Hospital Visits after Urology Ambulatory Surgical Center Procedures (Version 1.0)

Measure Technical Report

Submitted by:

Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (CORE)

Prepared for:

Centers for Medicare & Medicaid Services (CMS)

May 2017

Table of Contents

List of Tables 4
List of Figures 5
Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (CORE) Project Team 6
Acknowledgements 7
1. Executive Summary 9
1.1 Rationale for Assessing Hospital Visits after Ambulatory Surgery 9
1.2 Measure Development 10
1.3 Measure Specifications 10
1.4 Distribution of Measure Scores 11
1.5 Summary 11
2. Introduction 12
2.1 Background 12
2.2 Definition of an Ambulatory Surgical Center (ASC) 12
2.3 Importance of Assessing Unplanned Hospital Visits after ASC Procedures 13
2.4 Related Measures Under Development 14
3. Measure Development Methods 15
3.1 Overview of Measure Development Process 15
3.2 Data Sources 15
3.3 Cohort Definition 16
3.3.1 Inclusion Criteria 16
3.3.2 Exclusion Criteria 18
3.4 Outcome 18
3.4.1 Definition of Outcome 18
3.4.2 Outcome Timeframe 19
3.4.3 Multiple Qualifying Procedures within a 7-Day Period 19
3.4.4 All-Cause Hospital Visits 20
3.4.5 Removal of Planned Admissions from the Outcome 20
3.5 Model Development 21
3.5.1 Overview 21
3.5.2 Candidate Risk Factors for Patient-Level Risk Adjustment 21
3.5.3 Final Risk-Adjustment Variable Selection 22
3.5.4 Model Performance and Validation 23
3.5.5 Calculation of ASC-Level Measure Score 23

3.5.6 ASC-Level Measure Score Reliability Testing 24
3.5.7 Disparities Testing 24
3.5.8 Face Validity Testing 25
3.5.9 Statistical Software 25
4. Results 26
4.1 Overall Summary 26
4.2 Patient-Level Risk-Adjustment Model 26
4.2.1 Candidate and Final Model Variables 26
4.2.2 Model Performance and Validation 27
4.3 ASC-Level Measure Score 27
4.3.1 ASC-Level Measure Score Variation 27
4.3.2 ASC-Level Measure Score Reliability Testing 27
4.3.3 Disparities Testing 27
4.3.4 Face Validity Testing 28
5. Summary and Discussion 29
6. References 30
7. Tables 33
8. Figures 44
9. Appendices 48
Appendix A: List of Included Current Procedural Terminology (CPT®) Codes Defining Urology Procedures 48
Appendix B: Emergency Department Visits and Observation Stays Definition 56
Appendix C: Planned Admission Algorithm 57
C1. Planned Admission Algorithm Overview 57
C2. Detailed Description of Readmission Algorithm Version 4.0 Adapted for Urology ASC Measure 57
Appendix D: Measure Score Calculation and Reporting 74
D1. Risk-Standardized Measure Score Calculation Algorithm 74
D2. Provider Performance Reporting 74
D3. Outlier Evaluation 75
D4. Bootstrapping Algorithm 75
Appendix E: Risk-Adjustment Model Development 77

List of Tables

Table 1. Frequency of risk model variables in the Medicare FFS Development and Validation Samples 33
Table 2. Top 20 procedures in the urology cohort (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015) 33
Table 3. Number and frequency of emergency department visits, observation stays, and unplanned inpatient admissions (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015) 35
Table 4. Top hospital visit diagnoses for any hospital visit within 7 days of urology procedures (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015) 36
Table 5. Risk-adjustment model performance summaries in the Medicare Development and Validation Samples 42
Table 6. Model parameter estimates and odds ratios in the Medicare Development and Validation Samples 42
Table 7. Variation in RSHVRs across ASCs by proportion of Medicaid dual-eligible, African-American, and low SES patients (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015) 43
Table A1. List of included Current Procedural Terminology (CPT®) codes defining urology procedures 48
Table B1. HCPCS codes or revenue center codes that define ED visits and observation stays 56
Table PA1. Procedure categories that are always planned (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0) 60
Table PA2. Diagnosis categories that are always planned (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0) 60
Table PA3. Procedure categories that are potentially planned (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0) 60
Table PA4. Diagnosis categories that are acute (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0) 65
Table E1. Candidate variables considered for the risk adjustment model 77
Table E2. Condition Categories (CCs) that are not risk adjusted for if they occur only at the time of the procedure 83

List of Figures

Figure 1. Timing of hospital visits within 30 days of urology ASC procedures (event rate per day post discharge for 0- through 30-day period) (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015) 44
Figure 2. Calibration plot of predicted versus observed outcomes across deciles of patient risk in the Development Sample (10/01/2014 – 09/30/2015) 45
Figure 3. Calibration plot of predicted versus observed outcomes across deciles of patient risk in the Validation Sample (10/01/2014 – 09/30/2015) 46
Figure 4. Distribution of risk-adjusted hospital visit rates following urology ASC procedures (data source: Medicare FFS FYs 2014-2015 Dataset, 10/01/2013 – 09/30/2015) 47
Figure PA1. Planned admission algorithm flowchart 59

Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (CORE) Project Team

Jennifer Schwartz, PhD, MPH – Project Lead

Craig S. Parzynski, MS – Analytic Co-Lead

Haikun Bao, PhD – Analytic Co-Lead

Faseeha K. Altaf, MPH – Research Project Coordinator II

Erica Norton, BS – Research Associate

Cheryl K. Zogg, MSPH, MHS – Research Assistant

Megan LoDolce, MA – Project Manager

Mayur M. Desai, PhD, MPH – Project Lead for Orthopedic Measure

Zhenqiu Lin, PhD – Director, Data Management and Analytics

Harlan M. Krumholz, MD, SM – Principal Investigator

Elizabeth E. Drye, MD, SM – Project Director

Acknowledgements

This work is a collaborative effort. The authors gratefully acknowledge and thank the project's consultants and the participants of the project's national technical expert panel (TEP) for their input. These individuals provided guidance on key clinical and methodological decisions, though our acknowledgment of their input does not imply their endorsement. In addition, the authors would like to acknowledge and thank staff of the Centers for Medicare & Medicaid Services (CMS) and others for their contribution to this work. These individuals are listed below.

Surgical Consultants

Robert Becher, MD, MS	Yale University School of Medicine (Assistant Professor of Surgery)	New Haven, CT
Simon Kim, MD, MPH	University Hospitals Case Medical Center, and Case Western Reserve University School of Medicine (Assistant Professor, Urology)	Cleveland, OH

TEP Members

Kirk Campbell, MD	New York University Hospital for Joint Diseases (Clinical Assistant Professor of Orthopedic Surgery)	New York, NY
Gary Culbertson, MD, FACS	Iris Surgery Center (Surgeon; Medical Director)	Sumter, SC
Martha Deed, PhD	Consumers Union Safe Patient Project (Patient Safety Advocate)	Austin, TX
James Dupree, MD, MPH	University of Michigan (Assistant Professor in Urology; Urologist)	Ann Arbor, MI
Nester Esnaola, MD, MPH, MBA	Fox Chase Cancer Center (Professor of Surgery; Associate Director for Cancer Health Disparities and Community Engagement)	Philadelphia, PA
John Gore, MD, MS	University of Washington (Associate Professor of Urology)	Seattle, WA
Lisa Ishii, MD, MHS	Johns Hopkins School of Medicine (Associate Professor of Otolaryngology - Head and Neck Surgery); American Academy of Otolaryngology-Head and Neck Surgery (Coordinator for Research and Quality)	Baltimore, MD; Alexandria, VA

Atul Kamath, MD	Perelman School of Medicine, University of Pennsylvania (Assistant Professor and Clinical Educator Director of Orthopedic Surgery); Hospital of the University of Pennsylvania (Attending Surgeon)	Philadelphia, PA
Tricia Meyer, PharmD, MS, FASHP	Scott & White Medical Center (Regional Director of Pharmacy); Texas A&M University College of Medicine (Associate Professor of Anesthesiology)	Temple, TX
Amita Rastogi, MD, MHA, CHE, MS	Health Care Incentives Improvement Institute (Chief Medical Officer)	Newtown, CT
Donna Slosburg, RN, BSN, LHRM, CASC	ASC Quality Collaboration (Executive Director)	St. Pete Beach, FL
Thomas Tsai, MD, MPH	Brigham and Women's Hospital (General Surgeon); Harvard T.H. Chan School of Public Health (Research Associate)	Boston, MA
Katherine Wilson, RN, BA, MHA	AMSURG Corp (Vice President of Quality)	Nashville, TN
Patient	Participation is confidential	
Patient	Participation is confidential	

CMS Staff

Anita J. Bhatia, PhD, MPH	CMS, Center for Clinical Standards and Quality, Quality Measurement & Value-Based Incentives Group (Program Lead, Ambulatory Surgical Center Quality Reporting Program)
Vinitha Meyyur, PhD	CMS, Center for Clinical Standards and Quality, Quality Measurement & Value-Based Incentives Group (Contracting Officer Representative)

Statistical Consultant

Sharon-Lise Normand, MSc, PhD	Harvard Medical School (Professor of Biostatistics, Department of Health Care Policy)	Boston, MA

1. Executive Summary

This report presents the development, testing, and specifications of a quality measure of urology ambulatory surgical center (ASC) procedures. The measure assesses the quality of urology ASC procedures using the outcome of hospital visits – including emergency department (ED) visits, observation stays, and unplanned inpatient admissions – within 7 days after the surgery. Yale New Haven Health Services Corporation—Center for Outcomes Research and Evaluation (CORE) developed the measure for the Centers for Medicare & Medicaid Services (CMS). This ASC-level measure will inform patient choice and help providers and ASCs improve the quality of care.

This report presents the rationale for the measure, the specific technical approach to the measure, the measure specifications, and the national distribution of measure scores across ASC facilities.

1.1 Rationale for Assessing Hospital Visits after Ambulatory Surgery

Ambulatory surgery is increasingly common in the United States (US). Nearly 70% of all surgeries in the US are performed in an outpatient setting, with an expanding number and variety of procedures being performed at stand-alone ASCs.[1] While ambulatory surgery is considered low risk for complications, there are well-described and potentially preventable adverse events that can occur after ambulatory surgery leading to unplanned care in a hospital. These events include urinary retention, uncontrolled pain, infection, bleeding, and venous thromboembolism.

Hospital visits following same-day surgery are an important and accepted patient-centered outcome reported in the literature.[2-9] National estimates of hospital visit rates following surgery vary from 0.5% to 9.0% based on the type of surgery, outcome measured (admissions alone or admissions and ED visits), and timeframe for measurement after surgery.[3-9] Such events also vary among ASCs, suggesting possible variation in surgical care, post-surgical care, and the care and support provided to patients post-discharge.

We estimated the unadjusted 7-day rate of hospital visits, as defined for this measure, following urology ASC procedures. In our analysis of a national 100% dataset of Medicare Fee-for-Service (FFS) claims from Fiscal Year (FY) 2015 (October 1, 2014 – September 30, 2015), the median national observed facility rate of any unplanned hospital visit within 7 days following urology procedures performed at ASCs was 6.0% (the 25th and 75th percentiles were 3.8% and 8.2%, respectively). These results suggest a performance gap and opportunity for quality improvement. The median outcome rates specifically for ED or observation stay visits and for unplanned inpatient admissions were 4.3% and 1.6%, respectively.

Providers at ASCs are often unaware of patients' subsequent acute care visits given that patients tend to present to the ED or to hospitals unaffiliated with the ASC.[10] For these reasons, a quality measure of hospital visits following ASC surgery will serve to improve transparency, inform patients and providers, and foster quality improvement.

1.2 Measure Development

This measure was developed consistent with CMS's measure development guidance. The primary measure developers, a multidisciplinary team of clinicians, health services researchers, and statisticians, were supported and informed by a national technical expert panel (TEP) consisting of patients, surgeons, methodologists, researchers, and providers. We also held a public comment period soliciting stakeholder input on the measure methodology and publicly posted a summary of the comments received as well as our responses (available in the Downloads section at https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/MMS/CallforPublicComment.html).

1.3 Measure Specifications

The population included in the measure is Medicare FFS patients aged 65 years and older, undergoing outpatient urology procedures at ASCs.

The measure's outcome is any unplanned hospital visit (ED visit, observation stay, or unplanned inpatient admission) by a patient occurring within 7 days of an index procedure (a patient's initial procedure).

The measure is risk adjusted. In order to ensure that differences in the facilities' measure scores do not just reflect differences in the mix of patients and procedures across ASCs, the model adjusts for patient demographics (age and sex) and comorbidities as well as surgical procedural complexity. We adjust for these characteristics because they can vary across ASC patient populations, are unrelated to quality, and influence the outcome.

The measure score is an ASC-level risk-standardized hospital visit rate (RSHVR). The RSHVR is calculated as the ratio of the predicted to the expected number of post-surgical unplanned hospital visits among an ASC's patients, multiplied by the national observed rate of unplanned hospital visits. For each ASC, the numerator of the ratio is the number of hospital visits predicted for the ASC's patients, accounting for its observed rate, the number and complexity of urology procedures performed at the ASC, and the case mix. The denominator is the number of hospital visits expected nationally for the ASC's case and procedure mix. To calculate an ASC's predicted-to-expected (P/E) ratio, the measure uses a two-level hierarchical logistic regression model. The log-odds of the outcome for an index procedure is modeled as a function

of the patient demographic, comorbidity, and procedure characteristics as well as a random ASC-specific intercept. A ratio greater than one indicates that the ASC's patients have more hospital visits than expected, compared to an average ASC with similar patient and procedural complexity. A ratio less than one indicates that the ASC's patients have fewer hospital visits than expected, compared to an average ASC with similar patient and procedural complexity. An ASC's P/E ratio is then multiplied by the overall 7-day national rate of unplanned hospital visits to calculate the ASC-level RSHVR. This approach is analogous to an observed-to-expected ratio, but accounts for within-facility correlation of the observed outcome and sample size differences and accommodates the assumption that underlying differences in quality across ASCs lead to systematic differences in outcomes.

1.4 Distribution of Measure Scores

There was variation in risk-standardized scores across ASCs nationally. In a national Medicare FFS claims dataset for FYs 2014-2015 that included 130,144 procedures at 1,204 ASCs, the facility measure scores ranged from 3.7% to 10.1%, with a median RSHVR of 5.8% (the 25th and 75th percentiles were 5.6% and 6.1%, respectively).

1.5 Summary

This report describes the measure specifications and results for a risk-standardized quality measure of 7-day unplanned hospital visits following urology ASC procedures. Stakeholder and expert input informed measure development throughout. The purpose of this measure is to illuminate variation in quality of care for urology procedures across ASCs, inform patient choice, and drive quality improvement.

2. Introduction

2.1 Background

National efforts to measure the quality of ambulatory surgical care are essential, given the increasing number of ambulatory surgical centers (ASCs) in the United States (US) and the increasing variety of procedures that they perform. ASCs have become the preferred setting for the provision of low-risk surgical and medical procedures in the US, including the provision of many types of urologic surgical care.[1] ASCs have gained favor among patients given their tendency toward shorter wait times, decreased need for hospitalization, and more rapid return to work when compared to similar patients managed in other types of healthcare facilities.[1] In 2015 alone, more than 3.4 million Medicare Fee-for-Service (FFS) beneficiaries received care at 5,475 ASCs.[11] Associated spending on ASC services for all types of procedures by Medicare per beneficiary increased by an average of 2.8% per year between 2010 and 2014, and by 5.2% in 2015, resulting in a total expenditure of $4.1 billion spent on ASC services in 2015.[11] Due to advances in surgical and anesthetic techniques, nearly 70% of all surgical procedures in the US are performed in outpatient settings,[1] with many of these procedures taking place as same-day surgeries at ASCs. The resultant shift in ASC utilization has led to an increase not only in ASC operative volume, but also in the average age and complexity of patients managed at ASCs.[12,13]

Urology procedures are commonly performed at ASCs. Based on our empiric analyses of Medicare FFS patients aged 65 years and older, from October 1, 2014 through September 30, 2015, 1,062 ASCs performed 65,169 outpatient urology procedures of the type included in this measure (see Section 3.3 for cohort definition); 433 (41%) of those ASCs performed at least 30 such procedures.

2.2 Definition of an Ambulatory Surgical Center (ASC)

Medicare defines ASCs as healthcare facilities that operate "exclusively for the purpose of providing surgical services to patients not requiring hospitalization and in which the expected duration of services [does] not exceed 24 hours following an admission" (42 CFR 416.2). Eligible ASCs vary in their organizational and financial structures. Many ASCs are hospital-owned; most are run by groups of physicians in the same specialty area and are limited to a single type of procedure, such as eye or urology surgery. Other ASCs conduct procedures in two or more specialty areas.

The types of urology procedures performed at ASCs range from very minor procedures, such as circumcision, to more major operations, such as prostatectomy. Procedures performed at ASCs typically have less than 90-minute operating times and 4- to 6-hour same-day recovery periods.

The surgeries performed usually do not: (1) involve major or prolonged invasion of body cavities, (2) require active medical monitoring and care overnight, (3) result in extensive blood loss, (4) directly involve major blood vessels, or (5) involve care that is either emergent or life-threatening (42 CFR 416.65).

2.3 Importance of Assessing Unplanned Hospital Visits after ASC Procedures

Despite increasing availability of ASCs and their use by patients, there are few quality measures to gauge ASC performance. Existing ASC quality measures tend to focus on very rare, patient safety-related events. For example, one measure counts cases in which a wrong site, wrong side, wrong patient, wrong procedure, or wrong implant event occurred.[14] While such rare, patient-safety related events are important to assess, generally lacking at this time are measures designed to capture more common adverse outcomes that patients experience, such as urinary retention, urinary tract infection, pain, and other complications, requiring acute care hospital visits or admissions.

