15.02
	PA1	1121	\$26.48	707	\$24.54

Notes: The 'A' suffix corresponds to group A of the WIM-2 model (predicted ancillary charges in the highest 1 percent), B indicates predicted ancillary charges in the 95-99<sup>th</sup> percentile, C is the 90-95<sup>th</sup> percentile, D is the 75<sup>th</sup>-90<sup>th</sup> percentile, E is the 50<sup>th</sup>-75<sup>th</sup> percentile, and F is for residents with predicted ancillary costs below the 50<sup>th</sup> percentile

Sources: Medicare MDS and SNF claims data, 1995-1997.

**Table 4.9**  
**Count by Group and Mean Ancillary Charges for the UWIM Model**

UWIM Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
<b>REHABILITATION AND EXTENSIVE SERVICES</b>					
<b>Ultra-high Rehabilitation and Extensive Services</b>	RUC+SE-A	24	\$480.63	9	\$392.03
	RUC+SE-B	89	\$187.08	65	\$170.01
	RUC+SE-C	70	\$108.69	56	\$137.29
	RUB+SE-A	12	\$354.40	4	\$615.38
	RUB+SE-B	84	\$296.62	73	\$183.68
	RUB+SE-C	185	\$102.76	98	\$105.92
	RUA+SE-B	4	\$151.41	3	\$109.22
	RUA+SE-C	23	\$103.18	10	\$68.66
<b>Very-high Rehabilitation and Extensive Services</b>	RVC+SE-A	16	\$312.01	8	\$247.30
	RVC+SE-B	73	\$143.89	47	\$220.57
	RVC+SE-C	71	\$82.00	46	\$82.13
	RVC+SE-D	0	N/A	1	\$20.94
	RVB+SE-A	5	\$379.45	3	\$292.60
	RVB+SE-B	78	\$159.30	57	\$175.80
	RVB+SE-C	165	\$90.64	95	\$116.28
	RVC+SE-B	13	\$194.13	5	\$91.01
RVC+SE-C	18	\$88.38	16	\$109.13	
<b>High Rehabilitation and Extensive Services</b>	RHC+SE-A	17	\$218.27	7	\$300.11
	RHC+SE-B	96	\$159.20	76	\$116.27
	RHC+SE-C	131	\$65.32	85	\$82.36
	RHB+SE-A	1	\$259.77	2	\$646.27
	RHB+SE-B	38	\$166.43	20	\$141.87
	RHB+SE-C	90	\$101.00	47	\$91.24
	RHB+SE-D	0	N/A	2	\$88.88
	RHC+SE-C	1	\$34.66	1	\$30.15
<b>Medium Rehabilitation and Extensive Services</b>	RMC+SE-A	67	\$275.09	36	\$269.54
	RMC+SE-B	338	\$155.16	217	\$131.93
	RMC+SE-C	344	\$59.94	245	\$75.47
	RMB+SE-A	8	\$144.23	5	\$204.61
	RMB+SE-B	187	\$126.05	121	\$130.35
	RMB+SE-C	556	\$64.69	362	\$75.25
	RMB+SE-D	2	\$15.52	1	\$175.67
	RMA+SE-B	1	\$394.81	1	\$0.00
RMA+SE-C	14	\$67.18	2	\$163.82	
<b>Low Rehabilitation and Extensive Services</b>	RLB+SE-A	0	N/A	2	\$288.63
	RLB+SE-B	16	\$191.59	16	\$58.24
	RLB+SE-C	24	\$71.61	18	\$85.07
	RLA+SE-B	3	\$63.99	4	\$120.98
	RLA+SE-C	31	\$73.52	20	\$73.05
<b>REHABILITATION (ONLY)</b>					
<b>Ultra-high rehabilitation</b>	RUC-A	2	\$260.98	3	\$86.30
	RUC-B	79	\$92.42	50	\$105.44
	RUC-C	436	\$45.40	346	\$50.02

**Table 4.9**  
**Count by Group and Mean Ancillary Charges for the UWIM Model**

UWIM Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
Very-high Rehabilitation	RUC-D	269	\$27.04	195	\$29.05
	RUB-A	5	\$24.58	4	\$157.79
	RUB-B	113	\$86.83	74	\$121.91
	RUB-C	1115	\$55.42	782	\$54.70
	RUB-D	1557	\$29.76	1134	\$33.81
	RUA-B	30	\$128.01	11	\$132.98
	RUA-C	351	\$75.95	304	\$57.94
	RUA-D	814	\$34.06	568	\$30.11
	RVC-A	4	\$43.53	3	\$38.46
	RVC-B	63	\$86.84	54	\$85.06
	RVC-C	374	\$43.68	219	\$43.86
	RVC-D	251	\$31.90	177	\$22.57
	RVB-A	2	\$205.13	2	\$95.05
	RVB-B	95	\$97.18	58	\$94.14
	RVB-C	1092	\$49.52	673	\$50.89
	RVB-D	1374	\$25.93	970	\$29.02
High rehabilitation	RVA-B	44	\$167.64	23	\$153.85
	RVA-C	468	\$63.11	334	\$65.96
	RVA-D	838	\$30.48	612	\$27.03
	RHC-A	5	\$127.51	8	\$129.85
	RHC-B	90	\$64.76	70	\$64.00
	RHC-C	753	\$38.53	543	\$36.36
	RHC-D	715	\$22.13	475	\$22.35
	RHB-A	1	\$51.14	26	\$84.66
	RHB-B	41	\$63.57	396	\$46.70
	RHB-C	601	\$43.70	700	\$24.22
Medium rehabilitation	RHB-D	1022	\$22.47	1	\$362.65
	RHA-B	27	\$188.15	20	\$135.08
	RHA-C	307	\$60.85	206	\$57.38
	RHA-D	566	\$21.20	434	\$25.47
	RMC-A	7	\$78.76	12	\$74.63
	RMC-B	272	\$78.33	164	\$82.89
	RMC-C	1627	\$38.14	1071	\$38.08
	RMC-D	1175	\$22.44	794	\$23.78
	RMB-A	3	\$170.96	2	\$195.34
	RMB-B	178	\$90.06	113	\$97.74
	RMB-C	2513	\$40.67	1763	\$42.77
	RMB-D	3684	\$22.35	2515	\$24.32
	RMA-A	1	\$171.36	2	\$24.27
	RMA-B	69	\$134.24	55	\$114.54
Low rehabilitation	RMA-C	802	\$52.44	594	\$52.85
	RMA-D	1536	\$23.82	965	\$21.72
	RLB-B	25	\$55.75	22	\$51.27
	RLB-C	190	\$28.43	129	\$22.40
	RLB-D	149	\$19.28	133	\$21.39

