Proposal for Adjusting the General Hospital Producer Price Index for Quality Change

Hospital Quality Valuation Team*

U.S. Bureau of Labor Statistics

2 Massachusetts Avenue, NE

Washington, DC 20212

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*The views expressed are those of the authors and do not reflect the policies of the U.S. Bureau of Labor Statistics (BLS) or the views of other BLS staff members.

INTRODUCTION

The Producer Price Index (PPI) measures the rate of inflation for the prices received by US domestic producers. The Bureau of Labor Statistics (BLS) also publishes PPI indexes by industry according to the North American Industry Classification System (NAICS). A major challenge to all price index programs is that for some of the industry level PPIs, product and service quality constantly changes, and these quality changes affect the value of the product or service. To produce an accurate price index one needs to be able to decompose a price change into the part that is a result of a quality change and the part that is the result of inflation. Ideally, the PPI should reflect only the inflation part of the price change.

Lack of quality information at the product and service level has prohibited BLS from estimating the effects of quality change for General Hospitals. However, the Department of Health and Human Services (DHHS) has released a new database called Hospital Compare (HC), that gives BLS an opportunity to quality adjust its PPI for General Hospitals. The HC data captures changes in inputs that indicate or serve as proxies for changes in health quality measures according to the panel of experts who were responsible for developing the HC database. Using these quality measures an estimation tool has been developed that enables an explicit value of quality adjustment (VQA). It is important to keep in mind that this proposed quality adjustment methodology should be viewed as an incremental improvement; it does not purport to be the panacea of quality adjustment.

This proposal briefly describes the General Hospital PPI, the HC database, and then outlines a method to use the HC database to derive a quality adjusted General Hospital PPI. Section I briefly describes the General Hospital PPI and how it is currently computed. Section II lists the disease areas and the service quality indicators for the treatments in these disease areas in the HC database. Although the HC database is not comprehensive, it gives the PPI program a good start in what is hoped to be an expanding quality adjustment process. Section III outlines how the HC database will be linked with the PPI sample, and establishes how the quality measures in the HC database will be used to quality adjust the General Hospital PPI. Finally, Section IV will provide a conclusion and solicit opinions from interested parties outside the BLS.

Section I: The General Hospital PPI

The PPI program introduced output price indexes for General Medical and Surgical Hospitals in 1992. Refer to Appendix A for the current publication structure for General Medical and Surgical Hospitals. The PPI for General Medical and Surgical Hospitals measures the monthly change in prices received by hospitals for the provision of medical care to patients. The provision of care is delivered through various inputs including, but certainly not limited to, many types of surgery, pharmaceutical treatments (aspirin, antibiotics, etc.), assessments of bodily functions, and rehabilitation and counseling from professional health care staff. The PPI for General Hospitals is based upon this hospital-specific item level data that is aggregated to the industry level. This item level data is

made up of actual treatment bundles which are represented by selected patient bills. In subsequent months, a respondent from the sampled hospital will construct current prices based upon identical inputs from month to month.

The PPI is a Laspeyres price index that is derived from data collected through a sampling of producers. In order to quality adjust the hospital indexes, the PPI needs marginal cost data. The difficulty in obtaining the cost of new inputs is magnified in the medical field because it is heavily dominated by a constant influx of new technologies and treatment procedures for each specific treatment package. Being able to capture small changes in the way a comprehensive treatment package is administered is a challenge to researchers in this field, especially those that are not clinicians, attempting both to understand quality change and to develop a methodology for addressing this change. The notion of what constitutes a change in the quality of a treatment bundle, i.e. a change in inputs, cannot necessarily, and arguably should not, be divorced from a change in the overall health outcome of the patient (considering a change in outcome is a change in outputs). The consideration of a change in health outcome as an indicator of quality change, even if it is implicit, is a necessary departure from the traditional PPI quality adjustment practices used in other industries.

PPI staff has been conscious of the fact that the index for General Hospitals has needed a methodology for quality adjustment for quite some time. However, the lack of exogenous medical input data to complete this task has limited the development of a systematic adjustment methodology. Data on inputs that has recently become available from DHHS in the HC database has allowed the PPI to move past this data impasse.

