Measuring The Quality Of Pennsylvania's Commercial HMOs

CALENDAR YEAR 2006

TECHNICAL REPORT

THE PENNSYLVANIA HEALTH CARE COST CONTAINMENT COUNCIL

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TABLE OF CONTENTS

Overview 1
HMO Plan Profile 1
PHC4 Database 1
Data Sources, Collection, and Verification 5
Description of Hospitalizations Used in Analyses 9
Risk Adjustment Methodology 14
Treatment Measures Calculated by PHC4 23
Preventing Hospitalization through Primary Care 23
  Pediatric Ear, Nose and Throat Infections 23
  Adult Ear, Nose and Throat Infections 23
  High Blood Pressure (Hypertension) 24
  Gastrointestinal Infections 25
  Kidney/Urinary Tract Infections 25
Managing On-Going Illnesses 26
  Chronic Obstructive Pulmonary Disease (COPD) 26
  Pediatric and Adult Asthma 27
  Diabetes 29
Surgical Procedures 31
  Hysterectomy (Abdominal and Vaginal) 31
  Mastectomy 32
  Neck and Back Procedures (With Fusion and Without Fusion) 34

Appendices

A. Description of Study Populations A-1
B. Clinically Complex Exclusions and DRGs Used to Define Conditions B-1
C. In-Hospital Complications for Surgical Procedures C-1
D. Risk Factor Descriptions D-1
E. Risk Factor Definitions E-1

Tables

1. Comparative References 4
2. Repeat of CY2005 HEDIS Measures, by Plan 8
3. Hospitalizations Used for Each Measure and Clinical Condition 11
4. Coefficients of Significant Predictors 16
5. Measures Using the Binomial Distribution 20
6. *Preventing Hospitalization through Primary Care*—Exclusions from “Hospitalization Rate” Analysis for:
   6A. Pediatric Ear, Nose and Throat Infections 23
   6B. Adult Ear, Nose and Throat Infections 24
   6C. High Blood Pressure 24
   6D. Gastrointestinal Infections 25
   6E. Kidney/Urinary Tract Infections 26
7. *Managing On-Going Illnesses*—Exclusions from “Hospitalization Rate,” “Length of Stay,” and “Rehospitalization Rating” Analyses:
   7A. – 7C. Chronic Obstructive Pulmonary Disease (COPD) 26-27
   7D. – 7F. Pediatric and Adult Asthma 28-29
   7G. – 7I. Diabetes 29-30
8. *Surgical Procedures*—Exclusions from “Hospitalization Rate,” “In-Hospital Complications,” and “Length of Stay” Analyses:
   8A. – 8C. Hysterectomy 31-32
   8D. – 8F. Mastectomy 33
   8G. – 8I. Neck and Back Procedures 34-35

Copies of the *Measuring the Quality of Pennsylvania's Commercial HMOs* report and this document, the *Technical Report*, can be obtained by contacting the Council, or can be accessed electronically via the Council's Web site.

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TECHNICAL REPORT

MEASURING THE QUALITY OF PENNSYLVANIA'S COMMERCIAL HMOS CALENDAR YEAR 2006 DATA

OVERVIEW

This technical supplement accompanies the calendar year 2006 version of the *Measuring the Quality of Pennsylvania's Commercial HMOs* report. Included in this *Technical Report* are detailed descriptions of the data and their sources, explanations for the adjustments to the data, and presentation of the methodology used for risk adjustment of the utilization and clinical outcomes data. Also included are detailed explanations for the data collection and verification procedures, selection of clinical conditions and outcomes for study, and other comparative measures. Descriptions of the ratings of HMOs and plan profile information are further explained.

The *Measuring the Quality of Pennsylvania's Commercial HMOs* report provides information related to the quality of health care services received by members of commercial Health Maintenance Organizations (HMOs), Gatekeeper Preferred Physician Organizations (GPPOs) and related Point of Service (POS) plans licensed by the Department of Health to do business in Pennsylvania. Throughout this report, the term HMO represents HMO, GPPO and POS data unless otherwise specified. The report brings together information from several sources that are of interest to purchasers, consumers, payors, and providers. This collection of information and data allows all interested readers to make comparisons among HMOs based upon a comprehensive set of data.

HMO PLAN PROFILE

The HMO "Plan Profile" contains information that is found on the PHC4 Web site only. The specific source of data and the information in the HMO profile are described below.

NCQA Accreditation Status. The "NCQA Accreditation Status" variable was obtained from the NCQA Web site and was current as of the publication date of the *CY2006 Measuring the Quality of Pennsylvania's Commercial HMOs*.

Additional Data. The following information was provided by the plans:

- Full plan name
- Abbreviated plan name
- Contact telephone number
- Web site address
- Counties served

PHC4 DATABASE

Utilization and outcome measures are provided for specific clinical conditions/treatments included in the report. The research methodology that yielded utilization and outcome ratings was complex and tailored to each clinical condition. Methodology development was based upon state-of-the-art research practice. This development included a review of the medical outcome literature, discussions with practicing medical professionals, and careful examination and approval by the Council's Technical Advisory Group. Each clinical condition was selected because:

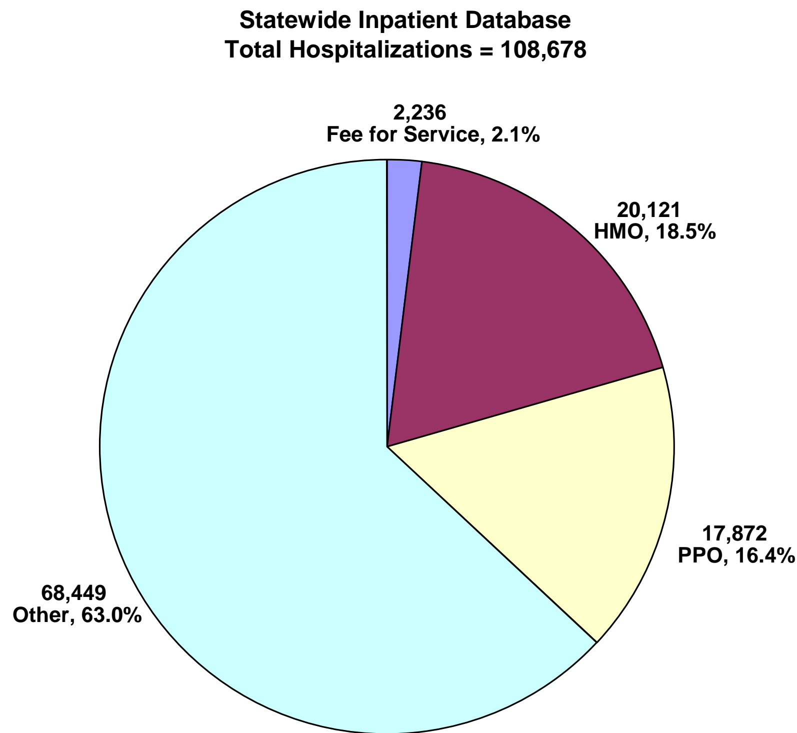
- it is of high importance to purchasers and consumers,
- it is generally a high-volume, high-risk, or high cost condition/procedure, and

- its management by HMOs and their providers can reasonably be expected.

The database used to analyze each of the clinical conditions was derived from discharge data submitted to PHC4 by Pennsylvania hospitals. The Statewide database is comprised of hospitalizations where the patient:

- was under 65 years of age (except for diabetes in which the age interval was 18 years through 75 years),
- met the clinical inclusion criteria for one of the conditions investigated (see Appendix A: "Description of Study Population"), and
- was discharged from a Pennsylvania *general acute care* (GAC) or *specialty GAC* hospital (or received care in an inpatient or ambulatory surgical setting for mastectomy or neck and back procedures) between January 1, 2006 and December 31, 2006.

Statewide Inpatient Database
Total Hospitalizations = 108,678



The HMO State Total/Average includes aggregate hospitalizations for members of all commercial HMOs included in this report.

The Fee-for-Service State Total/Average includes hospitalizations for members of commercial, traditional "fee-for-service" plans. This includes only those patients who were verified by the plans as members of one of the larger fee-for-service plans in Pennsylvania. Hospitalization rates per member are not reported for this group because detailed enrollment data by plan were not available.

The PPO (Preferred Provider Organization) State Total/Average includes hospitalizations for members of commercial PPO plans. This includes only those patients who were verified by the plans as members of one of the larger PPO plans in Pennsylvania. Hospitalization rates per member are not reported for this group because detailed enrollment data by plan were not available.

The "Other" group in the statewide database includes hospitalizations paid for by Medicare, Medicaid, or the patient, as well as those records where the payor could not be identified.

Data Used in the Risk Adjustment Process

Depending upon the condition under study, individual HMO plan data was compared to the statewide data, the HMO, fee-for-service and PPO data combined, or the HMO data alone. Table 1 lists the comparative data that were used to determine expected percents for each appropriate PHC4 measure (where actual percents were compared to expected percents), and to risk adjust each PHC4 measure that involved risk adjustment. For example, the comparative data for neck and back procedures included those hospitalizations where the patients met the definition criteria for neck and back procedures and were under age 65 but over age 17, regardless of the type of payor. These hospitalizations were then used as the comparative standard when determining the risk-adjusted length of stay for each HMO plan for neck and back procedures.

Results are presented in the public report in a manner that allows the reader to visually compare the results for individual HMO plans and the HMO state total/average. When the comparative reference was the statewide data or the HMO, fee-for-service, and PPO combined, then summary lines are shown for the fee-for-service and PPO totals as well.

Table 1. *Comparative References*

Reported Measure	Data Used
Hospitalization/Procedure Rate	
▪ Pediatric Ear, Nose and Throat Infections	HMO Hospitalizations (members 28 days – 17 years)
▪ Adult Ear, Nose and Throat Infections ▪ High Blood Pressure	HMO Hospitalizations (members 18 – 64 years)
▪ Gastrointestinal Infections ▪ Kidney/Urinary Tract Infections	HMO Hospitalizations (members 28 days – 64 years)
▪ Chronic Obstructive Pulmonary Disease	HMO Hospitalizations (members 18 – 64 years)
▪ Pediatric Asthma	HMO Hospitalizations (members 28 days – 17 years)
▪ Adult Asthma	HMO Hospitalizations (members 18 – 64 years)
▪ Diabetes	HMO Hospitalizations (members 18 – 75 years with diabetes)
▪ Hysterectomy ▪ Mastectomy ▪ Neck and Back Procedures	HMO Hospitalizations (members 18 – 64 years)
Length of Stay	
▪ Chronic Obstructive Pulmonary Disease	HMO, PPO and Fee-for-Service Sample Hospitalizations (members 18 – 64 years)
▪ Pediatric Asthma	HMO, PPO and Fee-for-Service Sample Hospitalizations (members 28 days – 17 years)
▪ Adult Asthma	HMO, PPO and Fee-for-Service Sample Hospitalizations (members 18 – 64 years)
▪ Diabetes	HMO, PPO and Fee-for-Service Sample Hospitalizations (members 18 – 75 years with diabetes)
▪ Hysterectomy ▪ Mastectomy ▪ Neck and Back Procedures	Statewide Hospitalizations (age 18 – 64 years)
Rehospitalization Rating –180 days	
▪ Chronic Obstructive Pulmonary Disease ▪ Asthma (adult only)	HMO, PPO and Fee-for-Service Sample Hospitalizations (members 18 – 64 years)
▪ Diabetes	HMO, PPO and Fee-for-Service Sample Hospitalizations (members 18 – 75 years with diabetes)
In-Hospital Complications	
▪ Hysterectomy ▪ Mastectomy ▪ Neck and Back procedures	Statewide Hospitalizations (age 18 – 64 years)

DATA SOURCES, COLLECTION, AND VERIFICATION

The data utilized in the *Measuring the Quality of Pennsylvania's Commercial HMOs* report were obtained from: 1) discharge data submitted to PHC4 by Pennsylvania health care facilities, and 2) the National Committee for Quality Assurance (NCQA) through the purchase of *Quality Compass®*. Pennsylvania hospitals verified data used to generate utilization measures and clinical outcomes, and commercial payors verified payor information listed in the hospital-submitted records. A more detailed explanation of the data and data sources follows.

PHC4: Hospital-Submitted Data and Commercial Payor Verification

Data specific to the clinical conditions in this report were submitted to PHC4 by licensed Pennsylvania health care facilities. Refer to Appendix A: "Description of Study Population" for a listing of the diagnosis and procedure codes that defined each clinical condition in the *Measuring the Quality of Pennsylvania's Commercial HMOs* report.

The ten largest commercial payors (plans) in Pennsylvania participated in a quarterly data exchange to verify the hospital discharges for which they were responsible for payment. Any hospital discharge record that was clearly attributable to one of these ten commercial payors (as the primary payor) was sent to the respective plan who either accepted the record (the plan agreed it was responsible for payment of the claim), or rejected the record (the plan disagreed it was the responsible payor).

Also, plans could provide additional records (not originally attributed/sent to them) for which they were the responsible payor (as identified by the plan). These added records were eligible to be included in the analysis only if PHC4 was able to match them to valid clinical records in the study population. If more than one plan accepted the same record, the plan that claimed the higher payment amount was assumed to be the primary payor.

Included in the information returned from the payors was a field to identify the line of business in which the patient was enrolled. Hospitalizations belonging to a PPO line of business were included in the PPO State Total/Average, those belonging to a Fee-For-Service line of business were included in the Fee-For-Service State Total/Average. Eight of the ten payors were identified as having sufficiently large managed care populations to include in this report, and those plans' HMO, POS, or GPPO line of business were included in the HMO State Total/Average.

National Committee for Quality Assurance (NCQA)

NCQA is a private, not-for-profit organization dedicated to assessing and reporting on the quality of managed care plans. NCQA collects data via the Health Plan Employer Data and Information Set® (HEDIS) and the Consumer Assessment of Health Plans Study® (CAHPS) survey. These instruments assess health plan performance and member satisfaction with their HMO. These data, available collectively in NCQA's *Quality Compass®* (the central repository of data collected nationally from the NCQA accreditation surveys), are then available for purchase. Select outcome measures from NCQA's *2007 Quality Compass* (2006 measurement year) are included in the *Measuring the Quality of Pennsylvania's Commercial HMOs* report and are described below.

HEDIS Measures

HEDIS is a health plan performance tool developed by NCQA and is a component of the NCQA accreditation process. The "HMO State Average" for each measure (derived from the *Quality Compass* database and weighted by NCQA enrollment) was calculated by PHC4. The *HEDIS Technical Specifications Manual* provides a detailed description of the calculations used to determine the numerator and denominator for these measures. The HEDIS "Effectiveness of Care" and "Use of Services" measures reported include:

Comprehensive Diabetes Care is a composite measure used to examine the frequency and results of certain tests for HMO members with diabetes. The measure evaluates HMO performance on six aspects of diabetes care using a single sample of members age 18 through 75 years of age who have Type 1 or Type 2 diabetes. The six components of the comprehensive diabetes care measure are expressed as a percent of members with diabetes who had each of the following:

- *Poorly Controlled Hemoglobin A1c Levels for Members with Diabetes*: Poor Hemoglobin A1c (HbA1c) control; that is, the most recent HbA1c test level within the calendar year 2006 that was greater than 9.0 percent. If no test was performed, then it was counted as poor HbA1c control.
- *Hemoglobin A1c Blood Tests for Members with Diabetes*: HbA1c tested; that is, at least one HbA1c test conducted during the calendar year 2006.
- *Eye Exams Performed for Members with Diabetes*: Eye exam performed; that is, an eye screening for diabetic retinal disease conducted during the calendar year 2006 or, in certain circumstances, the calendar year 2005.
- *Monitoring Kidney Disease for Members with Diabetes*: Kidney disease monitored; that is, a microalbuminuria screening performed during the calendar year 2006, or previous evidence of kidney disease such as a positive microalbuminuria screening or medical treatment for kidney disease.
- *Cholesterol Screening for Members with Diabetes*: LDL-C screening performed; that is, a low-density lipoprotein cholesterol test conducted during the calendar year 2006.
- *"Bad" Cholesterol Controlled for Members with Diabetes*: LDL-C controlled; that is, the most recent low-density lipoprotein cholesterol test performed during the calendar year 2006 that was less than 100 mg/dL. If there was no valid LDL-C value during the calendar year 2006, it was counted as exceeding the threshold.

As a set, these six aspects of care provide a comprehensive picture of the clinical management of patients with diabetes.

Advising Smokers to Quit is reported as the percent of members 18 years and older who were continuously enrolled during calendar year 2006, who were current smokers, who were seen by a plan practitioner during the measurement year, and who received advice to quit smoking.

Childhood Immunizations is reported as the percent of enrolled children who turned two years old during the calendar year 2006, who were continuously enrolled for 12 months immediately preceding their second birthday, and who were identified as having four DTaP/DT, three IPV, one MMR, three H influenza type B, three hepatitis B, and one chicken pox vaccination (VZV). It is reported as a combination rate.

Timely Initiation of Prenatal Care is reported as the percent of women who delivered a live birth between November 6th of calendar year 2005 and November 5th of calendar year 2006, who were continuously enrolled at least 43 days prior to delivery, and who received a prenatal care visit in the first trimester or within 42 days of enrolling in the HMO.

Screening for Breast Cancer is reported as the percent of women age 52 through 69 years, who were continuously enrolled during the calendar years 2005 and 2006, and who had a mammogram during either of those two years.

Screening for Cervical Cancer is reported as the percent of commercially enrolled women age 21 through 64 years, who were continuously enrolled during the calendar years 2004 through 2006, and who received one or more Pap tests during one of those three years.

Appropriate Medications for Members with Asthma evaluates whether members (age 5 through 56) with persistent asthma are being prescribed medications acceptable as primary therapy for long-term control of asthma. Members with "persistent" asthma were approximated based on services received during the prior year and medication utilization, rather than by a clinical measure

of severity. The consistent use of the following medications resulted in a member being added to the numerator: Inhaled Corticosteroids, Cromolyn Sodium and Nedocromil, Leukotriene Modifiers, and Methylxanthines.

Controlling High Blood Pressure is an intermediate outcome measure that assesses whether blood pressure was controlled among adult members with diagnosed hypertension. This measure can only be calculated by using the hybrid method (for further explanation of the hybrid methodology, see the *HEDIS Technical Specifications Volume 2*). For the Controlling High Blood Pressure measure, the hybrid method used membership data and ambulatory claims/encounter data to identify members ages 18 through 85 years of age with a diagnosis of hypertension and a medical record review to confirm the hypertension diagnosis and to assess blood pressure control during the membership year.

Beta Blockers after a Heart Attack is reported as the percent of commercial HMO members age 35 years and older as of December 31, 2006 who were hospitalized and discharged alive from January 1, 2006 through December 24, 2006 with a diagnosis of acute myocardial infarction (AMI) and who received an ambulatory prescription for beta blockers upon discharge. NCQA provides a list of contraindications to allow plans to adjust the number of commercial members who qualify for treatment.

Colorectal Cancer Screening is reported as the percent of adults age 51 through 80 years, who were continuously enrolled during the calendar years 2005 and 2006, and who had appropriate screening for colorectal cancer. Appropriate screenings are defined by any one of the following four criteria; fecal occult blood test (FOBT) during the measurement year, flexible sigmoidoscopy during the measurement year or the four years prior to the measurement year, double contrast barium enema (DCBE) during the measurement year or the four years prior to the measurement year, or colonoscopy during the measurement year or the nine years prior to the measurement year.