**Table 4.9**  
**Count by Group and Mean Ancillary Charges for the UWIM Model**

UWIM Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
	RLB-B	19	\$63.90	18	\$50.38
	RLB-C	248	\$31.10	126	\$35.26
	RLB-D	397	\$17.77	250	\$20.38
<b>EXTENSIVE SERVICES</b>	SE3-A	182	\$253.27	120	\$186.62
	SE3-B	1073	\$129.30	689	\$121.30
	SE3-C	794	\$57.31	466	\$68.82
	SE2-A	118	\$177.64	80	\$130.03
	SE2-B	993	\$118.17	657	\$118.24
	SE2-C	1793	\$70.72	1214	\$63.41
	SE2-D	30	\$45.89	17	\$45.95
	SE1-B	35	\$99.01	21	\$88.61
	SE1-C	224	\$50.94	143	\$56.91
	SE1-D	11	\$33.82	15	\$17.44
<b>SPECIAL CARE</b>	SSC-A	32	\$74.99	16	\$45.64
	SSC-B	551	\$59.04	385	\$63.95
	SSC-C	1856	\$34.54	1178	\$39.51
	SSC-D	678	\$27.56	465	\$23.86
	SSB-A	22	\$75.48	24	\$104.83
	SSB-B	471	\$58.58	330	\$70.68
	SSB-C	2138	\$36.45	1414	\$34.49
	SSB-D	956	\$22.91	701	\$23.82
	SSA-A	7	\$207.60	7	\$77.91
	SSA-B	450	\$80.60	306	\$98.12
	SSA-C	3681	\$43.09	2513	\$43.32
	SSA-D	2086	\$25.79	1383	\$27.68
<b>CLINICALLY COMPLEX</b>	CC2-B	3	\$77.19	1	\$55.34
	CC2-C	31	\$80.59	14	\$22.85
	CC2-D	23	\$25.58	21	\$21.27
	CC1-A	1	\$120.27	1	\$0.00
	CC1-B	40	\$88.83	25	\$79.04
	CC1-C	165	\$55.60	120	\$51.94
	CC1-D	102	\$27.58	75	\$25.80
	CB2-B	9	\$59.12	6	\$108.11
	CB2-C	111	\$50.83	61	\$30.52
	CB2-D	141	\$18.60	105	\$23.79
	CB1-A	1	\$37.19		
	CB1-B	57	\$96.99	45	\$80.79
	CB1-C	637	\$56.68	453	\$49.90
	CB1-D	726	\$26.92	477	\$22.06
	CA2-B	18	\$108.42	12	\$88.49
	CA2-C	315	\$49.11	202	\$46.70
	CA2-D	463	\$29.75	325	\$27.65
	CA1-A	1	\$10.91		
	CA1-B	113	\$88.58	82	\$100.34

**Table 4.9**  
**Count by Group and Mean Ancillary Charges for the UWIM Model**

UWIM Category	Code	Test Sample		Validation Sample	
		Count	Mean	Count	Mean
	CA1-C	2064	\$49.23	1342	\$50.30
	CA1-D	2778	\$24.02	1796	\$23.76
<b>IMPAIRED COGNITION</b>	IB2	59	\$16.58	28	\$18.83
	IB1	555	\$21.28	378	\$18.80
	IA2	12	\$18.15	4	\$16.74
	IA1	373	\$23.94	267	\$19.90
<b>BEHAVIORAL ONLY</b>	BB2	1	\$0.03	2	\$13.25
	BB1	51	\$30.27	35	\$32.73
	BA2	2	\$22.05	0	N/A
	BA1	70	\$27.46	37	\$43.44
<b>REDUCED PHYSICAL FUNCTIONING</b>	PE2	41	\$15.13	9	\$9.90
	PE1	395	\$33.48	251	\$30.49
	PD2	117	\$16.89	51	\$24.96
	PD1	1167	\$29.98	792	\$29.03
	PC2	33	\$15.72	15	\$19.88
	PC1	333	\$21.27	239	\$26.53
	PB2	38	\$9.90	26	\$19.51
	PB1	595	\$27.44	377	\$26.38
	PA2	39	\$13.98	23	\$15.02
	PA1	1121	\$26.48	707	\$24.54

Notes: The 'A' suffix corresponds to group A of the WIM-2 model (predicted ancillary charges in the highest 1 percent), B indicates predicted ancillary charges in the 95-99<sup>th</sup> percentile, C is the 90-95<sup>th</sup> percentile, D is the 75<sup>th</sup>-90<sup>th</sup> percentile, E is the 50<sup>th</sup>-75<sup>th</sup> percentile, and F is for residents with predicted ancillary costs below the 50<sup>th</sup> percentile

Sources: Medicare MDS and SNF claims data, 1995-1997.

## Limitations to the Analysis

The potential refinements described in Table 4.6 result in some improvement over the RUG-III system, but the results are only moderately successful. The most powerful model designed achieved rather modest predictive power, explaining 15 percent of the variance in ancillary charges and about 21 percent of the variance in total costs (for the validation sample). While this represents the best result that could be produced given select limitations, the findings do suggest that one of the recommended models be implemented. The potential refinements do lead to improved statistical performance and allow for higher payment rates for residents with characteristics associated with high ancillary charges, addressing some significant portion of the long term care industry's concerns.

It is informative to understand the reasons for the relatively modest results that were observed. They are largely the result of several phenomena. Two have the result of increasing the “noise”, or measurement error, in either the dependent variable (costs) or the independent variables (the MDS items), reducing the predictive power of RUG-III and potential refinements.

- § *Measurement error in the derivation of ancillary charges.* Deriving accurate measures of drug costs from Section U or measures of ancillary charges from Medicare claims data have intrinsic problems (see discussion in Section 2.0 regarding limitations in ancillary charge measures based on SNF claims and reasons for differences between drug cost measures based on SNF claims and Section U).
- § *Measurement error in resident characteristics.* By using a population-based sample, it can be expected that some MDS assessments will be accurate, but a substantial portion may have been inaccurately completed, especially for items that do not affect payment rates. In the earlier Abt study, the statistical performance of potential refinements similar to those described above was somewhat higher (Abt Associates, 1999, unpublished). For example, a model similar to WIM2 achieved a variance explanation of 24 percent (validation sample) in the earlier study, compared to 19 percent in the current study. This may partly be due to lower quality MDS data. The MDS assessments used in the earlier study were collected as part of HCFA's Staff Time Measurement Study and were likely to be more accurately completed than the MDS assessments used for this study. This suggests that if particular items are identified in the casemix system as related to reimbursement, the accuracy of these items will increase and the eventual explanation of actual cost can be expected to increase concurrently.

In addition to reductions in statistical performance resulting from measurement error, there is considerable variation in ancillary charges across states (See Appendix G) and facilities (e.g., hospital-based, for-profit/non-profit, part of chain). These items are associated with differences in ancillary charges, but are not appropriate for inclusion in index models or other types of casemix refinements. The portion of ancillary charge variance that is due to state and facility effects, as well as other variables that could not be included in the models is thus beyond the reach of the models, reducing statistical performance. In future work, the models should be expanded upon, in order to control for some of these effects, and thereby give a more accurate picture of the true between-resident variation in costs.

## 5.0 Conclusions and Recommendations

The Medicare SNF prospective payment system, which began in July 1998, covers virtually all costs for services provided to residents while in a Part A stay, including routine services, ancillary, and capital-related costs. Payment is casemix-adjusted based on the RUG-III classification system. The primary purpose of this study was to evaluate potential refinements to RUG-III that improved the ability of the system to predict variance in non-therapy ancillary charges. Data on non-therapy ancillary charges were measured using Medicare claims data.

RUG-III was developed based on nursing and therapy time and does not reflect differences in medical conditions or other resident characteristics associated with higher ancillary charges (e.g., prescription drugs, medical equipment and supplies, IV therapy). The analyses presented in this report show that RUG-III accounted for only four percent of the variance in *per diem* ancillary charges and nine percent of the variance in a measure of total costs that included ancillary charges and a simulated staff time cost measure (data on actual staff time costs were unavailable).

The relatively low statistical power of RUG-III in predicting total costs (staff time plus ancillary charges) raises concerns about the adequacy of the system to adjust for resident characteristics associated with differences in the level of non-therapy ancillary charges, particularly for residents who require more medically complex care. A casemix system that accounts for only a small proportion of the variance in costs may lead to access or quality-related problems for high-cost residents. It may also increase opportunities for the skimming of financially attractive residents, and increases financial risk to providers.