Section II: The Hospital Compare database

The HC database was created to compare the service quality across hospitals. The database contains measures of service quality for the treatment of some major conditions/ diseases (heart attack, heart failure, pneumonia, or surgery). HC collects this measurement data from the records of hospitals. These measures are services that medical experts deem are important for optimal recovery.

Once these data are collected, they are used to construct a performance rating for each measure. It is this rating that allows one to compare the hospitals in a specific county, region, or the entire nation. Hospital ratings are based on the fraction of eligible patients who receive these services. There are some patients who should not receive these services for a variety of reasons such as allergies, disabilities, or comorbidities. These patients are excluded in these ratings.

Presently, 3,956 hospitals submit data to HC over four different time periods throughout the year. The longitudinal aspect of the database allows for comparisons across time as well as comparisons across hospitals. The public can then compare rates of service quality improvements as well as quality levels for various hospitals.

The database is accessed through a website[1] that is updated by DHHS.

As mentioned previously, the database reports on four major health conditions: heart attack, heart failure, pneumonia, and surgery. These conditions were selected as the condition 'starter' set by the Hospital Quality Alliance (HQA) because they represent common conditions that require hospital treatment. The HQA was launched by The American Hospital Association (AHA); the Federation of American Hospitals (FAH); and the Association of American Medical Colleges (AAMC) in 2002. The HQA was established to improve hospital care by providing measurement and public reporting of care given by the nation's hospitals.

For each of the conditions, specific service quality measures were developed by the HQA that represent what experts determined were the best treatment elements for each medical condition based on scientific evidence. The treatment elements for each condition are defined as quality measures in the HC database and will be referred to as such henceforth. Currently, the HC database includes eight service quality measures for heart attack treatment; four service quality measures for heart failure treatment; seven service quality measures for treatment of pneumonia; and five service quality measures for surgical infection prevention[2].

The limited number of conditions currently captured in the database allows for development of a methodology to quality adjust a small set of price quotes while awaiting the introduction of an expanded HC database from DHHS in the future. For example, the measures for surgical infection prevention are not specific enough to be used for PPI quality adjustment at this time.

For each health condition reported in the HC database, the PPI contains price quotes for the treatments of these conditions. The remaining three conditions, heart attack, heart failure, and pneumonia, represent a significant proportion of the revenues in the hospital industry. These conditions are those that occur frequently and are relatively revenue intensive to treat[3]. Since the PPI sample size is robust but confidential, information on the number of price quotes (and their relative weights) eligible for quality adjustment will not be released by BLS.

For the vast majority of sampled hospitals, the PPI is able to pinpoint when changes in the recommended care have occurred by comparing HC hospital performance rates over time. This is done by matching the HC provider number with the hospitals in the PPI sample. The changes in these rates serve as an indicator of the magnitude and direction of the quality of treatment provided for a given condition.

[1] http://www.hospitalcompare.hhs.gov/hospital/home2.asp
[2] Please refer to Appendix B for the HC measure set. Detailed information on each measure can be found at: http://www.hospitalcompare.hhs.gov/Hospital/Static/About-HospQuality.asp?dest=NAV|Home|About|QualityMeasures#TabTop
[3] Please refer to Appendix C.

The PPI was concerned that some of the smaller hospitals in the HC dataset would have a relatively high variance in their utilization rates on a quarterly basis that, potentially, would cause large changes in the VQA for these types of hospitals in the PPI sample. Analysis was done on the HC data to view the distribution of the average composite utilization score between 2006 and 2007. The average change in scores for the entire dataset was 0.0183 while the standard deviation was 0.0411, showing that the data are highly dispersed, relative to the mean. Next, the dataset was tested to see if it was normally distributed. The Anderson-Darling test was used and the A-squared statistic is 4.652047. Since this A-squared value is larger than the critical value of 0.752 at the 5% level, the null hypothesis of normality is rejected and the hypothesis that the data do not follow a normal distribution is accepted.

Since the data are highly dispersed, the division of the data into empirically determined strata could give a more accurate picture of how the data vary and what population parameters may be contributing to this variation. The strata that were chosen are the strata used in the PPI sample; large metropolitan (LM), large urban (LU), large rural (LR), small metropolitan (SM), small urban (SU), and small rural (SR). The mean score change for each strata was calculated and the results show that the mean score changes for the stratum are not significantly different from zero, demonstrating that stratification does not assist in determining the reasons behind the dispersion observed in the dataset. For this reason, the PPI will quality adjust all types of hospitals without regard to stratum[4].