Measuring ASC outcomes is an important strategy for improving transparency and fostering quality improvement. Facilities and surgical teams may be unaware of their patients' adverse events and hospitalizations following ASC procedures because separate providers (for example, emergency department physicians) tend to provide post-surgical care when it is required. For this reason, measuring unanticipated hospital visits following ASC procedures offers an important means of more broadly reflecting the quality of ASC care. Such visits are an unexpected and potentially preventable outcome for patients with a low anticipated perioperative risk.

In the literature, hospital visit rates following outpatient surgery vary from 0.5% to 9.0%, based on the type of surgery, outcome measured (admissions alone, or admissions and emergency department [ED] visits), and timeframe for measurement after surgery.[2-9,15] These hospital visits can occur due to a range of well-described adverse events, including major adverse events, such as bleeding, wound infection, septicemia, and venous thromboembolism. Patients also frequently report minor adverse events – for example, uncontrolled pain, nausea, and vomiting – that may result in unplanned acute care visits following surgery.

Several factors make unanticipated hospital visits a priority quality indicator. Because ASC providers are not aware of all post-surgical hospital visits that occur among their patients, reporting this outcome will help to illuminate problems that may not be currently visible. In addition, the outcome of hospital visits is broad, patient-centered, and reflects the full range of reasons leading to hospital use among patients undergoing same-day surgery. Public reporting of this outcome measure will provide ASCs with critical information and incentives to implement strategies to reduce unplanned hospital visits.

Given that ASCs vary widely in their focus and in the number of procedures they perform, narrowing in on a surgical subspecialty area, such as urology surgery, enables use of a quality measure to make fair comparisons of outcome rates across facilities that perform similar procedures. Specifically, we are measuring urology procedures performed at ASCs because:

1. The procedures plausibly lead to preventable complications resulting in unplanned hospital visits;
2. Hospital visit rates are elevated within the first week following urology procedures;
3. The reasons for hospital visits are commonly related to the procedures or are preventable; and
4. There are an adequate number of facilities in the US performing urology procedures.

2.4 Related Measures Under Development

This measure of unplanned 7-day hospital visits following urology procedures performed at ASCs was developed in conjunction with one additional quality measure that focuses on orthopedic procedures and also utilizes the same hospital visits outcome. This hospital visits outcome is also the focus of two existing, National Quality Forum (NQF)-CMS quality measures: (1) Facility 7-Day Risk-Standardized Hospital Visit Rate after Outpatient Colonoscopy (NQF #2539) and (2) Hospital Visits after Hospital Outpatient Surgery (NQF #2687).

3. Measure Development Methods

3.1 Overview of Measure Development Process

Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (CORE) led the development of the urology ASC measure under the guidance of CMS. The CORE Project Team consisted of a multidisciplinary group of clinicians, health services researchers, and statisticians with expertise in outcome measure development. We obtained clinical input from a urologist consultant and convened, through a public process, a national Technical Expert Panel (TEP) consisting of patients, expert clinicians, methodologists, researchers, and providers to give input on the measure methodology. Additionally, a public comment period was held to solicit stakeholder input on the measure methodology.

3.2 Data Sources

The measure requires a data source that allows us to link patient data across care settings in order to identify appropriate surgical procedures for inclusion, comorbidities for risk adjustment, and the outcome of hospital visits.[23–25] Therefore, claims data are used, as they support these linkages and are available for the patient population of interest. Furthermore, facilities do not need to submit any data to CMS because claims data are used to calculate the measure results.

To develop and test the patient-level model, we used a national dataset of Fiscal Year (FY) 2015 (October 1, 2014 – September 30, 2015) claims data from the Health Account Joint Information (HAJI) database that included Medicare Inpatient, Outpatient, and Carrier (Part B Physician) claims (hereinafter, Medicare FFS FY 2015 Dataset). Outpatient urology procedures performed at ASCs were identified using the full set of Medicare beneficiaries' claims from the Carrier non-institutional claims, which includes the ASC facility claim (with a unique facility identifier). The outcomes of ED visits and observation stays after urology ASC surgery were identified from the hospital outpatient institutional claims, and the outcome of inpatient hospital admissions was identified from the inpatient institutional claims. The measure cohort included patients who underwent urology ASC procedures in FY 2015. Inpatient and outpatient claims data from the year prior (FY 2014: October 1, 2013 – September 30, 2014) were used to identify comorbidities for risk adjustment for these patients.

For public reporting, CMS is planning to use 2 years of data to increase the reliability of the measure score. Therefore, to calculate ASCs' measure scores, we used 2 years of claims data from FYs 2014 and 2015 (October 1, 2013 – September 30, 2015; hereinafter, Medicare FFS FYs 2014-2015 Dataset). To calculate measure score reliability for a 2-year reporting period, we used 4 years of claims data from FYs 2012-2015 (October 1, 2011 – September 30, 2015), and

randomly split the dataset into two samples, with each containing the equivalent sample size of 2 years of data.

3.3 Cohort Definition

The target population for this measure is Medicare FFS patients aged 65 years and older, undergoing outpatient urology procedures typically performed by urologists at ASCs. The Medicare FFS population was selected because of the availability of a national dataset (Medicare claims) that can be used to develop, test, and publicly report the measure. The target population is defined based on the following inclusion and exclusion criteria.

3.3.1 Inclusion Criteria

Included patients

- Medicare FFS patients aged 65 years and older.

  Rationale: Medicare beneficiaries under age 65 typically are a highly diverse group with a higher burden of disability, and it is, therefore, difficult to adequately risk adjust for the under-65 population.

- Patients with continuous enrollment in Medicare FFS Parts A and B in the 12 months prior to the procedure.

  Rationale: Patients with full enrollment have all claims available for identifying comorbidities for risk adjustment.

Included procedures

- Our target group of procedures was surgical procedures that (1) are routinely performed at ASCs, (2) involve increased risk of post-surgery hospital visits, and (3) are routinely performed by urologists. See Appendix A for a complete listing of all Current Procedural Terminology® (CPT®) procedure codes included in the measure cohort.

  - The measure includes a subset of procedures on Medicare's list of covered ASC procedures for 2014 and 2015. This list of surgeries is publicly available at: https://www.cms.gov/medicare/medicare-fee-for-service-payment/ascpayment/11_addenda_updates.html (download Addendum AA). Surgeries on the ASC list of covered procedures do not involve or require major or prolonged invasion of body cavities, extensive blood loss, major blood vessels, or

care that is emergent or life threatening.[1]

- To focus the measure only on the subset of surgeries on Medicare's list of covered ASC procedures that impose a meaningful risk of post-procedure hospital visits, the measure includes only "major" and "minor" procedures, as indicated by the Medicare Physician Fee Schedule global surgery indicator (GSI) values of 090 and 010, respectively, and certain cystoscopy procedures, as described below. The GSI code reflects the number of post-operative days that are included in a given procedure's global surgical payment and identifies surgical procedures of greater complexity and follow-up care. This list of GSI values is publicly available at: https://www.cms.gov/Medicare/Medicare-fee-for-service-payment/physicianfeesched/pfs-federal-regulation-notices-items/cms-1590-fc.html (download Addendum B).

  Rationale: Ambulatory procedures include a heterogeneous mix of non-surgical procedures, minor surgeries, and more substantive surgeries. We aim to include major and minor surgeries but not very low-risk (very minor) surgeries or non-surgical procedures that typically have a high volume and a very low outcome rate.

- To identify the subset of ASC procedures typically performed by urologists, we used the Clinical Classifications Software (CCS) developed by the Agency for Healthcare Research and Quality (AHRQ) to group procedures and surgeries into clinically-related mutually exclusive categories. For this measure, we use AHRQ's "operations on the urinary system" and "operations on the male genital organs" groups of procedures.[16] The CCS is maintained by AHRQ; thus, as new procedures and codes evolve, the list will evolve, facilitating measure updates. Nephrotomy and nephrostomy procedures (defined by AHRQ clinical category CCS 103) were removed because our experts indicated that these procedures are typically performed by interventional radiologists.

- We include cystoscopy with intervention and define these procedures using the procedure codes indicated in Appendix A. We only consider cystoscopy with therapeutic intervention and do not include cystoscopy alone or cystoscopy with biopsy alone in the measure cohort. We do not include other endoscopy procedures

[1] This list of surgeries was used for several reasons. The ASC list is publicly available, is annually reviewed and updated by Medicare, and includes a transparent public comment submission and review process for addition and/or removal of procedures. Using an existing, defined list of same-day surgical procedures, rather than defining surgical procedures de novo, is useful for long-term measure maintenance. Procedures included on Medicare's list of covered ASC procedures are defined using Healthcare Common Procedure Coding System (HCPCS) and Current Procedural Terminology (CPT®) codes.

in the measure cohort. These endoscopy procedures are lower-risk procedures often with a high volume and a low outcome rate (much like minor surgeries), are often diagnostic procedures (rather than therapeutic), are not typically performed by surgical teams, and do not require an operating room.

Rationale: All endoscopy procedures are considered non-surgical procedures based on Medicare coding (GSI code 000) and are not included in the measure cohort. However, we include cystoscopy with intervention because it is a common procedure, often performed for therapeutic intervention by surgical teams, and our analysis indicated that outcome rates and causes of hospital visits post-procedure are similar to other procedures in the measure cohort.

See Table A1 for a complete list of all CPT® procedure codes included in the measure cohort.

3.3.2 Exclusion Criteria

- Surgeries for patients who survived at least 7 days, but were not continuously enrolled in Medicare FFS Parts A and B in the 7 days after the surgery are excluded.

  Rationale: These patients are excluded to ensure all patients have full data available for outcome assessment.

3.4 Outcome

3.4.1 Definition of Outcome

The outcome is any unplanned hospital visit within 7 days of an outpatient urology procedure. The outcome of hospital visits is the focus of this measure because this is a broad, patient-centered outcome that captures the full range of hospital visits resulting from adverse events or poor care coordination following outpatient surgery. This measure's goal is to assess and to illuminate variation in risk-adjusted hospital visits following surgery for quality improvement purposes.

A hospital visit is defined as any ED visit, observation stay, or unplanned inpatient admission occurring after the ASC procedure; "planned" admissions for anticipated care are not included, as these hospital visits do not reflect quality differences (see Section 3.4.5). Hospital acute care visits and admissions are well-described and recognized indicators of quality for outpatient same-day surgery at ASCs (see Section 2.3).

We have developed two other risk-adjusted outpatient procedure measures that use this same 7-day unplanned hospital visit outcome, both of which have been endorsed by the NQF and have been finalized for use in CMS's pay-for-reporting programs:

- Facility 7-Day Risk-Standardized Hospital Visit Rate after Outpatient Colonoscopy (NQF #2539)
- Hospital Visits after Hospital Outpatient Surgery (NQF #2687)

ED visits and observation stays are defined using billing codes identified in Medicare Part B outpatient hospital claims (see Appendix B, Table B1).

3.4.2 Outcome Timeframe

The outcome of hospital visits is limited to 7 days since existing literature suggests that the majority of adverse events after outpatient surgery occur within the first 7 days following the surgery.[4,17] In addition, our data analysis showed the highest rates of hospital visits occurred within 7 days of urology ASC surgery. As the results in Figure 1 show, the daily rate of unplanned hospital visits was heightened immediately following the procedure. The daily rate then steadily declines until eventually beginning to level off after 7 days to a constant rate of approximately 3.0 visits per 1,000 procedures near 30 days' post-surgery. Based on empiric analyses and expert input from our urologist consultant and TEP members, we concluded that unplanned hospital visits within 7 days is the optimal timeframe to ensure capture of surgery-related adverse events and to minimize capture of hospital visits unrelated to the surgery.

3.4.3 Multiple Qualifying Procedures within a 7-Day Period

In rare instances (1.2%), an index procedure is followed by another qualifying ASC urology procedure within 7 days. When there are two or more qualifying surgical procedures within a 7-day period, we will consider all of them as index procedures; however, the timeframe for outcome assessment will be defined as the interval between procedures (including the day of the next procedure) and then 7 days after the last procedure. If the timeframe for outcome assessment were 7 days after each procedure that occurs within a 7-day period, it would be possible for a single outcome to be attributed to two or more index procedures. For example, consider the following scenario: Procedure #1 on Day 1, Procedure #2 on Day 4, and ED visit on Day 6. Using the standard 7-day timeframe, the outcome on Day 6 would be attributed to both of the procedures. Using the refined algorithm, however, the outcome on Day 6 would be attributed to only Procedure #2, and Procedure #1 would not have an outcome because there was no unplanned hospital visit between Procedures #1 and #2.

3.4.4 All-Cause Hospital Visits

We measure all-cause hospital visits to encourage facilities to minimize all types of risks that may lead to the need for a hospital visit after ASC surgery. Measuring only hospital visits that are overtly related to a procedure, such as pain and bleeding, would limit the measure's impact on quality improvement efforts. Measuring all-cause patient outcomes encourages facilities to minimize the risk of a broad range of outcomes, including the risk of urinary retention, urinary tract infection, dehydration, nausea and vomiting, and dizziness. These are common problems that may or may not be related to a recent ASC surgery. Thus, the measure is structured so that facilities that most effectively minimize patient risk of these outcomes will perform better on the measure.

The rate of hospital visits is not expected to be zero since some patients will have visits for reasons unrelated to the procedure. The measure is risk adjusted for patient demographics and surgical procedural complexity so that facilities that experience more unrelated visits due to a generally higher-risk patient mix will not be disadvantaged.

3.4.5 Removal of Planned Admissions from the Outcome

For inpatient admissions occurring after urology procedures performed at ASCs, only unplanned admissions are included in the measure outcome. "Planned admissions" are those planned by providers for anticipated medical treatment or procedures that must be provided in the inpatient setting; these are not included in the outcome because variation in planned admissions does not reflect quality of care differences.

To identify admissions as planned or unplanned, we apply an algorithm we previously developed for CMS's hospital readmission measures, the CMS Planned Readmission Algorithm Version 4.0. In brief, the algorithm uses the procedure codes and principal discharge diagnosis code on each hospital claim to identify admissions that are typically planned. A few specific, limited types of care are always considered planned (for example, major organ transplant, rehabilitation, or maintenance chemotherapy). Otherwise, a planned admission is defined as a non-acute admission for a scheduled procedure (for example, total hip replacement, or cholecystectomy). Post-discharge admissions for an acute illness or for complications of care are never considered planned. We did not identify any ASC urology procedures routinely followed by planned admissions that were not already captured in the algorithm.

See Appendix C for the detailed planned admission algorithm.

3.5 Model Development

3.5.1 Overview

The measure adjusts for case-mix differences across facilities based on patient demographics, clinical characteristics, and surgical procedural complexity. Risk adjustment is necessary to ensure that variation in the measure score among ASCs is due to differences in quality of care rather than differences in case mix.

The measure score is an ASC-level risk-standardized hospital visit rate (RSHVR). The RSHVR is calculated as the ratio of the predicted to the expected number of post-surgical unplanned hospital visits among an ASC's patients, multiplied by the national observed 7-day rate of unplanned hospital visits. For each ASC, the numerator of the ratio is the number of hospital visits predicted for the ASC's patients, accounting for its observed rate, the number and complexity of urology procedures performed at the ASC, and the case mix. The denominator is the number of hospital visits expected nationally for the ASC's case and procedure mix. To calculate an ASC's predicted-to-expected (P/E) ratio, the measure uses a two-level hierarchical logistic regression model (see Appendix D). The log-odds of the outcome for an index procedure is modeled as a function of the patient demographics, clinical comorbidities, procedure characteristics, and a random ASC-specific intercept. A ratio greater than one indicates that the ASC's patients have more hospital visits than expected, compared to an average ASC with similar patient and procedural complexity. A ratio less than one indicates that the ASC's patients have fewer hospital visits than expected, compared to an average ASC with similar patient and procedural complexity. An ASC's P/E ratio is then multiplied by the overall 7-day national rate of unplanned hospital visits to calculate the ASC-level RSHVR. This approach is analogous to an observed-to-expected ratio, but accounts for within-facility correlation of the observed outcome and for sample size differences across facilities; and accommodates the assumption that underlying differences in quality across ASCs lead to systematic differences in outcomes, and is tailored to and appropriate for a publicly reported outcome measure as articulated in published scientific guidelines.[18-20]

3.5.2 Candidate Risk Factors for Patient-Level Risk Adjustment

The measure adjusts for differences across facilities in patient demographics, clinical factors, and procedure-related risk. Potential candidate risk factors were identified through prior work on related quality measures and through a focused literature review. Specifically, we reviewed risk factors considered in developing a broader NQF-endorsed claims-based surgery measure with the same outcome: Hospital Visits after Hospital Outpatient Surgery (NQF #2687). To identify additional clinical and procedural risk factors, we searched the literature for relevant

peer-reviewed publications of claims-based variables that predicted hospital visits after outpatient surgery using Ovid MEDLINE®. The search yielded a total of six studies relevant to the urology measure. We added variables from the literature to our list of candidate risk factors if they were significantly associated with unplanned hospital visits in bivariate or multivariable analyses at the 0.05 level. From the six studies, we identified four variables not included in the related measure: (1) prior hospital inpatient admission[4], (2) procedure type[21], (3) anesthesia type[22], and (4) diagnosis-related group[22].