A set of potential RUG-III refinements was developed that was designed to improve the casemix system's ability to capture variance in non-therapy ancillary charges, particularly for residents who require more medically complex care. It should be noted that the analyses were designed to augment, but not replace, the RUG-III system. The RUG-III system has been proven in a large number of studies, both in the U.S. and abroad, to be effective in explaining nursing and therapy costs (see Appendix A). Because one of the main goals of these analyses was to maintain the basic RUG-III structure, potential refinements were primarily designed as splits of the RUG-III groups; for example, as an index "add-on" to existing RUG-III groups.

In the analysis of potential refinements, a number of approaches were considered. Analytic results pointed to the use of regression-derived index models of multiple MDS variables rather than AID-derived interactive tree structures based on "indicator variables." The use of index models based on multiple variables has a disadvantage of adding complexity to the system, but the advantage that increased payment is likely linked to more than one single resident characteristic or service. Evaluation of potential changes to the casemix system is a complicated process, which involves consideration not only of the statistical factors that are emphasized in this report, but also of the clinical meaningfulness of the casemix categories and the incentive effects that the system introduces.

Development of index model-based refinements began with a search for variables associated with large differences in costs for residents, either overall or within RUG-III categories. Through an iterative process, a group of MDS items that were associated with differences in non-therapy ancillary charges

were identified. This search was not limited only to those variables already utilized in the RUG-III classification system.

In addition to index model-based refinements, potential modifications based on interactions between existing RUG-III categories were examined. The most promising of these was based on a new category for residents who qualified for both the Rehabilitation and Extensive Services RUG-III categories. The RUG-III Rehabilitation category included some residents who also qualify for Extensive Services. Mean ancillary charges for residents who qualified for both categories were much higher (\$119 per day) than for residents who qualified only for Rehabilitation (\$37 per day).

## Recommendations

It is recommended that a new ‘Extensive Services and Rehabilitation’ category be added. The structure of this new category would be similar to the RUG-III Rehabilitation category, but would include residents who also qualify for the Extensive Services category. This new category would go at the “top” of the casemix system (i.e., residents would be considered first for inclusion in these categories); the Extensive Services and the existing Rehabilitation categories would now include only one type of resident or the other. The ADL splits for these five new “Extensive Services and Rehabilitation” categories would be the same as for the corresponding RUG-III Rehabilitation category. This proposed refinement has been termed the “RUG-III+” model.

While many of the most expensive residents qualified for Extensive Services, considerable within-category variance in cost remained even after the addition of the new Extensive Services and Rehabilitation category. Failure to refine the casemix system so that it explains some of this variance will continue to leave a great deal of variance unadjusted for in the resident classification system.

The predictive power of the RUG-III classification system can be further improved by incorporating refinements based on the index model. It is recommended that HCFA implement one of two index model-based refinements:

- § *Model WIM 2:* Applies the weighted index model to Extensive Services residents (including residents in the Extensive Services and Rehabilitation category), and to Rehabilitation, Special Care, and Clinically Complex residents. Model WIM2 was the most statistically powerful refinement examined. It accounted for 15 percent of the variance in ancillary charges and 21 percent of the validation sample variance in total costs. Because the model applies a six-group ancillary index to 40 RUG-III+ groups (14 Rehabilitation/Extensive Services groups, three Extensive Services groups, 14 Rehabilitation groups, three Special Care and six Clinically Complex groups), it results in a large number of groups (up to 258) if it is implemented as part of an integrated classification system. Alternatively, as with the other index model-based refinements, WIM2 could be thought of as a six-group ancillary add-on that works alongside RUG-III to determine total payment. This approach would result in 58 groups plus the six-group ancillary add-on.
- § *Model UWIM:* Applies the unweighted index model to Extensive Services residents (including residents in the Extensive Services and Rehabilitation category), and to Rehabilitation, Special Care, and Clinically Complex residents. For the unweighted index model, groups were defined

based on whether zero, one to two, three to five, or six or more index model variables were present. In this model, there would be up to 178 groups if it were implemented as new terminal splits rather than as a four-group ancillary add-on system. UWIM accounted for about 12 percent of the validation sample variance in ancillary charges and 19 percent of the variance in total costs. The sensitivity and specificity of the model were slightly less than for WIM2. UWIM would be favored over WIM2 if there were concerns about the complexity of the weighted index models or other concerns about the weighted models.

The analyses presented here show that there is little to be gained by modifying the RUG-III Impaired Cognition, Behavior Only, or Reduced Physical Function categories. This was due to a combination of low costs for most of these residents and low predictive capability of MDS variables to explain these costs. Although some small gains in explanatory power could be achieved by modifying or altering this part of the RUG-III system, such an approach was deemed an undesirable tradeoff with the degree of complexity that would be introduced by such a system.

In conclusion, the potential casemix model refinements described in this report result in some improvement over the RUG-III system; however, the results are only moderately successful. The most powerful model designed achieved rather modest predictive power, explaining less than 15 percent of the variance in ancillary charges and less than 21 percent of the validation sample variance in total costs. Despite the modest increase in statistical power, the results presented here represent the best that could be produced with the available data and their previously-described limitations. It is, therefore, suggested that one of the recommended models be implemented. The potential refinements do lead to improved statistical performance and do allow for higher payment rates for residents with characteristics associated with high ancillary charges. Thus, the proposed refinements would address some significant portion of the long term care industry and other's concerns regarding the adequacy of the current RUG-III system in explaining total costs, and in ensuring access to SNF care for Medicare beneficiaries.

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# **Appendix A**

## **The RUG-III Classification System**

## Appendix A: The RUG-III Classification System

Over the past two decades, there have been a large number of systems developed to measure casemix--the characteristics of residents related to their resource use--in nursing homes (Fries, and Cooney, 1985; Cameron, 1985; Minnesota Department of Health, 1986; and Morris, et al., 1987). Casemix measurement in health care facilities was first addressed in hospitals, most notably with the development of the Diagnosis-Related Groups (DRGs) (Fetter, et al., 1981). When applied to nursing homes, however, several changes were necessary to these concepts. While the DRGs explain the cost of an entire hospital stay which, for a particular DRG may vary within a fairly narrow range, in nursing homes the variability of length of stay — and thereby episode cost — is too great for virtually identical residents. Thus, nursing home casemix systems generally focus on explaining daily resource use. Technically, measuring actual per-diem resource use at the level of the individual resident adds significantly to the complexity of deriving these systems. Such a per-diem system manifests other nursing home differences. As in any health care system, residents' clinical and functional status change over time. With a per diem system used for payment determination, residents need to be reassessed and there are intrinsic opportunities to manipulate those resident characteristics that define casemix, both appropriately (e.g., responding to policy incentives) and inappropriately (e.g., "gaming").

A second major difference is that, unlike acute hospital care, where the patient's clinical diagnosis is the major determinant of resource use, residents' functional status and major health conditions explain most resource use in nursing homes. A number of studies have emphasized the importance of functional abilities in explaining the cost of care and have shown little or no link between the clinical diagnosis and the resources used in caring for nursing home residents. Virtually all studies have found that Katz' indexes based on Activities of Daily Living (ability to dress, bathe, eat, toilet, transfer and walk) are critical determinants of the time and cost of caring for nursing home residents (Katz, 1963; Fries and Cooney, 1985).

A series of efforts, funded by HCFA, have developed casemix classification systems for nursing homes, denoted Resource Utilization Groups (RUGs); these have achieved substantial use and a variety of applications in the U.S. The goal of RUGs is to group nursing home residents through the functional characteristics and service requirements that explain their use of nursing home resources. The Resource Utilization Groups - Version II (RUG-II) classification system was developed specifically for use in the Medicaid casemix payment system for New York State nursing homes, which went into operation in January 1986 (Schneider, et. al., 1988). The RUG-II system also was used for resource allocation among the Department of Veterans Affairs Medical Centers and a derivative was used for Medicaid nursing home payment in the State of Texas.