Recent research by Davidson, Moscovice, and Remus (2007) has been published regarding hospital size and quality ranking. The findings indicate that hospitals with small sample sizes have an increased expected amount of uncertainty in terms of their ranking, against all other hospitals in the sample, for a given condition. The primary data source for this study was Premiere Inc. with a supplement of critical access hospitals (CAH) from the HC dataset. The main focus of this paper was on relative performance while our assessment focuses on individual hospital performance without regard for rank. In terms of dealing with uncertainty the paper recommends some of the approaches we have already incorporated.

Section III: Quality Adjustment in the PPI

Traditionally in the PPI, quality adjustment is done when a change in the price basis can be specified and measured in terms of a change in production costs. Therefore, in order to employ a methodology similar to this accepted method for quality adjustment in General Hospitals, it would be necessary to determine the production cost of each element in the HC database. The initial focus to quality adjust at the individual measure level was thought to be well-founded because theoretically it would follow that a change in one of the measures should affect the PPI item by the marginal cost change associated with that measure.

[4] See Appendix D for stratification testing results

In order to determine the cost of the individual measures, the PPI quality adjustment team employed the "Current Specification Manual for National Hospital Quality Measures" published by the Joint Commission on Accreditation of Healthcare Organizations for a more detailed view of the data measures. The manual provides specifics on medical codes or specific medical treatment details that link to each measure. A list of the type of drugs included for each of the drug-related measures is also included.

Using this information, the PPI team worked with CMS officials to attempt to determine a correct cost proxy for each measure element. Unfortunately this was not possible due to the fact that some of the HC measures are not specifically tied to cost information (a large set of the measures were only able to be matched with ICD-9 codes and these codes do not have any relevant cost information because CMS reimburses at the aggregated DRG level). In addition, the coding information received from CMS did not allow for a consistent approach to match each measure with a cost proxy because of incompatibility in the different medical coding systems. Though approximations were determined and test models were run, the team felt that this methodology was inherently flawed by either a complete lack of any type of cost information or a lack of consistent and reliable cost information.

Quality Adjustment at the Condition Level

Due to the limitations described above, the team looked for an alternative quality adjustment method based on the available medical data. CMS reimburses hospitals at the DRG level and determines these reimbursements by using cost data from hospitals. Cost information at the DRG level, then, represents the cost of the entire package of care. Similarly, the HC database reports on the quality of care for each of the conditions and each condition can be matched to a specific set of DRGs. Given these compatible data elements, assessing and valuing the change in the quality of care at the DRG level appear plausible and appropriate.

The PPI proposal employs an aggregation methodology to the HC data to determine a composite utilization score for each hospital at the condition level. Applying an aggregated methodology to HC data was originally developed in 1998 by the Hospital Core Performance Measurement Project (HCPM) for the Rhode Island Public Reporting Program for Health Care Services. This was a pilot project prior to the introduction of the national HC database and instead of looking at performance based on each measure, the HCPM wanted to determine a score for the entire hospital. According to CMS, the aggregate/ composite methodology developed during the Hospital Quality Initiative demonstration model overcomes "challenges involving individual weighting, missing data, and sensitivity to case volumes"[5] that existed when using the data at the individual measure level and thus provided an aggregate score for each hospital. Aspects of this

[5] Center for Medicare and Medicaid Services. "CMS HQI Demonstration Project; Composite Quality Score Methodology Overview." Accessed: November, 2006. http://www.cms.hhs.gov/HospitalQualityInits/downloads/HospitalCompositeQualityScoreMethodologyOverview.pdf

methodology were used to develop this PPI proposal which uses an aggregate methodology and is described below.