"Bad" Cholesterol Controlled after Acute Cardiovascular Events is reported as the percent of members age 18 through 75 as of December 31, 2006 who were discharged alive from January 1-November 1 of the prior year for AMI, CABG, or PTCA, or who had a diagnosis of ischemic vascular disease (IVD) and had an LDL-C screening during the measurement year. The most recent low-density lipoprotein cholesterol test performed during the calendar year 2006 that was less than 100 mg/dL. If there was no valid LDL-C value during the calendar year 2006, it was counted as exceeding the threshold.

Annual Monitoring for Patients on Persistent Medications is reported as the percent of members 18 years of age and older who received at least a 180-days supply of ambulatory medication therapy for specific therapeutic agents during the year and at least one therapeutic monitoring event for the therapeutic agent in the measurement year. The therapeutic agents include: angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARB), digoxin, diuretics, anticonvulsants and statins.

The source of the HEDIS data contained in the Measuring the Quality of Pennsylvania's Commercial HMOs report was Quality Compass® and was used with the permission of the NCQA. Any analysis, interpretation, or conclusion based on these data was solely that of PHC4; NCQA specifically disclaims responsibility for any such analysis, interpretation, or conclusion. Quality Compass is a registered trademark of NCQA.

HEDIS Rotation Strategy

Beginning with HEDIS 1999, NCQA implemented a measures rotation strategy. The purpose of the strategy is to reduce data collection burdens for the HMOs while still providing relevant and accurate data to consumers. The strategy allows HMOs to skip, for one year, the task of collecting data for certain HEDIS measures, and permits the plans to use the results from the previous year instead. Measures included in the rotation schedule must have been in the

measurement set for two years and have stable data collection specifications. The following table provides a summary of all the plans that, per the NCQA guidelines, chose not to collect new data for the rotated HEDIS measures included in this year's managed care report:

Table 2. *Repeat of CY2005 HEDIS Measures, by Plan*

	Beta Blockers after a Heart Attack	Childhood Immunizations	Colorectal Cancer Screening
Aetna Health Inc.	✓	✓	
First Priority Health	✓	✓	✓
Geisinger Health Plan	✓		
HealthAmerica & HealthAssurance	✓	✓	
Keystone Health Plan Central			✓
Keystone Health Plan West – HMO	✓	✓	✓
Keystone Health Plan West – POS	✓	✓	✓

CAHPS Measures

Another important component of the NCQA accreditation process is the CAHPS survey instrument. Commercial HMOs hire vendors from an NCQA-approved list to administer this member satisfaction survey. The *Measuring the Quality of Pennsylvania's Commercial HMOs* report includes calendar year 2006 CAHPS scores for 8 Pennsylvania plans. The following CAHPS Survey Questions are included in the *Measuring the Quality of Pennsylvania's Commercial HMOs* report for calendar year 2006:

- Question 23 "In the last 12 months, how often was it easy to get appointments with specialists?"
- Question 27 "In the last 12 months, how often was it easy to get the care, tests or treatment you thought you needed through your health plan?"
- Question 35 "In the last 12 months, how often did your health plan's customer service give you the information or help you needed?"
- Question 42 "How would you rate your health plan?"

All reported CAHPS measures include an average for the group of Pennsylvania HMO plans. These averages were calculated by PHC4 by weighting each plan's score by its CY2006 NCQA enrollment. National averages were also included when available from NCQA. The national averages (provided in the NCQA *Quality Compass®* database) include all lines of business across all reporting managed care organizations in the United States.

DESCRIPTION OF HOSPITALIZATIONS USED IN ANALYSES

Discharge data submitted to PHC4 by Pennsylvania hospitals is housed in the Database of Record (DBOR). Once the submitted data is verified by the hospitals, the DBOR is analyzed to identify unique patients and their hospitalization histories. This process involves linking the individual hospitalizations of each unique patient, identifying each hospitalization as an index or non-index hospitalization, and creating episodes of care. Accurate construction of hospitalization histories and correct identification of the various components within a hospitalization history is crucial to PHC4 research methodology. The following paragraphs define the components of a hospitalization history and explain their role in the analyses for the clinical conditions included in the report.

Procedures for Linking Hospitalizations

The patient Social Security Number (SSN), sex, and date of birth, as reported by the hospitals, are used to identify patients across hospitalizations. In the vast majority of instances these values are identical for the same patient. Inconsistencies in essential data elements are resolvable if the discrepancy is clearly a typographical error (e.g., October 13 and October 31 of the same year). In this instance both records are assigned to the same patient. Hospitalizations assigned to the same patient are linked to create the hospitalization history.

Index Hospitalizations

After the linking of hospitalizations for unique patients is complete, the index hospitalization for each particular condition represented in that patient's hospitalization history is identified. For any single patient, the index hospitalization is the first hospitalization in the study period that meets the study population inclusion criteria. Therefore, there is only one index hospitalization per patient per condition.

Episode of Care

An episode of care is comprised of the acute care hospitalization(s) associated with a patient's need for inpatient care. Single-hospitalization episodes of care are especially frequent for the preventable hospitalizations such as those in the "Preventing Hospitalization through Primary Care" section of the *CY2006 Measuring the Quality of Pennsylvania's Commercial HMOs* report. Multiple-hospitalization episodes are more frequent for chronic illnesses (i.e., COPD, Asthma, and Diabetes). Episodes involving more than one hospitalization are an important aspect of PHC4 methodology in that they account for the intricately related hospitalizations that are typical of the comprehensive care required to treat an illness.

Multiple-hospitalization episodes consist of a string of contiguous acute care inpatient hospitalizations. For two contiguous hospitalizations to be considered part of the same episode, the discharge date of the first hospitalization must be the same date as the admission date of the second hospitalization.

Multiple-hospitalization episodes may be comprised of hospitalizations with identical or differing principal diagnosis or procedure codes. For example, within the same diabetes episode a hospitalization with a principal diagnosis of diabetes may be followed by a hospitalization with a principal diagnosis of COPD.

Hospitalizations and Measures

All utilization and outcome measures for the clinical conditions in the *CY2006 Measuring the Quality of Pennsylvania's Commercial HMOs* report relied on the linking of hospitalizations and the proper identification of index and non-index hospitalizations. Table 3 lists all the measures reported for each clinical condition and details the hospitalizations that were used to extract utilization and/or clinical information for each measure. All episodes in a patient's hospitalization history and all hospitalizations in a multiple-hospitalization episode were not necessarily used for each measure. For example:

- The hospitalization rates for COPD were based upon the number of individual members that were hospitalized for this condition. If a person was hospitalized several times during the study period, only the index hospitalization was counted. Non-index hospitalizations were excluded so that a single member was counted in the hospitalization rate analysis rather than individual hospitalizations. Therefore, the number of members hospitalized for COPD was the basis of the hospitalization rate, not the number of hospitalizations for COPD.
- The percent rehospitalized for diabetes was also derived from the index hospitalization of each patient. However, to accurately assess percent rehospitalized across all HMO members hospitalized, the discharge date of the last acute care hospitalization in the diabetes episode was used to determine if the member had been rehospitalized within six months.

Additional hospitalizations were excluded from the analysis if they met certain clinical and procedural exclusion criteria. Refer to subsequent sections of this report that pertain to each clinical condition for detailed descriptions of the particular records excluded for each relevant measure.

Table 3. *Hospitalizations Used for Each Measure and Clinical Condition*

Condition	Data Source	Measure	Hospitalizations[1]
Ear, Nose and Throat Infections	PHC4	*Pediatric and Adult reported separately:* • Hospitalization Rate per 10,000 Members (age & sex-adjusted) • Statistical Rating for Hospitalization Rate	• Index hospitalization only (one per member)[2]
High Blood Pressure	PHC4	• Hospitalization Rate per 10,000 Members (age & sex-adjusted) • Statistical Rating for Hospitalization Rate	• Index hospitalization only (one per member)[2]
	HEDIS	• Controlling High Blood Pressure	Not Applicable
Gastrointestinal Infections	PHC4	• Hospitalization Rate per 10,000 Members (age & sex-adjusted) • Statistical Rating for Hospitalization Rate	• Index hospitalization only (one per member)[2]
Kidney/Urinary Tract Infections	PHC4	• Hospitalization Rate per 10,000 Members (age & sex-adjusted) • Statistical Rating for Hospitalization Rate	• Index hospitalization only (one per member)[2]
Chronic Obstructive Pulmonary Disease	PHC4	• Number of Hospital Admissions • Hospitalization Rate per 10,000 Members (age & sex-adjusted) • Statistical Rating for Hospitalization Rate • Length of Stay (risk-adjusted)	• Index hospitalization only (one per member)[2]
		• Statistical Rating for Rehospitalizations – 180 day	• Index hospitalization (one per member)[2] • Any respiratory-related hospitalization beginning no more than 180 days after the discharge date of the last acute care hospitalization[3] linked to the index hospitalization
Asthma	PHC4	*Pediatric and Adult reported separately:* • Number of Hospital Admissions • Hospitalization Rate per 10,000 Members (age & sex-adjusted) • Statistical Rating for Hospitalization Rate • Length of Stay (risk-adjusted)	• Index hospitalization only (one per member)[2]
		Adult only: • Statistical Rating for Rehospitalizations – 180 day	• Index hospitalization (one per member)[2] • Any respiratory-related hospitalization beginning no more than 180 days after the discharge date of the last acute care hospitalization[3] linked to the index hospitalization
	HEDIS	Appropriate Medications for Members (age 5 – 56; percent)	Not Applicable

[1]Identifies the hospitalizations that were used to extract utilization and/or clinical information for the associated measure.
[2]Records with missing/invalid SSNs cannot be linked to a single member, and therefore were counted as separate members for the hospitalization rate. If records had matching valid social security numbers but had inconsistent birth dates or sex identifiers that could not be resolved, each record was counted as a single index hospitalization.
[3]Non-index hospitalization that may or may not have a principal diagnosis related to condition analyzed.

Table 3. *Hospitalizations Used for Each Measure and Clinical Condition* continued

Condition	Data Source	Measure	Hospitalizations[1]
Diabetes	PHC4	• Number of Members with Diabetes	Not Applicable
		• Number of Hospital Admissions • Hospitalization Rate per 10,000 Members with Diabetes (age & sex-adjusted) • Statistical Rating for Hospitalization Rate • Length of Stay (risk-adjusted) • Percent of Admissions for Short-term Complications of Diabetes	• Index hospitalization only (one per member)[2]
		• Statistical Rating for Rehospitalizations – 180 day	• Index hospitalization (one per member)[2] • Any diabetes-related hospitalization beginning no more than 180 days after the discharge date of the last acute care hospitalization[3] linked to the index hospitalization
	HEDIS	• Poorly Controlled Hemoglobin A1c Levels (percent) • Hemoglobin A1c Blood Tests (percent) • Eye Exam Performed (percent) • Monitoring Kidney Disease (percent) • Cholesterol Screening (percent) • "Bad" Cholesterol Controlled (percent)	Not Applicable

Condition	Data Source	Measure	Hospitalizations[1]
Hysterectomy	PHC4	• Total Hysterectomy Hospital Admissions • Procedure Rate per 10,000 Female Members (age-adjusted) • Statistical Rating for Procedure Rate *Abdominal and Vaginal reported separately:* • Number of Hospital Admissions • Procedure Rate per 10,000 Female Members (age-adjusted) • Statistical Rating for Procedure Rate • Length of Stay (risk-adjusted) • Expected In-Hospital Complications (risk-adjusted; percent) • Actual In-Hospital Complications (percent) • Statistical Rating for In-Hospital Complications	• Index hospitalization only (one per member)[2]
	HEDIS	• Screening for Cervical Cancer (percent)	Not Applicable

[1]Identifies the hospitalizations that were used to extract utilization and/or clinical information for the associated measure.
[2]Records with missing/invalid SSNs cannot be linked to a single member, and therefore were counted as separate members for the hospitalization rate. If records had matching valid social security numbers but had inconsistent birth dates or sex identifiers that could not be resolved, each record was counted as a single index hospitalization.
[3]Non-index hospitalization that may or may not have a principal diagnosis related to condition analyzed.

Table 3. *Hospitalizations Used for Each Measure and Clinical Condition* continued

	Data Source	Measure	Hospitalizations[1]
Mastectomy	PHC4	• Total Mastectomy Procedures • Procedure Rate per 10,000 Female Members (age-adjusted) • Percent Performed Inpatient	• Single Encounters [2,3]
		• Length of Stay (risk-adjusted) • Expected In-Hospital Complications (risk-adjusted; percent) • Actual In-Hospital Complications (percent) • Statistical Rating for In-Hospital Complications	• Single Hospitalizations (inpatient only)[3]
	HEDIS	• Screening for Breast Cancer (percent)	Not Applicable
Neck and Back Procedures	PHC4	• Total Neck and Back Procedures • Procedure Rate per 10,000 Members (age & sex-adjusted) *With Fusion and Without Fusion reported separately:* • Number of Procedures • Percent Performed Inpatient	• Single Encounters [2,3]
		• Length of Stay (risk-adjusted) • Expected In-Hospital Complications (risk-adjusted; percent) • Actual In-Hospital Complications (percent) • Statistical Rating for In-Hospital Complications	• Single Hospitalizations (inpatient only)[3]
Other Measures	HEDIS	• Advising Smokers to Quit (percent) • Childhood Immunizations (percent) • Timely Initiation of Prenatal Care (percent) • Colorectal Cancer Screening (percent) • Beta Blockers after a Heart Attack (percent) • Annual Monitoring for Patients on Persistent Medications – Total Rate (percent) • "Bad" Cholesterol Controlled after Acute Cardiovascular Events (percent)	Not Applicable

[1]Identifies the hospitalizations that were used to extract utilization and/or clinical information for the associated measure.
[2]Encounter refers to a single patient visit (impatient or ambulatory).
[3]Over the course of the study period, a single patient may have more than one hospitalization/encounter for said condition. If so, each of the single hospitalizations/encounters were analyzed.

RISK ADJUSTMENT METHODOLOGY

Risk Adjustment Approach for Hospitalization/Procedure Rates

Age and Sex Adjustment

Hospitalization and procedure rates are age and sex adjusted to account for differences in the mix of members (by sex or age) in one HMO plan compared to another. For example, older populations often experience more health problems. When this is true, PHC4's system "expected" more health problems in the HMO with an older population and made appropriate adjustments. Sex is often an important risk factor, therefore the system also accounted for differences among HMOs in this category. The hospitalization rate data were adjusted using age and sex cohorts derived from the total membership population of each HMO. These cohorts were constructed with the assistance and review of each HMO. The age cohorts used in the risk adjustment of hospitalization/procedure rates are described in Appendix D.

To standardize hospitalization/encounter data across plans and across age categories, only records for those patients age 64 or younger as of December 31, 2006 were included in the analysis. HMO members were excluded from an analysis if they turned 65 at any point during 2005, even if the individual was age 64 at the time of their hospitalization. Likewise, in conditions involving adults only, records were included for patients who were 18 years or older as of December 31, 2006. As part of the data verification process, HMOs were instructed to follow this same age criterion when adding records to the file of verified data. (Note that diabetes records were included if the patient was 18 years or older and 75 years or younger as of December 31, 2006 and excluded if the patient turned 76 at any time during the 2006 calendar year even if the patient was 75 at the time of the hospitalization.)

Calculation of Adjusted Hospitalization/Procedure Rates

Indirect standardization, using the risk factors of age and sex, was used to compare the hospitalization rates for each HMO plan against the hospitalization rate for the HMO aggregate for each clinical condition (see the "Statistical Ratings" section.) Because enrollment data were not collected from the insurance groups that comprise the "fee-for-service" or PPO categories, hospitalization rates cannot be reported for these samples.

Risk Adjustment Approach for Outcome Measures

Regression techniques were used to construct "risk-adjustment models" for length of stay, rehospitalizations–180 days, and in-hospital complications. These models were used to calculate expected (predicted) results. HMO plans whose membership was characterized by a greater number of risk factors (e.g., severity of illness, comorbidity, demographic factors, socioeconomic factors, etc.) were given "credit" in the system; patients with significant risk factors were expected to have longer lengths of stay and a greater probability of rehospitalization, and/or complications.

The first step in building the risk adjustment models was to identify possible risk-adjustment factors—those factors that potentially contribute to a particular event for a particular condition. In doing so, both clinical and demographic factors identified in the literature were considered. The *Atlas Outcomes*™ Predicted Probability of Death (MQPredDeath) and Predicted Length of Stay (MQPredLOS) scores were also considered. The process for gathering and reporting the Atlas information is explained in the following section.

Atlas Outcomes™ Approach for Risk Adjustment

In a contractual agreement with MediQual Systems®, Inc., a business of Cardinal Health in Marlborough, Massachusetts, acute care hospitals are required to use MediQual's *Atlas Outcomes™* Severity of Illness System to assess each patient's condition from date of admission through the first two days of the hospital stay (or a maximum of 30 hours, based on when the patient was admitted to the hospital). This system represents a summarization of patient risk/severity, characterized as scores such as predicted probability of death (MQPredDeath) or predicted length of stay (MQPredLOS). These scores, determined from objective data abstracted from medical records, were included as potential risk factors in this report. The MQPredDeath is derived from a logistic regression model and has a value from 0.000 to 1.000. The MQPredLOS is derived from a linear regression model and has no bounds.

The *Atlas Outcomes™* system is based on the examination of numerous Key Clinical Findings (KCFs) such as lab tests, EKG readings, vital signs, the patient's medical history, imaging results, pathology, age, sex, and operative/endoscopy findings. Hospital personnel abstract these KCFs during specified timeframes in the hospitalization. Some pre-admission data are also captured (e.g., cardiac catheterization findings), as are some history findings. The KCF results are entered into algorithms that calculate the overall predicted probability of death or the predicted length of stay.

PHC4 Model Selection

Model selection identified those candidate variables that were statistically significant predictors of the relevant event (i.e., length of stay, rehospitalization–180 day, or in-hospital complication). Linear regression models were used for length of stay, while binary logistic regression models were used for rehospitalization and complication outcomes. Forward stepwise model selection methods were used to determine the significant risk factors. Factors were included in the model if they met the $p < 0.10$ significance criteria. Evaluation of model performance for linear regression models was accomplished by considering the R-squared (R^2) values. The measures of model adequacy applied to the binary logistic regression models included the percentage explained, R^2, and the ROC area.

PHC4 Model Coefficients

The coefficients associated with the significant risk factors and their p-values are listed in the following table. (See Appendices D and E for descriptions of the variables.)