From 1993 to 1995, as part of HCFA's multi-state Nursing Home Casemix and Quality demonstration, Version III of RUGs — RUG-III — was completed. Derived in a manner similar to that of RUG-II, RUG-III improved upon the version by incorporating better cognitive measures, additional ADLs, and "high-tech" residents such as those parenterally fed or on ventilators. RUG-III also updated the RUGs to reflect current clinical practice and moved its basis to the nationally-mandated Resident Assessment Instrument (RAI) (a few items needed for the RAI were missing from the MDS, but were added in Version 2.0 of the MDS).

RUG-III was derived from data gathered in the HCFA-funded Staff Time Measurement (STM) study. This study is described in more detail in Appendix C. Data gathered in this study included time spent by nursing, therapy and other staff in resident care and other activities. These data were paired with MDS+ data (an earlier version of the MDS developed specifically for use in the NHCMQ demonstration states).

In nursing homes, the majority of costs that vary by residents are driven by staff time. Thus, wage weighted staff times were developed as the resource measure to be used as a dependent variable. These weights acknowledged the differences in cost for care provided by a registered nurse or a nurse aide, for example. The resulting classification system structures, however, are reasonably insensitive to changes in these weights.

The second type of data provided the independent variables to define the classification groups. As stated earlier, resident characteristics were assessed using an early version of the MDS, providing information on resident demographics, medical conditions, diagnoses, mental functioning, activities of daily living (ADLs), behavior problems, and services provided.

The development of RUG-III addressed three major types of criteria described earlier: statistical, clinical, and administrative. The statistical criteria included measures of the cost homogeneity of the groups as well as how well the system explained resource use. Based on a study of the total cost of resident care in the combined 7-state STM sample, the RUG-III system of 44 groups explained 55.5 percent of the variation among individual residents in 24-hour resource use with groups that were relatively homogeneous (i.e., with low (less than 1) coefficients of variation). (For comparison purposes, the DRG system with ten times as many groups, when applied to all patients in acute care hospitals, has a variance reduction of between 26 and 40 percent, depending upon which components of cost are included, although caution must be used when comparing these numbers since, as described earlier, the RUGs system measures nursing home per diem resource costs and the DRG system measures hospital episode costs.) When facility or unit identifiers were added as covariates to the model, the RUG-III variance explanations increased to 68 percent and 71 percent, respectively (Fries, et. al., 1994). Clinical rationale assured that the RUG groupings made sense to practitioners — that they could "visualize" their patients. Finally, care was taken to use patient characteristics that could reliably be assessed or audited, which would reduce the possibility of nursing homes classifying residents into more expensive categories with little change in the actual cost of resources used ("gaming"), and which would provide incentives for appropriate care.

The RUG-III system incorporates up to three dimensions in describing a resident. The first dimension indicates one of seven major types of nursing home residents. The second dimension is an ADL index, a summary measure of functional capability, produced by combining four late-loss ADL measures (toileting, eating, transfer, and bed mobility). Although ADLs are the most effective measures in explaining resource use, they demonstrate even greater statistical power within defined major types of residents. Also, four ADLs are sufficient; additional ADLs provide little marginal information about resource use (Williams et al, 1994). The final dimension of RUG-III describes particular services (such as nursing rehabilitation) or problems (such as behavior).

The complete RUG-III system is shown in Appendix A. The classification system has seven hierarchy groups describing types of residents (Special Rehabilitation, Extensive Care, Special Care, Clinically Complex, Cognitively Impaired, Behavioral Problems, and Reduced Physical Functions), in decreasing

order of resource use. Assignment to the Special Rehabilitation category, is based on the amount of therapy resources (staff time) provided to the resident, with further splits based on ADL scores. For the next intensive resource groups, Extensive Service and Special Care, resident assignment is based on the receipt of certain significant services (parenteral feeding, tracheotomy, suctioning, or ventilator/respirator care), or the presence of certain clinical conditions (e.g., quadriplegia, stage three or four pressure ulcers, coma). Additional splits of these categories are based on the number of extensive treatments or ADL level, respectively. Assignment to the Clinically Complex category is based on the presence of conditions such as aphasia, hemiplegia, terminal illness or services such as dialysis or chemotherapy. The rare resident in the Extensive or Special Care categories with almost complete ADL functioning (an ADL index score of less than 7) is also included here. The Clinically Complex category has secondary splits based on ADL and a tertiary split according to the presence of signs and symptoms of depression or sad mood. Residents manifesting characteristics of cognitive impairment, and residents without such characteristics but who daily have behavior problems including wandering, physical or verbal abuse, regressive behavior, or hallucinations are assigned to the Cognitively Impaired and Behavior categories, respectively. These two categories are restricted to residents with ADL index scores of 10 or less. Residents who do not meet the criteria of any of the earlier categories are assigned to the Reduced Physical Functions category. The three categories — Cognitive Impairment, Behavior Problems, and Reduced Physical Functions — are split by ADL and finally by the presence of nursing rehabilitation activities.

During the final stages of the NHCMQ demonstration, some modifications to the RUG-III system were instituted. During the last year of the demonstration (Demonstration Phase III, Stage 2), payment rates were modified to incorporate wage rate changes, and the combined 1995 and 1997 STM data were utilized to add the Ultra High Rehabilitation group and update the casemix indices.

One final modification was made to RUG-III in preparation for national PPS implementation. MDS Version 2.0 item J5c, “terminal prognosis”, was removed from the classification system, as it did not offer explanatory power or help to better clinically define the RUG-III categories. In addition, this was the one variable found to waiver somewhat from usual Medicare coverage requirements for SNF care (i.e., the daily skilled service requirement) (Sherwood, 1999).

In addition to having been implemented as part of the Medicare Prospective Payment System for skilled nursing facility care, the RUG-III classification system is currently used by approximately 15 states for Medicaid payment. Many additional states are considering the use of RUG-III for casemix-adjusted Medicaid payment.

# **Appendix B**

## **Minimum Data Set (MDS) Version 2.0**

# **Appendix D**

## **Drug Charge Imputation Analyses**



# **Appendix G**

## **Descriptive Tables**

**Figure D1: Total non-imputed daily drug costs compared to total daily drug costs based on RUG imputation method**

**Figure D2: Total non-imputed daily drug costs compared to total daily drug costs based on state/year imputation method**

**Figure D3: Total daily drug costs by RUG-based imputation method compared to total daily drug costs based on state/year imputation method**

**Figure D4: Relation between RUG-based total daily costs and proportion of drugs imputed**

**Figure D5: Relation between state/year-based total daily costs and proportion of drugs imputed**

**Figure D6: Distribution of imputed total daily cost by RUG-based imputation method**

**Figure D7: Distribution of imputed total daily cost by state/year-based imputation method**

**Figure D8: Proportion of imputed total daily cost by RUG category — RUG-based imputation method**

**Figure D9: Proportion of imputed total daily cost by RUG category — state/year-based imputation method**

**Figure D10: Proportion of imputed total daily drug cost by RUG category among non-hospital based facilities**

**Figure D11: Proportion of imputed total daily drug cost by RUG category among hospital-based facilities**

**Figure D12: Proportion of imputed daily drug cost by RUG category for gastrointestinal medications — non-hospital based facilities**

**Figure D13: Proportion of imputed daily drug cost by RUG category for endocrine agents among hospital-based facilities**

**Figure D14: Proportion of imputed daily drug cost by RUG category for endocrine agents among non-hospital based facilities**