When an explicit quality adjustment is to be performed, the price relative takes the following form:

$$\textbf{Equation 1:}\ \text{Price Relative}_t = \frac{P_t - (VQA_t)}{P_{t-1}}$$

This PPI proposal defines the VQA as:

$$\textbf{Equation 2:}\ VQA_t = Cost_t * \Delta\%Score_t$$

$$\textbf{Equation 3:}\ Score_t = \sum_{i=1}^{I} w_i u_{i,t}$$

Where:
t indexes time
i indexes the quality measure
P_t = Price in time t
VQA_t = Value of the Quality Adjustment in time t
$Cost_t$ = Operating plus capital cost derived/ imputed from DHHS data at the DRG level
$\Delta\%Score_t$ = percent change in the composite utilization score from t-1 to t
w_i = ratio of eligible patients for quality measure i to the entire sample of eligible patients
u_{it} = utilization rate of measure i in time period t

While the HC measures were agreed upon by expert clinicians, they were not ranked in any way by DHHS. Ranking would offer a relative importance for each measure, as shown by Berndt, et al. (2002). Using the Delphi procedure to examine the price of treating episodes of major depression, the value of each treatment process was ranked (Berndt, et al. 2002).

Since the experts did not rank the measures, the composite utilization score is computed by simply aggregating the utilization score for each measure in the first time period. Computing the composite utilization is more complicated in the second time period because the individual utilization scores are weighted by the ratio of eligible patients for each measure in the first time period (2006 in the example that follows) to the overall eligible patient count. These steps produce a $Score_t$ for each time period (equation 3). The change in the composite utilization score can then be calculated which represents $\Delta\%Score_t$ in equation 2.

The next step is to calculate the costs (refer to $Cost_t$ in equation 2) associated with the change in the composite utilization score so that the VQA can be computed. The cost data (or output measure) is imputed from various DHHS data sources.

As noted in the definition of the cost variable in equation 2, the cost data is calculated at the DRG level. At this point, PPI staff is allowing the observed HC quality measures related to a given condition to implicitly impute all the other non-observed inputs to the treatment of a given condition which are not covered in the HC database. If this imputing is incorrect it would cause a bias in the estimated value of the quality adjustment. A detailed example follows.

Example of the Quality Adjustment Methodology-Heart Failure

In this example, w_i in equation 3 is Column A in Table 1 divided by its total in row E of Table 1 which yields Column G in Table 2 (note that w_i only needs to be calculated for the second time period for weighting purposes). The utilization rate, u_{it}, is Column B in Table 1 and Column F in Table 2. The $\Delta\%Score_t$ variable (equation 2) is computed in Table 3. The $Cost_t$ variable (equation 2) is computed in Table 4. Lastly, the VQA_t (equation 1 and 2) is computed in Table 5.

A random hospital in the Northeast Region[6] has been chosen for this example. The HC dataset provides the number of eligible patients (A) and the utilization rate (B) for each quality measure on a quarterly basis (Table 1). Performance measures for heart failure over a two year period are evaluated. Each quality measure is aggregated from all reporting periods for the given year. Note that this hospital reported four times in 2006 and three times in 2007 as of this writing.

The number of eligible patients receiving the correct treatment (C) is calculated by multiplying these two columns (A and B) together for each quarter. Next, the Utilization Score (column D in Table 1) is calculated by dividing column C by the universe of Eligible Patients (E). Next, the Utilization scores for each measure are aggregated to arrive at the Composite Utilization Score. Refer to Table 1 for details.

[6] DRG regional costs are obtained using HCUP. The four regions are defined by the Bureau of the Census: Northeast, Midwest, South, and West.

Table 1: 2006 data: Calculating the Composite Utilization Score

Measure Name	(A) Eligible Patients	(B) Utilization Rate (%)= u_{it}	(C) # of eligible patients receiving the correct treatment (C=A*B)	(D) Utilization Score (D=C/E)
Heart Failure Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)	1773	97%	1720	0.2018
Heart Failure Patients Given an Evaluation of Left Ventricular Systolic (LVS) Function	3369	96%	3234	0.3795
Heart Failure Patients Given Discharge Instructions	2965	59%	1749	0.2052
Heart Failure Patients Given Smoking Cessation Advice/Counseling	415	100%	415	0.0487
Total number of Eligible Patients (E)	8522		**Composite Utilization Score=** $Score_{t-1}$	0.8352

Note: All figures used in this example have been rounded to the nearest patient or to the fourth decimal point.