We expanded the list of candidate variables with input from the TEP and comments received during our public comment period. The additional variables suggested were benign prostatic hyperplasia, nocturia, urinary frequency, use of alpha blockers, anesthetic type, and transurethral versus non-transurethral procedure type. We added three of these variables -- benign prostatic hyperplasia, nocturia, and urinary frequency – to the candidate variables. We were not able to include alpha blockers because we do not have data on patient-level medication use. We did not include anesthetic type because we do not risk adjust for discretionary procedure differences (such as approach to anesthesia or surgical techniques).

To operationalize the candidate risk factors, we defined the clinical risk factors in claims data using Version 22 of CMS's hierarchical condition categories (HCC) model, which classifies over 15,000 International Classification of Diseases, Ninth Revision (ICD-9-CM) diagnosis codes into clinically coherent condition categories (CCs). In some cases (for example, morbid obesity), individual ICD-9-CM codes were used to define the risk factor. To address surgical procedural complexity, we used the work Relative Value Units (RVUs) of the procedure, an approach employed by the American College of Surgeons National Surgical Quality Improvement Program (NSQIP).[23] Finally, to consolidate similar risk factors into fewer, broader risk variables, we checked the direction and strength of association of the individual risk factors defined by CCs or ICD-9-CM codes, and then combined risk factor diagnoses into clinically coherent comorbidity variables. For example, we created a "cancer" variable that combined several individual cancer diagnoses.

The list of candidate risk variables is in Appendix E, Table E1. Diagnoses included in these variables that may represent complications of care if they are only recorded for a patient at the time of the ASC procedure are not used as risk adjusters for that patient. These diagnoses, grouped by CCs, are listed in Appendix E, Table E2.

3.5.3 Final Risk-Adjustment Variable Selection

For development and testing of the patient-level model, we randomly split the Medicare FFS FY 2015 Dataset into Development and Validation samples. The Development Sample included a random 70% and the Validation Sample included the remaining 30% of the urology ASC procedures contained in the FY 2015 data.

To select the set of variables to include in the risk-adjustment model, we performed a bootstrap variable selection method. Briefly, 1,000 samples were selected with replacement from the Development Sample. For each of the 1,000 samples, a parsimonious logistic regression model was selected by iteratively removing non-significant candidate variables from the model using a stepwise selection approach described by Hosmer and Lemeshow.[28] All variables significant at $p<0.05$ were retained in the final model. This approach yielded 1,000 models from which we then selected all variables that entered the model at least 70% of the time for inclusion in our final model. This method allowed us to select variables that reliably and consistently enter the model across the 1,000 bootstrap samples.

3.5.4 Model Performance and Validation

To assess performance of the patient-level risk-adjustment model in the Development Sample, the area under the receiver operating characteristic curve as measured by the c-statistic was calculated. Observed hospital visit rates were compared to predicted hospital visit probabilities across predicted rate deciles to assess calibration, and the range of observed hospital visit rates between the lowest and highest predicted deciles was calculated to assess model discrimination.

Several analyses to validate the patient-level risk-adjustment model were performed. First, we compared model performance in the Development Sample with its performance in the Validation Sample. The c-statistic, model information criteria (Akaike Information Criteria [AIC], Bayesian Information Criteria [BIC]), and model discrimination (predictive ability) were compared.[24] Second, we examined the stability of the risk variable frequencies and regression coefficients across the development and validation datasets. Third, we calculated over-fitting indices in the 2013 Validation Sample. Over-fitting refers to the phenomenon in which a model describes the relationship between predictive variables and outcome well in the development dataset but fails to provide valid predictions in new patients. Estimated calibration values of γ_0 far from 0 and estimated values of γ_1 far from 1 provide evidence of over-fitting.

3.5.5 Calculation of ASC-Level Measure Score

We examined different distributions (Normal, T, Exponential, and Gamma distributions) of random effects in the hierarchical logistic regression model by evaluating model DIC (Deviance Information Criteria). The hierarchical model with normally distributed random effects had the lowest DIC and was used to calculate ASC-level measure scores.

ASCs' measure scores were calculated in the Medicare FFS FYs 2014-2015 Dataset. As noted above in Section 3.5.1, we calculated the RSHVR for each ASC by computing the ratio of the number of predicted unplanned hospital visits to the number of expected unplanned hospital

visits and then multiplying the ratio by the national outcome rate in the Medicare FFS FYs 2014-2015 Dataset. Then, we evaluated variation in the risk-adjusted measure scores among ASCs.

3.5.6 ASC-Level Measure Score Reliability Testing

To calculate measure score reliability for a 2-year reporting period, we used 4 years of claims data from FYs 2012-2015 (October 1, 2011 – September 30, 2015). Data for ASCs with two or more urology procedures during the 4-year period were randomly split into two samples within each facility, yielding patient samples per facility that were equivalent in size to 2 years of data. Reliability of the ASC-level measure score was tested by calculating the intra-class correlation coefficient (ICC). Since we are measuring the underlying quality of urology procedures at the ASC using patient outcomes, the measure score calculated using two independent samples of patients from the facility should generate scores that are similar. The ICC evaluated the agreement between the RSHVR calculated in the two randomly selected samples.[25]

3.5.7 Disparities Testing

Using the Medicare FFS FY 2015 Dataset, we evaluated the potential impact of race and socioeconomic status (SES) on the urology ASC measure score. We assessed the relationship of SES to hospital visits at the patient and facility levels.

First, at the patient level, we assessed whether risk adjustment for Medicaid dual-eligibility status, African-America race, or a composite measure of SES (AHRQ-validated SES index[26]) affected ASC measure scores by comparing the facility-specific measure score with and without adjustment for each of these variables.

Second, at the ASC-level, we assessed whether ASCs with a high proportion of dual-eligible patients, African-American patients, or low-SES patients (as identified by the AHRQ SES index) performed as well on the measure as ASCs with lower proportions of these patients. To perform this ASC-level analysis, we categorized ASCs into quartiles based on the proportions of Medicare-Medicaid dual-eligible patients, African-American patients, and low-SES patients, and then examined the distribution of measure scores across the lowest and highest quartiles.

These analyses were performed using the Medicare FFS FY 2015 Dataset and data from the Census Bureau's American Community Survey. Specifically, we used the 2009-2013 American Community Survey to calculate AHRQ SES index scores and mapped them to patients' nine-digit ZIP codes.

3.5.8 Face Validity Testing

We systematically assessed the face validity of the measure score as an indicator of quality by confidentially soliciting the TEP members' agreement with the following statement (via an online survey): "The risk-standardized hospital visit rates obtained from the urology ASC measure, as specified, can be used to distinguish between better and worse quality facilities." Response options ranged from "strongly disagree" to "strongly agree."

3.5.9 Statistical Software

All statistical analyses were performed using Statistical Analysis System (SAS) version 9.4 (SAS Institute Inc., Cary, NC). We used both GLIMMIX and Markov Chain Monte Carlo (MCMC) procedures in SAS for identifying the optimal model for this measure. The final hierarchical logistic regression model was estimated using the GLIMMIX procedure in SAS.

4. Results

4.1 Overall Summary

After applying all inclusion and exclusion criteria, the Medicare FFS FY 2015 Dataset included 65,169 urology procedures performed at 1,062 ASCs. The Development and Validation Samples consisted of 45,619 and 19,550 urology procedures performed at 1,017 and 905 ASCs, respectively. In both the Development and Validation Samples, the average age of patients was 75.5, and the comorbidity frequencies were similar (Table 1).

Table 2 presents the top 20 most common surgeries included in the Medicare FFS FY 2015 Dataset (FY 2015 urology ASC measure cohort); they represent 87.2% of all surgeries in the cohort. The overall national 7-day unplanned hospital visit rate was 6.0%, including 4.3% for ED or observation stay visits and 1.6% for unplanned inpatient admissions (Table 3).

Across ASCs in the Medicare FFS FY 2015 data, the median volume of urology procedure cases in the cohort was 18 and ranged from 1 to 1,346 procedures per ASC (the 25th and 75th percentiles were 4 and 65 procedures, respectively). These results show that there were many ASCs with few cases in the Medicare FFS FY 2015 Dataset; 433 ASCs had more than 30 cases.

The distribution of unadjusted outcome rates was skewed, suggesting variation in quality. Among the 433 ASCs with at least 30 cases in the Medicare FFS FY 2015 Dataset, the unadjusted rate of unplanned hospital visits ranged from 0% to 19.4%. Among these ASCs with 30 or more cases, 4.2% had a rate of 0%; however, 10% had rates of 10.5% or greater. The results show important variation in performance across ASC facilities. While many achieve very low rates, there is a wide range of outcome rates, suggesting room for improvement.

Hospital visits after urology ASC procedures were for a diverse array of reasons. Potentially preventable causes, such as urinary retention, urinary tract infection, pain, nausea, vomiting, and other surgery-related complications, were common diagnoses associated with unplanned hospital visits across the AHRQ clinical categories included in the measure cohort (Table 4).

4.2 Patient-Level Risk-Adjustment Model

4.2.1 Candidate and Final Model Variables

Candidate variables for risk adjustment included patient demographics, clinical comorbidities, and procedural-related characteristics (see Appendix E, Table E1). After performing the bootstrap variable selection method described in Section 3.5.3 above, the selected variables retained for the final model were age, 6 comorbidities, number of qualifying procedures (2 vs. 1, 3 or more vs. 1), and a variable to adjust or surgical procedural complexity – work RVUs.

4.2.2 Model Performance and Validation

As the results in Table 5 show, the c-statistic in the Development Sample final model was 0.610, which indicated moderate model discrimination; the c-statistic in the Validation Sample was slightly higher (0.615). It should be noted that our goal is not to maximize prediction but rather to make fair comparisons across ASC facilities. Risk models designed to predict hospital visits rather than to adjust for differences unrelated to quality would likely have higher c-statistics, as they would typically adjust for variables such as complications of the procedure. We intentionally do not adjust for such variables. Additionally, the risk decile plots showed good calibration; the model performed well in each of the risk deciles in both the Development Sample (Figure 2) and the Validation Sample (Figure 3). The mean predicted unplanned hospital visit rate in the Development Sample ranged from 3.2% in the lowest decile of predicted urology procedure hospital visits to 11.2% in the highest predicted risk decile, a range of 8.0%; comparable results were found in the Validation Sample (Table 5).

The regression coefficients of the model variables were also stable across the Development and Validation Samples (Table 6).

4.3 ASC-Level Measure Score

4.3.1 ASC-Level Measure Score Variation

Using the Medicare FFS FYs 2014-2015 Dataset, we found variation in the risk-standardized measure score among ASCs (Figure 4). The median RSHVR was 5.8%, ranging from 3.7% to 10.1% (the 25th and 75th percentiles were 5.0% and 6.1%, respectively). Using a bootstrapped 95% interval estimate, we found 19 significant outliers among 1,204 ASCs. Of the 1,204 ASCs, 4 were categorized as better than expected, 15 as worse than expected, and 1,185 as no different than expected.

4.3.2 ASC-Level Measure Score Reliability Testing

The results of reliability testing are consistent with existing measures of patient outcomes in the ambulatory surgery setting. The agreement between the two RSHVR values for each ASC was calculated for two years to be ICC [2,1] = 0.45, indicating moderate measure score reliability.[25] The ICC [2,1] score, calculated for two years of data, indicates agreement between samples across the full range of measure score values.

4.3.3 ASC-Level Measure Score Disparities Testing

The ASC-level risk-standardized scores were highly correlated (Spearman correlation coefficients of nearly 1.0) when calculated with and without the addition of the three SES

variables. The correlation coefficients were 0.999, 0.999, and 0.999 for the risk-standardized scores with and without Medicaid dual-eligibility status, African-American race, and the AHRQ SES index, respectively.

In addition, the analyses of ASCs categorized into quartiles based on proportions of Medicare-Medicaid dual-eligible patients, of African-American patients, and of low-SES patients (as identified by the ARHQ SES index) showed limited differences in the distributions of the RSHVRs by quartile. Also, the differences in the median rates were less than 0.2 absolute percentage points for all three variables (Table 7).

4.3.4 Face Validity Testing

All 14 TEP members responded to the survey of face validity. Of the 14 respondents, 12 respondents indicated that they somewhat, moderately, or strongly agreed; and 2 respondents moderately disagreed with the following statement: "The risk-standardized hospital visits rates obtained from the urology ASC measure, as specified, can be used to distinguish between better and worse quality facilities." These validity testing results demonstrate TEP agreement with the overall face validity of the measure. (Note: One TEP member was not polled as she only participated in the early stages of measure development.)

5. Summary and Discussion

Medicare beneficiaries commonly undergo urology procedures at ASCs. Based on our empiric analyses of Medicare FFS patients aged 65 years and older, from October 1, 2014 through September 30, 2015, 1,062 ASCs performed 65,169 outpatient urology procedures of the type included in this measure. Our analysis showed that 6.0% of urology procedures at ASCs among Medicare FFS patients aged 65 years and older are followed by unplanned hospital visits within 7 days. Hospital visits often occur due to potentially preventable adverse events, such as urinary retention, bleeding, postoperative pain, and nausea and vomiting. Our results also showed significant variation in unplanned hospital visits among ASCs after adjusting for case mix, which suggests variation in quality of care.

The many small-volume ASCs make development and use of outcome measures to assess quality of care challenging. ASCs with few cases in a given year limit our ability to estimate risk-adjusted ASC-level measure scores, thereby limiting CMS's ability to assess quality. To expand the number of cases available for estimating rates across all facilities and to increase the reliability of the measure score, CMS is planning to use using 2 years of data for public reporting.

In summary, hospital visits following urology procedures performed at ASCs are unexpected by patients, currently largely invisible to providers, and costly to the healthcare system. The urology ASC measure, as specified, has the potential to illuminate these differences in quality, inform patient choice, drive quality improvement, enhance care coordination, and ultimately to reduce unplanned hospital visits following urology procedures performed at ASCs.

6. References

1. Cullen KA, Hall MJ, Golosinskiy A, National Center for Health Statistics. *Ambulatory surgery in the United States, 2006.* US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2009.

2. Majholm BB. Is day surgery safe? A Danish multicentre study of morbidity after 57,709 day surgery procedures. *Acta Anaesthesiologica Scandinavica.* 2012;56(3):323-331.

3. Whippey A, Kostandoff G, Paul J, Ma J, Thabane L, Ma HK. Predictors of unanticipated admission following ambulatory surgery: A retrospective case-control study. *Canadian Journal of Anesthesia/Journal Canadien d'Anesthésie.* 2013;60(7):675-683.

4. Fleisher LA, Pasternak LR, Herbert R, Anderson GF. Inpatient hospital admission and death after outpatient surgery in elderly patients: Importance of patient and system characteristics and location of care. *Archives of Surgery.* 2004;139(1):67-72.

5. Coley KC, Williams BA, DaPos SV, Chen C, Smith RB. Retrospective evaluation of unanticipated admissions and readmissions after same day surgery and associated costs. *Journal of Clinical Anesthesia.* 2002;14(5):349-353.

6. Hollingsworth JMJM. Surgical quality among Medicare beneficiaries undergoing outpatient urological surgery. *The Journal of Urology.* 2012;188(4):1274-1278.

7. Bain J, Kelly H, Snadden D, Staines H. Day surgery in Scotland: Patient satisfaction and outcomes. *Quality in Health Care.* 1999;8(2):86-91.

8. Fortier J, Chung F, Su J. Unanticipated admission after ambulatory surgery--A prospective study. *Canadian Journal of Anaesthesia/Journal Canadien d'Anesthesie.* 1998;45(7):612-619.

9. Aldwinckle R, Montgomery J. Unplanned admission rates and postdischarge complications in patients over the age of 70 following day case surgery. *Anaesthesia.* 2004;59(1):57-59.

10. Mezei G, Chung F. Return hospital visits and hospital readmissions after ambulatory surgery. *Annals of Surgery.* 1999;230(5):721-727.

11. Medicare Payment Advisory Commission (MedPAC). Report to Congress: Medicare Payment Policy. March 2017; http://www.medpac.gov/docs/default-source/reports/mar17_entirereport.pdf?sfvrsn=0.

12. Bettelli G. High risk patients in day surgery. *Minerva Anestesiologica.* 2009;75(5):259-268.

13. Fuchs K. Minimally invasive surgery. *Endoscopy.* 2002;34(2):154-159.

14. Centers for Medicare & Medicaid Services. Ambulatory Surgical Center Quality Reporting Specifications Manual Release Notes Version: 6.0. 2016; http://qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier2&cid=1228772475754 Accessed July 13, 2016.

15. Molina G, Neville BA, Lipsitz SR, et al. Postoperative acute care use after freestanding ambulatory surgery. *Journal of Surgical Research.* 2016;205(2):331-340.

16. Agency for Healthcare Research and Quality. HCUP CCS-Services and Procedures. Healthcare Cost and Utilization Project (HCUP). March 2016; www.hcup-us.ahrq.gov/toolssoftware/ccs_svcsproc/ccssvcproc.jsp. Accessed July 26, 2016.

17. Mattila K, Toivonen J, Janhunen L, Rosenberg PH, Hynynen M. Postdischarge symptoms after ambulatory surgery: First-week incidence, intensity, and risk factors. *Anesthesia and Analgesia.* 2005;101(6):1643-1650.

18. Normand S-LT, Shahian DM. Statistical and clinical aspects of hospital outcomes profiling. *Statistical Science.* 2007;22(2):206-226.

19. Krumholz HM, Brindis RG, Brush JE, et al. Standards for statistical models used for public reporting of health outcomes an American Heart Association scientific statement from the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council endorsed by the American College of Cardiology Foundation. *Circulation.* 2006;113(3):456-462.