**Figure D15: Proportion of imputed daily drug cost by RUG category for endocrine agents among hospital-based facilities**

**Figure D16: Overall total daily drug costs by RUG category using RUG-based imputation method**

**Figure D17: Overall total daily drug costs by RUG category using state/year-based imputation method**

**Figure D18: Total daily drug costs estimated using the RUG-based imputation method — Kansas**

**Figure D19: Total daily drug costs estimated using the RUG-based imputation method — Mississippi**

**Figure D20: Total daily drug costs estimated using the RUG-based imputation method — Ohio**

**Figure D21: Total daily drug costs estimated using the RUG-based imputation method — South Dakota**

**Figure D22: Total daily drug costs estimated using the RUG-based imputation method — Maine**

**Figure D23: Total daily drug costs estimated using the RUG-based imputation method — New York**

**Figure D24: Total daily drug costs estimated using the RUG-based imputation method — Texas**

**Figure D25: Variation in the proportion of total drug cost owing to anti-infectives among those receiving at least one anti-infective**

**Figure D26: Variation in the proportion of total drug cost owing to biologics among those receiving at least one biologic**

**Figure D27: Variation in the proportion of total drug cost owing to antineoplastics among those receiving at least one antineoplastic**

**Figure D28: Variation in the proportion of total drug cost owing to endocrine medications among those receiving at least one endocrine medication**

**Figure D29: Variation in the proportion of total drug cost owing to cardiovascular medications among those receiving at least one cardiovascular medication**

**Figure D30: Variation in the proportion of total drug cost owing to respiratory medications among those receiving at least one respiratory medication**

**Figure D31: Variation in the proportion of total drug cost owing to gastrointestinal medications among those receiving at least one gastrointestinal medication**

**Figure D32: Variation in the proportion of total drug cost owing to genitourinary medications among those receiving at least one genitourinary medication**

**Figure D33: Variation in the proportion of total drug cost owing to CNS medications among those receiving at least one CNS medication**

**Figure D34: Variation in the proportion of total drug cost owing to anti-infectives among those receiving at least one anti-infective**

**Figure D35: Variation in the proportion of total drug cost owing to neuromuscular medications among those receiving at least one neuromuscular medication**

**Figure D36: Variation in the proportion of total drug cost owing to nutritional products among those receiving at least one nutritional product**

**Figure D37: Variation in the proportion of total drug cost owing to hemotological drugs among those receiving at least one hemotological drug**

**Figure D38: Variation in the proportion of total drug cost owing to topical agents among those receiving at least one topical agent**

**Figure D39: Non-imputed daily drug costs among non-hospital based facilities**

**Figure D40: Total daily drug cost using the RUG-based imputation method among non-hospital based facilities**

**Figure D41: Total daily drug cost using the state/year-based imputation method among non-hospital based facilities**

**Figure D42: Non-imputed total daily drug costs among hospital-based facilities**

**Figure D43: Total daily drug cost using the RUG-based imputation method among hospital-based facilities**

**Figure D44: Total daily drug cost using the state/year-based imputation method among hospital-based facilities**

## **Appendix C**

### **Staff Time Measurement (STM) Study Data**

# Appendix C: Staff Time Measurement (STM) Study Data

## *Staff Time Measurement (STM) Data*

The 1995 STM data reflects states with medium and low rehabilitation utilization (only 14 of the 77 facilities in the study were considered “high rehab”). The 1995 STM data were collected in 77 Medicare units across seven states (Kansas, Maine, Mississippi, Ohio, South Dakota, Texas, and Washington), and included detailed nursing staff time information as well as MDS assessments on 1,896 residents. In order to base a federal Medicare reimbursement system on a nationally representative sample, HCFA initiated another STM study in 1997. This study focused on high rehabilitation facilities and represented a broader geographic distribution. These 1997 STM data included 2,037 residents from 73 units in five states (California, Florida, Maryland, Colorado, and New York). Several of these states (e.g., California) have high levels of managed care penetration and are areas with significant subacute activity.

Staff time was separated into resident-specific and non-resident specific time. Resident specific nursing staff time included all staff time of 30 seconds or more spent in direct care attributable to a particular resident. Non-resident specific nursing time included tasks such as meetings, administration, breaks, and unit maintenance that were not performed on behalf of any particular resident. Nonresident specific time was allocated equally across all unit residents. Therapy resident-specific time included time spent on the evaluation, treatment, and education attributable to an individual resident.

## *Specification of Staff Time Costs*

The STM data report the number of minutes of resident care provided by nursing and therapy staff. The staff time supplied by nurses, therapists, and aides are only imperfectly substitutable and are purchased by facilities at different average hourly rates. As a result, the hours reported in the STM data must be weighted by relative wages before the relationship between staff time and any casemix measure can be computed. Weighted staff minutes per day for each sampled resident were computed by multiplying the number of minutes for that resident by each occupation by that occupation’s salary weight and summing across all of the occupations included in the STM data.

Because previous studies that relied on the STM data (Fries et al., 1994, Cornelius et al., 1994) considered only staff time costs and did not use data on non-therapy ancillary charges, relative (and therefore unitless) weights were used in constructing a measure of the total costs of caring for residents. This method was not appropriate for the current RUG refinement study, since staff time data needed to be combined with a measure of *per diem* ancillary charges to create a measure of total costs. In order to aggregate staff time costs and ancillary charges, it was necessary to value staff time in terms of actual dollars rather than relative weights. The steps used to create the dollar measure of staff time resources are described below.

### *Occupation-specific Wage Rates*

To create a measure of the total dollars associated with the staff time information reported in the STM data, individual time measures were weighted by the occupation-specific mean wage from the Bureau of Labor Statistics. This information was used to calculate the cost per minute of different types of staff, based on the assumption that staff work 2,080 hours per year. The occupation-specific wage rates were based on wages for workers of a given occupation across all settings, as we were unable to obtain occupation-specific data for those employed at nursing facilities. The wage rates assumed for this study are reported in Table C1. Note that these figures imply slightly different relative weights for occupations than those used in previous studies which were used to develop the RUG-III system (Cornelius et al. (1994), Fries et al. (1994)).

The costs for respiratory services (Revenue codes 410-419 on Part A SNF claims) were measured using Medicare claims data rather than the STM. While the 1997 STM recorded information on the care time of respiratory therapists, this time represents only a portion of the cost associated with respiratory therapy. Respiratory therapists treat residents with a variety of lung diseases and illnesses, but for much of the time that residents receive respiratory therapy, the resident is using respiratory equipment and no respiratory therapist is required to be present.

**Table C1**  
**Wage Rates for Occupations Included in the Staff Time Measurement Database**

Occupation	Annual Wage Rate	Cost/minute	Data Source
<b>Nursing staff</b>			
Registered nurse <sup>A</sup>	\$36,244	\$0.290	Current Population Survey
Licensed practical nurse <sup>A</sup>	\$24,336	\$0.195	Current Population Survey
Nurses Aide	\$15,165	\$0.122	Derived indirectly, based on RN wage data from the Current Population Survey and the relative cost of nurse aides relative to RNs.
<b>Therapy staff</b>			
Occupational therapist <sup>A</sup>	\$40,562	\$0.325	Current Population Survey
Occupational therapist assistant	\$27,442	\$0.220	American Occupational Therapy Association, via Bureau of Labor Statistics
Speech therapist <sup>A</sup>	\$35,776	\$0.287	Current Population Survey
Physical therapist <sup>A</sup>	\$39,364	\$0.315	Current Population Survey
Physical therapist assistant	\$30,000	\$0.240	Physical Therapy Association, via Bureau of Labor Statistics
Therapy aide <sup>A</sup>	\$16,324	\$0.131	Current Population Survey
Dietician	\$24,853	\$0.199	Current Population Survey
Social worker	\$27,248	\$0.218	Current Population Survey
Notes:			
A Annual wage calculated based on average weekly wage * 52 weeks per year.			