Next, the 2007 Weighted Composite Utilization Score is calculated. CMS states that the two composite methodologies which they are considering for possible implementation in the future will equally weight all the quality measures. The PPI decided, however, that weighting was needed, so the PPI will implicitly weight the 2007 data on the heart failure quality measures by the hospital's number of eligible patients for each measure, using 2006 data. This will ensure that, for example, a high score in smoking cessation (keeping in mind that many patients do not smoke and are not eligible for this measure) will not affect the overall composite utilization score as much as a high score in the LVSD measure. An alternative weighting scheme would incorporate opinions by clinicians to rank the individual quality measures but this information does not exist to the PPI's knowledge. A weighted utilization score is then calculated for each measure. Lastly, the weighted utilization score is aggregated to arrive at the weighted composite utilization score. Refer to Table 2.

Table 2: 2007 data: Calculating the weighted Composite Utilization Score

Measure Name	(F) Utilization Rate (%)= u_{it}	(G) Weighting by Eligible Patients; Using 2006 figures= w_i (G=A/E: from table 1)	(H) Weighted Utilization Score (H=F*G)
Heart Failure Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)	95%	0.2080	0.1976
Heart Failure Patients Given an Evaluation of Left Ventricular Systolic (LVS) Function	98%	0.3953	0.3874
Heart Failure Patients Given Discharge Instructions	56%	0.3479	0.1948
Heart Failure Patients Given Smoking Cessation Advice/Counseling	100%	0.0487	0.0487
		Weighted Composite Utilization Score= $Score_t$	0.8285

The change in the Composite Utilization Score from 2006 to 2007 is then determined as follows in Table 3:

Table 3: Change in the Composite Utilization Score

2006	2007	% Change in score= $\Delta\%Score_t$
0.8352	0.8285	**-0.8022%**

After determining the percent change in the score, the median DRG charges associated with heart failure, DRG 127, in the relevant region are identified[7].

*2005 DRG 127 Median charge for the Northeast region = $15,019

2005 median charges are used because CMS employs a two year lag when calculating DRG reimbursements. Data can not be reported by hospitals any quicker than this, so the PPI will also use a two year lag, i.e. using the 2005 National Inpatient Sample (NIS) data for 2007 quality adjustments.

DRG costs can then be calculated by applying the CMS' cost-to-charge ratio (CCR) to the median DRG charge. CCR files[8] are published by CMS and used to estimate the resource cost of inpatient care and its variation across hospitals and conditions. These files are published in the Federal Register on an annual basis under the IPPS Final Rule. For this case study, the capital CCRs and the operating CCRs for this hospital are used to

[7] This information is available at http://hcup.ahrq.gov/ as part of the National Inpatient Sample (NIS).
[8] Center for Medicare and Medicaid Services. "Impact file for the IPPS FY 2007 Final Rule." Accessed July, 2007. http://www.cms.hhs.gov/AcuteInpatientPPS/FFD/list.asp.

generate a total CCR. By applying the total CCR to the median DRG rate, an estimated cost is derived for DRG 127. (Table 4)

Table 4: Converting Charges to Costs

DRG 127 Northeast Region Median Charges for 2005 from NIS	**$15,019**
operating charges* as % of total charges	92.58%
operating charges	$13,905.12
operating CCR*	0.352453173
operating costs	**$4,900.90**
capital charges as % of total charges	7.42%
capital charges	$1,113.88
capital CCR*	0.028233517
capital costs	**$31.45**
DRG 127 Northeast Region Total Cost (all payors included)	**$4,932.35**

*This example uses national CCR data to protect the identity of the hospital. CCR data specific to the hospital being quality adjusted will be used by the PPI for actual quality adjustment purposes

The estimated DRG costs are then applied to the percentage change of the composite utilization scores creating a quality adjustment value for a specific patient receiving treatment for heart failure at this hospital.