20. National Quality Forum. Measure Evaluation Criteria and Guidance for Evaluating Measures for Endorsement. 2015; http://www.qualityforum.org/Measuring_Performance/Submitting_Standards/2015_Measure_Evaluation_Criteria.aspx. Accessed July 26, 2016.

21. Crew JP, Turner KJ, Millar J, Cranston DW. Is day case surgery in urology associated with high admission rates? *Annals of The Royal College of Surgeons of England.* 1997;79(6):416-419.

22. Paez A, Redondo E, Linares A, Rios E, Vallejo J, Sanchez-Castilla M. Adverse events and readmissions after day-case urological surgery. *International Brazilian Journal of Urology.* 2007;33(3):330-338.

23. Raval MV, Cohen ME, Ingraham AM, et al. Improving American College of Surgeons National Surgical Quality Improvement Program risk adjustment: Incorporation of a novel procedure risk score. *Journal of the American College of Surgeons.* 2010;211(6):715-723.

24. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: A nonparametric approach. *Biometrics.* 1988:837-845.

25. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics.* 1977;33(1):159-174.

26. Bonito A, Bann C, Eicheldinger C, Carpenter L. Creation of new race-ethnicity codes and socioeconomic status (SES) indicators for Medicare beneficiaries. *RTI International, Agency for Healthcare Research and Quality.* 2008.

27. Horwitz LI, Grady JN, Cohen DB, et al. Development and validation of an algorithm to identify planned readmissions from claims data. *Journal of Hospital Medicine.* 2015;10(10):670-677.

7. Tables

Table 1. Frequency of risk model variables in the Medicare FFS Development and Validation Samples

Variable (definition)	Development Sample, 10/01/2014 – 09/30/2015		Validation Sample, 10/01/2014 – 09/30/2015	
	#	%	#	%
Number of procedures	45,619		19,550	
Age: mean (standard deviation [SD])	75.52	6.7	75.53	6.7
Work Relative Value Units: mean (SD)	6.28	3.7	6.26	3.6
Benign prostatic hyperplasia with obstruction	14,441	31.7%	6,110	31.3%
Complications of specified implanted device or graft (This variable includes codes for complications of implanted devices and grafts, including cystostomies, vascular and genitourinary devices, and urethral catheters.)	2,309	5.1%	1,021	5.2%
Number of qualifying procedures: 1	41,176	90.3%	17,587	90.0%
Number of qualifying procedures: 2	4,094	9.0%	1,807	9.2%
Number of qualifying procedures: 3 or more	349	0.8%	156	0.8%
Poisonings and inflammatory allergic reactions (This variable includes codes for adverse drug effects and allergies).	2,434	5.3%	1,013	5.2%
Major symptoms, abnormalities (This variable includes diagnoses of fever, sleep disorders, altered consciousness, and abdominal pain.)	32,921	72.2%	13,989	71.6%
Parkinson's and Huntington's diseases; seizure disorders and convulsions	1,697	3.7%	722	3.7%
Ischemic heart disease	15,295	33.5%	6,558	33.5%

Table 2. Top 20 procedures in the urology cohort (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015)

CPT®	CPT® code short description	Number of procedures	% of all surgeries
50590	fragmenting of kidney stone	9,373	14.4%
52281	cystoscopy and treatment	6,735	10.3%
52310	cystoscopy and treatment	5,234	8.0%
52332	cystoscopy and treatment	4,722	7.3%

CPT®	CPT® code short description	Number of procedures	% of all surgeries
52234	cystoscopy and treatment	4,036	6.2%
52224	cystoscopy and treatment	3,676	5.6%
52235	cystoscopy and treatment	3,539	5.4%
52648	laser surgery of prostate	2,662	4.1%
52287	cystoscopy chemodenervation	2,498	3.8%
52601	prostatectomy (turp)	2,325	3.6%
54161	circum 28 days or older	1,509	2.3%
52240	cystoscopy and treatment	1,502	2.3%
52214	cystoscopy and treatment	1,431	2.2%
52276	cystoscopy and treatment	1,408	2.2%
52352	cystouretero w/stone remove	1,325	2.0%
55875	transperi needle place pros	1,131	1.7%
57288	repair bladder defect	1,097	1.7%
55040	removal of hydrocele	913	1.4%
52353	cystouretero w/lithotripsy	871	1.3%
52317	remove bladder stone	868	1.3%

Table 3. Number and frequency of emergency department visits, observation stays, and unplanned inpatient admissions (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015)

Outcome type	Number of urology procedures with outcome	7-day visit rate
Hospital visits (emergency department visit, observation stay, or unplanned inpatient admissions)	3,884	6.0%
Emergency department visit or observation stay visit	2,820	4.3%
Unplanned inpatient admission	1,064	1.6%

Table 4. Top hospital visit diagnoses for any hospital visit within 7 days of urology procedures (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015)

AHRQ clinical category	Number of unplanned hospital visits	Rate of unplanned hospital visits (%)	Top 10 primary diagnoses at hospital	ICD-9-CM diagnosis description	Frequency of diagnosis
100 - Endoscopy and endoscopic biopsy of the urinary tract	2,038	7.8%	78820	Retention urine NOS	28
			99631	Malfunc urethral cath	11
			59970	Hematuria NOS	8
			99811	Hemorrhage complic proc	8
			99676	Comp-genitourin dev/grft	7
			0389	Septicemia NOS	6
			5990	Urin tract infection NOS	5
			59689	Disorders of bladder NEC	5
			78909	Abdmnal pain oth spcf st	4
			7802	Syncope and collapse	3
101 - Transurethral excision, drainage, or removal urinary obstruction	22,260	6.1%	78820	Retention urine NOS	198
			5990	Urin tract infection NOS	74
			99811	Hemorrhage complic proc	56
			59970	Hematuria NOS	50
			59971	Gross hematuria	49
			5921	Calculus of ureter	41
			99631	Malfunc urethral cath	40
			0389	Septicemia NOS	39
			99676	Comp-genitourin dev/grft	34
			5849	Acute kidney failure NOS	30
102 - Ureteral catheterization	4,722	6.7%	5990	Urin tract infection NOS	21
			0389	Septicemia NOS	20
			5849	Acute kidney failure NOS	20

AHRQ clinical category	Number of unplanned hospital visits	Rate of unplanned hospital visits (%)	Top 10 primary diagnoses at hospital	ICD-9-CM diagnosis description	Frequency of diagnosis
102 - Ureteral catheterization			5921	Calculus of ureter	16
			78820	Retention urine NOS	13
			5920	Calculus of kidney	12
			78900	Abdmnal pain unspcf site	9
			78909	Abdmnal pain oth spcf st	9
			7880	Renal colic	6
			59971	Gross hematuria	6
106 - Genitourinary incontinence procedures	1,466	3.9%	78820	Retention urine NOS	10
			5990	Urin tract infection NOS	3
			42731	Atrial fibrillation	3
			56400	Constipation NOS	2
			99811	Hemorrhage complic proc	2
			99631	Malfunc urethral cath	2
			9975	Surg compl-urinary tract	2
			78650	Chest pain NOS	2
			5589	Noninf gastroenterit NEC	1
			7840	Headache	1
107 - Extracorporeal lithotripsy, urinary	10,244	5.5%	5921	Calculus of ureter	111
			5920	Calculus of kidney	62
			7880	Renal colic	25
			5990	Urin tract infection NOS	25
			78909	Abdmnal pain oth spcf st	22
			78820	Retention urine NOS	22
			0389	Septicemia NOS	19
			99812	Hematoma complic proc	15

AHRQ clinical category	Number of unplanned hospital visits	Rate of unplanned hospital visits (%)	Top 10 primary diagnoses at hospital	ICD-9-CM diagnosis description	Frequency of diagnosis
107 - Extracorporeal lithotripsy, urinary			7802	Syncope and collapse	11
			78650	Chest pain NOS	9
109 - Procedures on the urethra	7,426	3.7%	78820	Retention urine NOS	51
			5990	Urin tract infection NOS	16
			99631	Malfunc urethral cath	9
			0389	Septicemia NOS	7
			59970	Hematuria NOS	6
			5849	Acute kidney failure NOS	6
			9975	Surg compl-urinary tract	6
			99676	Comp-genitourin dev/grft	5
			78650	Chest pain NOS	5
			42823	Ac on chr syst hrt fail	4
111 - Other non-OR therapeutic procedures of urinary tract	96	4.2%	1889	Malig neo bladder NOS	1
			7851	Palpitations	1
			92401	Contusion of hip	1
			73313	Path fx vertebrae	1
112 - Other OR therapeutic procedures of urinary tract	5,001	6.0%	78820	Retention urine NOS	62
			99631	Malfunc urethral cath	15
			5990	Urin tract infection NOS	14
			99811	Hemorrhage complic proc	11
			0389	Septicemia NOS	10
			59970	Hematuria NOS	9
			99676	Comp-genitourin dev/grft	7
			78829	Oth spcf retention urine	6
			59971	Gross hematuria	6

AHRQ clinical category	Number of unplanned hospital visits	Rate of unplanned hospital visits (%)	Top 10 primary diagnoses at hospital	ICD-9-CM diagnosis description	Frequency of diagnosis
112 - Other OR therapeutic procedures of urinary tract			78659	Chest pain NEC	6
113 - Transurethral resection of prostate (TURP)	2,698	12.1%	78820	Retention urine NOS	59
			59970	Hematuria NOS	25
			99811	Hemorrhage complic proc	25
			5990	Urin tract infection NOS	16
			59971	Gross hematuria	15
			99631	Malfunc urethral cath	14
			V536	Fitting urinary devices	13
			78829	Oth spcf retention urine	11
			9975	Surg compl-urinary tract	10
			99676	Comp-genitourin dev/grft	9
114 - Open prostatectomy	95	13.7%	59970	Hematuria NOS	3
			78820	Retention urine NOS	3
			9975	Surg compl-urinary tract	1
			78701	Nausea with vomiting	1
			5845	Ac kidny fail, tubr necr	1
			27651	Dehydration	1
			99859	Other postop infection	1
			9961	Malfunc vasc device/graf	1
			9953	Allergy, unspecified	1
115 – Circumcision	1,537	3.2%	99811	Hemorrhage complic proc	7
			78820	Retention urine NOS	4
			56400	Constipation NOS	3
			99859	Other postop infection	2
			9989	Surgical complicat NOS	2

AHRQ clinical category	Number of unplanned hospital visits	Rate of unplanned hospital visits (%)	Top 10 primary diagnoses at hospital	ICD-9-CM diagnosis description	Frequency of diagnosis
115 – Circumcision			60783	Edema of penis	2
			5990	Urin tract infection NOS	2
			41071	Subendo infarct, initial	2
			9975	Surg compl-urinary tract	1
			99679	Comp-int prost devic NEC	1
116 - Diagnostic procedures, male genital	374	6.2%	78820	Retention urine NOS	8
			59971	Gross hematuria	1
			99676	Comp-genitourin dev/grft	1
			55221	Obstr incisional hernia	1
			5990	Urin tract infection NOS	1
			78060	Fever NOS	1
			78829	Oth spcf retention urine	1
			9975	Surg compl-urinary tract	1
			59970	Hematuria NOS	1
			99631	Malfunc urethral cath	1
117 - Other non-OR therapeutic procedures, male genital	1,309	4.0%	78820	Retention urine NOS	15
			99811	Hemorrhage complic proc	3
			59970	Hematuria NOS	3
			185	Malign neopl prostate	2
			5849	Ac kidny fail, unspecified	2
			78841	Urinary frequency	2
			5990	Urin tract infection NOS	2
			41519	Pulm embol/infarct NEC	1
			V153	Hx of irradiation	1
			99889	Oth spcf cmplc procd NEC	1

AHRQ clinical category	Number of unplanned hospital visits	Rate of unplanned hospital visits (%)	Top 10 primary diagnoses at hospital	ICD-9-CM diagnosis description	Frequency of diagnosis
118 - Other OR therapeutic procedures, male genital	5,903	6.6%	78820	Retention urine NOS	69
			5990	Urin tract infection NOS	23
			99811	Hemorrhage complic proc	18
			V536	Fitting urinary devices	17
			99631	Malfunc urethral cath	16
			7802	Syncope and collapse	15
			99676	Comp-genitourin dev/grft	12
			59970	Hematuria NOS	11
			9975	Surg compl-urinary tract	9
			0389	Septicemia NOS	8

Table 5. Risk-adjustment model performance summaries in the Medicare Development and Validation Samples

Characteristic	Development Sample, 10/01/2014 – 09/30/2015	Validation Sample, 10/01/2014 – 09/30/2015
N	45,619	19,550
# of hospital visits in 7 days	2,724 (6.0%)	1,160 (5.9%)
Calibration (γ0, γ1)	(0, 1)	(-0.05, 0.98)
c-statistic	0.610	0.615
Predictive ability (lowest-highest risk decile)	3.2%-11.2%	3.1%-11.4%

Table 6. Model parameter estimates and odds ratios in the Medicare Development and Validation Samples

Risk variable	Development Sample, 10/01/2014 – 09/30/2015		Validation Sample, 10/01/2014 – 09/30/2015	
	Estimate	Odds ratio (95% CI)	Estimate	Odds ratio (95% CI)
Intercept	-3.854		-3.790	
Age > 65	0.024	1.02 (1.02-1.03)	0.026	1.03 (1.02-1.04)
Work Relative Value Units (work RVUs) - mean (standard deviation)	0.060	1.06 (1.05-1.07)	0.056	1.06 (1.04-1.07)
Benign prostatic hyperplasia with obstruction	0.223	1.25 (1.15-1.36)	0.202	1.22 (1.08-1.39)
Complications of specified implanted device or graft	0.352	1.42 (1.22-1.65)	0.479	1.61 (1.3-2.01)
Number of qualifying procedures: 2 vs 1	0.273	1.31 (1.16-1.48)	0.320	1.38 (1.15-1.65)
Number of qualifying procedures: 3+ vs 1	0.455	1.58 (1.11-2.25)	-0.266	0.77 (0.37-1.57)
Poisonings and allergic and inflammatory reactions	0.304	1.35 (1.16-1.58)	0.261	1.30 (1.02-1.65)
Major symptoms, abnormalities	0.260	1.30 (1.18-1.43)	0.091	1.10 (0.95-1.26)
Parkinson's and Huntington's diseases; seizure disorders and convulsions	0.362	1.44 (1.21-1.71)	0.270	1.31 (0.99-1.73)
Ischemic heart disease	0.208	1.23 (1.13-1.34)	0.368	1.44 (1.28-1.63)

Table 7. Variation in RSHVRs across ASCs by proportion of Medicaid dual-eligible, African-American, and low-SES patients (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015)

	Medicaid dual-eligible status		African-American race		Low-SES	
	Low % (≤1.96%)	High % (≥7.54%)	Low % (0.00%)	High % (≥6.34%)	Low % (≤4.93%)	High % (≥18.30%)
Number of ASCs	106	109	125	108	108	109
Number of patients	11,842	11,705	9,490	17,011	11,286	14,348
Maximum RSHVR	10.8%	8.8%	8.4%	8.8%	10.8%	9.3%
90th	7.3%	7.4%	7.3%	7.4%	6.9%	7.5%
75th	6.4%	6.6%	6.6%	6.6%	6.3%	6.6%
Median	5.9%	6.0%	6.0%	6.0%	5.8%	6.0%
25th	5.3%	5.5%	5.5%	5.5%	5.2%	5.6%
10th	4.8%	5.0%	5.2%	5.0%	4.6%	5.3%
Minimum RSHVR	4.0%	4.5%	4.1%	4.2%	4.0%	4.9%

8. Figures

Figure 1. Timing of hospital visits within 30 days of urology ASC procedures (event rate per day post discharge for 0- through 30-day period) (data source: Medicare FFS FY 2015 Dataset, 10/01/2014 – 09/30/2015)