### *Costs Associated With Fringe Benefits*

In addition to wage costs, providers are responsible for fringe benefits and taxes. According to the Bureau of Labor Statistics, 24.3 percent of total compensation for nursing home employees consisted of paid leave, supplemental pay, insurance, retirement and savings, and legally required benefits (Table C2).

**Table C2**  
**Percentages of Employer Costs for Employee Compensation**

<b>Setting</b>	<b>Wages and salaries</b>	<b>Total benefits</b>	<b>Paid leave</b>	<b>Supplemental pay</b>	<b>Insurance</b>	<b>Retirement and savings</b>	<b>Legally required benefits</b>
Nursing Homes	75.7	24.3	6.2	2.1	4.9	1.2	9.9
Health services	74.1	25.9	7.2	2.4	5.6	2.5	8.0
Hospitals	71.6	28.5	8.4	3.1	6.7	2.6	7.7

*Source: Bureau of Labor Statistics News Release, "Employer Costs for Employee Compensation," Table 15.*

Failure to account for these staff time-associated costs would result in a measure of total cost that overemphasizes ancillary charges. If wages and salaries constitute 75.7 percent of total compensation, then total compensation is 1.32 times larger than wage cost alone ( $1/.757=1.32$ ). We therefore inflate our measures of wage cost by a factor of 1.3 to account for the additional staff time costs associated with fringe benefits.

# **Appendix H**

## **Short Stay Analyses**

## Appendix H: Short Stay Analyses

In order to understand how PPS may impact the Short-Stay Medicare patient, a separate study was undertaken to describe that population and the variation in costs of care for them. Findings and a description of this special study are presented here. All SNF claims from 1995 through 1997 were downloaded. Although no definitive estimate is known, HCFA believed that 25 percent of SNF stays may have terminated without the need for a completed MDS assessment to be performed during the period of the current study. As a result, the variation of medication costs by RUG within this sub-population were evaluated. With the availability of an analog to the RUG-III classification system (Cornelius et al, 1994) which was modified and provided by HCFA, the RUG and actual reimbursement and charges on the SNF claim for per diem non-therapy ancillary costs were evaluated. Also, the variability of medication and other non-therapy ancillary costs recorded on the SNF claim by the estimated RUG were evaluated. The RUG analog (written in COBOL and provided by HCFA) was rewritten in SAS and applied to SNF claims for which no MDS assessment appeared within 30 days.

The RUG analog uses diagnosis and revenue codes on the SNF claims to identify clinical conditions and the types of services rendered to assign residents to a RUG-III category. The RUG analog reproduces the variety of therapy given by approximating the frequency and duration using Part A charges for skilled therapy thought to be commensurate with certain patterns of service. The sum of physical therapy charges, occupational therapy charges, and speech language therapy charges estimate the Rehabilitation RUG categories. The low intensity groups range from \$600 to \$1000, the medium intensity ranges from \$1000 to \$2500, the high intensity from \$2500-\$4000, the very high intensity from \$4000-\$6500 and the ultra high intensity is greater than \$6500 with at least two therapies greater than \$1500. The SNF claims contain variables describing diagnoses and procedures which are based on the *International Classification of Diseases 9<sup>th</sup> Revision, Clinical Modification* (ICD-9-CM). The ICD-9-CM system uses five-digit codes, the first three digits representing broad classes of diagnoses. The last two digits of the ICD-9-CM codes represent more detailed sub-classifications of the broad classes of diagnoses. The analog matches numerical diagnosis and procedure codes in the claims file to specific clinical criteria used to classify residents in the Extensive Services, Special Care, or Clinically Complex categories. The analog makes the assumption that the same range of services is represented by the diagnosis code.

The authors of the analog note that the RUG analog is limited by the SNF claims data. The analog cannot include all the categories of the RUG-III system. It only represents the RUG at the highest level of aggregation. The proxy represents only Part A therapy services and may not represent the full range of therapy services SNF residents receive. Because SNFs across states bill ancillary services differently, the extent to which the RUG analog can classify residents is subject to this variability. For example, in the original analysis of the RUG analog, Cornelius et al (1994) report that one-third of facilities in Texas do not include therapy charges on the SNF claim. Instead, the services are provided by independent rehabilitation agencies that usually bill Medicare separately under Part B.

The same algorithm used to create the measure of per diem non-therapy ancillary costs from the information contained on the SNF claim was applied in this analysis. Estimated costs were derived from the charges using a facility-specific adjustment factor. Details regarding this process are provided in Section 2.0 of the final project report. To be consistent with the RUG refinement analyses, the same set of exclusions that were applied to the creation of the analytic sample from which the potential refinements

were derived were used. 482,811 residents with a SNF claim were identified that also had no corresponding MDS assessment within 30 days of the claim date between 1995-1997 in the seven states. All residents for which a cost-to-charge ratio could not be calculated (n=297,241) were excluded. Facilities were required to have Medicare cost reports for at least two years between 1995 and 1997. Residents with total costs greater than \$1000 (n=981) were also excluded. Because many facilities in New York billed SNF stays using an all-inclusive rate, no assessments from New York (n=40,049) were included. Consistent with the analysis for the RUG refinements, assessments from facilities for which the correlation between a measure of drug costs calculated from Section U and one calculated from the Medicare claims data was less than zero (n=57,419) were excluded. The remaining 102,638 residents constituted the study sample.

Seven percent of the sample was classified as Ultra high (UHC), 10 percent in Very high (VHC), 12 percent in High Rehabilitation (HC), 22 percent in the Medium Rehabilitation category (MC), with an additional nine percent as Low Rehabilitation (LC). Only 0.1 percent of residents was classified under the Extensive Services RUG (SE), one percent as Special Care (SC), and 0.8 percent under the Impaired Condition RUG (IC). Four percent were classified as Clinically Complex (CC). The remaining 33 percent could not be classified into any RUG category.

As shown by Figures H-1 through H-5 in all RUGs, the total cost has a skewed distribution owing to high cost residents. Regardless of RUG, the majority of the non-therapy ancillary costs was from the costs of pharmaceutical products. The variability was minimal for the UHC group with a median of \$18 and a range of \$0- \$75. The Extensive Services category showed the most variability with a median value of \$40 and a range of \$0 to \$300 per day. The analyses were stratified by state and year. In general, deviations from the patterns seen in Figures H-1 through H-5 were not observed, except for variation in sub-populations with extremely small sample sizes. When stratifying by year, little to no residents were classified in the EC, SP, CC, and IC groups in 1996 and 1997. Facility-specific means were estimated and noted to follow a normal distribution.

## Figure H-1

## Figure H-2

## Figure H-3

## Figure H-4

## Figure H-5

# **Appendix E**

## **Detailed Specifications for Cost to Charge Multipliers**

# Appendix E: Detailed Specifications for Cost to Charge Multipliers

## Process

Data for each facility was drawn from annual Cost Summary files at the HCFA Data Center for each of the years 1995, 1996 and 1997. Only three data elements were pulled for each year - S1: the facility code; S271: the claims total for that facility; S286: the payment totals for that facility.

For each year, the ratio S286/S271 was calculated, or set to zero for zero denominators. If at least two years' worth of ratios were present, a mean was calculated, and a facility-level record written out to a special data file.

After all other processing had taken place, the facility code was used to look up this file/format and, if a valid hit was found, the following variables were adjusted for charge-to-cost ratios. This is in addition to the inflation/deflation, and facility correlation ratios which were also applied.