Table 5: Calculating the Value of the Quality Adjustment

Northeast Region cost= $Cost_t$	**$4,932.35**
Percentage change in quality measures	-0.8022%
VQA	**-$39.57**

In this case, assuming that the reported reimbursement from this hospital for the treatment was $11,560 and remained $11,560 over this period, the hospital's inputs have declined and the quality of care has deteriorated. This would lead to an increase in the index level for that particular item for the given hospital. If quality decreases then the price relative takes the following form (equation 1):

$$\text{Price Relative}_t = \frac{P_t - VQA_t}{P_{t-1}} \quad \text{where} \quad \begin{aligned} P_t &= \$11{,}560 \\ P_{t-1} &= \$11{,}560 \\ VQA_t &= -\$39.57 \end{aligned}$$

$$\text{Price relative: } \frac{11{,}560 - (-39.57)}{11{,}560} = 1.0034$$

This change in the price relative signifies a price increase of 0.34% since the quality declined and there was no reported price change. The index would increase and output and productivity would decrease in this example[9].

Using this methodology, a few similar case studies were conducted. The methodology yielded results that were similar to the case study above; the VQA produced movements that are consistent with quality adjustment theory and the VQA magnitude is comparable to the magnitude of the quality change. For example, additional producer inputs (i.e. more eligible patients receiving discharge instructions) yielded a higher utilization rate which led to a higher composite utilization rate which in turn led to a positive VQA and a decline in the price relative (given no reported price change). This decline in the price relative signifies a price decrease since quality increased, so that the index would decline and output and productivity would increase. Therefore, we are presenting this methodology for comment and evaluation of its use as a realistic and effective way to quality adjust this index.

Section IV: Conclusion

The introduction of the HC database as an exogenous source of quality change data has prompted the PPI to evaluate its use to quality adjust prices collected for select hospital treatments. With the help of many outside experts, the PPI quality adjustment team has determined that the quality adjustment methodology presented here could be performed on an annual basis for each of the treatments for which quality indicators exist. Using the HC data as well as other public data sources which include the provider number for each hospital, the regional median DRG charge, and the CCR rate for each hospital, this proposed PPI methodology was applied to real case studies. The results of these case studies reveal that CMS data may offer the PPI a method to explicitly quality adjust this industry; thereby decreasing the potential bias currently present from lack of capturing quality changes. Though the use of this data only allows for partial quality adjustment at this time, it is hoped that as the HC data expands so will the opportunity to expand the PPI quality adjustment for hospital services.

The PPI program is interested in receiving feedback from experts and clinicians in the industry, as well as feedback from outside economists with price index expertise. Specifically, does the use of utilization rates at the condition level offer a method that is sufficiently robust enough to serve as an estimator of the value of the quality adjustment? The response from outside medical and economic experts will help the PPI determine whether the proposed quality change valuation, or a variation of this methodology, can be implemented in the official PPI release.

[9] Another way of calculating the quality adjustment would have been to apply the 0.8022 percent quality change estimate directly to the total reimbursement. Adjusting cost by 0.8022 percent is more consistent with the PPI's resource-cost model of quality adjustment.

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Appendix A: Publication Structure for NAICS 622110

622110 General medical and surgical hospitals
- **622110P Primary services**
  - **6221102 Medicare patients**
  - **6221104 Medicaid patients**
  - **6221106 All other patients**
    - **622110601 Diseases and disorders of the nervous system**
    - **622110603 Diseases and disorders of the ear, nose, mouth, and throat**
    - **622110604 Diseases and disorders of the respiratory system**
    - **622110605 Diseases and disorders of the circulatory system**
    - **622110606 Diseases and disorders of the digestive system**
    - **622110607 Diseases and disorders of the hepatobiliary system and pancreas**
    - **622110608 Diseases and disorders of the musculoskeletal system and connective tissue**
    - **622110609 Diseases and disorders of the skin, subcutaneous tissue and breast**
    - **622110611 Endocrine, nutritional, and metabolic diseases and disorders**
    - **622110612 Diseases and disorders of the kidney and urinary tract**
    - **622110613 Diseases and disorders of the male reproductive system**
    - **622110614 Diseases and disorders of the female reproductive system**
    - **622110615 Pregnancy, childbirth, and the puerperium**
    - **622110616 Newborns and other neonates w/ conditions orig. in the perinatal period**
    - **622110617 Diseases & disorders of blood & blood forming organs and immun. diseases**
    - **622110618 Myeloproliferative diseases & disorders, & poorly differentiated neoplasms**
    - **622110619 Infectious and parasitic diseases (systematic or unspecified sites)**
    - **622110622 Alcohol/drug use and alcohol/drug induced organic mental disorders**
    - **622110623 Injuries, poisonings, and toxic effects of drugs**
    - **622110625 Factors influencing health status and other contacts with health services**
    - **622110626 Multiple significant trauma**
    - **622110627 Human immunodeficiency virus infections**
    - **622110628 Other diseases and disorders**
- **622110SM Other receipts**