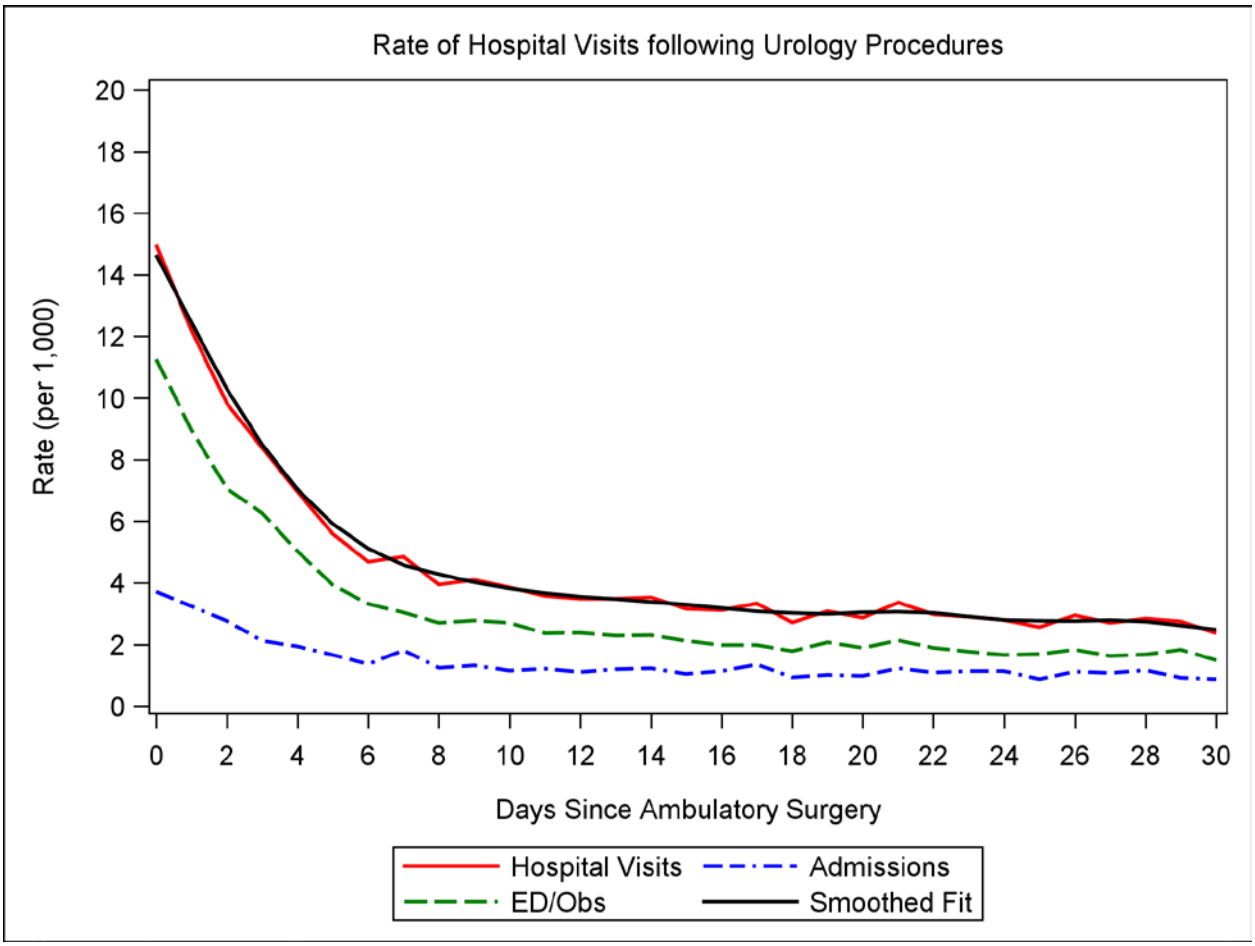


Figure 2. Calibration plot of predicted versus observed outcomes across deciles of patient risk in the Development Sample (10/01/2014 – 09/30/2015)

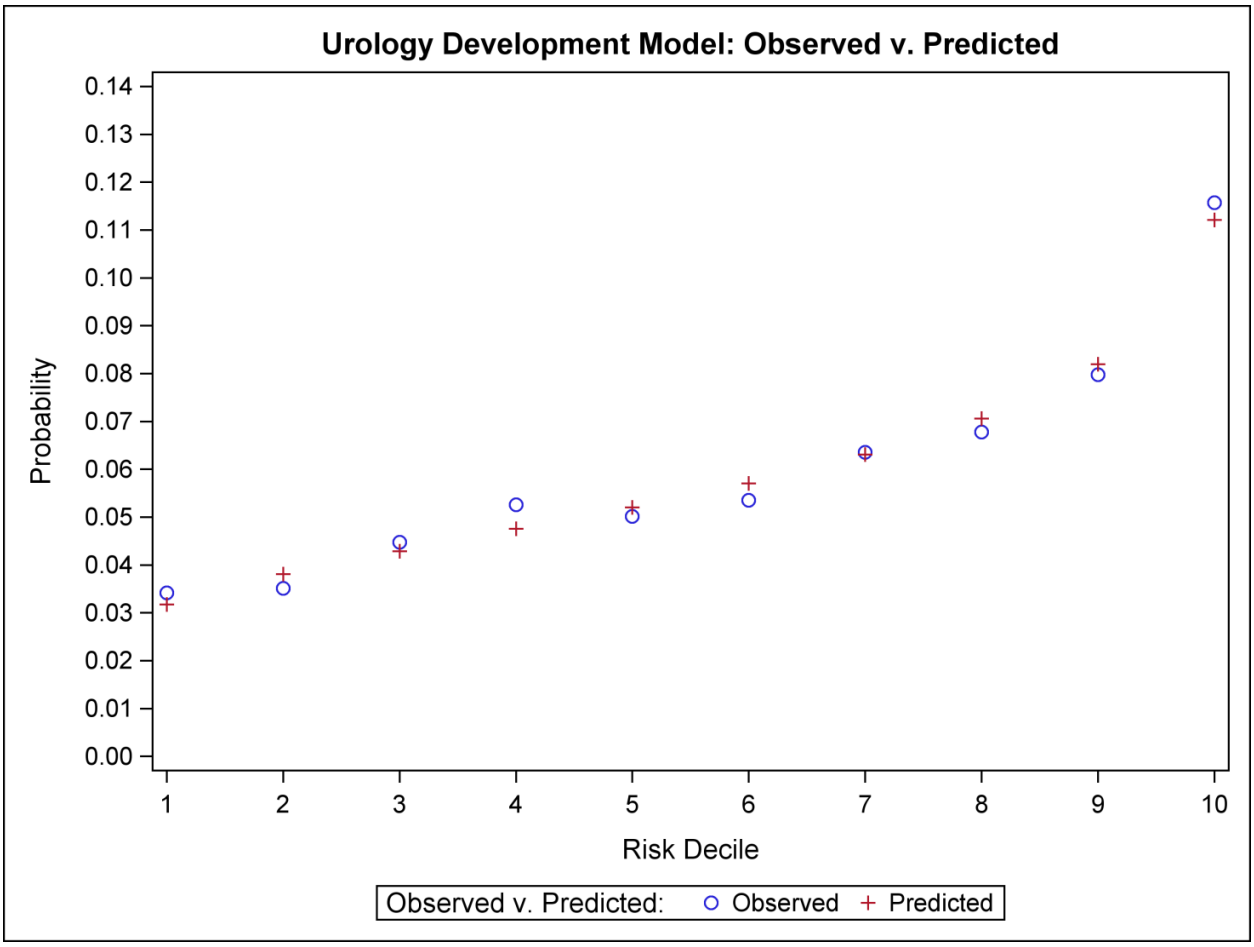


Figure 3. Calibration plot of predicted versus observed outcomes across deciles of patient risk in the Validation Sample (10/01/2014 – 09/30/2015)

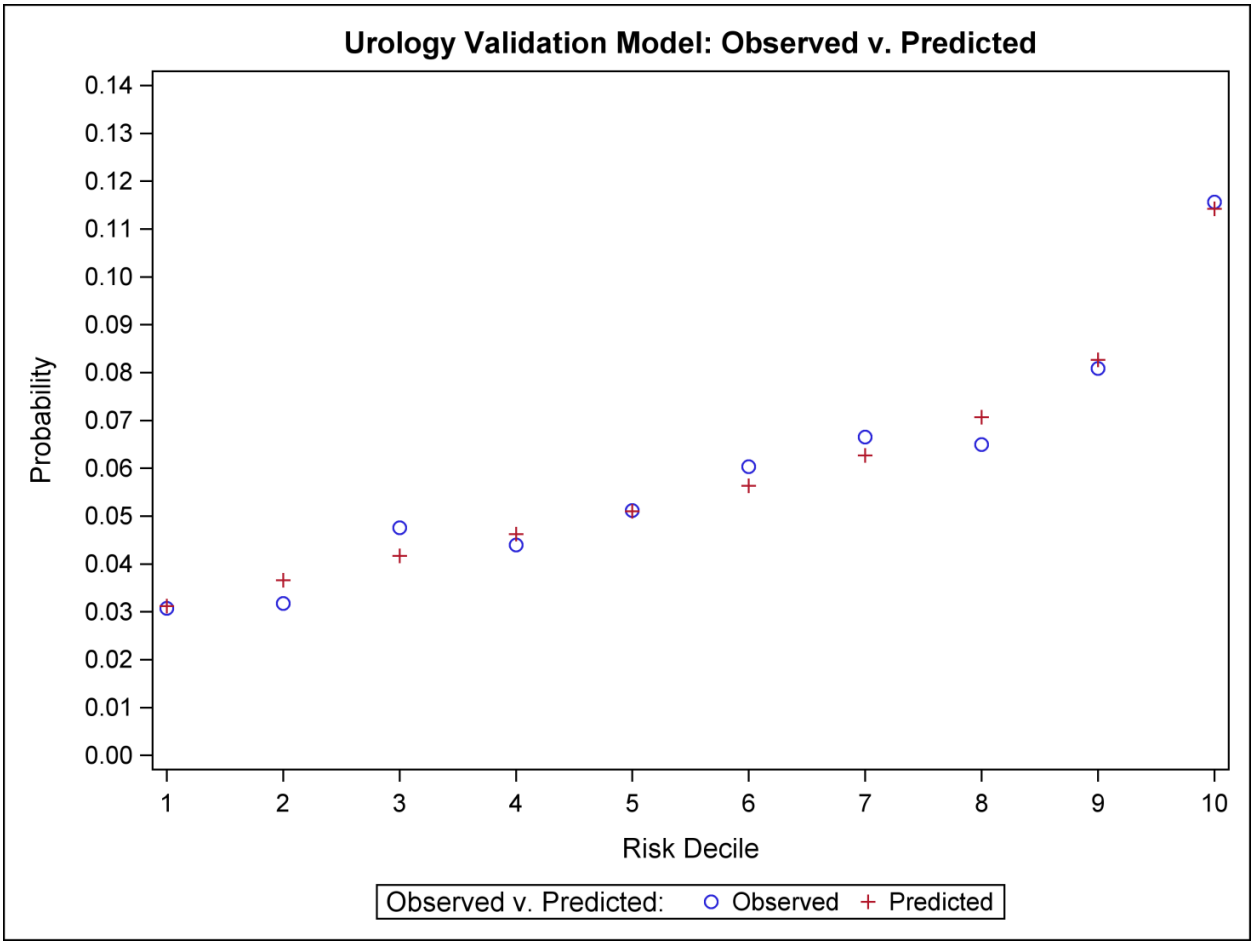
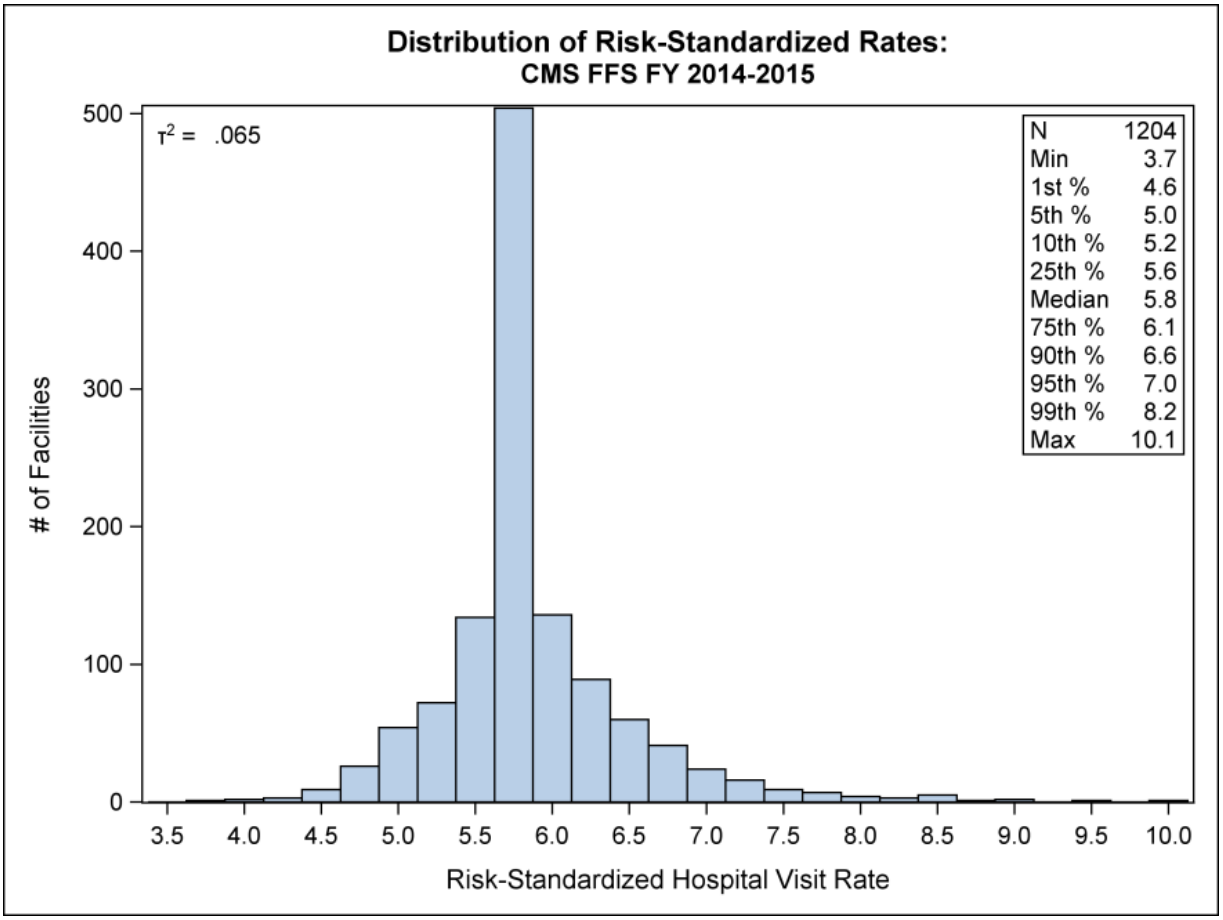


Figure 4. Distribution of risk-adjusted hospital visit rates following urology ASC procedures (data source: Medicare FFS FYs 2014-2015 Dataset, 10/01/2013 – 09/30/2015)



9. Appendices

Appendix A: List of Included Current Procedural Terminology (CPT®) Codes Defining Urology Procedures

Table A1. List of included Current Procedural Terminology (CPT®) codes defining urology procedures

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
100	Endoscopy and endoscopic biopsy of the urinary tract	52276	cystoscopy and treatment	000
		52354	cystouretero w/biopsy	000
101	Transurethral excision, drainage, or removal urinary obstruction	52500	Revision of bladder neck	090
		52640	Relieve bladder contracture	090
102	Ureteral catheterization	50948	Laparo new ureter/bladder	090
		50947	Laparo new ureter/bladder	090
106	Genitourinary incontinence procedures	51992	Laparo sling operation	090
		57220	Revision of urethra	090
		57288	Repair bladder defect	090
		53440	Male sling procedure	090
		53447	Remove/replace ur sphincter	090
		53449	Repair uro sphincter	090
		53445	Insert uro/ves nck sphincter	090
		53442	Remove/revise male sling	090
		57287	Revise/remove sling repair	090
107	Extracorporeal lithotripsy, urinary	50590	Fragmenting of kidney stone	090
109	Procedures on the urethra	53250	Removal of urethra gland	090
		53405	Revise urethra stage 2	090
		53275	Repair of urethra defect	010
		53270	Removal of urethra gland	010
		53446	Remove uro sphincter	090
		53400	Revise urethra stage 1	090

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
109	Procedures on the urethra	53260	Treatment of urethra lesion	010
		54308	Reconstruction of urethra	090
		52400	Cystouretero w/congen repr	090
		53265	Treatment of urethra lesion	010
		53410	Reconstruction of urethra	090
		53460	Revision of urethra	090
		53520	Repair of urethra defect	090
		53444	Insert tandem cuff	090
		53510	Repair of urethra injury	090
		53000	Incision of urethra	010
		53230	Removal of urethra lesion	090
		53215	Removal of urethra	090
		53860	Transurethral rf treatment	090
		53502	Repair of urethra injury	090
		53220	Treatment of urethra lesion	090
		53010	Incision of urethra	090
		53210	Removal of urethra	090
		54312	Reconstruction of urethra	090
		53505	Repair of urethra injury	090
		53515	Repair of urethra injury	090
		54318	Reconstruction of urethra	090
		54316	Reconstruction of urethra	090
		53430	Reconstruction of urethra	090
		53420	Reconstruct urethra stage 1	090
		53425	Reconstruct urethra stage 2	090
		53040	Drainage of urethra abscess	090
		53450	Revision of urethra	090
		53240	Surgery for urethra pouch	090
		53431	Reconstruct urethra/bladder	090

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
109	Procedures on the urethra	53235	Removal of urethra lesion	090
		53060	Drainage of urethra abscess	010
111	Other non-OR therapeutic procedures of urinary tract	50688	Change of ureter tube/stent	010
		50592	Perc rf ablate renal tumor	010
112	Other OR therapeutic procedures of urinary tract	50593	Perc cryo ablate renal tum	010
		57320	Repair bladder-vagina lesion	090
		51535	Repair of ureter lesion	090
		51020	Incise & treat bladder	090
		51040	Incise & drain bladder	090
		51080	Drainage of bladder abscess	090
		51520	Removal of bladder lesion	090
		50727	Revise ureter	090
		51030	Incise & treat bladder	090
		51880	Repair of bladder opening	090
		53080	Drainage of urinary leakage	090
		50562	Renal scope w/tumor resect	090
		51045	Incise bladder/drain ureter	090
		53085	Drainage of urinary leakage	090
		51065	Remove ureter calculus	090
		51050	Removal of bladder stone	090
		51500	Removal of bladder cyst	090
113	Transurethral resection of prostate (TURP)	52601	Prostatectomy (TURP)	090
		53852	Prostatic rf thermotx	090
		52630	Remove prostate regrowth	090
		53850	Prostatic microwave thermotx	090
114	Open prostatectomy	55873	Cryoablate prostate	090
115	Circumcision	54161	Circum 28 days or older	010
		54160	Circumcision neonate	010
		54163	Repair of circumcision	010