\$ Apd_phar:	ADJ. PRES.DRUG/PHARMACY PER-DIEM
\$ Aivtherp:	ADJ. IV THERAPY PER-DIEM
\$ Amedsure:	ADJ. MED/SUR/DME PER-DIEM
\$ Aother:	ADJ. OTHER ANCILLARY PER-DIEM
\$ Arespthe:	ADJ. RESPIRATORY THERAPY PER-DIEM
\$ Aphysthe:	ADJ. PHYSICAL THERAPY PER-DIEM
\$ Aoccnthe:	ADJ. OCCUPATIONAL THERAPY PER-DIEM
\$ Aspechl:	ADJ. SPEECH/LANGUAGE PER-DIEM
\$ Atot_anc:	ADJ. TOTAL ANCILLARY PER-DIEM

If no hit was found, the record was flagged with a value of 'P' in the DROPFLAG variable. These records were filtered out of subsequent analyses.

# **Appendix F**

## **Technical Expert Panel Participants**

## **Appendix F: Technical Expert Panel Participants**

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# **Appendix I**

## **Descriptive Analysis of the Use of Cancer Therapy in Skilled Nursing Facilities**

The Balanced Budget Refinement Act (BBRA) of 1999 included a provision to exclude certain chemotherapy items from the SNF PPS per diem payment. This study was performed to inform the affect of that legislation on the Medicare SNF reimbursement system. In order to estimate the prevalence of cancer therapies among residents of nursing facilities, medications used for cancer therapy were classified according to the distinctions made in Table 1 below.

<b>Drug Class</b>	<b>Drug</b>
Alkylating agents	Altretamine
	Busulfan
	Chlorambucil
	Cyclophosphamide
	Dacarbazine
	Estramustine phosphate
	Isofosfamide
	Lomustine
	Melphalan
	Thiotepa
Antimetabolites	Capecitabine
	Cytarabine
	Fludarabine
	Fluorouracil
	Gemcitabine
	Irinotecan
	Mercaptopurin
	Methotrexate
	Thioguanine
	Topotecan
Uracil mustard	
Hormones/hormones antagonists	Anastrozole
	Bicalutamide
	Calusterone
	Diethylstilbestrol
	Fluoxymesterone
	Flutamide
	Goserelin
	Letrozole
	Leuprolide acetate
	Nilutamide
Tamoxifen	
Natural products	Daunorubicin
	Doxorubicin
	Etoposide
	Interferon
	Mitomycin
	Paclitaxel
	Plicamycin

**Table 1**  
**Categorization of cancer therapies**

Drug Class	Drug
Adjuvant medications	Vinblastine
	Vincristine
	Vinorelbine
	Granisetron
	Medroxyprogesterone
	Megestrol
Miscellaneous	Ondansetron
	Tretinoin
	Aminoglutethimide
	BCG vaccine
	Carboplatin
	Cisplatin
	Hydroxyurea
	Mitotane
	Mitoxantrone
	Pegaspargase
Procarbazine	

The prevalence of the use of these drugs was assessed using Minimum Data Set (MDS) data for residents newly admitted to SNFs (n = 193,264). The overall use of the individual classes of drugs stratified by year is reported in Table 2. The overall prevalence of use is very low. This may be due to the fact that these drugs, with few exceptions (e.g., hormones and hormones antagonists), are usually not used chronically. Since this is a cross-sectional analysis (i.e., drugs used within seven days of the assessment), these data likely represent an underestimate of the true prevalence of chemotherapy use.

**Table 2**  
**Use of antineoplastic agents by year (%)**

	Total (n=193,294)	Year		
		1995 (n=60,128)	1996 (n=63,511)	1997 (n=62,881)
No use	97.3	97.8	97.7	97.4
Alkylating agents	0.10	0.07	0.13	0.10
Antimetabolites	0.17	0.14	0.19	0.18
Hormones	1.30	1.46	1.17	1.22
Natural products	0.04	0.02	0.07	0.04
Adjuvants	0.63	0.40	0.60	0.92
Miscellaneous	0.17	0.16	0.17	0.18

Table 3 shows the prevalence of use of each type of agent among those residents treated. Clearly, among users of any antineoplastic agent, the most frequently-used drugs are hormones/hormone antagonists and adjuvants. Adjuvant drugs show an increase in the use from 1995 to 1997, while the use of hormonal / anti-hormonal drugs decreases in those years.

**Table 3**  
**Use of antineoplastic agents among treated residents, by year (%).**

	Total (n=4,579)	Year		
		1995 (n=1,345)	1996 (n=1,453)	1997 (n=1,622)
Alkykating agents	4.21	3.35	5.57	4.01
Antimetabolites	7.23	6.17	8.40	7.15
Hormones	54.8	65.2	51.1	47.3
Natural products	1.86	1.12	3.03	1.54
Adjuvants	26.6	18.1	26.2	35.6
Miscellaneous	6.99	6.99	7.30	6.84

Trends in the prevalence of cancer therapies according to geographic location were also evaluated. Tables 4 and 5 show the results of this analysis. The overall prevalence of any use of chemotherapy drugs did not vary substantially across the states, or across treated residents by state.

**Table 4**  
**Use of antineoplastic agents by state (%).**

	Total (n=193,294)	State						
		KS (n=21,305)	ME (n=14,858)	MS (n=13,687)	NY (n=109,803)	OH (n=15,757)	SD (n=8,176)	TX (n=9,708)
No use	97.3	97.5	98.1	97.8	97.6	97.5	97.6	97.6
Alkykating agents	0.10	0.14	0.07	0.07	0.07	0.20	0.15	0.20
Antimetabolites	0.17	0.26	0.28	0.15	0.13	0.27	0.13	0.14
Hormones	1.30	1.13	0.94	1.07	1.50	1.03	1.14	0.81
Natural products	0.04	0.04	0.02	0.12	0.02	0.11	0.13	0.06
Adjuvants	0.63	0.73	0.46	0.73	0.56	0.76	0.64	1.14
Miscellaneous	0.17	0.19	0.14	0.08	0.18	0.13	0.20	0.14

Table 5 also displays the choice of therapy used among those receiving a cancer medication. Among treated residents, prevalence of use of antimetabolite drugs is about six percent in New York, South Dakota and Texas, while is 14.6 percent in Maine. Also, natural products are used in 23 – 30 percent of treated residents in all states except Texas, where the prevalence of use of these drugs is 47 percent.

**Table 5**  
**Use of antineoplastic agents among treated residents, by state (%).**

	Total (4,579)	State						
		KS (n=523)	ME (n=280)	MS (n=297)	NY (n=2,663)	OH (n=288)	SD (n=192)	TX (n=236)
Alkylating agents	4.21	5.54	3.93	3.37	3.04	7.99	6.25	8.05
Antimetabolites	7.23	10.7	14.6	7.07	5.44	11.1	5.73	5.93
Hormones	54.8	45.9	49.6	49.5	62.0	42.0	48.4	33.5
Natural products	1.86	1.72	1.07	5.39	0.83	4.64	5.73	2.54
Adjuvants	26.6	29.6	24.6	33.7	22.9	30.7	27.1	47.0
Miscellaneous	6.99	7.84	7.50	3.70	7.40	5.15	8.33	5.93

It is almost impossible to provide the “average” cost of therapy for these medications. Antineoplastic therapy is often complex, and the frequency, dosage and route of administration change according to the type of tumor treated, the therapeutic protocol employed, the stage of the disease and the hepatic and renal function of the patient. Furthermore, in this population other conditions (e.g., swallowing problems) need to be considered when determining the drug regimen. To provide an example of the complexity of this issue, the different regimens prescribed for vinblastine use are provided below:

*For the treatment of breast carcinoma:*

4.5 mg/m<sup>2</sup> IV on day one of every 21 days with doxorubicin and thiotepa.