Table 4. Coefficients of Significant Predictors

Significant Predictors	Coefficient	p-value
COPD		
Length of Stay		
• Intercept	0.8062	
• MQPredLOS[1]	0.6620	<.0001
Rehospitalization		
• Intercept	-1.1941	
• MQPredLOS[1]	0.1700	0.0526
• Psychological Disorder[2]	0.3352	0.0264
• MQPredDeath (logit)[3]	0.2390	0.0305
• Poverty Rate	1.5947	0.0451

Significant Predictors	Coefficient	p-value
Pediatric Asthma		
Length of Stay		
• Intercept	0.5763	
• MQPredLOS[1]	0.3694	<.0001
• Age	0.0313	<.0001
• Asthma Presentation-Acute Exacerbation	0.0812	
• Asthma Presentation-Status Asthmaticus	0.3184	0.0002
• Asthma Presentation-Unspecified	0.0000	
• Female	0.2156	0.0006

Significant Predictors	Coefficient	p-value
Adult Asthma		
Length of Stay		
• Intercept	0.4006	
• MQPredLOS[1]	0.6394	<.0001
• Asthma Type- Chronic Obstructive	0.6933	
• Asthma Type- Extrinsic	0.1783	<.0001
• Asthma Type- Intrinsic/Unspecified	0.0000	
• Diabetes[2]	0.5195	<.0001
• Asthma Presentation-Acute Exacerbation	0.1226	
• Asthma Presentation-Status Asthmaticus	0.6244	0.0002
• Asthma Presentation-Unspecified	0.0000	
• Female[2]	0.2624	0.0046
• Psychological Disorder[2]	0.2221	0.0278
Rehospitalization		
• Intercept	-3.6056	
• Asthma Presentation-Acute Exacerbation	0.8518	
• Asthma Presentation-Status Asthmaticus	0.9233	<.0001
• Asthma Presentation-Unspecified	0.0000	
• MQPredLOS[1]	0.1945	0.0016
• Poverty Rate	1.8070	0.0013
• Asthma Type- Chronic Obstructive	0.3665	
• Asthma Type- Extrinsic	0.4898	0.0040
• Asthma Type- Intrinsic/Unspecified	0.0000	

[1] Atlas Outcomes™ Predicted Length of Stay
[2] These factors were tested as binary variables.
[3] Atlas Outcomes™ Predicted Probability of Death (logit)
[4] Principal Diagnosis Group

Significant Predictors	Coefficient	p-value
Diabetes		
Length of Stay		
• Intercept	0.2306	
• MQPredLOS[1]	0.5020	<.0001
• Amputation[2]	2.7952	<.0001
• Poverty Rate	1.9826	0.0010
• Heart Failure[2]	0.6312	0.0094
• Female[2]	0.3148	0.0067
• Age	0.0139	0.0032
• Diabetes Complication - Long Term	-0.3424	
• Diabetes Complication - None	-0.1344	0.0392
• Diabetes Complication - Short Term	0.0000	
• Renal Failure[2]	0.3159	0.0537
• COPD[2]	0.4715	0.0967
Rehospitalization		
• Intercept	-1.4112	
• Renal Failure[2]	0.7056	<.0001
• Age	-0.0331	<.0001
• Peripheral Vascular Disorder[2]	1.0820	0.0002
• Diabetes Complication - Long Term	0.3442	
• Diabetes Complication - None	-0.7616	0.0074
• Diabetes Complication - Short Term	0.0000	
• Psychological Disorder[2]	0.5207	0.0134
• Female[2]	0.3781	0.0089
• MQPredLOS[1]	0.0746	0.0152
• Alcohol/Drug Abuse[2]	0.5275	0.0971

Significant Predictors	Coefficient	p-value
Abdominal Hysterectomy		
Length of Stay		
• Intercept	-0.0512	
• MQPredLOS[1]	0.8220	<.0001
• Poverty Rate	1.8101	<.0001
• Radical[2]	0.7325	<.0001
In-Hospital Complications		
• Intercept	-4.5289	
• MQPredLOS[1]	0.7443	<.0001
• Radical[2]	1.2851	0.0108
• Poverty Rate	0.8475	0.0279

Significant Predictors	Coefficient	p-value
Vaginal Hysterectomy		
Length of Stay		
• Intercept	0.5137	
• MQPredLOS[1]	0.3747	<.0001
• Poverty Rate	1.5804	<.0001
• Laparoscopic Procedure[2]	-0.1662	<.0001
• Age	0.0055	<.0001
• PDxGrp[4] - Bleeding/Other	-0.0522	0.0131
• PDxGrp[4] - Fibroids/Hyperplasia/Etc	0.0000	
In-Hospital Complications		
• Intercept	-5.1774	
• MQPredLOS[1]	1.2071	<.0001

Table 4. *Coefficients of Significant Predictors* continued

Significant Predictors	Coefficient	p-value
Mastectomy		
Length of Stay		
• Intercept	0.7310	
• Reconstruction - Flap/Graft	2.2168	
• Reconstruction - Implant/ Other	0.2950	<.0001
• Reconstruction - None	0.0000	
• Poverty Rate	2.1677	<.0001
• MQPredLOS[1]	0.3219	<.0001
• Bilateral Procedure[2]	0.2658	<.0001
• Obesity[2]	0.2254	0.0698
• Diabetes[2]	0.1892	0.0547
• Radical[2]	0.3317	0.0712
In-Hospital Complications		
• Intercept	-3.0274	
• Reconstruction - Flap/Graft	1.1755	
• Reconstruction - Implant/ Other	-0.0328	<.0001
• Reconstruction - None	0.0000	

Significant Predictors	Coefficient	p-value
Neck and Back Procedure With Fusion		
Length of Stay		
• Intercept	1.5529	
• Vertebral Column Location - Cervical	-1.7328	
• Vertebral Column Location – Unspecified	-0.0908	<.0001
• Vertebral Column Location - Lumbar or Lumbosacral, or Thoracic or Thoracolumbular	0.0000	
• MQPredLOS[1]	0.6899	<.0001
• Poverty Rate	2.5435	<.0001
• Procedure Group - Both	0.8267	
• Procedure Group - Discectomy	-0.0581	<.0001
• Procedure Group - Laminectomy	0.0000	
• Alcohol/Drug Abuse[2]	0.9293	<.0001
In-Hospital Complications		
• Intercept	-2.3094	
• Vertebral Column Location - Cervical	-1.6682	
• Vertebral Column Location - Unspecified	-0.3843	<.0001
• Vertebral Column Location - Lumbar and Lumbosacral, or Thoracic and Thoracolumbular	0.0000	
• MQPredLOS[1]	0.2894	<.0001
• COPD[2]	0.7757	0.0002
• Procedure Group - Both	0.6516	
• Procedure Group - Discectomy	-0.2522	<.0001
• Procedure Group - Laminectomy	0.0000	
• Alcohol/Drug Abuse[2]	0.6146	0. 0504

Significant Predictors	Coefficient	p-value
Neck and Back Procedure Without Fusion		
Length of Stay		
• Intercept	0.7046	<.0001
• MQPredLOS[1]	0.9814	<.0001
• Vertebral Column Location - Cervical	-1.1108	
• Vertebral Column Location - Lumbar or Lumbosacral, or Unspecified	-0.9642	<.0001
• Vertebral Column Location - Thoracic or Thoracolumbular	0.0000	
• Procedure Group-Disc/Laminectomy	0.0157	
• Procedure Group-Discectomy	-0.2169	<.0001
• Procedure Group-Laminectomy	0.0000	
• Poverty Rate	1.3409	<.0001
• Alcohol/Drug Abuse[2]	0.6118	<.0001
• Female[2]	-0.0887	0.0027
• Obesity[2]	0.0870	0.0893
In-Hospital Complications		
• Intercept	-3.1433	
• MQPredLOS[1]	0.3891	<.0001
• Procedure Group-Disc/Laminectomy	-0.1816	
• Procedure Group-Discectomy	-0.5570	<.0001
• Procedure Group-Laminectomy	0.0000	
• Vertebral Column Location - Cervical	-1.5970	
• Vertebral Column Location - Lumbar or Lumbosacral, or Unspecified	-0.8348	<.0001
• Vertebral Column Location - Thoracic or Thoracolumbular	0.0000	
• Age	0.0182	0.0003
• Female[2]	-0.2569	0.0068

[1] Atlas Outcomes™ Predicted Length of Stay
[2] These factors were tested as binary variables.
[3] Principal Diagnosis Group

Calculation of Risk-Adjusted Outcomes

Actual and expected rates and statistical ratings (greater than expected, as expected, or less than expected) were calculated for length of stay, rehospitalization – 180 day, and/or in-hospital complications for each appropriate clinical condition. The expected rate was based on the risk factors of the hospitalizations included. Actual and expected rates could then be compared to determine if differences were statistically significant.

Determining Actual (Observed) Rates

Length of Stay	This value was determined as the arithmetic mean length of stay for the hospitalizations included for a particular condition.
Percent Rehospitalized	This rate was determined by dividing the total number of members rehospitalized (at least once) to a general or specialty acute care hospital within 180 days of discharge (from the last hospitalization in the episode) by the total number of members hospitalized for that particular principal diagnoses.
In-Hospital Complication	This rate was determined by dividing the total number of hospitalizations with at least one complication by the total number of hospitalizations included for that particular condition.

Determining Expected Rates

The models for each outcome used the risk factor values and corresponding coefficients to provide a predicted value (predicted length of stay, probability of rehospitalization, or probability of complication) for each observation after exclusions. The expected rate for an individual HMO plan was the average of these predicted values for all observations associated with the plan.

For both the linear and logistic regression models, the first step to determine these predicted values was to multiply the vector of model coefficients (ß) by the vector of risk factors (X). This value, ßX, is calculated for each patient and equals:

$$ßX = ß_0 + ß_1x_1 + ß_2x_2 + ß_3x_3 \ldots$$

where

$ß_n$ = the relevant model coefficient (see Table 4; $ß_0$ is the intercept)
X_n = the value of the risk factor for this patient

(risk factors that are binary, i.e., yes/no, were coded as yes = 1 and no =0)

For linear models, the value ßX was the final predicted value. For logistic models, the predicted value was calculated as:

$$p = \frac{e^{\beta X}}{1 + e^{\beta X}}$$

where $e \approx 2.7182818285$

Linear Example – Calculations Used in COPD Length of Stay (LOS)

Total Cases: Number of hospitalizations after exclusions (equal to n).

Actual Length of Stay: Mean of the length of stay for each hospitalization.

Expected Length of Stay: Mean of the predicted length of stay for each hospitalization.

Step 1: Calculate each patient's predicted length of stay (PLOS):

$$\begin{aligned} PLOS &= ßX \\ &= ß_0 + ß_1 x_1 \\ &= 0.8062 + (0.6620)(x_1) \end{aligned}$$

where
x_1 = MediQual PredLOS value

(ß's can be found in Table 4.)

Step 2: Calculate the mean PLOS for an HMO plan:

$$\text{Mean PLOS} = \frac{\Sigma \text{ PLOS}}{n}$$

Risk-Adjusted Length of Stay:

$$\frac{\text{Mean Actual LOS}}{\text{Mean PLOS}}\left(\text{Mean Actual LOS for the HMO, PPO and FFS combined data}\right)$$

Logistic Example – Calculations used in COPD Percent Rehospitalized

Total Cases: Number of hospitalizations after exclusions (equal to n).

Actual Percent Rehospitalized: Total number of members rehospitalized at least once / total number of hospitalizations.

Predicted Percent Rehospitalized: Mean of the predicted probability of rehospitalization for each hospitalization.

Step 1: Calculate each patient's predicted probability of rehospitalization (PRehosp):

$$\begin{aligned} ßX &= ß_0 + ß_1 x_1 + ß_2 x_2 + ß_3 x_3 + ß_4 x_4 \\ &= -1.1941 + (0.1700)(x_1) + (0.3352)(x_2) + (0.2390)(x_3) + (1.5947)(x_4) \end{aligned}$$

where
x_1 = MediQual PredLOS value
x_2 = Psychological Disorder (1 if yes, 0 if no)
x_3 = MediQual Predicted Probability of Death value (logit)
x_4 = Poverty Rate of the Patient's Zip Code (proportion in poverty)

(ß's can be found in Table 4.)

$$\text{PRehosp} = \frac{e^{\beta X}}{1 + e^{\beta X}}$$

Step 2: Calculate the mean PRehosp for an HMO plan:

$$\text{Mean PRehosp} = \frac{\Sigma \text{ PRehosp}}{n}$$

Statistical Ratings

Significance tests (using binomial distribution) were performed for the measures listed in the table below.

Table 5. *Measures Using the Binomial Distribution*

Measure	Clinical Conditions
Hospitalization Rate (Members hospitalized for a given clinical condition per HMO population)	Ear, Nose and Throat Infections; High Blood Pressure; Gastrointestinal Infections; Kidney/Urinary Tract Infections; Chronic Obstructive Pulmonary Disease; Asthma; Diabetes
Procedure Rate (Members hospitalized for a hysterectomy)	Hysterectomy
In-Hospital Complications (Complication vs. No Complication)	Hysterectomy; Mastectomy; Neck and Back Procedures
Percent Rehospitalized (Rehospitalized vs. Not Rehospitalized)	COPD; Adult Asthma; Diabetes

Although the measures for any single HMO plan may be comparable to the statewide norm (or other reference data), random variation plays a role in such comparisons. Statistical evaluation was used to determine whether the difference between the observed and the expected (or average) value was *too large* to be attributed solely to chance.

Binomial Distribution

The use of binomial distribution required the following assumptions:

- Each observation included in the study had one of two observable events (e.g., in-hospital complication vs. no in-hospital complication). In other words, the response was dichotomous.
- The probability of the event (e.g., having a complication) for each observation studied within a clinical condition group was equal to the probability provided by the risk models.
- The result for any one observation in the analyses had no impact on the result of another observation. In other words, the observations were independent.

The probability distributions were based on the HMO plans' predicted or expected rates. Using the probability distribution, a p-value was calculated for each observed value. This p-value is the probability, or likelihood, that the observed value could have occurred by chance. If it was very unlikely ($p < 0.05$; see "Inferential Error" section below) that the observed value could have occurred only by chance, then it was concluded that the observed value was "significantly different" from the expected value.

Calculation of p-values

Calculating the p-value for the binomial test is defined by a formula that sums discrete probabilities based upon the binomial distribution. The binomial formula (see below) was used, in part, to derive the p-value. The probability that a binomial random variable takes on a specific value is defined by the following equation (i.e., the binomial formula):

$$P(X=a) = [(N!)/(a!(N-a)!)]\ p^a(1-p)^{N-a}$$

where (for in-hospital complications analysis),

- $P(X=a)$ is the probability that the binomial random variable (X) takes on a specific value (a); that is, a = 1 hospitalization with complication, a = 2 hospitalizations with complications, etc.
- X is the binomial random variable. X is a discrete random variable that can range from 0 through N ($0 \le X \le N$).
- N is the number of observations for a particular HMO plan's clinical condition.
- p is the overall expected probability of patient in-hospital complications for a particular HMO plan's clinical condition.

The p-value for a specific result is determined to be the sum of all probabilities associated with that result and all other results that are more extreme. The p-value associated with the observed number of in-hospital complications was calculated for each HMO plan and clinical condition.

Inferential Error

A type of inferential error that can be made in statistics is called a Type I error or "false positive." The probability of committing a Type I error is equal to the level of significance established by the researcher. For the current analysis, the level of significance was set to 0.05. In the context of the *Measuring the Quality of Pennsylvania's Commercial HMOs* report, a Type I error occurred when the difference between the observed in-hospital complications percent and the expected in-hospital complications percent was declared statistically significant, when in fact, the difference was due to chance. That is, for a particular clinical condition, the HMO plan was declared to be statistically higher or lower than expected, when in reality the HMO plan's level of performance was comparable to the statewide norm. Since the level of significance was set to 0.05, there was a 5% (or 1 in 20) chance of committing this type of error.

Assignment of Statistical Rating

A statistical rating was assigned to each HMO if the difference between what was observed and what was expected in a particular clinical condition was statistically significant. The p-value, calculated in terms of a "two-tailed" test was compared to the level of significance. For example, in the calculation of in-hospital complications percent for each HMO:

- If the calculated p-value was greater than or equal to 0.05, then the conclusion was made that the difference between what was expected and what was observed was *not* statistically significant. It *cannot be concluded* that the in-hospital complications percent for that particular clinical condition in that particular HMO was different from the comparative reference.

- If the calculated p-value was less than 0.05, then the conclusion was made that the difference between what was expected and what was observed *was* statistically significant.

- If the observed in-hospital complications percent was lower than expected, which was based on the statewide in-hospital complications percent, the HMO was assigned the symbol "○" (as shown in the *Measuring the Quality of Pennsylvania's Commercial HMOs* report) to indicate the in-hospital complications percent was significantly lower than expected for a particular clinical condition.

- If the observed in-hospital complications percent was higher than expected, which was based on the statewide in-hospital complications percent, the HMO was assigned the symbol "●" (as shown in the *Measuring the Quality of Pennsylvania's Commercial HMOs* report) to indicate the in-hospital complications percent was significantly higher than expected for a particular clinical condition.

In the *Measuring the Quality of Pennsylvania's Commercial HMOs* report, statistical ratings are shown for HMO plans that have sufficient records. When the number of records for analysis was less than 10, "NR" (Not Reported) is displayed (except for analyses related to the rate of hospitalizations or procedures).

TREATMENT MEASURES CALCULATED BY PHC4

PREVENTING HOSPITALIZATION THROUGH PRIMARY CARE

Pediatric Ear, Nose and Throat Infections

Inclusion Criteria

Cases were included in the data analysis for pediatric ear, nose, and throat infections if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population." Pediatric HMO members included in this analysis were 0 through 17 years of age.

Hospitalization Rate and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate shown for each HMO used the total number of pediatric index hospitalizations per 10,000 pediatric members. Excluded hospitalizations are listed in Table 6A. The comparative reference was all HMO hospitalizations.

Table 6A. *Exclusions from "Hospitalization Rate" Analysis for Pediatric Ear, Nose and Throat Infections*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*431*	*100.0*
Exclusions:		
❖ Duplicate Record	0	0.0
❖ Non-PA Resident	8	1.9
❖ Neonate (age < 28 days)	10	2.3
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	10	2.3
❖ Mechanical Ventilation*	3	0.7
❖ Tracheitis*	3	0.7
❖ Metastatic Cancer; Ear, Nose, and Throat Cancer; Lung Cancer; HIV Infection; Extensive OR Procedures Unrelated to Principal Diagnosis; Tracheostomy; Cleft Lip and Palate Repair*	0	0.0
Total exclusions	*34*	*7.9*
Total members remaining in analysis	*397*	*92.1*

*See Appendix B for definitions of clinically complex exclusions.

Adult Ear, Nose and Throat Infections

Inclusion Criteria

Cases were included in the data analysis for adult ear, nose, and throat infections if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population." Adult HMO members included in this analysis were 18 through 64 years of age.

Hospitalization Rate and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate shown for each HMO used the total number of adult index hospitalizations per 10,000 adult members. Excluded hospitalizations are listed in Table 6B. The comparative reference was all HMO hospitalizations.

Table 6B. *Exclusions from "Hospitalization Rate" Analysis for Adult Ear, Nose and Throat Infections*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	466	100.0
Exclusions:		
❖ Duplicate Record	0	0.0
❖ Non-PA Resident	15	3.2
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	3	0.6
❖ Metastatic Cancer*	2	0.4
❖ ENT Cancer*	1	0.2
❖ Lung Cancer*	1	0.2
❖ HIV Infection*	1	0.2
❖ Extensive OR Procedures Unrelated to Principal Diagnosis*	1	0.2
❖ Mechanical Ventilation*	6	1.3
❖ Tracheostomy*	0	0.0
❖ Cleft Lip and Palate Repair*	0	0.0
❖ Tracheitis*	1	0.2
Total exclusions	*31*	*6.7*
Total members remaining in analysis	*435*	*93.3*

*See Appendix B for definitions of clinically complex exclusions.

High Blood Pressure (Hypertension)

Inclusion Criteria

Only adult (18 through 64 years of age) HMO members were included in this analysis. Cases were included in the data analysis for high blood pressure if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population."

Hospitalization Rate and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate shown for each HMO used the total number of index hospitalizations per 10,000 adult members. Excluded hospitalizations are listed in Table 6C. The comparative reference was all HMO hospitalizations.

Table 6C. *Exclusions from "Hospitalization Rate" Analysis for High Blood Pressure*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*544*	*100.0*
Exclusions:		
❖ Duplicate Record	1	0.2
❖ Non-PA Resident	8	1.5
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	16	2.9
❖ Metastatic Cancer*	0	0.0
❖ HIV Infection*	0	0.0
❖ Renal Dialysis*	5	0.9
❖ Open Heart Surgery*	0	0.0
❖ Extensive OR Procedures Unrelated to Principal Diagnosis*	0	0.0
❖ PTCA/Stent*	2	0.4
❖ Mechanical Ventilation*	1	0.2
❖ Tracheostomy*	0	0.0
Total exclusions	*33*	*6.1*
Total members remaining in analysis	*511*	*93.9*

*See Appendix B for definitions of clinically complex exclusions.