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
116	Diagnostic procedures, male genital	55110	Explore scrotum	090
		54865	Explore epididymis	090
		54105	Biopsy of penis	010
		54505	Biopsy of testis	010
		55705	Biopsy of prostate	010
		55706	Prostate saturation sampling	010
117	Other non-OR therapeutic procedures, male genital	55250	Removal of sperm duct(s)	090
		55450	Ligation of sperm duct	010
		54057	Laser surg penis lesion(s)	010
		55200	Incision of sperm duct	090
		54000	Slitting of prepuce	010
		54055	Destruction penis lesion(s)	010
		54056	Cryosurgery penis lesion(s)	010
		55120	Removal of scrotum lesion	090
		54200	Treatment of penis lesion	010
		54001	Slitting of prepuce	010
		55875	Transperi needle place pros	090
		55100	Drainage of scrotum abscess	010
		54050	Destruction penis lesion(s)	010
118	Other OR therapeutic procedures, male genital	55040	Removal of hydrocele	090
		55180	Revision of scrotum	090
		52647	Laser surgery of prostate	090
		54348	Secondary urethral surgery	090
		55550	Laparo ligate spermatic vein	090
		54115	Treatment of penis lesion	090
		55520	Removal of sperm cord lesion	090
		54860	Removal of epididymis	090
		54700	Drainage of scrotum	010
		54861	Removal of epididymis	090

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
118	Other OR therapeutic procedures, male genital	54692	Laparoscopy orchiopexy	090
		54324	Reconstruction of urethra	090
		55725	Drainage of prostate abscess	090
		55600	Incise sperm duct pouch	090
		54120	Partial removal of penis	090
		54680	Relocation of testis(es)	090
		54111	Treat penis lesion graft	090
		54420	Revision of penis	090
		54408	Repair multi-comp penis pros	090
		54060	Excision of penis lesion(s)	010
		54840	Remove epididymis lesion	090
		55041	Removal of hydroceles	090
		54322	Reconstruction of urethra	090
		55680	Remove sperm pouch lesion	090
		54410	Remove/replace penis prosth	090
		54326	Reconstruction of urethra	090
		54512	Excise lesion testis	090
		52649	Prostate laser enucleation	090
		54110	Treatment of penis lesion	090
		54901	Fusion of spermatic ducts	090
		54112	Treat penis lesion graft	090
		54690	Laparoscopy orchiectomy	090
		54162	Lysis penil circumic lesion	010
		54530	Removal of testis	090
		54640	Suspension of testis	090
		54406	Remove muti-comp penis pros	090
		54015	Drain penis lesion	010
		54385	Repair penis	090
		54205	Treatment of penis lesion	090

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
118	Other OR therapeutic procedures, male genital	54304	Revision of penis	090
		55500	Removal of hydrocele	090
		54600	Reduce testis torsion	090
		55400	Repair of sperm duct	090
		54830	Remove epididymis lesion	090
		55530	Revise spermatic cord veins	090
		54380	Repair penis	090
		54400	Insert semi-rigid prosthesis	090
		55535	Revise spermatic cord veins	090
		55720	Drainage of prostate abscess	090
		54405	Insert multi-comp penis pros	090
		52450	Incision of prostate	090
		54550	Exploration for testis	090
		54352	Reconstruct urethra/penis	090
		54344	Secondary urethral surgery	090
		54401	Insert self-contd prosthesis	090
		54415	Remove self-contd penis pros	090
		55860	Surgical exposure prostate	090
		54416	Remv/repl penis contain pros	090
		54620	Suspension of testis	010
		55060	Repair of hydrocele	090
		54065	Destruction penis lesion(s)	010
		54560	Exploration for testis	090
		54435	Revision of penis	090
		54360	Penis plastic surgery	090
		54164	Frenulotomy of penis	010
		54340	Secondary urethral surgery	090
		52700	Drainage of prostate abscess	090
		54522	Orchiectomy partial	090

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
118	Other OR therapeutic procedures, male genital	55150	Removal of scrotum	090
		52648	Laser surgery of prostate	090
		54300	Revision of penis	090
		54660	Revision of testis	090
		55175	Revision of scrotum	090
		54328	Revise penis/urethra	090
		54670	Repair testis injury	090
		54900	Fusion of spermatic ducts	090
		54520	Removal of testis	090
Therapeutic cystoscopy procedures				
100	Endoscopy and endoscopic biopsy of the urinary tract	52276	Cystoscopy and treatment	000
		52354	Cystouretero w/biopsy	000
101	Transurethral excision, drainage, or removal urinary obstruction	52345	Cysto/uretero w/up stricture	000
		52310	Cystoscopy and treatment	000
		52235	Cystoscopy and treatment	000
		52346	Cystouretero w/renal strict	000
		52300	Cystoscopy and treatment	000
		52341	Cysto w/ureter stricture tx	000
		52343	Cysto w/renal stricture tx	000
		52344	Cysto/uretero stricture tx	000
101	Transurethral excision, drainage, or removal urinary obstruction	52315	Cystoscopy and treatment	000
		52330	Cystoscopy and treatment	000
		52240	Cystoscopy and treatment	000
		52320	Cystoscopy and treatment	000
		52325	Cystoscopy stone removal	000
		52305	Cystoscopy and treatment	000
		52352	Cystouretero w/stone remove	000
		52301	Cystoscopy and treatment	000
		52214	Cystoscopy and treatment	000

AHRQ clinical category	AHRQ clinical category description	Current Procedural Terminology (CPT®) code	Short description of CPT® code	Global Surgical Package Status *090 = major procedure (90-day post-operative period)* *010 = minor procedure (10-day post-operative period)* *000 = minor procedure (0-day post-operative period)*
101	Transurethral excision, drainage, or removal urinary obstruction	52224	Cystoscopy and treatment	000
		52234	Cystoscopy and treatment	000
		52342	Cysto w/up stricture tx	000
102	Ureteral catheterization	52332	Cystoscopy and treatment	000
107	Extracorporeal lithotripsy, urinary	52353	Cystouretero w/lithotripsy	000
109	Procedures on the urethra	52282	Cystoscopy implant stent	000
		52281	Cystoscopy and treatment	000
		52270	Cystoscopy & revise urethra	000
		52287	Cystoscopy chemodenervation	000
		52285	Cystoscopy and treatment	000
		52283	Cystoscopy and treatment	000
		52275	Cystoscopy & revise urethra	000
		52277	Cystoscopy and treatment	000
		52290	Cystoscopy and treatment	000
		52400	Cystouretero w/congen repr	090
111	Other non-OR therapeutic procedures of urinary tract	52265	Cystoscopy and treatment	000
112	Other OR therapeutic procedures of urinary tract	52260	Cystoscopy and treatment	000
		52317	Remove bladder stone	000
		52318	Remove bladder stone	000
		52327	Cystoscopy inject material	000
		52355	Cystouretero w/excise tumor	000
		52250	Cystoscopy and radiotracer	000
118	Other OR therapeutic procedures, male genital	52402	Cystourethro cut ejacul duct	000

Appendix B: Emergency Department Visits and Observation Stays Definition

Table B1. HCPCS codes or revenue center codes that define ED visits and observation stays

Billing (HCPCS) or Revenue Code[2]	Description
0450	Emergency Room
0451	Emergency Room: EM/EMTALA
0452	Emergency Room: ER/Beyond EMTALA
0456	Emergency Room: Urgent care
0459	Emergency Room: Other emergency room
0981	Professional fees (096x) emergency room
0762	Observation room
G0378[3]	Hospital observation service, per hour

[2] Identified in Medicare Part B Outpatient hospital claims.

[3] Denotes HCPCS Codes, all other codes are revenue center codes.

Appendix C: Planned Admission Algorithm

C1. Planned Admission Algorithm Overview

The planned admission algorithm is adapted from the CMS Planned Readmission Algorithm Version 4.0. The algorithm is a set of criteria for classifying hospital inpatient admissions occurring after a urology ASC procedure as planned or unplanned using Medicare claims. CMS seeks to count only unplanned admissions in the measure outcome because variation in planned admissions does not reflect quality differences. CORE developed the Planned Readmission Algorithm under contract to CMS based on a hospital-wide (not condition-specific) cohort of patients.[27]

The algorithm classifies admissions as planned or unplanned using a flow chart (Figure PA1) and four tables of procedures and conditions (Table PA1–Table PA4). Table PA1 identifies procedures that, if present in an admission, classify the admission as planned. Table PA2 identifies principal discharge diagnoses that classify admissions as planned. Table PA3 identifies procedures that, if present, classify an admission as planned as long as that admission does not have an acute (unplanned) principal discharge diagnosis. Table PA4 lists the acute (unplanned) principal discharge diagnoses that disqualify admissions with a potentially planned procedure in Table PA3 as planned.

The algorithm uses the Agency for Healthcare Research and Quality's (AHRQ's) Clinical Classifications Software (CCS) (http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp) codes to group thousands of individual procedure and diagnosis ICD-9-CM codes into clinically coherent, mutually exclusive procedure CCS categories and mutually exclusive diagnosis CCS categories, respectively.

C2. Detailed Description of Readmission Algorithm Version 4.0 Adapted for Urology ASC Measure

The planned admission algorithm uses the flow chart (Figure PA1) and Table PA1–Table PA4). Table PA4, adapted for the urology ASC procedure population, to identify specific procedure categories and discharge diagnosis categories to classify admissions as planned or unplanned. As illustrated in the flow chart (Figure PA1), admissions that include certain procedures (Table PA1) or are for certain diagnoses Table PA2 are always considered planned. If the admission does not include a procedure or diagnosis in Table PA1 or Table PA2 that is always considered planned, the algorithm checks whether the admission has at least one procedure that is considered potentially planned (Table PA3). If the admission has no procedures from Table PA3, the admission is considered unplanned. Table PA3 includes AHRQ procedure CCS categories and

individual ICD-9-CM procedure codes. Examples of potentially planned procedures are total hip replacement (Procedure CCS 153) and hernia repair (Procedure CCS 85).

If the admission has at least one potentially planned procedure from Table PA3, the algorithm checks for a principal discharge diagnosis that is considered acute (Table PA4). If the admission has an acute principal discharge diagnosis from Table PA4, the admission is considered unplanned. Otherwise, it is considered planned. The list of acute principal discharge diagnoses includes diagnosis groups from AHRQ condition categories and groupings of individual ICD-9-CM diagnosis codes that represent cardiac diagnoses that would not be associated with a planned admission. Examples of acute principal discharge diagnoses that identify admissions with potentially planned procedures as unplanned are pneumonia (Diagnosis CCS 122) and cardiac arrest (Diagnosis CCS 107).

Figure PA1. Planned admission algorithm flowchart

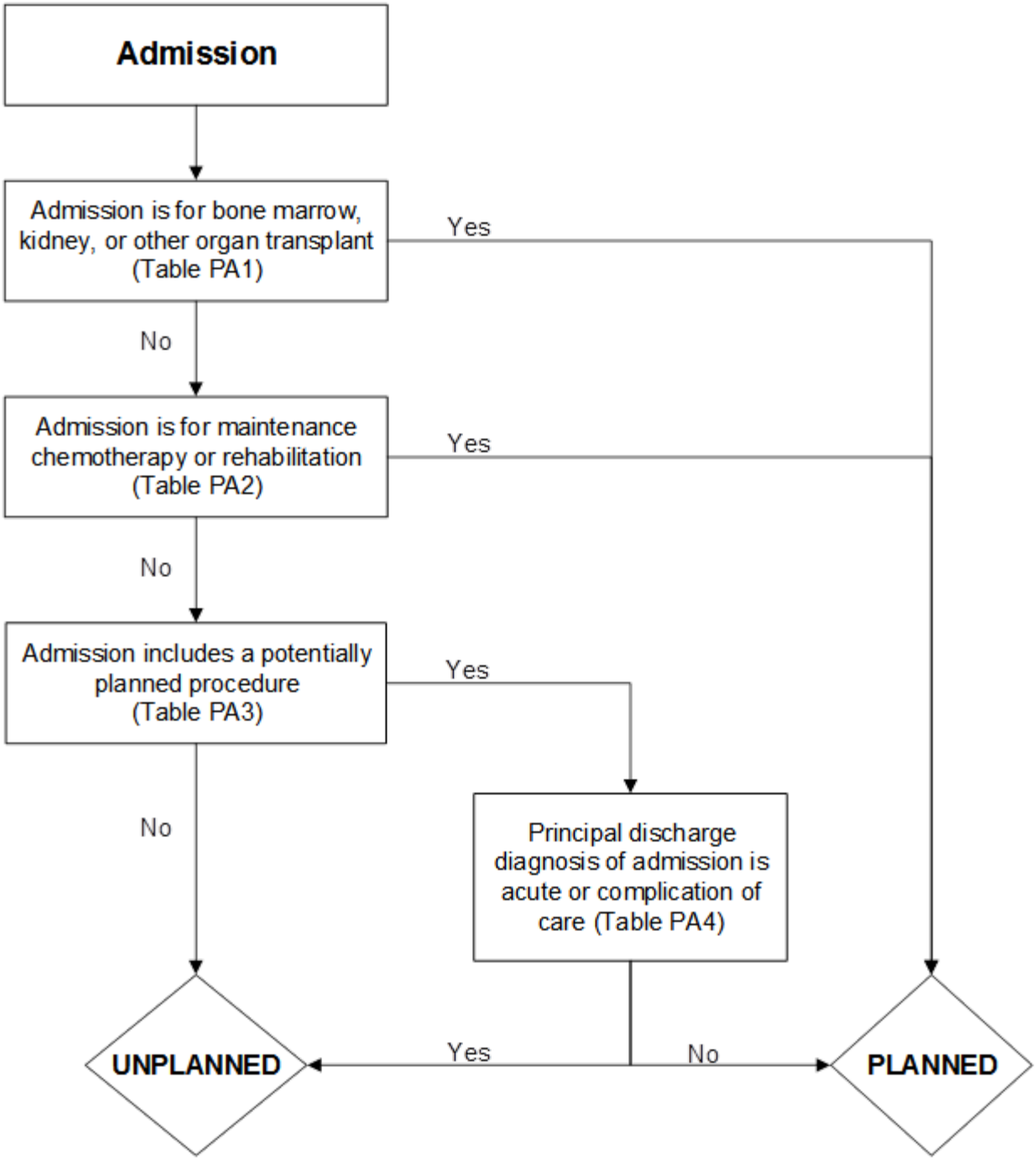


Table PA1. Procedure categories that are always planned (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0)

Procedure CCS (ICD-9-CM & ICD-10-CM)	Description
64	Bone marrow transplant
105	Kidney transplant
176	Other organ transplantation (in ICD-10-CM version, description adds: "[other than bone marrow corneal or kidney]")

Table PA2. Diagnosis categories that are always planned (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0)

Diagnosis CCS (ICD-9-CM & ICD-10-CM)	Description
45	Maintenance chemotherapy
254	Rehabilitation

Table PA3. Procedure categories that are potentially planned (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0)

Code	Description
Procedure CCS (ICD-9-CM & ICD-10-CM)	
1	Incision and excision of central nervous system (CNS)
3	Laminectomy; excision intervertebral disc (in ICD-10-CM version, description is: "excision, destruction or resection of intervertebral disc")
5	Insertion of catheter or spinal stimulator and injection into spinal canal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures (in ICD-10-CM version, description is: "therapeutic endocrine procedures")
33	Other OR therapeutic procedures on nose; mouth and pharynx
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures of respiratory tract and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA) (in ICD-10-CM version, description adds: "with or without stent")
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis

Code	Description
53	Varicose vein stripping; lower limb
55	Peripheral vascular bypass
56	Other vascular bypass and shunt; not heart
59	Other OR procedures on vessels of head and neck
66	Procedures on spleen
67	Other therapeutic procedures; hemic and lymphatic system
74	Gastrectomy; partial and total
78	Colorectal resection
79	Local excision of large intestine lesion (not endoscopic)
84	Cholecystectomy and common duct exploration
85	Inguinal and femoral hernia repair
86	Other hernia repair
99	Other OR gastrointestinal therapeutic procedures
104	Nephrectomy; partial or complete
106	Genitourinary incontinence procedures
107	Extracorporeal lithotripsy; urinary
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
124	Hysterectomy; abdominal and vaginal
129	Repair of cystocele and rectocele; obliteration of vaginal vault
132	Other OR therapeutic procedures; female organs
142	Partial excision bone
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
158	Spinal fusion
159	Other diagnostic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
170 (only in ICD-9-CM version of algorithm)	Excision of skin lesion
172	Skin graft

Code	Description
175 (only in ICD-10-CM version of algorithm)	Other OR therapeutic procedures on skin subcutaneous tissue fascia and breast
ICD-9-PCS Code	
30.1	Hemilaryngectomy
30.29	Other partial laryngectomy
30.3	Complete laryngectomy
30.4	Radical laryngectomy
31.74	Revision of tracheostomy
34.6	Scarification of pleura
38.18	Endarterectomy, lower limb arteries
55.03	Percutaneous nephrostomy without fragmentation
55.04	Percutaneous nephrostomy with fragmentation
94.26	Subconvulsive electroshock therapy
94.27	Other electroshock therapy
ICD-10-PCS Code	
0CBS0ZZ	Excision of larynx, open approach
0CBS3ZZ	Excision of larynx, percutaneous approach
0CBS4ZZ	Excision of larynx, percutaneous endoscopic approach
0CBS7ZZ	Excision of larynx, via natural or artificial opening
0CBS8ZZ	Excision of larynx, via natural or artificial opening endoscopic
0CBS0ZZ	Excision of larynx, open approach
0CBS3ZZ	Excision of larynx, percutaneous approach
0CBS4ZZ	Excision of larynx, percutaneous endoscopic approach
0B110F4	Bypass trachea to cutaneous with tracheostomy device, open approach
0B110Z4	Bypass trachea to cutaneous with, open approach
0B113F4	Bypass trachea to cutaneous with tracheostomy device, percutaneous approach
0B113Z4	Bypass trachea to cutaneous, percutaneous approach
0B114F4	Bypass trachea to cutaneous with tracheostomy device, percutaneous endoscopic approach
0B114Z4	Bypass trachea to cutaneous, percutaneous endoscopic approach
0CTS0ZZ	Resection of larynx, open approach
0CTS4ZZ	Resection of larynx, percutaneous endoscopic approach
0CTS7ZZ	Resection of larynx, via natural or artificial opening
0CTS8ZZ	Resection of larynx, via natural or artificial opening endoscopic
0GTG0ZZ	Resection of left thyroid gland lobe, open approach
0GTG4ZZ	Resection of left thyroid gland lobe, percutaneous endoscopic approach