Appendix B: HC Process of Care Measures

Heart Attack Process of Care Measures
Percent of Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)
Percent of Heart Attack Patients Given Aspirin at Arrival
Percent of Heart Attack Patients Given Aspirin at Discharge
Percent of Heart Attack Patients Given Beta Blocker at Arrival
Percent of Heart Attack Patients Given Beta Blocker at Discharge
Percent of Heart Attack Patients Given Fibrinolytic Medication Within 30 Minutes Of Arrival
Percent of Heart Attack Patients Given PCI Within 90 Minutes Of Arrival
Percent of Heart Attack Patients Given Smoking Cessation Advice/Counseling
Heart Failure Process of Care Measures
Percent of Heart Failure Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)
Percent of Heart Failure Patients Given an Evaluation of Left Ventricular Systolic (LVS) Function
Percent of Heart Failure Patients Given Discharge Instructions
Percent of Heart Failure Patients Given Smoking Cessation Advice/Counseling
Pneumonia Process of Care Measures
Percent of Pneumonia Patients Assessed and Given Influenza Vaccination
Percent of Pneumonia Patients Assessed and Given Pneumococcal Vaccination
Percent of Pneumonia Patients Given Initial Antibiotic(s) within 4 Hours After Arrival
Percent of Pneumonia Patients Given Oxygenation Assessment
Percent of Pneumonia Patients Given Smoking Cessation Advice/Counseling
Percent of Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)

Pneumonia Process of Care Measures (continued)
Percent of Pneumonia Patients Whose Initial Emergency Room Blood Culture Was Performed Prior To The Administration Of The First Hospital Dose Of Antibiotics
Surgical Care Improvement/Surgical Infection Prevention Process of Care Measures
Percent of Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision
Percent of Surgery Patients Who Received the Appropriate Preventative Antibiotic(s) for Their Surgery
Percent of Surgery **Patients Who Received Treatment** To Prevent Blood Clots Within 24 Hours Before or After Selected Surgeries to Prevent Blood Clots
Percent of Surgery Patients Whose **Doctors Ordered Treatments** to Prevent Blood Clots (Venous Thromboembolism) For Certain Types of Surgeries
Percent of Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 hours After Surgery

Appendix C: Relative Importance of HC conditions by DRG

Heart Attack

DRG	Rank by discharges	Rank by aggregate charges	Aggregate Charges	Percent of Aggregate Charges
DRG 121	30	31	$6,407,700,199	0.73%
DRG 122	59	77	$2,156,018,598	0.25%
DRG 123	156	128	$1,172,436,949	0.13%

Heart Failure

DRG	Rank by discharges	Rank by aggregate charges	Aggregate Charges	Percent of Aggregate Charges
DRG 127	4	3	$19,300,501,024	2.21%

Pneumonia

DRG	Rank by discharges	Rank by aggregate charges	Aggregate Charges	Percent of Aggregate Charges
DRG 89	6	8	$17,057,654,507	1.95%
DRG 90	74	140	$1,295,996,721	0.15%
DRG 91	55	137	$1,729,363,192	0.20%

Note: All figures obtained from the latest HCUP data (2005).

Appendix D: Stratification Testing Results

Stratification Results				
Strata	**Mean**	**Std Deviation**	**Variance**	**Coefficient of Variation**
LM	0.0153	0.0309	0.0010	2.0241
LU	0.0119	0.0332	0.0011	2.7767
LR	0.0364	0.0474	0.0023	1.3022
SM	0.0076	0.0370	0.0014	4.8342
SU	0.0546	0.0750	0.0056	1.3727
SR	0.0015	0.0410	0.0017	27.6567

LM - large metropolitan SM - small metropolitan
LU - large urban SU - small urban
LR - large rural SR - small rural