Gastrointestinal Infections

Inclusion Criteria

Cases were included in the data analysis for gastrointestinal infections if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population." HMO members included in this analysis were 0 through 64 years of age.

Hospitalization Rate and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate shown for each HMO used the total number of index hospitalizations per 10,000 members. Excluded hospitalizations are listed in Table 6D. The comparative reference was all HMO hospitalizations.

Table 6D. *Exclusions from "Hospitalization Rate" Analysis for Gastrointestinal Infections*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*1,162*	*100.0*
Exclusions:		
❖ Duplicate Record	2	0.2
❖ Non-PA Resident	19	1.6
❖ Neonate (age < 28 days)	1	0.1
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	12	1.0
❖ Gastrointestinal Cancer*	12	1.0
❖ Metastatic Cancer*	6	0.5
❖ HIV Infection*	3	0.3
❖ Extensive OR Procedures Unrelated to Principal Diagnosis*	1	0.1
❖ Major Large and Small Bowel Procedures*	4	0.3
❖ Other Digestive System OR Procedures with Complications*	2	0.2
Total exclusions	*62*	*5.3*
Total members remaining in analysis	*1,100*	*94.7*

*See Appendix B for definitions of clinically complex exclusions.

Kidney/Urinary Tract Infections

Inclusion Criteria

Cases were included in the data analysis for kidney/urinary tract infections if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population." HMO members included in this analysis were 0 through 64 years of age.

Hospitalization Rate and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate shown for each HMO used the total number of index hospitalizations per 10,000 members. Excluded hospitalizations are listed in Table 6E. The comparative reference was all HMO hospitalizations.

Table 6E. *Exclusions from "Hospitalization Rate" Analysis for Kidney/Urinary Tract Infections*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*1,348*	*100.0*
Exclusions:		
❖ Duplicate Record	1	0.1
❖ Non-PA Resident	39	2.9
❖ Neonate (age < 28 days)	3	0.2
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	58	4.3
❖ Metastatic Cancer*	20	1.5
❖ Kidney/Urinary Tract Cancer*	6	0.4
❖ HIV Infection*	1	0.1
❖ Chronic Renal Failure*	31	2.3
❖ Renal Dialysis*	1	0.1
❖ Cases in DRGs Unrelated to Kidney/Urinary Tract Infections *	40	3.0
Total exclusions	*200*	*14.8*
Total members remaining in analysis	*1,148*	*85.2*

*See Appendix B for definitions of clinically complex exclusions and DRGs used to define Kidney/Urinary Tract Infections.

MANAGING ON-GOING ILLNESSES

Chronic Obstructive Pulmonary Disease (COPD)

Inclusion Criteria

Only adult (18 through 64 years of age) HMO members were included in this analysis. Cases were included in the data analysis for COPD if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population."

Utilization/Outcome Measures and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate is shown for each HMO using the total number of index hospitalizations per 10,000 adult HMO members. Excluded hospitalizations are listed in Table 7A. The comparative reference was all HMO hospitalizations.

Table 7A. *Exclusions from "Hospitalization Rate" Analysis for COPD*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*1,046*	*100.0*
Exclusions:		
❖ Duplicate Record	3	0.3
❖ Non-PA Resident	11	1.1
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	141	13.5
❖ Cases in DRGs Unrelated to COPD*	33	3.2
❖ Metastatic Cancer*	11	1.1
❖ Lung Cancer*	4	0.4
❖ HIV Infection; Mechanical Ventilation; Tracheostomy	0	0.0
Total exclusions	*203*	*19.4*
Total members remaining in analysis	*843*	*80.6*

*See Appendix B for definitions of clinically complex exclusions and DRGs used to define COPD.

Length of Stay (risk-adjusted). The inpatient length of stay measure was calculated from the COPD index hospitalization only, beginning with the date of admission and ending with the date of discharge of the index hospitalization (length of stay was calculated as discharge date minus

admit date). Hospitalizations that were excluded from the risk-adjusted length of stay analysis for COPD are listed in Table 7B. The comparative reference was all HMO, PPO and fee-for-service hospitalizations.

Table 7B. *Exclusions from "Length of Stay" (LOS) Analysis for COPD*

	Total HMO, PPO and Fee-for-Service Hospitalizations		
	N	***% of Total***	***Avg. LOS***
Total hospitalizations before exclusions	*2,002*	*100.0*	*4.5*
Exclusions:			
❖ Hospitalization Rate Exclusions	418	20.9	6.9
❖ Death in Hospital	6	0.3	5.8
❖ Missing *Atlas Outcomes™* Score	11	0.5	3.8
❖ Outlier[1]/Missing or Invalid[2] LOS	8	0.4	18.6
Total exclusions	*443*	*22.1*	*7.0*
Total members remaining in analysis	*1,559*	*77.9*	*3.7*

[1]LOS values that were > 15 days.
[2]LOS value < 0.

Rehospitalizations (risk-adjusted). To calculate the percent rehospitalized, the first return hospitalization for respiratory-related acute care (MDC 4) within 180 days of discharge from an acute care facility in Pennsylvania was used. For multiple-hospitalization episodes, the discharge date of the last hospitalization (which may not be COPD-related) in the COPD episode was used as the start point for counting the 180 days. If a member was rehospitalized multiple times, he or she was still counted as one member who was rehospitalized. Exclusions are listed in Table 7C. The comparative reference was all HMO, PPO and fee-for-service hospitalizations.

Table 7C. *Exclusions from "Rehospitalizations" Analysis for COPD*

	Total HMO, PPO and Fee-for-Service Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*2,002*	*100.0*
Exclusions:		
❖ Length of Stay Exclusions	443	22.1
❖ Patient was transferred and died in hospital	0	0.0
❖ Invalid Social Security Number	9	0.4
❖ Invalid Admit Date/Discharge Date/Birth Date/Sex	0	0.0
Total exclusions	*452*	*22.6*
Total members remaining in analysis	*1,550*	*77.4*

Pediatric and Adult Asthma

Inclusion Criteria

Pediatric (0 through 17 of age) and adult (18 through 64 years of age) hospitalizations were analyzed separately. HMO hospitalizations were included in the data analysis if they included as a principal diagnosis one of the ICD-9-CM codes listed under this condition in Appendix A: "Description of Study Population."

Utilization/ Outcome Measures and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate is shown for each HMO using the total number of asthma index hospitalizations per 10,000 pediatric/adult members. Excluded hospitalizations are listed in Table 7D. The comparative reference was all HMO hospitalizations.

Table 7D. *Exclusions from "Hospitalization Rate" Analysis for Asthma*

	Total HMO Hospitalizations			
	Pediatric		Adult	
	N	% of Total	N	% of Total
Total hospitalizations before exclusions	1,157	100.0	1,845	100.0
Exclusions:				
❖ Duplicate Record	0	0.0	1	0.1
❖ Non-PA resident	14	1.2	17	0.9
❖ Neonate (age < 28 days)	0	0.0	NA	NA
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	61	5.3	229	12.4
❖ HIV Infection*	0	0.0	1	0.1
❖ Metastatic Cancer*	0	0.0	6	0.3
❖ Lung Cancer*	0	0.0	0	0.0
❖ Tracheostomy*	0	0.0	0	0.0
❖ Mechanical Ventilation*	3	0.3	13	0.7
Total exclusions	78	6.7	267	14.5
Total members remaining in analysis	1,079	93.3	1,578	85.5

*See Appendix B for definitions of clinically complex exclusions.
NA: Not Applicable

Length of Stay (risk-adjusted). Length of stay was calculated from the asthma index hospitalization only, beginning with the date of admission and ending with the date of discharge of the index hospitalization (length of stay was calculated as discharge date minus admit date). Hospitalizations that were excluded from the risk-adjusted length of stay analysis for asthma are listed in Table 7E. The comparative reference was all HMO, PPO and fee-for-service hospitalizations.

Table 7E. *Exclusions from "Length of Stay" (LOS) Analyses for Asthma*

	Total HMO, PPO and Fee-for-Service Hospitalizations					
	Pediatric			*Adult*		
	N	*% of Total*	*Avg. LOS*	*N*	*% of Total*	*Avg. LOS*
Total hospitalizations before exclusions	*1,874*	*100.0*	*1.9*	*3,255*	*100.0*	*3.6*
Exclusions:						
❖ Hospitalization Rate Exclusions	118	6.3	2.5	439	13.5	4.4
❖ Death in Hospital	0	0.0	0.0	0	0.0	0.0
❖ Missing *Atlas Outcomes*™ Score	247	13.2	1.8	27	0.8	4.9
❖ Outlier[1]/Missing or Invalid[2] LOS	2	0.1	12.5	8	0.2	20.4
Total exclusions	*367*	*19.6*	*2.1*	*474*	*14.6*	*4.7*
Total members remaining in analysis	*1,507*	*80.4*	*1.9*	*2,781*	*85.4*	*3.4*

[1]LOS values that were > 10 days for pediatric asthma and > 15 days for adult asthma.
[2]LOS value < 0.
NA: Not Applicable

Rehospitalizations (risk-adjusted). The percent rehospitalized was calculated for adult asthma only. Because pediatric cases frequently lack social security number identification, potential rehospitalizations cannot be linked to previous hospitalizations. Thus, the rehospitalization analysis was not performed for pediatric asthma hospitalizations.

To calculate the percent rehospitalized, the first return hospitalization for respiratory-related acute care (MDC 4) within 180 days of discharge from an acute care facility in Pennsylvania was used. For multiple-hospitalization episodes, the discharge date of the last hospitalization (which may not be asthma-related) in the asthma episode was used as the start point for counting the 180 days. If a member was rehospitalized multiple times, he or she was still counted as one member who was rehospitalized. Exclusion criteria for rehospitalizations are listed in Table 7F. The comparative reference was all HMO, PPO and fee-for-service hospitalizations.

Table 7F. *Exclusions from "Rehospitalizations" Analysis for Adult Asthma*

	Total HMO, PPO and Fee-for-Service Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*3,255*	*100.0*
Exclusions:		
❖ Length of Stay Exclusions	474	14.6
❖ Patient was transferred and died in hospital	0	0.0
❖ Invalid Social Security Number	34	1.0
❖ Invalid Admit Date/Discharge Date/Birth Date/Sex	0	0.0
Total exclusions	*508*	*15.6*
Total members remaining in analysis	*2,747*	*84.4*

Diabetes

Inclusion Criteria

Hospitalizations for HMO members (18 through 75 years of age) were included in this analysis only if: 1) the member was identified as having diabetes according to HEDIS NCQA guidelines, 2) met continuous enrollment requirements set by NCQA, and 3) the hospitalization had a principal diagnosis of diabetes (ICD-9-CM codes are listed in Appendix A: *Description of Study Population).* Note that the age interval for this analysis is different from the other clinical treatments/conditions included in the report.

Utilization/Outcome Measures and Exclusion Criteria

Hospitalization Rate (age and sex-adjusted). The hospitalization rate is shown for each HMO using the total number of adult HMO members with diabetes hospitalized per 10,000 diabetic members. Excluded hospitalizations are listed in Table 7G. The comparative reference was all HMO hospitalizations.

Table 7G. *Exclusions from "Hospitalization Rate" Analysis for Diabetes*

	Total HMO Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*1,508*	*100.0*
Exclusions:		
❖ Duplicate Record	1	0.1
❖ Non-PA Resident	27	1.8
❖ Subsequent Hospitalization(s) (non-index) for the Same Person	256	17.0
❖ Metastatic Cancer*	4	0.3
❖ HIV Infection*	2	0.1
❖ Major Organ Transplant*	22	1.5
❖ Cases in DRGs Unrelated to Diabetes*	178	11.8
Total exclusions	*490*	*32.5*
Total members remaining in analysis	*1,018*	*67.5*

*See Appendix B for definitions of clinically complex exclusions and DRGs used to define diabetes.

Length of Stay (risk-adjusted). Length of stay was calculated from the diabetes index hospitalization, beginning with the date of admission and ending with the date of discharge of the hospitalization (length of stay was calculated as discharge date minus admit date). Hospitalizations that were excluded from the risk-adjusted length of stay analysis for diabetes are listed in the Table 7H. The comparative reference was all HMO, PPO and fee-for-service hospitalizations.

Table 7H. *Exclusions from " Length of Stay" (LOS) Analysis for Diabetes*

	Total HMO, PPO and Fee-for-Service Hospitalizations		
	N	***% of Total***	***Avg. LOS***
Total hospitalizations before exclusions	*3,143*	*100.0*	*4.7*
Exclusions:			
❖ Hospitalization Rate Exclusions	959	30.5	6.3
❖ Death in Hospital	1	<0.1	1.0
❖ Missing *Atlas Outcomes*™ Scores	24	0.8	4.0
❖ Outlier[1]/ Missing or Invalid[2] LOS	6	0.2	38.7
Total exclusions	*990*	*31.5*	*6.5*
Total members remaining in analysis	*2,153*	*68.5*	*3.9*

[1]LOS values that were > 30 days.
[2]LOS value < 0.

Percent of Admissions for Short-Term Complications of Diabetes. For all diabetes hospitalizations included in the hospitalization rate analysis, PHC4 also calculated the percent that were hospitalized due to short-term complications of diabetes. These hospitalizations may be an immediate reflection of how well members are managing their diabetes. Short-term complications of diabetes are acute, life-threatening events related to blood sugar control. The following codes were used to identify short-term complications: 250.02, 250.03, 250.10-250.13, 250.20-250.23, 250.30-250.33.

Rehospitalizations (risk-adjusted). To calculate the percent rehospitalized, the first return hospitalization for diabetes-related acute care within 180 days of discharge from an acute care facility in Pennsylvania was used. For multiple-hospitalization episodes, the discharge date of the last hospitalization (which may not be diabetes-related) in the diabetes episode was used as the start point for counting the 180 days. If a member was rehospitalized multiple times, he or she was still counted as one member who was rehospitalized. Exclusion criteria for rehospitalizations are listed in Table 7I. The comparative reference was all HMO, PPO and fee-for-service hospitalizations.

Table 7I. *Exclusions from "Rehospitalizations" Analysis for Diabetes*

	Total HMO, PPO and Fee-for-Service Hospitalizations	
	N	***% of Total***
Total hospitalizations before exclusions	*3,143*	*100.0*
Exclusions:		
❖ Length of Stay Exclusions	990	31.5
❖ Patient was transferred and died in hospital	0	0.0
❖ Invalid Social Security Number	40	1.3
❖ Invalid Admit Date/Discharge Date/Birth Date/Sex	0	0.0
Total exclusions	*1,030*	*32.8*
Total members remaining in analysis	*2,113*	*67.2*

SURGICAL PROCEDURES

Hysterectomy (Abdominal and Vaginal)

Inclusion Criteria

In the *Measuring the Quality of Pennsylvania's Commercial HMOs* report, data are reported for abdominal and vaginal hysterectomies combined and separately. The study population included hospitalizations that were assigned a principal or secondary procedure code of hysterectomy (see Appendix A: "Description of Study Population"). Only adult (18 through 64 years of age) female HMO members were included in this analysis. Hysterectomies performed due to cancer or trauma of the female reproductive system or other emergent occurrences such as pregnancy related complications were excluded. Thus, only non-traumatic and non-female reproductive malignant hysterectomies were analyzed.

Utilization/Outcome Measures and Exclusion Criteria

Procedure Rate (age-adjusted). The procedure rate shown for each HMO used the total number of adult female index hospitalizations per 10,000 adult female members. Excluded hospitalizations are listed in Table 8A. The comparative reference was all HMO hospitalizations.

Table 8A. *Exclusions from "Procedure Rate" Analyses for Hysterectomy*

	Total HMO Hospitalizations					
	Total		***Abdominal***		***Vaginal***	
	N	***% of Total***	***N***	***% of Total***	***N***	***% of Total***
Total hospitalizations before exclusions	*6,154*	*100.0*	*4,372*	*100.0*	*1,782*	*100.0*
Exclusions:						
❖ Duplicate Record	4	0.1	3	0.1	1	0.1
❖ Non-PA Resident	123	2.0	87	2.0	36	2.0
❖ Multiple Hysterectomies for One Patient	3	<0.1	3	0.1	0	0.0
❖ Metastatic Cancer[1, 2]	128	2.1	125	2.9	3	0.2
❖ Malignant/In situ Cancer[1,2]	553	9.0	468	10.7	85	4.8
❖ Hemorrhage on Admission[2]	0	0.0	0	0.0	0	0.0
❖ Cases in DRGs Unrelated to Hysterectomy[2]	105	1.7	90	2.1	15	0.8
❖ HIV Infection[2]	0	0.0	0	0.0	0	0.0
❖ Abdominal Trauma	1	<0.1	1	<0.1	0	0.0
Total exclusions	*917*	*14.9*	*777*	*17.8*	*140*	*7.9*
Total members remaining in analysis	*5,237*	*85.1*	*3,595*	*82.2*	*1,642*	*92.1*

[1]These hospitalizations were excluded due to cancer status of any body site, including reproductive organs.
[2]See Appendix B for definitions of clinically complex exclusions and DRGs used to define hysterectomy.

In-Hospital Complications (risk-adjusted). This measure is reported separately for abdominal and vaginal adult hysterectomies and was calculated for each HMO. In-hospital complications are any one of a particular set of ICD-9-CM codes in any procedure or secondary diagnosis position in the index hysterectomy hospitalization (refer to Appendix C for a detailed listing of the in-hospital complications). The exclusions to the in-hospital complications analysis for hysterectomy are outlined in Table 8B. The comparative reference was all hospitalizations regardless of type of payor.

Table 8B. *Exclusions from "In-Hospital Complications" Analyses for Hysterectomy*

	Total Statewide Hospitalizations			
	Abdominal		***Vaginal***	
	N	***% of Total***	***N***	***% of Total***
Total hospitalizations before exclusions	*15,299*	*100.0*	*6,532*	*100.0*
Exclusions:				
❖ Procedure Rate Exclusions	3,047	19.9	*647*	*9.9*
❖ Missing *Atlas Outcomes*™ Score	186	1.2	*20*	*0.3*
Total exclusions	*3,233*	*21.1*	*667*	*10.2*
Total members remaining in analysis	*12,066*	*78.9*	*5,865*	*89.8*

Length of Stay (risk-adjusted). The inpatient length of stay for hysterectomy is the period of hospitalization beginning with the date of admission of the hospitalization in which the hysterectomy procedure was performed and ending with the date of discharge of the same hospitalization (length of stay was calculated as discharge date minus admit date). The exclusions to the risk-adjusted length of stay analysis for abdominal and vaginal hysterectomy are outlined in Table 8C. The comparative reference was all hospitalizations regardless of type of payor.

Table 8C. *Exclusions from "Length of Stay" (LOS) Analyses for Hysterectomy*

	Total Statewide Hospitalizations					
	Abdominal			***Vaginal***		
	N	***% of Total***	***Avg. LOS***	***N***	***% of Total***	***Avg. LOS***
Total hospitalizations before exclusions	*15,299*	*100.0*	*2.9*	*6,532*	*100.0*	*1.6*
Exclusions						
❖ In-Hospital Complications Exclusions	3,233	21.1	4.0	667	10.2	1.7
❖ Death in Hospital	2	<0.1	5.5	2	<0.1	11.5
❖ Outlier[1]/ Missing or Invalid[2] LOS	15	0.1	23.2	6	0.1	17.5
Total exclusions	*3,250*	*21.2*	*4.1*	*675*	*10.3*	*1.9*
Total members remaining in analysis	*12,049*	*78.8*	*2.6*	*5,857*	*89.7*	*1.6*

[1]LOS > 16 days for abdominal and > 11 days for vaginal hysterectomy hospitalizations.
[2]LOS value < 0.