Code	Description
0GTH0ZZ	Resection of right thyroid gland lobe, open approach
0GTH4ZZ	Resection of right thyroid gland lobe, percutaneous endoscopic approach
0GTK0ZZ	Resection of thyroid gland, open approach
0GTK4ZZ	Resection of thyroid gland, percutaneous endoscopic approach
0WB60ZZ	Excision of neck, open approach
0WB63ZZ	Excision of neck, percutaneous approach
0WB64ZZ	Excision of neck, percutaneous endoscopic approach
0WB6XZZ	Excision of neck, external approach
0BW10FZ	Revision of tracheostomy device in trachea, open approach
0BW13FZ	Revision of tracheostomy device in trachea, percutaneous approach
0BW14FZ	Revision of tracheostomy device in trachea, percutaneous endoscopic approach
0WB6XZ2	Excision of neck, stoma, external approach
0WQ6XZ2	Repair neck, stoma, external approach
0B5N0ZZ	Destruction of right pleura, open approach
0B5N3ZZ	Destruction of right pleura, percutaneous approach
0B5N4ZZ	Destruction of right pleura, percutaneous endoscopic approach
0B5P0ZZ	Destruction of left pleura, open approach
0B5P3ZZ	Destruction of left pleura, percutaneous approach
0B5P4ZZ	Destruction of left pleura, percutaneous endoscopic approach
04CK0ZZ	Extirpation of matter from right femoral artery, open approach
04CK3ZZ	Extirpation of matter from right femoral artery, percutaneous approach
04CK4ZZ	Extirpation of matter from right femoral artery, percutaneous endoscopic approach
04CL0ZZ	Extirpation of matter from left femoral artery, open approach
04CL3ZZ	Extirpation of matter from left femoral artery, percutaneous approach
04CL4ZZ	Extirpation of matter from left femoral artery, percutaneous endoscopic approach
04CM0ZZ	Extirpation of matter from right popliteal artery, open approach
04CM3ZZ	Extirpation of matter from right popliteal artery, percutaneous approach
04CM4ZZ	Extirpation of matter from right popliteal artery, percutaneous endoscopic approach
04CN0ZZ	Extirpation of matter from left popliteal artery, open approach
04CN3ZZ	Extirpation of matter from left popliteal artery, percutaneous approach
04CN4ZZ	Extirpation of matter from left popliteal artery, percutaneous endoscopic approach
04CP0ZZ	Extirpation of matter from right anterior tibial artery, open approach
04CP3ZZ	Extirpation of matter from right anterior tibial artery, percutaneous approach
04CP4ZZ	Extirpation of matter from right anterior tibial artery, percutaneous endoscopic approach
04CQ0ZZ	Extirpation of matter from left anterior tibial artery, open approach
04CQ3ZZ	Extirpation of matter from left anterior tibial artery, percutaneous approach

Code	Description
04CQ4ZZ	Extirpation of matter from left anterior tibial artery, percutaneous endoscopic approach
04CR0ZZ	Extirpation of matter from right posterior tibial artery, open approach
04CR3ZZ	Extirpation of matter from right posterior tibial artery, percutaneous approach
04CR4ZZ	Extirpation of matter from right posterior tibial artery, percutaneous endoscopic approach
04CS0ZZ	Extirpation of matter from left posterior tibial artery, open approach
04CS3ZZ	Extirpation of matter from left posterior tibial artery, percutaneous approach
04CS4ZZ	Extirpation of matter from left posterior tibial artery, percutaneous endoscopic approach
04CT0ZZ	Extirpation of matter from right peroneal artery, open approach
04CT3ZZ	Extirpation of matter from right peroneal artery, percutaneous approach
04CT4ZZ	Extirpation of matter from right peroneal artery, percutaneous endoscopic approach
04CU0ZZ	Extirpation of matter from left peroneal artery, open approach
04CU3ZZ	Extirpation of matter from left peroneal artery, percutaneous approach
04CU4ZZ	Extirpation of matter from left peroneal artery, percutaneous endoscopic approach
04CV0ZZ	Extirpation of matter from right foot artery, open approach
04CV3ZZ	Extirpation of matter from right foot artery, percutaneous approach
04CV4ZZ	Extirpation of matter from right foot artery, percutaneous endoscopic approach
04CW0ZZ	Extirpation of matter from left foot artery, open approach
04CW3ZZ	Extirpation of matter from left foot artery, percutaneous approach
04CW4ZZ	Extirpation of matter from left foot artery, percutaneous endoscopic approach
04CY0ZZ	Extirpation of matter from lower artery, open approach
04CY3ZZ	Extirpation of matter from lower artery, percutaneous approach
04CY4ZZ	Extirpation of matter from lower artery, percutaneous endoscopic approach
0T9030Z	Drainage of right kidney with drainage device, percutaneous approach
0T9040Z	Drainage of right kidney with drainage device, percutaneous endoscopic approach
0T9130Z	Drainage of left kidney with drainage device, percutaneous approach
0T9140Z	Drainage of left kidney with drainage device, percutaneous endoscopic approach
0TC03ZZ	Extirpation of matter from right kidney, percutaneous approach
0TC04ZZ	Extirpation of matter from right kidney, percutaneous endoscopic approach
0TC13ZZ	Extirpation of matter from left kidney, percutaneous approach
0TC14ZZ	Extirpation of matter from left kidney, percutaneous endoscopic approach
0TF33ZZ	Fragmentation in right kidney pelvis, percutaneous approach
0TF34ZZ	Fragmentation in right kidney pelvis, percutaneous endoscopic approach
0TF43ZZ	Fragmentation in left kidney pelvis, percutaneous approach
0TF44ZZ	Fragmentation in left kidney pelvis, percutaneous endoscopic approach
GZB4ZZZ	Other electroconvulsive therapy

Code	Description
GZB0ZZZ	Electroconvulsive therapy, unilateral-single seizure
GZB1ZZZ	Electroconvulsive therapy, unilateral-multiple seizure
GZB2ZZZ	Electroconvulsive therapy, bilateral-single seizure
GZB3ZZZ	Electroconvulsive therapy, bilateral-multiple seizure
GZB4ZZZ	Other electroconvulsive therapy

Table PA4. Diagnosis categories that are acute (Planned Readmission Algorithm Version 4.0 – adapted for urology ASC measure, Version 1.0)

Code	Description
Diagnosis CCS (ICD-9-CM & ICD-10-CM)	
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
63	Diseases of white blood cells
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78	Other CNS infection and poliomyelitis
82	Paralysis
83	Epilepsy; convulsions
84	Headache; including migraine
85	Coma; stupor; and brain damage
87	Retinal detachments; defects; vascular occlusion; and retinopathy
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo

Code	Description
99	Hypertension with complications and secondary hypertension
100	Acute myocardial infarction (with the exception of ICD-9-CM codes 410.x2)
102	Nonspecific chest pain
104	Other and ill-defined heart disease
107	Cardiac arrest and ventricular fibrillation
109	Acute cerebrovascular disease
112	Transient cerebral ischemia
116	Aortic and peripheral arterial embolism or thrombosis
118	Phlebitis; thrombophlebitis and thromboembolism
120	Hemorrhoids
122	Pneumonia (except that caused by TB or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection
137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs
168	Inflammatory diseases of female pelvic organs
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin

Code	Description
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
227	Spinal cord injury
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
232	Sprains and strains
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
237	Complication of device; implant or graft
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by non-medicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit, conduct, and disruptive behavior disorders (in ICD-10-CM version, description is: “attention-deficit”)
653	Delirium, dementia, and amnestic and other cognitive disorders (in ICD-10-CM version, description is: “delirium”)
656	Impulse control disorders, NEC (in ICD-10-CM version, description is: “impulse control disorders”)
658	Personality disorders
660	Alcohol-related disorders

Code	Description
661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous disorders
Acute ICD-9-CM codes within Diagnosis CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
3282	Diphtheritic myocarditis
3640	Meningococcal carditis NOS
3641	Meningococcal pericarditis
3642	Meningococcal endocarditis
3643	Meningococcal myocarditis
7420	Coxsackie carditis NOS
7421	Coxsackie pericarditis
7422	Coxsackie endocarditis
7423	Coxsackie myocarditis
11281	Candida endocarditis
11503	Histoplasma capsulatum pericarditis
11504	Histoplasma capsulatum endocarditis
11513	Histoplasma duboisii pericarditis
11514	Histoplasma duboisii endocarditis
11593	Histoplasmosis pericarditis
11594	Histoplasmosis endocarditis
1303	Toxoplasma myocarditis
3910	Acute rheumatic pericarditis
3911	Acute rheumatic endocarditis
3912	Acute rheumatic myocarditis
3918	Acute rheumatic heart disease NEC
3919	Acute rheumatic heart disease NOS
3920	Rheumatic chorea w heart involvement
3980	Rheumatic myocarditis
39890	Rheumatic heart disease NOS
39899	Rheumatic heart disease NEC
4200	Acute pericarditis in other disease
42090	Acute pericarditis NOS
42091	Acute idiopathic pericarditis
42099	Acute pericarditis NEC
4210	Acute/subacute bacterial endocarditis
4211	Acute endocarditis in other diseases

Code	Description
4219	Acute/subacute endocarditis NOS
4220	Acute myocarditis in other diseases
42290	Acute myocarditis NOS
42291	Idiopathic myocarditis
42292	Septic myocarditis
42293	Toxic myocarditis
42299	Acute myocarditis NEC
4230	Hemopericardium
4231	Adhesive pericarditis
4232	Constrictive pericarditis
4233	Cardiac tamponade
4290	Myocarditis NOS
Acute ICD-10-CM codes within Diagnosis CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
A3681	Diphtheritic cardiomyopathy
A3950	Meningococcal carditis, unspecified
A3951	Meningococcal endocarditis
A3952	Meningococcal myocarditis
A3953	Meningococcal pericarditis
B3320	Viral carditis, unspecified
B3321	Viral endocarditis
B3322	Viral myocarditis
B3323	Viral pericarditis
B376	Candida endocarditis
B394	Histoplasmosis capsulati, unspecified
B395	Histoplasmosis duboisii
B399	Histoplasmosis, unspecified
B5881	Toxoplasma myocarditis
I010	Acute rheumatic pericarditis
I011	Acute rheumatic endocarditis
I012	Acute rheumatic myocarditis
I018	Other acute rheumatic heart disease
I019	Acute rheumatic heart disease, unspecified
I020	Rheumatic chorea with heart involvement
I090	Rheumatic myocarditis
I0989	Other specified rheumatic heart diseases
I099	Rheumatic heart disease, unspecified
I300	Acute nonspecific idiopathic pericarditis

Code	Description
I308	Other forms of acute pericarditis
I309	Acute pericarditis, unspecified
I310	Chronic adhesive pericarditis
I311	Chronic constrictive pericarditis
I312	Hemopericardium, not elsewhere classified
I314	Cardiac tamponade
I32	Pericarditis in diseases classified elsewhere
I330	Acute and subacute infective endocarditis
I339	Acute and subacute endocarditis, unspecified
I39	Endocarditis and heart valve disorders in diseases classified elsewhere
I400	Infective myocarditis
I401	Isolated myocarditis
I408	Other acute myocarditis
I409	Acute myocarditis, unspecified
I41	Myocarditis in diseases classified elsewhere
I514	Myocarditis, unspecified
Acute ICD-9-CM codes within Diagnosis CCS 105: Conduction disorders	
4260	Atrioventricular
42610	Atrioventricular block NOS
42611	Atrioventricular block-1st degree
42612	Atrioventricular block-Mobitz II
42613	Atrioventricular block-2nd degree NEC
4262	Left bundle branch hemiblock
4263	Left bundle branch block NEC
4264	Right bundle branch block
42650	Bundle branch block NOS
42651	Right bundle branch block/left posterior fascicular block
42652	Right bundle branch block/left ant fascicular block
42653	Bilateral bundle branch block NEC
42654	Trifascicular block
4266	Other heart block
4267	Anomalous atrioventricular excitation
42681	Lown-Ganong-Levine syndrome
42682	Long QT syndrome
4269	Conduction disorder NOS
Acute ICD-10-CM codes within Diagnosis CCS 105: Conduction disorders	
I442	Atrioventricular block, complete

Code	Description
I4430	Unspecified atrioventricular block
I440	Atrioventricular block, first degree
I441	Atrioventricular block, second degree
I4469	Other fascicular block
I444	Left anterior fascicular block
I445	Left posterior fascicular block
I4460	Unspecified fascicular block
I447	Left bundle-branch block, unspecified
I4510	Unspecified right bundle-branch block
I4430	Unspecified atrioventricular block
I4439	Other atrioventricular block
I454	Nonspecific intraventricular block
I452	Bifascicular block
I453	Trifascicular block
I455	Other specified heart block
I456	Pre-excitation syndrome
I4581	Long QT syndrome
I459	Conduction disorder, unspecified
Acute ICD-9-CM codes within Diagnosis CCS 106: Dysrhythmia	
4272	Paroxysmal tachycardia NOS
7850	Tachycardia NOS
42789	Cardiac dysrhythmias NEC
4279	Cardiac dysrhythmia NOS
42769	Premature beats NEC
Acute ICD-10-CM codes within Diagnosis CCS 106: Dysrhythmia	
I479	Paroxysmal tachycardia, unspecified
I4949	Other premature depolarization
I498	Other specified cardiac arrhythmias
I499	Cardiac arrhythmia, unspecified
R000	Tachycardia, unspecified
R001	Bradycardia, unspecified
Acute ICD-9-CM codes within Diagnosis CCS 108: Congestive heart failure; non-hypertensive	
39891	Rheumatic heart failure
4280	Congestive heart failure
4281	Left heart failure
42820	Unspecified systolic heart failure
42821	Acute systolic heart failure

Code	Description
42823	Acute on chronic systolic heart failure
42830	Unspecified diastolic heart failure
42831	Acute diastolic heart failure
42833	Acute on chronic diastolic heart failure
42840	Unspecified combined systolic & diastolic heart failure
42841	Acute combined systolic & diastolic heart failure
42843	Acute on chronic combined systolic & diastolic heart failure
4289	Heart failure NOS
Acute ICD-10-CM codes within Diagnosis CCS 108: Congestive heart failure; non-hypertensive	
I0981	Rheumatic heart failure
I509	Heart failure, unspecified
I501	Left ventricular failure
I5020	Unspecified systolic (congestive) heart failure
I5021	Acute systolic (congestive) heart failure
I5023	Acute on chronic systolic (congestive) heart failure
I5030	Unspecified diastolic (congestive) heart failure
I5031	Acute diastolic (congestive) heart failure
I5033	Acute on chronic diastolic (congestive) heart failure
I5040	Unspecified combined systolic and diastolic (congestive) heart failure
I5041	Acute combined systolic (congestive) and diastolic (congestive) heart failure
I5043	Acute on chronic combined systolic (congestive) and diastolic (congestive) heart failure
I509	Heart failure, unspecified
Acute ICD-9-CM codes within Diagnosis CCS 149: Biliary tract disease	
5740	Calculus of gallbladder with acute cholecystitis
57400	Calculus of gallbladder with acute cholecystitis without mention of obstruction
57401	Calculus of gallbladder with acute cholecystitis with obstruction
5743	Calculus of bile duct with acute cholecystitis
57430	Calculus of bile duct with acute cholecystitis without mention of obstruction
57431	Calculus of bile duct with acute cholecystitis with obstruction
5746	Calculus of gallbladder and bile duct with acute cholecystitis
57460	Calculus of gallbladder and bile duct with acute cholecystitis without mention of obstruction
57461	Calculus of gallbladder and bile duct with acute cholecystitis with obstruction
5748	Calculus of gallbladder and bile duct with acute and chronic cholecystitis
57480	Calculus of gallbladder and bile duct with acute and chronic cholecystitis without mention of obstruction

Code	Description
57481	Calculus of gallbladder and bile duct with acute and chronic cholecystitis with obstruction
5750	Acute cholecystitis
57512	Acute and chronic cholecystitis
5761	Cholangitis
Acute ICD-10-CM codes within Diagnosis CCS 149: Biliary tract disease	
K8000	Calculus of gallbladder with acute cholecystitis w/o obstruction
K8001	Calculus of gallbladder with acute cholecystitis with obstruction
K8042	Calculus of bile duct with acute cholecystitis w/o obstruction
K8043	Calculus of bile duct with acute cholecystitis with obstruction
K8062	Calculus of GB and bile duct with acute cholecystitis w/o obstruction
K8063	Calculus of GB and bile duct with acute cholecystitis with obstruction
K8066	Calculus of GB and bile duct with acute and chronic cholecystitis w/o obstruction
K8067	Calculus of GB and bile duct with acute and chronic cholecystitis with obstruction
K810	Acute cholecystitis
K812	Acute cholecystitis with chronic cholecystitis
K830	Cholangitis
Acute ICD-9-CM codes with Diagnosis CCS 152: Pancreatic disorders	
5770	Acute pancreatitis
Acute ICD-10-CM codes with Diagnosis CCS 152: Pancreatic disorders	
K859	Acute pancreatitis, unspecified

Appendix D: Measure Score Calculation and Reporting

D1. Risk-Standardized Measure Score Calculation Algorithm

We will fit a hierarchical generalized linear model (HGLM), which will account for the clustering of observations within ASCs. We assume the outcome is a known exponential family distribution and is related linearly to the covariates via a known linked function, *h*. For our model, we assume a binomial distribution and a logit link function. Further, we account for the clustering within an ASC by estimating a facility-specific effect, α_i, which is assumed to follow a normal distribution with mean μ and variance τ^2, the between-facility variance component. The HGLM is defined by the following equations:

$$h(Y_{ij}) = \alpha_i + \beta \mathbf{Z}_{ij} \quad (1)$$

$$\alpha_i = \mu + \omega_i;\ \omega_i \sim N(0, \tau^2) \quad (2)$$

$$i = 1 \ldots I; j = 1 \ldots$$

Where Y_{ij} denotes the outcome (equal to 1 if patient has an eligible hospital visit within 7 days of a surgery procedure, 0 otherwise) for the *j-th* patient who had a surgery procedure at the *i-th* ASC; $\mathbf{Z}_{ij} = (Z_{1ij}, Z_{2ij}, \ldots, Z_{pij})$ is a set of *p* patient-specific covariates derived from the data; and *I* denotes the total number of ASCSs and n_i the number of surgeries performed at ASC *i*. The facility-specific intercept of the *i-th* ASC, α_i, defined above, is comprised of μ, the adjusted average intercept over all ASCs in the sample and ω_i the facility-specific intercept deviation from μ. A point estimate of ω_i, greater or less than 0, determines if ASC performance is worse or better compared to the adjusted average outcome.