*For the treatment of bladder carcinoma (not approved by FDA):*

3 mg/m<sup>2</sup> IV on days 2, 15, and 22 every 28 days along with methotrexate, doxorubicin, and cisplatin (MVAC). Another regimen includes vinblastine 4 mg/m<sup>2</sup> IV on days one and eight in combination with methotrexate and cisplatin (CMV).

*For the treatment of Hodgkin's disease:*

6 mg/m<sup>2</sup> IV on days one and 15 every 28 days along with doxorubicin, bleomycin, and dacarbazine (ABVD).

*For the treatment of non-Hodgkin's lymphoma (NHL):*

4 mg/m<sup>2</sup>/day IV on days one and two of a 28 day cycle in combination with cisplatin and bleomycin.

*For the treatment of testicular carcinoma or choriocarcinoma:*

6 mg/m<sup>2</sup> IV on days one and two every 21—28 days along with cisplatin and bleomycin (PVB) or 0.11 mg/kg IV on days one and two every 21 days along with cisplatin and ifosfamide.

*For the treatment of Kaposi's sarcoma:*

Intravenous dosage:

3 mg/m<sup>2</sup> IV weekly x three weeks, then 6 mg/m<sup>2</sup> IV every three weeks.

Intralesional dosage:

Inject each lesion with vinblastine solution 0.3 mg/ml until blanching occurs. Most lesions require two cc total. Repeat every three weeks as needed.

*For the treatment of stage III non-small cell lung carcinoma (not approved by FDA):*  
In combination with cisplatin and radiation therapy, vinblastine 5 mg/m<sup>2</sup>/day IV on days 1, 8, 15, 22, 29.

*Patients with hepatic impairment:*

Bilirubin 1.5—3 mg/dl: reduce dose by 50 percent.

Bilirubin > 3 mg/dl: reduce dose by 75 percent.

Table 6 presents the prevalence rate, daily dose and estimated daily price of chemotherapeutic agents utilized by the study sample of SNFS. When differences are present for different routes of administration of the same drug, both prices are reported. When different dosages are indicated for acute phase or maintenance, the latter is reported. Given the impossibility of calculating a mean cost of therapy for each drug, price of a single dosage is shown. It has to be acknowledged that the cost of the drugs is not fixed, and different sources report different prices. For the present data, we used information from Clinical Pharmacology 2000, © 2000 by Golden Standard Multimedia was used.

## **Summary and Conclusions**

In order to determine the potential impact of the BBRA provision that allows chemotherapy drugs to be reimbursed outside of the per diem SNF PPS rate, MDS data (including drug Section U) were analyzed for 193,264 SNF residents. The vast majority of these residents (97-98 percent) had no cancer drug use between study years 1995 and 1997, and little variation was seen among study states.

**Table 6****Frequency of use among treated residents and unit price of the individual antineoplastic drugs.**

	Prevalence (%)	Daily dosage#	Daily price (estimated)
Altretamine	0.02	260 mg/m <sup>2</sup> PO	50 mg PO: \$6.24
Anastrozole	0.91	1 mg PO	1 mg PO: \$5.8
Aminoglutethimide	0.43	1000 mg PO*	250 mg PO: \$1.3
Bicalutamide	1.32	50 mg PO	50 mg PO: \$10.4
Busulfan	0.10	4 – 8 mg PO	8 mg PO: \$5.0 – 6.6
Capecitabine	0.24	2500 mg/m <sup>2</sup> PO	120 mg PO: \$200.0 – 299.9
Carboplatin	0.07	360 mg/m <sup>2</sup> IV	50 mg IV: \$100 – 150
Chlorambucil	0.65	0.1 mg/kg PO	8 mg PO: \$3.3 – 4.9
Cyclophosphamide	2.23	300 – 1000 mg/m <sup>2</sup> **	500 mg IV: \$20 - 30 200 mg PO: \$10.0 – 19.9
Cytarabine	0.46	5mg – 2 g/m <sup>2</sup> **	1 g IV: = \$38
Diethylstilbestrol	0.02	250 – 500 mg IV *	1 mg PO: < \$5 / month
Estramustine	0.17	14 mg/kg PO	140 mg PO: \$3.5
Etoposide	0.38	35 – 50 mg/m <sup>2</sup> PO 80 – 120 mg/m <sup>2</sup> IV	50 mg PO: \$44 100 mg IV: \$118
Fluorouracil	0.91	300 – 1000 mg/m <sup>2</sup> IV **	250 mg IV: \$4
Fluoxymesterone	2.81	10 – 40 mg PO	10 mg PO: \$10.3
Flutamide	6.98	750 mg PO	-
Goserelin	0.62	3.6 mg SC / mo.	3.6 mg: \$300 – 400 / mo.
Granisetron	0.19	10 µg/kg IV	1 mg/ml IV: \$178.7
Irinotecan	0.02	125 mg/m <sup>2</sup> IV	-
Letrozole	0.02	2.5 mg PO	2.5 mg PO: \$5 – 6.5
Leuprolide	3.98	1 mg SC 7.5 mg IM / mo.	1 mg SC: \$10 – 20 3.75 mg IM: \$300 – 400/mo
Medroxyprogesteron	0.34	400 mg - 1 g IM /wk	150 mg IM: \$10 – 20/mo
Megestrol	24.5	160 mg PO	160 mg PO: \$70 – 80
Melphalan	0.50	150 µg/kg PO	6 mg PO: \$4 – 5
Mesna	0.02	-	1 g PO: \$178
Mercaptopurin	0.12	60 – 100 mg/m <sup>2</sup> *, **	100 mg PO: \$3 – 4
Methotrexate	5.16	3 – 200 mg/m <sup>2</sup> PO/IM/IV **	10 mg PO/wk: \$10 – 20/mo.
Nilutamide	0.02	150 mg PO *	150 mg PO: \$6 – 10
Ondansetron	1.37	16 mg PO 32 mg IV	16 mg PO: \$100 – 120 32 mg IV: \$150 – 200
Procarbazine	0.31	4 – 6 mg/kg PO	100 mg PO: \$1 – 1.5
Paclitaxel	0.05	135 – 175 mg/m <sup>2</sup> IV **	150 mg IV: \$800 – 900
Plicamycin	0.02	25 – 30 µg/kg IV	1.25 mg IV: \$300 – 400
Tamoxifen	40.3	20 – 40 mg/day PO	20 mg PO: \$2.6 – 3
Testolactone	0.14	1 g PO	-
Thiotepa	0.07	0.2 – 0.4 mg/kg IV **	15 mg IV: \$50 – 60
Tretinoin	0.12	45 mg/m <sup>2</sup> PO	40 mg PO: \$44
Uracil mustard	0.05	0.15 mg/kg PO /wk	-
Vinblastine	0.14	3 – 6 mg/kg IV **	6 mg IV: \$20 – 30
Vincristine	0.10	1 – 1.4 mg/kg IV **	1 mg IV: \$10 – 20

\* Maintenance dose

\*\* Depending on the indication

\*\*\* Prices reflect only FDA-approved uses of this and other drugs.

## References

Calabresi P, Chabner BA “Chemotherapy of neoplastic diseases”, in Goodman & Gilman “*The Pharmacological Basis of Therapeutics*”, 9<sup>th</sup> edition. McGraw Hill, New York, 1996.

## **Appendix J**

### **Description of Proposed RUG-III Model Refinements**