Mastectomy

Inclusion Criteria

Only adult (age 18 through 64 years of age) female HMO members were included in this analysis. Mastectomy hospitalizations were included in the data analysis if they included a principal diagnosis of breast cancer and a procedure code, in any position, for mastectomy (see Appendix A: "Description of Study Population" for a list of the ICD-9-CM codes included in the study).

Utilization/Outcome Measures and Exclusion Criteria

Procedure Rate (age-adjusted). The procedure rate is shown for each HMO using the total number of procedures (both inpatient and ambulatory) per 10,000 adult female members. Procedure rates were based upon the *total number of mastectomies.* If a single patient had more than one mastectomy over the course of the study period, all encounters were included. Excluded hospitalizations are listed in Table 8D. The comparative reference was all HMO hospitalizations.

Table 8D. *Exclusions from "Procedure Rate" Analyses for Mastectomy–Inpatient and Ambulatory*

	Total HMO Procedures	
	N	***% of Total***
Total procedures before exclusions	*625*	*100.0*
Exclusions:		
❖ Duplicate Record	0	0.0
❖ Non-PA Resident	22	3.5
❖ HIV Infection*	0	0.0
❖ Metastatic cancer, except cancer of the breast*	19	3.0
Total exclusions	*41*	*6.6*
Total procedures remaining in analysis	*584*	*93.4*

*See Appendix B for definitions of clinically complex exclusions.

In-Hospital Complications (risk-adjusted). This measure was calculated only for inpatient procedures for each HMO. In-hospital complications are any one of a particular set of ICD-9-CM codes in any procedure or secondary diagnosis position in a discharge record associated with mastectomy (refer to Appendix C for a detailed listing of the in-hospital complications). The exclusions to the in-hospital complications analysis are found in Table 8E. The comparative reference was all hospitalizations regardless of type of payor.

Table 8E. *Exclusions from "In-Hospital Complications" Analyses for Mastectomy*

	Total Statewide Procedures	
	N	***% of Total***
Total procedures[1] before exclusions	*2,424*	*100.0*
Exclusions:		
❖ Procedure Rate Exclusions	297	12.3
❖ Ambulatory Case[2]	348	14.4
❖ Missing *Atlas Outcomes™* Score	19	0.8
Total exclusions	*664*	*27.4*
Total hospitalizations remaining in analysis	*1,760*	*72.6*

[1]Includes inpatient and ambulatory cases.
[2]Records related to ambulatory care were not analyzed in the in-hospital complications percent since this was derived from inpatient records only.

Length of Stay (risk-adjusted). Only inpatient hospitalizations were included in the length of stay outcome measure. Length of stay was calculated from a single hospitalization only, beginning with the date of admission and ending with the date of discharge (length of stay was calculated as discharge date minus admit date). Hospitalizations that were excluded from the analysis are listed in Table 8F. The comparative reference was all hospitalizations regardless of type of payor.

Table 8F. *Exclusions from "Length of Stay" (LOS) Analyses for Mastectomy*

	Total Statewide Procedures		
	N	***% of Total***	***Avg. LOS[1]***
Total procedures[2] before exclusions	*2,424*	*100.0*	*2.2*
Exclusions:			
❖ Procedure Rate Exclusions	664	27.4	2.7
❖ Death in Hospital	0	0.0	0.0
❖ Outlier[3]/Missing or Invalid[4] LOS	1	0.0	24.0
Total exclusions	*665*	*27.4*	*2.8*
Total hospitalizations remaining in analysis	*1,759*	*72.6*	*2.1*

[1] Based on inpatient cases only.
[2]Includes inpatient and ambulatory cases.
[3]LOS > 15 days.
[4]LOS value < 0.
NA: Not Applicable

Neck and Back Procedures (With Fusion and Without Fusion)

Inclusion Criteria

Adult (18 through 64 years of age) HMO members were included in the analyses of neck and back procedures. Cases were included in the data analysis if they included a principal diagnosis and a procedure code (in any position) of one of the ICD-9-CM codes listed in Appendix A: "Description of Study Population."

Utilization/Outcome Measures and Exclusion Criteria

Procedure Rate (age and sex-adjusted). The procedure rate is shown for each HMO using the total number of neck and back procedures (fusion and non-fusion combined; both inpatient and ambulatory) per 10,000 adult HMO members. Excluded encounters are listed in Table 8G. The comparative reference was all HMO hospitalizations.

Table 8G. *Exclusions from "Procedure Rate" Analyses for Neck and Back Procedures – Inpatient and Ambulatory*

	Total HMO Procedures					
	Total		***With Fusion***		***Without Fusion***	
	N	***% of Total***	***N***	***% of Total***	***N***	***% of Total***
Total procedures before exclusions	*4,748*	*100.0*	*1,746*	*100.0*	*3,002*	*100.0*
Exclusions:						
❖ Duplicate Record	1	<0.1	0	0.0	1	<0.1
❖ Non-PA Resident	144	3.0	57	3.3	87	2.9
❖ Congenital Defect*	29	0.6	27	1.5	2	0.1
❖ Refusion*	20	0.4	18	1.0	2	0.1
❖ Pathological Spinal Fracture*	1	<0.1	1	0.1	0	0.0
❖ Spinal Nerve Root Injury*	6	0.1	5	0.3	1	<0.1
❖ Paraplegia*	0	0.0	0	0.0	0	0.0
❖ Quadriplegia*	0	0.0	0	0.0	0	0.0
❖ Hemiplegia*	0	0.0	0	0.0	0	0.0
❖ Unspecified Paralysis*	1	<0.1	1	0.1	0	0.0
❖ Spinal Fracture*	2	<0.1	2	0.1	0	0.0
❖ Metastatic Cancer*	0	0.0	0	0.0	0	0.0
❖ HIV Infection*	0	0.0	0	0.0	0	0.0
❖ Infantile Cerebral Palsy*	0	0.0	0	0.0	0	0.0
Total exclusions	*204*	*4.3*	*111*	*6.4*	*93*	*3.1*
Total procedures remaining in analysis	*4,544*	*95.7*	*1,635*	*93.6*	*2,909*	*96.9*

*See Appendix B for definitions of clinically complex exclusions.

Percent Performed Inpatient. The percent of procedures that were performed in an inpatient setting is reported for both fusion and non-fusion procedures. All procedures that were counted in the respective procedure rates were included in this analysis. The percent is unadjusted.

In-Hospital Complications (risk-adjusted). This measure was calculated only for inpatient procedures for each HMO and is reported separately for fusion and non-fusion procedures. In-hospital complications are any one of a particular set of ICD-9-CM codes in any procedure or secondary diagnosis position in a discharge record associated with the neck/back hospitalization (refer to Appendix C for a detailed listing of the in-hospital complications). The exclusions to the in-hospital complications analysis are found in Table 8H. The comparative reference was all hospitalizations regardless of type of payor.

Table 8H. *Exclusions from "In-Hospital Complications" Analyses for Neck and Back Procedures – Inpatient Only*

	Total Statewide Procedures			
	With Fusion		*Without Fusion*	
	N	*% of Total*	*N*	*% of Total*
Total procedures[1] before exclusions	*7,764*	*100.0*	*12,673*	*100.0*
Exclusions:				
❖ Procedure Rate Exclusions	921	11.9	1,193	9.4
❖ Ambulatory Cases[2]	596	7.7	2,995	23.6
❖ Missing *Atlas Outcomes™* Score	17	0.2	NA	NA
❖ Improper Coding of Fusion Technique[3]	8	0.1	38	0.3
Total exclusions	*1,542*	*19.9*	*4,226*	*33.3*
Total hospitalizations remaining in analysis	*6,222*	*80.1*	*8,447*	*66.7*

[1]Includes inpatient and ambulatory cases
[2]Records related to ambulatory care were not analyzed in the in-hospital complications percent since this was derived from inpatient records only.
[3]Fusion technique was tested as a risk factor for in-hospital complications. Therefore, if the ICD-9-CM procedure coding did not clearly indicate the fusion technique, the hospitalization was excluded from the complications analysis.
NA: Not Applicable

Length of Stay (risk-adjusted). Length of stay was calculated from a single hospitalization only, beginning with the date of admission and ending with the date of discharge (length of stay was calculated as discharge date minus admit date). It is reported separately for fusion and non-fusion procedures and was calculated for each HMO. Only inpatient hospitalizations were included in the length of stay measure. Hospitalizations that were excluded from the risk-adjusted length of stay analysis for neck and back procedures are listed in Table 8I. The comparative reference was all hospitalizations regardless of type of payor.

Table 8I. *Exclusions from "Length of Stay" (LOS) Analysis for Inpatient Neck and Back Procedures*

	Total Statewide Inpatient Procedures					
	With Fusion			*Without Fusion*		
	N	*% of Total*	*Avg. LOS[1]*	*N*	*% of Total*	*Avg. LOS*
Total procedures[2] before exclusions	*7,764*	*100.0*	*2.4*	*12,673*	*100.0*	*1.7*
Exclusions:						
❖ In-Hospital Complications Exclusions	1,542	19.9	3.0	4,226	33.3	1.7
❖ Death in Hospital	1	<0.1	3.0	1	<0.1	30.0
❖ Outlier[3]/Missing or Invalid[4] LOS	6	0.1	29.3	10	0.1	20.3
Total exclusions	*1,549*	*20.0*	*3.1*	*4,237*	*33.4*	*1.9*
Total hospitalizations remaining in analysis	*6,215*	*80.0*	*2.3*	*8,436*	*66.6*	*1.7*

[1]Based on inpatient cases only.
[2]Includes inpatient and ambulatory cases.
[3]LOS > 20 days for neck and back procedures with fusion and > 16 days for procedures without fusion.
[4]LOS value < 0.

APPENDICES

Preventing Hospitalization Through Primary Care

Condition	Codes
Ear, Nose and Throat Infections *(Pediatric and Adult)*	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 017.40, 017.41, 017.42, 017.43, 017.44, 017.45, 017.46, 034.0, 055.2, 112.82, 380.10, 380.11, 380.12, 380.14, 380.16, 381.00, 381.01, 381.02, 381.03, 381.04, 381.05, 381.06, 381.10, 381.19, 381.20, 381.29, 381.3, 381.4, 382.00, 382.01, 382.1, 382.2, 382.3, 382.4, 382.9, 461.0, 461.1, 461.2, 461.3, 461.8, 461.9, 462, 463, 464.00, 464.01, 464.20, 464.21, 464.30, 464.31, 464.4, 464.50, 464.51, 465.0, 465.8, 465.9, 472.0, 472.1, 472.2, 473.0, 473.1, 473.2, 473.3, 473.8, 473.9, 474.00, 474.01, 474.02, 476.0, 476.1, 487.1
High Blood Pressure	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 401.0, 401.1, 401.9, 402.00, 402.10, 402.90, 403.00, 403.10, 403.90, 404.00, 404.10, 404.90
Gastrointestinal Infections	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 003.0, 006.2, 009.0, 009.1, 558.2, 558.9
Kidney/Urinary Tract Infections	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 590.00, 590.01, 590.10, 590.11, 590.2, 590.3, 590.80, 590.9, 595.0, 595.1, 595.2, 595.3, 595.81, 595.89, 595.9, 599.0

Managing On-Going Illness

Condition	Codes
Chronic Obstructive Pulmonary Disease	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 491.20, 491.21, 491.22, 492.0, 492.8, 496, 506.4
Asthma *(Pediatric and Adult)*	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.81, 493.82, 493.90, 493.91, 493.92
Diabetes	*Any one of the following ICD-9-CM diagnosis codes in the principal position:* 250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93

Surgical Procedures

Hysterectomy	*Any one of the following ICD-9-CM procedure codes in the any position:* *(Abdominal)* 68.31, 68.39, 68.4[1], 68.41[2], 68.49[2], 68.6[1], 68.61[2], 68.69[2], 68.7[1], 68.71[2], 68.79[2] *(Vaginal)* 68.51, 68.59, 68.9
Mastectomy	*Any one of the following ICD-9-CM or CPT procedure codes in any position:* 85.41, 85.42, 85.43, 85.44, 85.45, 85.46, 85.47, 85.48, 19180, 19200, 19220, 19240 *AND* *Any one of the following ICD-9-CM diagnosis codes in the principal position:* 174.0, 174.1, 174.2, 174.3, 174.4, 174.5, 174.6, 174.8, 174.9, 196.3, 198.2, 198.81, 233.0, 238.3, 239.3
Neck and Back Procedures *(With Fusion)*	*Any one of the following ICD-9-CM or CPT procedure codes in any position:* 03.09, 80.50, 80.51, 80.59, 22220, 22222, 22224, 63001, 63003, 63005, 63011, 63012, 63015, 63016, 63017, 63020, 63030, 63040, 63042, 63045, 63046, 63047, 63050, 63051, 63055, 63056, 63064, 63075, 63077 *AND* *Any one of the following ICD-9-CM or CPT fusion codes in any position:* 81.00, 81.01, 81.02, 81.03, 81.04, 81.05, 81.06, 81.07, 81.08, 81.62, 81.63, 81.64, 22548, 22554, 22556, 22558, 22590, 22595, 22600, 22610, 22612, 22630, 22800, 22802, 22804, 22808, 22810, 22812, *AND* *Any one of the following ICD-9-CM diagnosis codes in the principal position:* 720.0, 721.0, 721.1, 721.2, 721.3, 721.41, 721.42, 721.90, 721.91, 722.0, 722.10, 722.11, 722.2, 722.4, 722.51, 722.52, 722.6, 722.70, 722.71, 722.72, 722.73, 722.90, 722.91, 722.92, 722.93, 723.0, 723.1, 724.00, 724.01, 724.02, 724.09, 724.1, 724.2, 724.3, 724.5, 738.4, 756.11, 756.12
(Without Fusion)	*Any one of the following ICD-9-CM or CPT procedure codes in any position:* 03.09, 80.50, 80.51, 80.59, 22220, 22222, 22224, 63001, 63003, 63005, 63011, 63012, 63015, 63016, 63017, 63020, 63030, 63040, 63042, 63045, 63046, 63047, 63050, 63051, 63055, 63056, 63064, 63075, 63077 *AND* *Any one of the following ICD-9-CM diagnosis codes in the principal position:* 720.0, 721.0, 721.1, 721.2, 721.3, 721.41, 721.42, 721.90, 721.91, 722.0, 722.10, 722.11, 722.2, 722.4, 722.51, 722.52, 722.6, 722.70, 722.71, 722.72, 722.73, 722.90, 722.91, 722.92, 722.93, 723.0, 723.1, 724.00, 724.01, 724.02, 724.09, 724.1, 724.2, 724.3, 724.5, 738.4, 756.11, 756.12

[1]Code invalid as of October 1, 2006

[2]Code valid as of October 1, 2006

Clinically Complex Exclusions

Exclusion	Definition[1]
Abdominal Trauma	Dx: 867.4, 867.5, 867.6, 867.7, 867.8, 867.9, 868.00, 868.03, 868.04, 868.09, 868.10, 868.13, 868.14, 868.19, 869.0, 869.1, 879.6, 879.7, 879.8, 879.9, 906.0, 908.1, 908.2, 939.1, 947.4
Congenital Defect	Dx: 756.11, 756.12, principal diagnosis position only
Chronic Renal Failure	Dx: 585.1, 585.2, 585.3, 585.4, 585.5, 585.6, 585.9
Cleft Lip and Palate Repair	DRG: 052
Ear, Nose, or Throat Cancer	Dx: 146.0, 146.1, 146.2, 146.3, 146.4, 146.5, 146.6, 146.7, 146.8, 146.9, 147.0, 147.1, 147.2, 147.3, 147.8, 147.9, 148.0, 148.1, 148.2, 148.3, 148.8, 148.9, 149.0, 149.1, 149.8, 149.9, 160.0, 160.1, 160.2, 160.3, 160.4, 160.5, 160.8, 160.9, 161.0, 161.1, 161.2, 161.3, 161.8, 161.9, 162.0, 231.0, 231.1, 231.8, 231.9, 235.1, 235.6, 235.9
Extensive OR Procedures Unrelated to Principal Diagnosis	DRG: 468
Gastrointestinal Cancer	Dx: 150.0, 150.1, 150.2, 150.3, 150.4, 150.5, 150.8, 150.9, 151.0, 151.1, 151.2, 151.3, 151.4, 151.5, 151.6, 151.8, 151.9, 152.0, 152.1, 152.2, 152.3, 152.8, 152.9, 153.0, 153.1, 153.2, 153.3, 153.4, 153.5, 153.6, 153.7, 153.8, 153.9, 154.0, 154.1, 154.2, 154.3, 154.8, 155.0, 155.1, 155.2, 156.0, 156.1, 156.2, 156.8, 156.9, 157.0, 157.1, 157.2, 157.3, 157.4, 157.8, 157.9, 158.0, 158.8, 158.9, 159.0, 159.8, 159.9, 195.2, 197.4, 197.5, 197.6, 197.7, 197.8, 230.1, 230.2, 230.3, 230.4, 230.5, 230.6, 230.7, 230.8, 230.9, 235.2, 235.3, 235.4, 235.5, 239.0
Hemiplegia	Dx: 342.00, 342.01, 342.02, 342.10, 342.11, 342.12, 342.80, 342.81, 342.82, 342.90, 342.91, 342.92
Hemorrhage on Admission	Dx: 998.11
HIV Infection	Dx: 042
Infantile Cerebral Palsy	Dx: 333.71*, 343.0, 343.1, 343.2, 343.3
Kidney, Ureter and Major Bladder Procedures for Nonneoplasms with CC‡	DRG: 304
Kidney, Ureter and Major Bladder Procedures for Nonneoplasms without CC‡	DRG: 305
Kidney/Urinary Tract Cancer	Dx: 188.0, 188.1, 188.2, 188.3, 188.4, 188.5, 188.6, 188.7, 188.8, 188.9, 189.0, 189.1, 189.2, 189.3, 189.4, 189.8, 189.9, 233.7, 233.9, 236.7, 236.90, 236.91, 236.99, 239.4
Lung Cancer	Dx: 162.2, 162.3, 162.4, 162.5, 162.8, 162.9, 197.0, 231.2, 235.7, 239.1
Malignant/In Situ Cancer	Dx: 140.0-208.91, 230.0-239.9, V10.3, V10.40, V10.41, V10.42, V10.43, V10.44, V16.3
Major Large and Small Bowel Procedures with CC‡	DRG: 148
Major Large and Small Bowel Procedures without CC‡	DRG: 149
Major Organ Transplant	Px: 33.50, 33.51, 33.52, 33.6, 37.51, 37.52, 37.53, 41.00, 41.01, 41.02, 41.03, 41.04, 41.05, 41.06, 41.07, 41.08, 41.09, 41.94, 46.97, 50.51, 50.59, 52.80, 52.81, 52.82, 52.83. 52.84, 52.85, 52.86, 55.61, 55.69
Mechanical Ventilation	Px: 96.70, 96.71, 96.72

Appendix B: Clinically Complex Exclusions and DRGs Used to Define Conditions

Exclusion	Definition[1]
Metastatic Cancer	Dx: 196.0, 196.1, 196.2, 196.3, 196.5, 196.6, 196.8, 196.9, 197.0, 197.1, 197.2, 197.3, 197.4, 197.5, 197.6, 197.7, 197.8, 198.0, 198.1, 198.2, 198.3, 198.4, 198.5, 198.6, 198.7, 198.81, 198.82, 198.89, 199.0, 199.1
Metastatic Cancer, except Cancer of the Breast	Dx: 196.0, 196.1, 196.2, 196.5, 196.6, 196.8, 196.9, 197.0, 197.1, 197.2, 197.3, 197.4, 197.5, 197.6, 197.7, 197.8, 198.0, 198.1, 198.3, 198.4, 198.5, 198.6, 198.7, 198.82, 198.89, 199.0, 199.1
Open Heart Surgery	Px: 35.00, 35.01, 35.02, 35.03, 35.04, 35.10, 35.11, 35.12, 35.13, 35.14, 35.20, 35.21, 35.22, 35.23, 35.24, 35.25, 35.26, 35.27, 35.28, 35.31, 35.32, 35.33, 35.34, 35.35, 35.39, 35.42, 35.50, 35.51, 35.53, 35.54, 35.60, 35.61, 35.62, 35.63, 35.70, 35.71, 35.72, 35.73, 35.81, 35.82, 35.83, 35.84, 35.91, 35.92, 35.93, 35.94, 35.95, 35.98, 35.99, 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.19, 36.2, 36.31, 36.32, 36.39, 36.91, 36.99, 37.10, 37.11, 37.12, 37.31, 37.32, 37.33, 37.41, 37.49, 37.51, 37.52
Other Digestive System OR Procedures with CC[‡]	DRG: 170
Paraplegia	Dx: 344.1
Pathological Spinal Fracture	Dx: 733.13
PTCA/Stent	Px: 00.66, 36.06, 36.07
Quadriplegia	Dx: 344.00, 344.01, 344.02, 344.03, 344.04, 344.09
Refusion	Px: 81.30, 81.31, 81.32, 81.33, 81.34, 81.35, 81.36, 81.37, 81.38, 81.39 in any position
Renal Dialysis	Dx: V45.1, V56.0, V56.8 Px: 39.95, 54.98
Spinal Fracture	Dx: 805.00, 805.01, 805.02, 850.03, 850.04, 850.05, 850.06, 850.07, 850.08, 805.10, 805.11, 805.12, 850.13, 850.14, 850.15, 850.16, 850.17, 850.18, 805.2, 805.3, 805.4, 805.5, 805.6, 805.7, 805.8, 805.9, 806.00, 806.01, 806.02, 806.03, 806.04, 806.05, 806.06, 806.07, 806.08, 806.09, 806.10, 806.11, 806.12, 806.13, 806.14, 806.15, 806.16, 806.17, 806.18, 806.19, 806.20, 806.21, 806.22, 806.23, 806.24, 806.25, 806.26, 806.27, 806.28, 806.29, 806.30, 806.31, 806.32, 806.33, 806.34, 806.35, 806.36, 806.37, 806.38, 806.39, 806.4, 806.5, 806.60, 806.61, 806.62, 806.69, 806.70. 806.71, 806.72, 806.79, 806.8, 806.9
Spinal Nerve Root Injury	Dx: 952.00, 952.01, 952.02, 952.03, 952.04, 952.05, 952.06, 952.07, 952.08, 952.09, 952.10, 952.11, 952.12, 952.13, 952.14, 952.15, 952.16, 952.17, 952.18, 952.19, 952.2, 952.3, 952.4, 952.8, 952.9, 953.0, 953.1, 953.2, 953.3, 953.4, 953.5, 953.8, 953.9, 954.0, 954.1, 954.8, 954.9
Tracheitis	Dx: 464.10, 464.11, 464.20, 464.21
Tracheostomy	Px: 31.1, 31.21, 31.29
Unspecified Paralysis	Dx: 344.9

[1]Cases are defined by ICD-9-CM Diagnosis (Dx)/ Procedure (Px) Codes or Diagnostic Related Group (DRG).
[‡]Comorbidity(s) and/or Complication(s).
* Valid as of October 1, 2006.

DRGs Used to Define Conditions

Listed below are the DRGs used to define cases related to kidney/urinary tract infections, COPD, diabetes, and hysterectomy. For each condition, cases in DRGs other than those below are considered clinically complex and are excluded.

Kidney/Urinary Tract Infection cases are restricted to the following DRGs:

320	Kidney and Urinary Tract Infections, Age Greater than 17 with CC‡
321	Kidney and Urinary Tract Infections, Age Greater than 17 without CC‡
322	Kidney and Urinary Tract Infections, Age 0 – 17

COPD cases are restricted to the following DRG:

088	Chronic Obstructive Pulmonary Disease

Diabetes cases are restricted to the following DRGs:

018	Cranial and Peripheral Nerve Disorders with CC‡
019	Cranial and Peripheral Nerve Disorders without CC‡
113	Amputation for Circulatory System Disorders Except Upper Limb and Toe
114	Upper Limb and Toe Amputation for Circulatory System Disorders
130	Peripheral Vascular Disorders with CC‡
131	Peripheral Vascular Disorders without CC‡
285	Amputation of Lower Limb for Endocrine, Nutritional and Metabolic Disorders
294	Diabetes, Age Greater than 35
295	Diabetes, Age 0 – 35
331	Other Kidney and Urinary Tract Diagnoses, Age Greater than 17 with CC‡
332	Other Kidney and Urinary Tract Diagnoses, Age Greater than 17 without CC‡

Hysterectomy (abdominal and vaginal) cases are restricted to the following DRGs:

353	Pelvic Evisceration, Radical Hysterectomy and Radical Vulvectomy
354	Uterine and Adnexa Procedures for Nonovarian/Adnexal Malignancy with CC‡
355	Uterine and Adnexa Procedures for Nonovarian/Adnexal Malignancy without CC‡
357	Uterine and Adnexa Procedures for Ovarian or Adnexal Malignancy
358	Uterine and Adnexa Procedures for Nonmalignancy with CC‡
359	Uterine and Adnexa Procedures for Nonmalignancy without CC‡

Asthma, Mastectomy, and Neck and Back Procedures

No DRG restrictions

‡CC: Complication(s) and/or Comorbidity(s)

Statewide In-Hospital Complications for Hysterectomy

Total Abdominal Cases†				Total Vaginal Cases†			
Complication Type	#	%	Avg. LOS	Complication Type	#	%	Avg. LOS
• Procedure/Medical Care Related Events	379	3.1	3.7	• Procedure/Medical Care Related Events	169	2.9	2.6
• Digestive System Complications	341	2.8	5.2	• Hemorrhage	109	1.9	2.9
• Hemorrhage	280	2.3	3.8	• Urinary Complications	52	0.9	2.7
• Pulmonary Compromise	132	1.1	4.7	• Digestive System Complications	34	0.6	3.6
• Urinary Complications	80	0.7	4.4	• Pulmonary Compromise	27	0.5	4.4
• Infection	68	0.6	6.7	• Gastric/Intestinal Ulceration with Hemorrhage or Perforation	14	0.2	3.6
• Cardiac Complications	37	0.3	4.5	• Hypotension/Hypertension	13	0.2	2.3
• Venous Thrombosis/Pulmonary Embolism	33	0.3	6.4	• Cardiac Complications	10	0.2	4.2
• Hypotension/Hypertension	32	0.3	3.0	• Infection	5	0.1	6.8
• Pneumonia	29	0.2	6.1	• Venous Thrombosis/Pulmonary Embolism	4	0.1	15.3
• Gastric/Intestinal Ulceration with Hemorrhage or Perforation	18	0.1	4.5	• Pneumonia	3	0.1	4.3
• Device, Implant or Graft Complications	2	<0.1	2.5	• Device, Implant or Graft Complications	2	<0.1	1.0
• Death	2	<0.1	5.5	• Death	2	<0.1	11.5
• Stroke/Anoxic Brain Damage	1	<0.1	4.0	• Stroke/Anoxic Brain Damage	0	0.0	NA
Any Complication Above	***1,223***	***10.1***	***4.1***	***Any Complication Above***	***392***	***6.7***	***2.6***
Without Any Complication Above	***10,843***	***89.9***	***2.4***	***Without Any Complication Above***	***5,473***	***93.3***	***1.5***

Statewide In-Hospital Complications for Mastectomy

Total Mastectomy Cases†			
Complication Type	#	%	Avg. LOS
• Hemorrhage	47	2.7	3.9
• Procedure/Medical Care Related Events	14	0.8	2.9
• Pulmonary Compromise	14	0.8	4.0
• Digestive System Complications	11	0.6	3.0
• Hypotension/Hypertension	10	0.6	3.9
• Cardiac Complications	7	0.4	3.9
• Device, Implant or Graft Complications	7	0.4	7.0
• Infection	5	0.3	5.2
• Venous Thrombosis/Pulmonary Embolism	5	0.3	5.6
• Urinary Complications	3	0.2	4.0
• Pneumonia	1	0.1	4.0
• Stroke/Anoxic Brain Damage	1	0.1	11.0
• Lymphedema	1	0.1	4.0
• Gastric/Intestinal Ulceration with Hemorrhage or Perforation	0	0.0	NA
• Death	0	0.0	NA
Any Complication Above	***109***	***6.2***	***3.8***
Without Any Complication Above	***1,651***	***93.8***	***2.0***

†The term "cases" refers to hospitalizations after exclusions.
NA: Not Applicable

Statewide In-Hospital Complications for Neck and Back Procedures

Total Cases*† *With Fusion				***Total Cases*† *Without Fusion***			
Complication Type	**#**	**%**	**Avg. LOS**	**Complication Type**	**#**	**%**	**Avg. LOS**
• Procedure/Medical Care Related Events	158	2.5	4.7	• Procedure/Medical Care Related Events	253	3.0	2.9
• Digestive System Complications	89	1.4	5.3	• Urinary Complications	81	1.0	3.4
• Pulmonary Compromise	62	1.0	6.6	• Stroke/Anoxic Brain Damage	42	0.5	3.6
• Urinary Complications	48	0.8	5.1	• Digestive System Complications	37	0.4	4.5
• Hemorrhage	36	0.6	6.1	• Hemorrhage	34	0.4	4.2
• Hypotension/Hypertension	33	0.5	4.2	• Pulmonary Compromise	32	0.4	4.5
• Cardiac Complications	22	0.4	4.7	• Hypotension/Hypertension	24	0.3	2.6
• Stroke/Anoxic Brain Damage	22	0.4	6.3	• Venous Thrombosis/Pulmonary Embolism	17	0.2	8.1
• Pneumonia	19	0.3	8.4	• Cardiac Complications	15	0.2	4.9
• Device, Implant or Graft Complications	14	0.2	3.4	• Pneumonia	10	0.1	6.8
• Venous Thrombosis/Pulmonary Embolism	13	0.2	7.7	• Device, Implant or Graft Complications	6	0.1	3.3
• Infection	10	0.2	14.6	• Infection	5	0.1	14.0
• Death	1	<0.1	3.0	• Gastric/Intestinal Ulceration with Hemorrhage or Perforation	1	<0.1	2.0
• Gastric/Intestinal Ulceration with Hemorrhage or Perforation	0	0.0	NA	• Death	1	<0.1	30.0
Any Complication Above	***462***	***7.4***	***5.0***	***Any Complication Above***	***510***	***6.0***	***3.5***
Without Any Complication Above	***5,760***	***92.6***	***2.1***	***Without Any Complication Above***	***7,937***	***94.0***	***1.6***

†The term "cases" refers to hospitalizations after exclusions.
NA: Not Applicable

Appendix C: In-Hospital Complications for Surgical Procedures

Definition of In-Hospital Complications for Surgical Procedures

The following ICD-9-CM codes were used to define in-hospital complications for all surgical procedures including Hysterectomy (Abdominal and Vaginal), Mastectomy, and Neck and Back Procedures (With Fusion and Without Fusion). Exceptions are noted.

Procedure/Medical Care Related Events

995.4	998.0	998.32	998.7	998.9	999.8
995.86	998.2	998.4	998.83	999.6	999.9
995.89	998.31	998.6	998.89	999.7	

Digestive System Complications

557.0	560.1	560.9[1]	997.4

Pulmonary Compromise

31.1 (Procedure)	31.29 (Procedure)	514	518.5	518.82	997.3
31.21 (Procedure)	512.1	518.4	518.81	518.84	998.81

Lymphedema

457.0[2]

Hemorrhage

39.98 (Procedure)	57.93 (Procedure)[1]	998.11	998.12	998.13

Infection

038.0	038.41	567.21[1]	567.89[1]	995.94	996.66[3]
038.10	038.42	567.22[1]	567.9[1]	996.60[1,2]	996.67[3]
038.11	038.43	567.29[1]	995.90	996.62	996.69[2]
038.19	038.44	567.31[1]	995.91	996.63[3]	998.51
038.2	038.49	567.38[1]	995.92	996.64	998.59
038.3	038.8	567.39[1]	995.93	996.65[1]	999.3
038.40	038.9				

Pneumonia *Coded by causative organism.*

481	482.30	482.40	482.82	482.9	485
482.0	482.31	482.41	482.83	483.0	486
482.1	482.32	482.49	482.84	483.1	
482.2	482.39	482.81	482.89	483.8	

Cardiac Complications

410.01	410.21	410.41	410.61	410.81	997.1
410.11	410.31	410.51	410.71	410.91	

Venous and Arterial Thrombosis/Pulmonary Embolism

415.11	451.19	451.83	453.40	453.9	997.79
415.19	451.2	451.84	453.41	997.2	999.1
451.0	451.81	451.89	453.42	997.71	999.2
451.11	451.82	451.9	453.8	997.72	

Hypotension/Hypertension

458.21	458.29	997.91

Stroke/Anoxic Brain Damage

348.1	432.1	433.21	434.01	997.00
430	432.9	433.31	434.11	997.01
431	433.01	433.81	434.91	997.02
432.0	433.11	433.91	436	997.09

Device, Implant, or Graft Complications

996.2[3]	996.31	996.52[2,3]	996.55[2]	996.75[3]	996.78[3]
996.30[1]	996.39[1]	996.54[2]	996.70[2]	996.76[1]	996.79[2]

Gastric/Intestinal Ulceration with Hemorrhage or Perforation

49.95 (Procedure)[1]	531.41	532.21	533.11	534.01	534.61
531.00	531.60	532.40	533.20	534.10	537.84
531.01	531.61	532.41	533.21	534.11	568.81[1]
531.10	532.00	532.60	533.40	534.20	578.9
531.11	532.01	532.61	533.41	534.21	
531.20	532.10	533.00	533.60	534.40	
531.21	532.11	533.01	533.61	534.41	
531.40	532.20	533.10	534.00	534.60	

Urinary Complications

584.5	584.6	584.7	584.8	584.9	997.5

Death Discharge Status Code 20 was included as a complication for all surgical procedures.

[1] Hysterectomy group only
[2] Mastectomy group only
[3] Neck & back group only

Appendix D: Risk Factor Descriptions

Pediatric Ear, Nose and Throat Infections

Cases age 0 through 17

Hospitalization Rate	HMO Inpatient Cases* (N = 397)	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
0 – 4 years	217	54.7
5 – 17 years	180	45.3
• Sex		
Female	164	41.3
Male	233	58.7

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Adult Ear, Nose and Throat Infections

Cases age 18 through 64

Hospitalization Rate	HMO Inpatient Cases* (N = 435)	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	263	60.5
45 – 64 years	172	39.5
• Sex		
Female	250	57.5
Male	185	42.5

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

High Blood Pressure (Hypertension)

Cases age 18 through 64

Hospitalization Rate	HMO Inpatient Cases* (N = 511)	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	119	23.3
45 – 64 years	392	76.7
• Sex		
Female	278	54.4
Male	233	45.6

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Gastrointestinal Infections

Cases age 0 through 64

Hospitalization Rate	HMO Inpatient Cases* (N = 1,100)	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
0 – 4 years	130	11.8
5 – 17 years	114	10.4
18 – 44 years	413	37.5
45 – 64 years	443	40.3
• Sex		
Female	645	58.6
Male	455	41.4

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Kidney/Urinary Tract Infections

Cases age 0 through 64

Hospitalization Rate	HMO Inpatient Cases* (N = 1,148)	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
0 – 4 years	122	10.6
5 – 17 years	118	10.3
18 – 44 years	439	38.2
45 – 64 years	469	40.9
• Sex		
Female	893	77.8
Male	255	22.2

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Chronic Obstructive Pulmonary Disease

Cases age 18 through 64

Hospitalization Rate *Significant Variable*	**HMO Inpatient Cases* (N = 843)** *Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	46	5.5
45 – 64 years	797	94.5
• Sex		
Female	453	53.7
Male	390	46.3

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Length of Stay (LOS) *Significant Variable*	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 1,559)** *Number of Cases*	*Percent of Total*	*Avg. LOS*
• *Atlas Outcomes™* MQPredLOS			
0 – 3.645 days	311	19.9	3.0
3.646 – 4.048 days	311	19.9	3.3
4.049 – 4.490 days	314	20.1	3.5
4.491 – 5.068 days	312	20.0	4.0
5.069 + days	311	19.9	4.8

**Cases after LOS exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*

Rehospitalizations (Rehosp) *Significant Variable*	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 1,550)** *Number of Cases*	*Percent of Total*	*% Rehospitalized*
• *Atlas Outcomes™* MQPredLOS			
0 – 3.643 days	309	19.9	14.6
3.644 – 4.047 days	311	20.1	16.7
4.048 – 4.489 days	311	20.1	18.3
4.490 – 5.066 days	309	19.9	20.7
5.067 + days	310	20.0	28.4
• Poverty Rate			
0 – 5.2001%	318	20.5	19.8
5.2002 – 7.9843%	299	19.3	18.4
7.9844 – 10.6905%	313	20.2	20.8
10.6906 – 15.0188%	310	20.0	16.5
15.0189% +	310	20.0	23.2
• Predicted Death			
0 – 0.002	188	12.1	12.2
0.003 – 0.003	323	20.8	18.3
0.004 – 0.006	537	34.6	18.4
0.007 – 0.009	225	14.5	21.3
0.010 +	277	17.9	27.8
• Psychological Disorders			
No	1,204	77.7	18.4
Yes	346	22.3	24.3

**Cases after rehospitalization exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*

LOS	***Rehosp***	***Significant Risk Factors Used for Length of Stay and Rehospitalizations***
		• Age
		• Age-Squared
		• Alcohol and Drug Abuse (no, yes)
✓	✓	• *Atlas Outcomes™* Predicted Length of Stay (MQPredLOS)
		• Diabetes (no, yes)
		• Female (no, yes)
		• Heart Failure (no, yes)
		• Malignant/In situ cancer (no, yes)
		• Median Household Income (based on zip code)
	✓	• Poverty Rate (based on zip code)
	✓	• Predicted Death (logit of *Atlas Outcomes™* Predicted Probability of Death [MQPredDeath])
	✓	• Psychological Disorder (no, yes)
		• Race (black, other, white)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)

Pediatric Asthma

Cases age 0 through 17

Hospitalization Rate	**HMO Inpatient Cases* (N = 1,079)**	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
0 – 4 years	432	40.0
5 – 17 years	647	60.0
• Sex		
Female	400	37.1
Male	679	62.9
**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*		

Length of Stay (LOS)	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 1,507)**		
Significant Variable	*Number of Cases*	*Percent of Total*	*Avg. LOS*
• Age			
0 years	96	6.4	2.0
1 – 3 years	484	32.1	1.7
4 – 7 years	397	26.3	1.8
8 – 11 years	273	18.1	2.0
12 – 17 years	257	17.1	2.2
• Asthma Presentation			
Acute Exacerbation	780	51.8	1.8
Status Asthmaticus	590	39.2	2.0
Unspecified	137	9.1	1.7
• *Atlas Outcomes*™ PredLOS			
0 – 2.004 days	104	6.9	1.6
2.005 – 2.161 days	803	53.3	1.8
2.162 – 2.485 days	303	20.1	1.9
2.486 + days	297	19.7	2.3
• Female			
No	964	64.0	1.8
Yes	543	36.0	2.0
**Cases after LOS exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*			

LOS	***Significant Risk Factors Used for Length of Stay***
✔	• Age
	• Age-Squared
	• Alcohol and Drug Abuse (no, yes)
✔	• Asthma Presentation (unspecified, with Status asthmaticus, with acute exacerbation)
	• Asthma Type (extrinsic, intrinsic/chronic obstructive/unspecified)
✔	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
	• Diabetes (no, yes)
✔	• Female (no, yes)
	• Heart Failure (no, yes)
	• Malignant/In situ cancer (no, yes)
	• Median Household Income (based on zip code)
	• Poverty Rate (based on zip code)
	• Psychological Disorder (no, yes)
	• Race (black, other, white)
	• Renal Dialysis (no, yes)
	• Renal Failure (no, yes)
	• Rural Status (based on zip code)
	• Tobacco Use (no, yes)

Adult Asthma

Cases age 18 through 64

Hospitalization Rate *Significant Variable*	**HMO Inpatient Cases* (N = 1,578)** *Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	646	40.9
45 – 64 years	932	59.1
• Sex		
Female	1,145	72.6
Male	433	27.4

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Length of Stay (LOS) *Significant Variable*	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 2,781)** *Number of Cases*	*Percent of Total*	*Avg. LOS*
• *Atlas Outcomes*™ PredLOS			
0 – 2.800 days	555	20.0	2.3
2.801 – 3.292 days	553	19.9	2.9
3.293 – 3.745 days	563	20.2	3.3
3.746 – 4.296 days	554	19.9	3.9
4.297 + days	556	20.0	4.5
• Asthma Type			
Chronic Obstructive	797	28.7	4.2
Extrinsic	115	4.1	3.2
Intrinsic/Unspecified	1,869	67.2	3.0
• Asthma Presentation			
Acute Exacerbation	2,132	76.7	3.4
Status Asthmaticus	269	9.7	3.7
Unspecified	380	13.7	3.0
• Diabetes			
No	2,342	84.2	3.2
Yes	439	15.8	4.3
• Female			
No	742	26.7	2.9
Yes	2,039	73.3	3.6
• Psychological Disorders			
No	2,240	80.5	3.2
Yes	541	19.5	3.9

**Cases after LOS exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*

Rehospitalizations (Rehosp) *Significant Variable*	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 2,747)** *Number of Cases*	*Percent of Total*	*% Rehospitalized*
• *Atlas Outcomes*™ PredLOS			
0 – 2.805 days	544	19.8	11.8
2.806 – 3.296 days	553	20.1	11.9
3.297 – 3.752 days	553	20.1	15.7
3.753 – 4.303 days	548	19.9	15.0
4.304 + days	549	20.0	19.7
• Asthma Type			
Chronic Obstructive	794	28.9	19.6
Extrinsic	112	4.1	18.8
Intrinsic/Unspecified	1,841	67.0	12.5
• Asthma Presentation			
Acute Exacerbation	2,112	76.9	16.1
Status Asthmaticus	258	9.4	15.9
Unspecified	377	13.7	6.6
• Poverty Rate			
0 – 5.0657%	558	20.3	12.7
5.0658 – 8.0680%	543	19.8	12.9
8.0681 – 11.1080%	547	19.9	16.8
11.1081 – 17.3856%	550	20.0	13.3
17.3857% +	549	20.0	18.4

**Cases after rehospitalization exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*

Adult Asthma continued

LOS	*Rehosp*	*Significant Risk Factors Used for Length of Stay and Rehospitalizations*
		• Age
		• Age-Squared
		• Alcohol and Drug Abuse (no, yes)
✓	✓	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
✓	✓	• Asthma Type (extrinsic, chronic obstructive, intrinsic, unspecified)
✓	✓	• Asthma Presentation (unspecified, with status asthmaticus, with acute exacerbation)
✓		• Diabetes (no, yes)
✓		• Female (no, yes)
		• Heart Failure (no, yes)
		• Malignant/In situ cancer (no, yes)
		• Median Household Income (based on zip code)
	✓	• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
✓		• Psychological Disorder (no, yes)
		• Race (black, other, white)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)

Diabetes

Cases age 18 through 75

Hospitalization Rate	**HMO Inpatient Cases* (N = 1,018)**	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
18 – 25 years	67	6.6
26 – 35 years	74	7.3
36 – 45 years	172	16.9
46 – 55 years	307	30.2
56 – 65 years	337	33.1
66 – 75 years	61	6.0
• Sex		
Female	390	38.3
Male	628	61.7

**Cases after hospitalization rate exclusions; comparative reference = HMO hospitalizations*

Length of Stay (LOS)	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 2,153)**		
Significant Variable	*Number of Cases*	*Percent of Total*	*Avg. LOS*
• Age			
18 – 37 years	419	19.5	2.5
38 – 47 years	419	19.5	3.4
48 – 55 years	501	23.3	4.1
56 – 60 years	411	19.1	4.7
61 + years	403	18.7	4.7
• *Atlas Outcomes*™ PredLOS			
0 – 2.713 days	430	20.0	2.3
2.714 – 3.401 days	431	20.0	2.8
3.402 – 4.414 days	431	20.0	3.3
4.415 – 6.298 days	431	20.0	4.3
6.299 + days	430	20.0	6.7
• COPD			
No	2,062	95.8	3.8
Yes	91	4.2	5.1
• Diabetes Complications			
Long-term	1,002	46.5	4.7
Short-term	1,007	46.8	3.2
None	144	6.7	2.7
• Female			
No	1,307	60.7	3.9
Yes	846	39.3	3.8
• Heart Failure			
No	2,017	93.7	3.7
Yes	136	6.3	5.7
• Lower Extremity Amputation—non-traumatic			
No	1,926	89.5	3.3
Yes	227	10.5	8.3
• Poverty Rate			
0 – 4.9837%	431	20.0	3.9
4.9838 – 7.8884%	430	20.0	4.0
7.8885 – 11.1423%	431	20.0	3.5
11.1424 – 19.0621%	431	20.0	3.7
19.0622% +	430	20.0	4.2
• Renal Dialysis			
No	1,750	81.3	3.5
Yes	403	18.7	5.3

**Cases after LOS exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*

Diabetes continued

Rehospitalizations (Rehosp) *Significant Variable*	**HMO, PPO and Fee-for-Service Inpatient Cases* (N = 2,113)** *Number of Cases*	*Percent of Total*	*% Rehospitalized*
• Age			
18 – 37 years	397	18.8	14.1
38 – 47 years	411	19.5	13.6
48 – 55 years	497	23.5	13.5
56 – 60 years	406	19.2	10.1
61 + years	402	19.0	7.0
• Alcohol Drug Abuse			
No	2,016	95.4	11.6
Yes	97	4.6	15.5
• *Atlas Outcomes*™ PredLOS			
0 – 2.713 days	418	19.8	10.3
2.714 – 3.417 days	426	20.2	7.7
3.418 – 4.427 days	424	20.1	11.1
4.428 – 6.292 days	423	20.0	11.3
6.293 + days	422	20.0	18.2
• Diabetes Complications			
Long-term	997	47.2	13.3
Short-term	976	46.2	11.2
None	140	6.6	4.3
• Female			
No	1,280	60.6	10.5
Yes	833	39.4	13.7
• Peripheral Vascular Disease			
No	2,025	95.8	11.2
Yes	88	4.2	25.0
• Psychological Disorder			
No	1,889	89.4	11.1
Yes	224	10.6	17.0
• Renal Dialysis			
No	1,720	81.4	10.3
Yes	393	18.6	18.1

**Cases after rehospitalization exclusions; comparative reference = HMO, PPO and Fee-for-Service hospitalizations*

LOS	***Rehosp***	***Significant Risk Factors Used for Length of Stay and Rehospitalizations***
✔	✔	• Age
		• Age-Squared
	✔	• Alcohol and Drug Abuse (no, yes)
✔	✔	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
		• Cardiomyopathy (no, yes)
✔		• COPD (no, yes)
✔	✔	• Diabetes Complications (long-term, short-term, none)
✔	✔	• Female (no, yes)
✔		• Heart Failure (no, yes)
		• Hypertensive Disease (no, yes)
		• Ischemic Heart Disease (no, yes)
✔		• Lower Extremity Amputation—non-traumatic (no, yes)
		• Malignant/In situ cancer (no, yes)
		• Median Household Income (based on zip code)
		• Medical DRG (no, yes)
		• Obesity (no, yes)
	✔	• Peripheral Vascular Disease (no, yes)
✔		• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
	✔	• Psychological Disorder (no, yes)
		• Race (black, other, white)
		• Renal Dialysis (no, yes)
✔	✔	• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)

Hysterectomy (Abdominal and Vaginal)

Cases age 18 through 64

Procedure Rate *Significant Variable*	**HMO Inpatient Cases*** *Number of Cases*	**(N = 5,237)** *Percent of Total*
• Age		
18 – 44 years	2,341	44.7
45 – 64 years	2,896	55.3

**Cases after procedure rate exclusions; comparative reference = HMO hospitalizations*

Hysterectomy – Abdominal

Cases age 18 through 64

Procedure Rate *Significant Variable*	**HMO Inpatient Cases*** *Number of Cases*	**(N = 3,595)** *Percent of Total*
• Age		
18 – 44 years	1,579	43.9
45 – 64 years	2,016	56.1

**Cases after procedure rate exclusions; comparative reference = HMO hospitalizations*

Length of Stay (LOS) *Significant Variable*	**Statewide Inpatient Cases*** *Number of Cases*	**(N = 12,049)** *Percent of Total*	*Avg. LOS*
• *Atlas Outcomes*™ PredLOS			
0 – 2.603 days	2,395	19.9	2.2
2.604 – 2.717 days	2,370	19.7	2.4
2.718 – 2.879 days	2,475	20.5	2.5
2.880 – 3.125 days	2,400	19.9	2.6
3.126 + days	2,409	20.0	3.1
• Poverty Rate			
0 – 4.6380%	2,454	20.4	2.4
4.6381 – 7.4365%	2,328	19.3	2.5
7.4366 – 10.2538%	2,441	20.3	2.5
10.2539 – 14.9922%	2,387	19.8	2.5
14.9923% +	2,439	20.2	2.8
• Radical Hysterectomy			
No	12,009	99.7	2.5
Yes	40	0.3	3.2

**Cases after LOS exclusions; comparative reference = all hospitalizations, regardless of payor*

In-Hospital Complications (Compl) *Significant Variable*	**Statewide Inpatient Cases*** *Number of Cases*	**(N = 12,066)** *Percent of Total*	*% Complications*
• *Atlas Outcomes*™ PredLOS			
0 – 2.603 days	2,395	19.8	6.3
2.604 – 2.717 days	2,370	19.6	6.1
2.718 – 2.879 days	2,476	20.5	8.6
2.880 – 3.128 days	2,415	20.0	10.0
3.129 + days	2,410	20.0	19.6
• Poverty Rate			
0 – 4.6380%	2,456	20.4	10.1
4.6381 – 7.4365%	2,330	19.3	10.3
7.4366 – 10.2538%	2,444	20.3	9.3
10.2539 – 14.9922%	2,393	19.8	9.1
14.9923% +	2,443	20.2	11.9
• Radical Hysterectomy			
No	12,039	99.8	10.1
Yes	27	0.2	25.9

**Cases after in-hospital complications exclusions; comparative reference = all hospitalizations, regardless of payor*

Hysterectomy – Abdominal continued

LOS	Compl	Significant Risk Factors Used for Length of Stay and In-Hospital Complications
		• Age
		• Age-Squared
		• Alcohol and Drug Abuse (no, yes)
✓	✓	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
		• Diabetes (no, yes)
		• Heart Failure (no, yes)
		• History of Female Reproductive Cancer (no, yes)
		• Hypertensive Disease (no, yes)
		• Median Household Income (based on zip code)
		• Obesity (no, yes)
✓	✓	• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
		• Principal Diagnosis Group (bleeding/other, fibroids/hyperplasia/endometriosis/uterine prolapse)
		• Psychological Disorder (no, yes)
		• Race (black, other, white)
✓	✓	• Radical Hysterectomy (no, yes)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco use (no, yes)

Hysterectomy – Vaginal

Cases age 18 through 64

Procedure Rate	**HMO Inpatient Cases* (N = 1,642)**	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	762	46.4
45 – 64 years	880	53.6

*Cases after procedure rate exclusions; comparative reference = HMO hospitalizations

Length of Stay (LOS)	**Statewide Inpatient Cases* (N = 5,857)**		
Significant Variable	*Number of Cases*	*Percent of Total*	*Avg. LOS*
• Age			
18 – 36 years	1,006	17.2	1.5
37 – 41 years	1,162	19.8	1.6
42 – 46 years	1,428	24.4	1.5
47 – 51 years	1,098	18.7	1.6
52 – 64 years	1,163	19.9	1.8
• *Atlas Outcomes*™ PredLOS			
0 – 1.732 days	1,142	19.5	1.4
1.733 – 1.861 days	1,195	20.4	1.5
1.862 – 1.983 days	1,180	20.1	1.5
1.984 – 2.191 days	1,172	20.0	1.6
2.192 + days	1,168	19.9	1.8
• Laparoscopic Procedure			
No	3,574	61.0	1.6
Yes	2,283	39.0	1.5
• Poverty Rate			
0 – 4.6380%	1,172	20.0	1.5
4.6381 – 7.4595%	1,168	19.9	1.6
7.4596 – 10.2333%	1,162	19.8	1.6
10.2334 – 13.7147%	1,186	20.2	1.5
13.7148% +	1,169	20.0	1.7
• Principal Diagnosis Group			
Bleeding/Other	2,316	39.5	1.5
Fibroids/Hyperplasia/Endometriosis/ Uterine Prolapse	3,541	60.5	1.6

*Cases after LOS exclusions; comparative reference = all hospitalizations, regardless of payor

Hysterectomy – Vaginal continued

In-Hospital Complications (Compl)	Statewide Inpatient Cases* (N = 5,865)		
Significant Variable	*Number of Cases*	*Percent of Total*	*% Complications*
• *Atlas Outcomes*™ PredLOS			
0 – 1.732 days	1,142	19.5	4.0
1.733 – 1.861 days	1,196	20.4	4.8
1.862 – 1.983 days	1,182	20.2	4.1
1.984 – 2.191 days	1,174	20.0	5.8
2.192 + days	1,171	20.0	14.7

**Cases after in-hospital complications exclusions; comparative reference = all hospitalizations, regardless of payor*

LOS	Compl	Significant Risk Factors Used for Length of Stay and In-Hospital Complications
✓		• Age
✓		• Age-Squared
		• Alcohol and Drug Abuse (no, yes)
✓	✓	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
		• Diabetes (no, yes)
		• Heart Failure (no, yes)
		• History of Female Reproductive Cancer (no, yes)
		• Hypertensive Disease (no, yes)
✓		• Laparoscopic Procedure (no, yes)
		• Median Household Income (based on zip code)
		• Obesity (no, yes)
✓		• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
✓		• Principal Diagnosis Group (bleeding/other, fibroids/hyperplasia/endometriosis/uterine prolapse)
		• Psychological Disorder (no, yes)
		• Race (black, other, white)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)

Mastectomy

Cases age 18 through 64

Procedure Rate	HMO Procedures* (N = 584)	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	152	26.0
45 – 64 years	432	74.0

**Cases after procedure rate exclusions; comparative reference = HMO hospitalizations*

Mastectomy continued

Cases age 18 through 64

Length of Stay (LOS) *Significant Variable*	**Statewide Inpatient Cases*** *Number of Cases*	**(N = 1,759)** *Percent of Total*	*Avg. LOS*
• *Atlas Outcomes*™ PredLOS			
1.576 – 1.712 days	703	40.0	2.1
1.713 – 1.811 days	354	20.1	2.0
1.812 – 2.042 days	351	20.0	2.1
2.043 + days	351	20.0	2.4
• Bilateral			
No	1,289	73.3	2.0
Yes	470	26.7	2.4
• Diabetes			
No	1,609	91.5	2.1
Yes	150	8.5	2.2
• Obesity			
No	1,670	94.9	2.1
Yes	89	5.1	2.4
• Poverty Rate			
0 – 3.8409%	353	20.1	2.1
3.8410 – 6.2286%	349	19.8	2.1
6.2287– 9.7790%	349	19.8	2.1
9.7791 – 14.7727%	356	20.2	2.1
14.7728% +	352	20.0	2.3
• Radical Mastectomy			
No	1,721	97.8	2.1
Yes	38	2.2	2.3
• Reconstruction–Concurrent			
Flap/Graft	316	18.0	3.8
Implant/Other	469	26.7	1.9
None	974	55.4	1.7

**Cases after LOS exclusions; comparative reference = all hospitalizations, regardless of payor*

In-Hospital Complications (Compl) *Significant Variable*	**Statewide Inpatient Cases*** *Number of Cases*	**(N = 1,760)** *Percent of Total*	*% Complications*
• Reconstruction–Concurrent			
Flap/Graft	317	18.0	13.6
Implant/Other	469	26.6	4.5
None	974	55.3	4.6

** Cases after in-hospital complications exclusions; comparative reference = all hospitalizations, regardless of payor*

LOS	***Compl***	***Significant Risk Factors Used for Length of Stay and In-Hospital Complications***
		• Age
		• Age-Squared
		• Alcohol and Drug Abuse (no, yes)
✔		• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
✔		• Bilateral Procedure
		• Breast Cancer Type (malignant, in situ, metastatic)
✔		• Diabetes (no, yes)
		• Family History of Breast Cancer (no, yes)
		• Heart Failure (no, yes)
		• History of Breast Cancer (no, yes)
		• Hypertensive Disease (no, yes)
		• Median Household Income (based on zip code)
✔		• Obesity (no, yes)
✔		• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
		• Psychological Disorder (no, yes)
		• Race (Black, Other, White)
✔		• Radical Mastectomy (no, yes)
✔	✔	• Reconstruction-Concurrent (flap/graft, implant/other, none)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)

Neck and Back Procedures (With Fusion and Without Fusion)

Cases age 18 through 64

Procedure Rate	**HMO Procedures* (N = 4,544)**	
Significant Variable	*Number of Cases*	*Percent of Total*
• Age		
18 – 44 years	1,729	38.1
45 – 64 years	2,815	61.9
• Sex		
Female	2,234	49.2
Male	2,310	50.8

**Cases after procedure rate exclusions; comparative reference = HMO hospitalizations*

Neck and Back Procedures With Fusion

Cases age 18 through 64

Length of Stay (LOS)	**Statewide Inpatient Cases* (N = 6,215)**		
Significant Variable	*Number of Cases*	*Percent of Total*	*Avg. LOS*
• Alcohol/Drug Abuse			
No	6,109	98.3	2.2
Yes	106	1.7	3.6
• *Atlas Outcomes™* PredLOS			
0 – 1.602 days	1,243	20.0	1.5
1.603 – 1.904 days	1,240	20.0	1.8
1.905 – 2.399 days	1,247	20.1	1.9
2.400 – 3.036 days	1,242	20.0	2.4
3.037 + days	1,243	20.0	3.7
• Poverty Rate			
0 – 4.6380%	1,246	20.0	2.2
4.6381 – 7.3340%	1,229	19.8	2.2
7.3341 – 10.0849%	1,278	20.6	2.2
10.0850 – 13.6147%	1,196	19.2	2.2
13.6148% +	1,266	20.4	2.5
• Procedure Group			
Both Disectomy and Laminectomy	175	2.8	4.1
Discectomy	5,547	89.3	2.1
Laminectomy	493	7.9	3.7
• Vertebral Column Location			
Cervical	4,217	67.9	1.6
Lumbar and Lumbosacral/Thoracic and Thoracolumbar/	1,680	27.0	3.7
Unspecified	318	5.1	3.7

**Cases after LOS exclusions; comparative reference = all hospitalizations, regardless of payor*

Neck and Back Procedures With Fusion continued

In-Hospital Complications (Compl) *Significant Variable*	**Statewide Inpatient Cases* (N = 6,222)** *Number of Cases*	*Percent of Total*	*% Complications*
• Alcohol/Drug Abuse			
No	6,116	98.3	7.3
Yes	106	1.7	15.1
• *Atlas Outcomes*™ PredLOS			
0 – 1.607 days	1,244	20.0	3.1
1.608 – 1.904 days	1,240	19.9	4.7
1.905 – 2.401 days	1,252	20.1	5.7
2.402 – 3.039 days	1,243	20.0	9.5
3.040 + days	1,243	20.0	14.2
• COPD			
No	5,973	96.0	7.0
Yes	249	4.0	16.5
• Procedure Group			
Both Discectomy and Laminectomy	175	2.8	24.0
Discectomy	5,550	89.2	5.9
Laminectomy	497	8.0	18.1
• Vertebral Column Location			
Cervical	4,220	67.8	3.0
Lumbar and Lumbosacral/Thoracic and Thoracolumbar/	1,683	27.0	17.3
Unspecified	319	5.1	13.5

**Cases after in-hospital complications exclusions; comparative reference = all hospitalizations, regardless of payor*

LOS	*Compl*	*Significant Risk Factors Used for Length of Stay and In-Hospital Complications*
		• Age
		• Age-Squared
✔	✔	• Alcohol and Drug Abuse (no, yes)
✔	✔	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
	✔	• COPD (no, yes)
		• Diabetes (no, yes)
		• Female (no, yes)
		• Fusion Technique (anterior, posterior/lateral, multiple)
		• Heart Failure (no, yes)
		• Hypertensive Disease (no, yes)
		• Malignant/ In situ Cancer (no, yes)
		• Median Household Income (based on zip code)
		• Musculoskeletal Disorders (no, yes)
		• Obesity (no, yes)
✔		• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
✔	✔	• Procedure Group (discectomy, laminectomy, both discectomy and laminectomy)
		• Psychological Disorder (no, yes)
		• Race (Black, Other, White)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)
✔	✔	• Vertebral Column Location (cervical, lumbar and lumbosacral, thoracic and thoracolumbar, unspecified)

Neck and Back Procedures Without Fusion

Cases age 18 through 64

Length of Stay (LOS)	**Statewide Inpatient Cases***	**(N = 8,436)**	
Significant Variable	*Number of Cases*	*Percent of Total*	*Avg. LOS*
• Alcohol/Drug Abuse			
No	8,319	98.6	1.7
Yes	117	1.4	2.6
• *Atlas Outcomes™* PredLOS			
0 – 1.517 days	1,619	19.2	1.2
1.518 – 1.664 days	1,707	20.2	1.3
1.665 – 1.964 days	1,800	21.3	1.5
1.965 – 2.450 days	1,628	19.3	1.7
2.451 + days	1,682	19.9	2.8
• Female			
No	4,787	56.7	1.6
Yes	3,649	43.3	1.8
• Obesity			
No	7,702	91.3	1.7
Yes	734	8.7	2.0
• Poverty Rate			
0 – 4.3819%	1,673	19.8	1.6
4.3820 – 7.0709%	1,697	20.1	1.7
7.0710 – 9.7790%	1,682	19.9	1.7
9.7791 – 13.5417%	1,699	20.1	1.7
13.5418% +	1,685	20.0	1.9
• Procedure Group			
Both Discectomy and Laminectomy	492	5.8	2.1
Discectomy	5,634	66.8	1.6
Laminectomy	2,310	27.4	2.0
• Vertebral Column Location			
Cervical	796	9.4	1.6
Lumbar and Lumbosacral/Unspecified	7,551	89.5	1.7
Thoracic and Thoracolumbar	89	1.1	2.9

**Cases after LOS exclusions; comparative reference = all hospitalizations, regardless of payor*

In-Hospital Complications (Compl)	**Statewide Inpatient Cases***	**(N = 8,447)**	
Significant Variable	*Number of Cases*	*Percent of Total*	*% Complications*
• Age			
18 – 36 years	1,591	18.8	3.3
37 – 44 years	1,749	20.7	4.1
45 – 51 years	1,963	23.2	5.9
52 – 57 years	1,542	18.3	8.1
58 – 64 years	1,602	19.0	9.1
• *Atlas Outcomes™* PredLOS			
0 – 1.517 days	1,619	19.2	3.0
1.518 – 1.664 days	1,707	20.2	4.0
1.665 – 1.964 days	1,800	21.3	4.7
1.965 – 2.453 days	1,632	19.3	8.3
2.454 + days	1,689	20.0	10.2
• Female			
No	4,793	56.7	6.3
Yes	3,654	43.3	5.6
• Procedure Group			
Both Discectomy and Laminectomy	492	5.8	7.9
Discectomy	5,639	66.8	4.7
Laminectomy	2,316	27.4	9.0
• Vertebral Column Location			
Cervical	797	9.4	3.8
Lumbar and Lumbosacral/Unspecified	7,561	89.5	6.2
Thoracic and Thoracolumbar	89	1.1	14.6

**Cases after in-hospital complications exclusions; comparative reference = all hospitalizations, regardless of payor*

Neck and Back Procedures Without Fusion continued

LOS	*Compl*	*Significant Risk Factors Used for Length of Stay and In-Hospital Complications*
	✓	• Age
		• Age-Squared
✓		• Alcohol and Drug Abuse (no, yes)
✓	✓	• *Atlas Outcomes*™ Predicted Length of Stay (MQPredLOS)
		• COPD (no, yes)
		• Diabetes (no, yes)
✓	✓	• Female (no, yes)
		• Heart Failure (no, yes)
		• Hypertensive Disease (no, yes)
		• Malignant/In situ Cancer (no, yes)
		• Median Household Income (based on zip code)
		• Musculoskeletal Disorders (no, yes)
✓		• Obesity (no, yes)
✓		• Poverty Rate (based on zip code)
		• Predicted Death (logit of *Atlas Outcomes*™ Predicted Probability of Death [MQPredDeath])
✓	✓	• Procedure Group (discectomy, laminectomy, both discectomy and laminectomy)
		• Psychological Disorder (no, yes)
		• Race (Black, Other, White)
		• Renal Dialysis (no, yes)
		• Renal Failure (no, yes)
		• Rural Status (based on zip code)
		• Tobacco Use (no, yes)
✓	✓	• Vertebral Column Location (cervical, lumbar and lumbosacral, thoracic and thoracolumbar, unspecified)

Appendix E: Risk Factor Definitions

Risk Factor	Definition / ICD-9-CM Codes
Age	Age in years
Age-Squared	Age in years X Age in years
Alcohol and Drug Abuse	291.0, 291.1, 291.2, 291.3, 291.4, 291.5, 291.81, 291.82, 291.89, 291.9, 292.0, 292.11, 292.12, 292.2, 292.81, 292.82, 292.83, 292.84, 292.85, 292.89, 292.9, 303.00, 303.01, 303.02, 303.03, 303.90, 303.91, 303.92, 303.93, 304.00, 304.01, 304.02, 304.03, 304.10, 304.11, 304.12, 304.13, 304.20, 304.21, 304.22, 304.23, 304.30, 304.31, 304.32, 304.33, 304.40, 304.41, 304.42, 304.43, 304.50, 304.51, 304.52, 304.53, 304.60, 304.61, 304.62, 304.63, 304.70, 304.71, 304.72, 304.73, 304.80, 304.81, 304.82, 304.83, 304.90, 304.91, 304.92, 304.93, 305.00, 305.01, 305.02, 305.03, 305.20, 305.21, 305.22, 305.23, 305.30, 305.31, 305.32, 305.33, 305.40, 305.41, 305.42, 305.43, 305.50, 305.51, 305.52, 305.53, 305.60, 305.61, 305.62, 305.63, 305.70, 305.71, 305.72, 305.73, 305.80, 305.81, 305.82, 305.83, 305.90, 305.91, 305.92, 305.93, 357.5, 425.5, 535.30, 535.31, 571.0, 571.1, 571.2, 571.3, 980.0, 980.9, V11.3
Asthma Presentation	1) Unspecified: 493.00, 493.10, 493.20, 493.81, 493.82, 493.90 2) With status asthmaticus: 493.01, 493.11, 493.21, 493.91 3) With acute exacerbation: 493.02, 493.12, 493.22, 493.92
Asthma Type	1) Extrinsic: 493.00, 493.01, 493.02 2) Intrinsic: 493.10, 493.11, 493.12 3) Chronic obstructive 493.20, 493.21, 493.22 4) Unspecified: 493.81, 493.82, 493.90, 493.91, 493.92
Atlas Outcomes™ Predicted Length of Stay (MQPredLOS)	Expected length of stay as computed by Atlas Outcomes™ software
Bilateral Breast Cancer Procedure	Bilateral mastectomy code: 85.42, 85.44, 85.46, 85.48, **OR** Any two of the following unilateral mastectomy codes: 85.41, 85.43, 85.45, 85.47 **OR** One unilateral mastectomy code 85.41, 85.43, 85.45, 85.47 **and** one of the following codes: 85.23, 85.33, 85.34
Breast Cancer Type (3 levels)	1) Malignant: 174.0, 174.1, 174.2, 174.3, 174.4, 174.5, 174.6, 174.8, 174.9, 238.3, 239.3 2) In Situ: 233.0 3) Metastatic: 196.3, 198.2, 198.81
Cardiomyopathy	425.3, 425.4, 425.8, 425.9
COPD	491.20, 491.21, 491.22, 492.0, 492.8, 496, 506.4, 518.2
Diabetes	250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93
Diabetes Complications (3 levels)	1) Long-term: 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93 2) Short-term: 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33 3) None: 250.00, 250.01
Family History of Breast Cancer	V16.3
Female	Self explanatory
Fusion Technique (3 levels)	1) Multiple: 81.62, 81.63, 81.64 or at least one code from both of the following categories 2) Anterior: 81.00, 81.01, 81.02, 81.04, 81.06 3) Posterior/Lateral: 81.03, 81.05, 81.07, 81.08
Heart Failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 482.31, 482.32, 482.33, 428.40, 428.41, 428.42, 428.43, 428.9
High Poverty (3 levels; based on zip code)	1) High 2) Average 3) Very high
History of Breast Cancer	V10.3

[1]Code invalid as of October 1, 2006
[2]Code valid as of October 1, 2006

Appendix E: Risk Factor Definitions

Risk Factor	Definition / ICD-9-CM Codes
History of Female Reproductive Cancer	V10.40, V10.41, V10.42, V10.43, V10.44
Hypertensive Disease	401.0, 401.1, 401.9, 402.00, 402.10, 402.90, 403.00, 403.10, 403.90, 404.00, 404.10, 404.90, 405.01, 405.09, 405.11, 405.19, 405.91, 405.99
Ischemic Heart Disease	411.0, 411.1, 411.81, 411.89, 412, 413.0, 413.1, 413.9, 414.00, 414.01, 414.02, 414.03, 414.04, 414.05, 414.06, 414.07, 414.10, 414.11, 414.12, 414.19, 414.8, 414.9
Lower Extremity Amputation – Non-Traumatic	Procedure codes 84.10, 84.11, 84.12, 84.13, 84.14, 84.15, 84.16, 84.17 (exclude diagnosis codes 895.0, 895.1, 896.0, 896.1, 896.2, 896.3, 897.0, 897.1, 897.2, 897.3, 897.4, 897.5, 897.6, 897.7)
Malignant/ In situ Cancer	140.0 - 208.9, 230.0 - 239.9
Median Household Income (based on zip code)	Self-explanatory
Medical DRG	Diagnosis related group that is medical
Musculoskeletal Disorders	274.0, 274.10, 274.11, 274.19, 274.81, 274.82, 274.89, 274.9, 710.0, 712.10, 712.11, 712.12, 712.13, 712.14, 712.15, 712.16, 712.17, 712.18, 712.19, 712.20, 712.21, 712.22, 712.23, 712.24, 712.25, 712.26, 712.27, 712.28, 712.29, 712.30, 712.31, 712.32, 712.33, 712.34, 712.35, 712.36, 712.37, 712.38, 712.39, 712.80, 712.81, 712.82, 712.83, 712.84, 712.85, 712.86, 712.87, 712.88, 712.89, 712.90, 712.91, 712.92, 712.93, 712.94, 712.95, 712.96, 712.97, 712.98, 712.99, 713.0, 713.1, 713.2, 713.3, 713.4, 713.5, 713.6, 713.7, 713.8, 714.0, 714.1, 714.2, 714.30, 741.31, 741.32, 714.33, 714.4, 714.81, 714.89, 714.9, 715.00, 715.04, 715.09, 715.10, 715.11, 715.12, 715.13, 715.14, 715.15, 715.16, 715.17, 715.18, 715.20, 715.21, 715.22, 715.23, 715.24, 715.25, 715.26, 715.27, 715.28, 715.30, 715.31, 715.32, 715.33, 715.34, 715.35, 715.36, 715.37, 715.38, 715.80, 715.89, 715.90, 715.91, 715.92, 715.93, 715.94, 715.95, 715.96, 715.97, 715.98, 733.00, 733.01, 733.02, 733.03, 733.09, V43.60, V43.61, V43.62, V43.63, V43.64, V43.65, V43.66, V43.69
Obesity	278.00, 278.01, V85.30, V85.31, V85.32, V85.33, V85.34, V85.35, V85.36, V85.37, V85.38, V85.39, V85.40
Peripheral Vascular Disease	443.0, 443.1, 443.81, 443.89, 443.9
Poverty Rate (based on zip code)	Self-explanatory
Predicted Death (logit of MQPredDeath)	Expected probability of death as computed by Atlas Outcomes™ software
Principal Diagnosis Group for Hysterectomy (2 levels)	1) Fibroids/hyperplasia/endometriosis/uterine prolapse: 218.0, 218.1, 218.2, 218.9, 617.0, 617.1, 617.2, 617.3, 617.4, 617.5, 617.6, 617.7, 617.8, 617.9, 618.1, 618.2, 618.3, 618.4, 621.2; 621.30, 621.31, 621.32, 621.33 2) Bleeding abnormalities and other principal diagnoses: 626.2, 626.3, 626.4, 626.5, 626.6, 626.7, 626.8, 626.9, 627.0, 627.1
Procedure Group for Neck and Back Procedures (3 levels)	1) Discectomy: 80.50, 80.51, 80.59 2) Laminectomy: 03.09 3) Discectomy and laminectomy: **one** of the following codes - 80.50, 80.51, 80.59 **and** 03.09
Psychological Disorder	295.00, 295.01, 295.02, 295.03, 295.04, 295.05, 295.10, 295.11, 295.12, 295.13, 295.14, 295.15, 295.20, 295.21, 295.22, 295.23, 295.24, 295.25, 295.30, 295.31, 295.32, 295.33, 295.34, 295.35, 295.40, 295.41, 295.42, 295.43, 295.44, 295.45, 295.50, 295.51, 295.52, 295.53, 295.54, 295.55, 295.60, 295.61, 295.62, 295.63, 295.64, 295.65, 295.70, 295.71, 295.72, 295.73, 295.74, 295.75, 295.80, 295.81, 295.82, 295.83, 295.84, 295.85, 295.90, 295.91, 295.92, 295.93, 295.94, 295.95, 296.00, 296.01, 296.02, 296.03, 296.04, 296.05, 296.06, 296.10, 296.11, 296.12, 296.13, 296.14, 296.15, 296.16, 296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.30, 296.31, 296.32, 296.33, 296.34, 296.35, 296.36, 296.40, 296.41, 296.42, 296.43, 296.44, 296.45, 296.46, 296.50, 296.51, 296.52, 296.53, 296.54, 296.55, 296.56, 296.60, 296.61, 296.62, 296.63, 296.64, 296.65, 296.66, 296.7, 296.80, 296.81, 296.82, 296.89, 296.90, 296.99, 297.0, 297.1, 297.2, 297.3, 297.8, 297.9, 298.0, 298.1, 298.2, 298.3, 298.4, 298.8, 298.9, 299.00, 299.01, 299.10, 299.11, 299.80, 299.81, 299.90, 299.91, 300.00, 300.01, 300.02, 300.09, 300.10, 300.11, 300.12, 300.13, 300.14, 300.15, 300.16, 300.19, 300.20, 300.21, 300.22, 300.23, 300.29, 300.3, 300.4, 300.5, 300.6, 300.7, 300.81, 300.82, 300.89, 300.9, 301.0, 301.10, 301.11, 301.12, 301.13, 301.20, 301.21, 301.22, 301.3, 301.4, 301.50, 301.51, 301.59, 301.6, 301.7, 301.81, 301.82, 301.83, 301.84, 301.89, 301.9, 309.0, 309.1, 309.21, 309.22, 309.23, 309.24, 309.28, 309.29, 309.3, 309.4, 309.81, 309.82, 309.83, 309.89, 309.9, 310.0, 310.1, 310.2, 310.8, 310.9, 311, 312.00, 312.01, 312.02, 312.03, 312.10, 312.11, 312.12, 312.13, 312, 20, 312.21, 312.22, 312.23, 312.30, 312.31, 312.32, 312.33, 312.34, 312.35, 312.39, 312.4, 312.81, 312.82, 312.89, 312.9
Race (3 levels)	Black, Other, White
Radical Hysterectomy	68.6[1], 68.61[2], 68.69[2], 68.7[1], 68.71[2], 68.79[2]
Radical Mastectomy	85.45, 85.46, 85.47, 85.48
Reconstruction – Concurrent – Mastectomy	1) None 2) Implant/Other: 85.50, 85.51, 85.52, 85.53, 85.54, 85.86, 85.87, 85.89, 85.93, 85.95, 85.96 3) Flap/Graft: 85.7, 85.82, 85.83, 85.84, 85.85

[1]Code invalid as of October 1, 2006
[2]Code valid as of October 1, 2006

Appendix E: Risk Factor Definitions

Risk Factor	Definition / ICD-9-CM Codes
Renal Dialysis	One of the following diagnosis codes: V45.1, V56.0, V56.8 **or** one of the following procedure codes 39.95, 54.98
Renal Failure	403.01, 403.11, 403.91, 404.02, 404.12, 404.92, 585.1, 585.2, 585.3, 585.4, 585.5, 585.6, 585.9, 586
Rural Status (based on zip code)	Self-explanatory
Tobacco Use	305.1, V15.82
Vaginal Hysterectomy- Laparoscopic Procedure	68.51
Vertebral Column Location (4 levels)	1) Cervical: 721.0, 721.1, 722.0, 722.4, 722.71, 722.91, 723.0, 723.1 2) Thoracic and Thoracolumbar: 721.2, 721.41, 722.11, 722.51, 722.72, 722.92, 724.01, 724.1 3) Lumbar and Lumbosacral: 721.3, 721.42, 722.10, 722.52, 722.73, 722.93, 724.02, 724.2, 724.3, 724.5 4) Unspecified: 720.0, 721.90, 721.91, 722.2, 722.6, 722.70, 722.90, 724.00, 724.09, 738.4

[1]Code invalid as of October 1, 2006
[2]Code valid as of October 1, 2006