The HGLM is estimated using the SAS software system (GLIMMIX procedure).

D2. Provider Performance Reporting

Using the HGLM defined by Equations (1) - (2), we estimate the parameters $\hat{\mu}$, $\{\hat{\alpha}_1, \hat{\alpha}_2, \ldots, \hat{\alpha}_I\}$, $\hat{\beta}$, and $\hat{\tau}^2$. We calculate the measure score, s_i, for each ASC by computing the ratio of the number of predicted hospital visits to the number of expected hospital visits. Specifically, we calculate:

Predicted $\quad \hat{y}_{ij}(Z) = h^{-1}(\hat{\alpha}_i + \hat{\beta}\mathbf{Z}_{ij})$

Expected $\quad \hat{e}_{ij}(Z) = h^{-1}(\hat{\mu} + \hat{\beta}\mathbf{Z}_{ij})$

Measure score $$\hat{s}_i(Z) = \frac{\sum_{j=1}^{n_i} \hat{y}_{ij}(Z)}{\sum_{j=1}^{n_i} \hat{e}_{ij}(Z)}$$

If the "predicted" number of hospital visits is higher (lower) than the "expected" number of hospital visits, then $\hat{s}_i$ that ASC's will be higher (lower) than 1.0.

The risk-standardized hospital visit rate (RSHVR) is calculated by multiplying the measure score by the national observed hospital visit rate.

D3. Outlier Evaluation

Because the measure score is a complex function of parameter estimates, we use re-sampling and simulation techniques to derive an interval estimate to determine if an ASC is performing better than, worse than, or no different from expected. An ASC is considered better than expected if its entire standardized rate ratio interval estimate falls below 1, and considered worse if the entire confidence interval falls above 1. It is considered no different if the confidence interval overlaps 1.

More specifically, we use a bootstrapping procedure to compute confidence intervals. Because the theoretical-based standard errors are not easily derived, and to avoid making unnecessary assumptions, we use the bootstrap to empirically construct the sampling distribution for each facility-level risk-standardized rate. The bootstrapping algorithm is described below.

D4. Bootstrapping Algorithm

Let *I* denote the total number of ASCs in the sample. We repeat steps 1 – 4 below for b = 1,2,…B times:

1. Sample *I* ASCs with replacement.
2. Fit the hierarchical logistic regression model using all patients within each sampled ASC. We use as starting values the parameter estimates obtained by fitting the model to all ASCs. If some ASCs are selected more than once in a bootstrapped sample, we treat them as distinct so that we have *I* random effects to estimate the variance components. At the conclusion of Step 2, we have:
   a. $\hat{\beta}^{(b)}$ (the estimated regression coefficients of the risk factors).
   b. The parameters governing the random effects, ASC adjusted outcomes, distribution, $\hat{\mu}^{(b)}$ and $\hat{\tau}^{2(b)}$.

c. The set of facility-specific intercepts and corresponding variances:

$$\{\hat{\alpha}_i^{(b)},\ \hat{\text{var}}\left(\alpha_i^{(b)}\right);\ i = 1,2,\ldots,I\}.$$

3. We generate an ASC random effect by sampling from the distribution of the facility-specific distribution obtained in Step 2c. We approximate the distribution for each random effect by a normal distribution. Thus, we draw $\alpha_i^{(b^*)} \sim N\left(\hat{\alpha}_i^{(b)}, \hat{\text{var}}\left(\hat{\alpha}_i^{(b)}\right)\right)$ for the unique set of ASCs sampled in Step 1.

4. Within each unique ASC *i* sampled in Step 1, and for each case *j* in that ASC, we calculate $\hat{y}_{ij}^{(b)}$, $\hat{e}_{ij}^{(b)}$, and $\hat{s}_i\left(Z\right)^{(b)}$ where $\hat{\beta}^{(b)}$ and $\hat{\mu}^{(b)}$ are obtained from Step 2 and $\hat{\alpha}_i^{(b^*)}$ is obtained from Step 3.

95% interval estimates (or alternative interval estimates) for the ASC-standardized outcome can be computed by identifying the 2.5th and 97.5th percentiles of the B estimates (or the percentiles corresponding to the alternative desired intervals).

Appendix E: Risk-Adjustment Model Development

Table E1. Candidate variables considered for the risk adjustment model

Patient demographic, comorbidity, and procedural complexity candidate variables for risk adjustment	
Variable category	**Definition**
Age	
Sex	
Number of qualifying procedures	Defined as 1, 2, or ≥3
Work Relative Value Units (work RVUs)	Work RVUs are assigned to each CPT® procedure code and approximate procedure complexity by incorporating elements of physician time and effort
Prostate/urinary tract procedures vs. other (male genital procedures)	AHRQ CCS (AHRQ clinical category) 100, 101, 102, 106, 107, 109, 111, 112, 113, 114
Septicemia, sepsis, systemic inflammatory response syndrome/shock	Condition category (CC) 2
History of infection	CC 1, 3, 4, 5, 6, 7
Metastatic and other major cancers	CC 8, 9, 10, 13
Bladder, prostate, urinary, and other cancers	CC 11, 12, 14
Diabetes and diabetes mellitus complications	CC 17, 18, 19, 122, 123
Protein-calorie malnutrition	CC 21
Morbid obesity	CC 22 (remove ICD-9-CM diagnosis code 27803: obesity hypoventilation syndrome; ICD-10-CM diagnosis code E662: morbid [severe] obesity with alveolar hypoventilation)
Disorders of fluid/electrolyte/acid-base balance	CC 23, 24
Other endocrine/metabolic/nutritional disorders	CC 26
Liver or biliary disease	CC 27, 28, 29, 30, 31, 32
Intestinal obstruction/perforation	CC 33
Chronic pancreatitis; and peptic ulcer, hemorrhage, other specified gastrointestinal disorders	CC 34, 36
Inflammatory bowel disease	CC 35
Other gastrointestinal disorders	CC 38
Bone/joint/muscle infections/necrosis	CC 39
Rheumatoid and osteoarthritis	CC 40-42
Osteoporosis and other bone/cartilage disorders	CC 43
Hematological disorders including coagulation defects and iron deficiency	CC 46, 48, 49
Disorders of immunity	CC 47
Delirium and encephalopathy	CC 50
Dementia or senility	CC 51, 52, 53
Drug/alcohol abuse/dependence/psychosis	CC 54, 55, 56 From CC 55, remove ICD-9-CM diagnosis codes:

Patient demographic, comorbidity, and procedural complexity candidate variables for risk adjustment	
Variable category	**Definition**
Drug/alcohol abuse/dependence/psychosis	• 30400: Opioid dependence-unspec • 30401: Opioid dependence-contin • 30402: Opioid dependence-episod • 30403: Opioid dependence-remiss • 30470: Opioid/other dep-unspec • 30471: Opioid/other dep-contin • 30472: Opioid/other dep-episod From CC 56, remove ICD-9-CM diagnosis codes: • 30550: Opioid abuse-unspec • 30551: Opioid abuse-continuous • 30552: Opioid abuse-episodic • 30553: Opioid abuse-in remiss From CC 55, remove ICD-10-CM diagnosis codes: • F1120: Opioid dependence, uncomplicated • F1121: Opioid dependence, in remission • F11220: Opioid dependence with intoxication, uncomplicated • F11221: Opioid dependence with intoxication delirium • F11222: Opioid dependence with intoxication with perceptual disturbance • F11229: Opioid dependence with intoxication, unspecified • F1123: Opioid dependence with withdrawal • F1124: Opioid dependence with opioid-induced mood disorder • F11250: Opioid dependence with opioid-induced psychotic disorder with delusions • F11251: Opioid dependence with opioid-induced psychotic disorder with hallucinations • F11259: Opioid dependence with opioid-induced psychotic disorder, unspecified • F11281: Opioid dependence with opioid-induced sexual dysfunction • F11282: Opioid dependence with opioid-induced sleep disorder • F11288: Opioid dependence with other opioid-induced disorder • F1129: Opioid dependence with unspecified opioid-induced disorder From CC 56, remove ICD-10-CM diagnosis codes: • F1110: Opioid abuse, uncomplicated

Patient demographic, comorbidity, and procedural complexity candidate variables for risk adjustment	
Variable category	**Definition**
Drug/alcohol abuse/dependence/psychosis	• F11120: Opioid abuse with intoxication, uncomplicated • F11121: Opioid abuse with intoxication delirium • F11122: Opioid abuse with intoxication with perceptual disturbance • F11129: Opioid abuse with intoxication, unspecified • F1114: Opioid abuse with opioid-induced mood disorder • F11150: Opioid abuse with opioid-induced psychotic disorder with delusions • F11151: Opioid abuse with opioid-induced psychotic disorder with hallucinations • F11159: Opioid abuse with opioid-induced psychotic disorder, unspecified • F11181: Opioid abuse with opioid-induced sexual dysfunction • F11182: Opioid abuse with opioid-induced sleep disorder • F11188: Opioid abuse with other opioid-induced disorder • F1119: Opioid abuse with unspecified opioid-induced disorder
Psychiatric disorders	CC 57, 58, 59, 60, 61, 62, 63
Hemiplegia, paraplegia, paralysis, functional disability	CC 70, 71, 73, 74, 103, 104
Polyneuropathy	CC 75, 81
Multiple sclerosis	CC 77
Parkinson's and Huntington's diseases; seizure disorders and convulsions	CC 78, 79
Coma, brain compression/anoxic damage	CC 80
Cardiorespiratory arrest, failure and respiratory dependence	CC 82, 83, 84
Congestive heart failure	CC 85
Ischemic heart disease	CC 86, 87, 88, 89
Valvular and rheumatic heart disease	CC 91
Hypertension and hypertensive disease	CC 94, 95
Specified arrhythmias and other heart rhythm disorders	CC 96, 97
Other and unspecified heart disease	CC 98
Stroke	CC 99, 100
Pre-cerebral arterial occlusion and transient cerebral ischemia	CC 101
Cerebrovascular disease	CC 102, 105
Vascular or circulatory disease	CC 106, 107, 108, 109

Patient demographic, comorbidity, and procedural complexity candidate variables for risk adjustment	
Variable category	**Definition**
Chronic lung disease	CC 111, 112, 113
Pneumonia	CC 114, 115, 116
Pleural effusion/pneumothorax	CC 117
Other respiratory disorders	CC 118
Retinal disorders, except detachment and vascular retinopathies	CC 125
Glaucoma	CC 126
Other eye disorders	CC 128
Significant ear, nose, and throat disorders	CC 129
Hearing loss	CC 130
Other ear, nose, throat, and mouth disorders	CC 131
Dialysis status	CC 134
Renal failure	CC 135, 136, 137, 138, 139, 140
Nephritis	CC 141
Urinary obstruction and retention	CC 142
Urinary incontinence	CC 143
UTI and other urinary tract disorders	CC 144, 145
Pelvic inflammatory disease and other specified female genital disorders	CC 147
Male genital disorders (without benign prostatic hyperplasia [BPH])	CC 149 From CC 149, remove ICD-9-CM diagnosis codes: • 60000: BPH w/o urinary obs/LUTS • 60001: BPH w urinary obs/LUTS • 60020: BPH loc w/o ur obs/LUTS • 60021: BPH loc w urin obs/LUTS • 60090: BPH NOS w/o ur obs/LUTS • 60091: BPH NOS w ur obs/LUTS From CC 149, remove ICD-10-CM diagnosis codes: • N400: Enlarged prostate without lower urinary tract symptoms • N401: Enlarged prostate with lower urinary tract symptoms
Decubitus ulcer or chronic skin ulcer	CC 157, 158, 159, 160, 161
Cellulitis, local skin infection	CC 164
Other dermatological disorders	CC 165
Trauma	CC 166, 167, 168, 170, 171, 172
Vertebral fractures	CC 169
History of adverse drug effects or allergies	CC 175
Complications of specified implanted device or graft	CC 176
Other complications of medical care	CC 177
Major symptoms, abnormalities	CC 178
Minor symptoms, signs, findings	CC 179

Patient demographic, comorbidity, and procedural complexity candidate variables for risk adjustment	
Variable category	**Definition**
Amputation status	CC 189, 190
Benign prostatic hyperplasia (BPH) with obstruction	ICD-9-CM diagnosis codes: • 60001: BPH w urinary obs/LUTS • 60021: BPH loc w urin obs/LUTS • 60091: BPH NOS w ur obs/LUTS ICD-10-CM diagnosis codes: • N401: Enlarged prostate with lower urinary tract symptoms
BPH without obstruction	ICD-9-CM diagnosis codes: • 60000: BPH w/o urinary obs/LUTS • 60020: BPH loc w/o ur obs/LUTS • 60090: BPH NOS w/o ur obs/LUTS ICD-10-CM diagnosis codes: • N400: Enlarged prostate without lower urinary tract symptoms
Urinary system symptoms	ICD-9-CM diagnosis codes: • 7880: Renal colic • 7881: Dysuria • 78841: Urinary frequency • 78842: Polyuria • 78843: Nocturia • 7885: Oliguria & anuria • 78861: Splitting urinary stream • 78862: Slowing urinary stream • 78864: Urinary hesitancy • 78865: Straining on urination • 78869: Oth abnormalt urination • 7887: Urethral discharge • 7888: Extravasation of urine • 78899: Oth symptm urinary systm ICD-10-CM diagnosis codes: • N23: Unspecified renal colic • R300: Dysuria • R301: Vesical tenesmus • R309: Painful micturition, unspecified • R34: Anuria and oliguria • R350: Frequency of micturition • R351: Nocturia • R358: Other polyuria • R360: Urethral discharge without blood • R369: Urethral discharge, unspecified • R390: Extravasation of urine • R3911: Hesitancy of micturition

Patient demographic, comorbidity, and procedural complexity candidate variables for risk adjustment	
Variable category	**Definition**
Urinary system symptoms	• R3912: Poor urinary stream • R3913: Splitting of urinary stream • R3916: Straining to void • R3919: Other difficulties with micturition • R392: Extrarenal uremia R3989: Other symptoms and signs involving the genitourinary system
Tobacco use	ICD-9-CM diagnosis code: • 3051: tobacco use disorder ICD-10-CM diagnosis code: • F17200: nicotine dependence, unspecified, uncomplicated

Table E2. Condition Categories (CCs) that are not risk adjusted for if they occur only at the time of the procedure

Condition Category (CC)	CC description
CC 2	Septicemia, sepsis, systemic inflammatory response syndrome/shock
CC 7	Other infectious diseases
CC 17	Diabetes with acute complications
CC 24	Disorders of fluid/electrolyte/acid-base
CC 30	Acute liver failure/disease
CC 33	Intestinal obstruction/perforation
CC 36	Peptic ulcer, hemorrhage, other specified gastrointestinal disorders
CC 50	Delirium and encephalopathy
CC 80	Coma, brain compression/anoxic damage
CC 82	Respirator dependence/tracheostomy status
CC 83	Respiratory arrest
CC 84	Cardio-respiratory failure and shock
CC 85	Congestive heart failure
CC 86	Acute myocardial infarction
CC 87	Unstable angina and other acute ischemic heart disease
CC 96	Specified heart arrhythmias
CC 97	Other heart rhythm and conduction disorders
CC 98	Other and unspecified heart disease
CC 99	Cerebral hemorrhage
CC 100	Ischemic or unspecified stroke
CC 101	Precerebral arterial occlusion and transient cerebral ischemia
CC 103	Hemiplegia/hemiparesis
CC 104	Monoplegia, other paralytic syndromes
CC 107	Vascular disease with complications
CC 114	Aspiration and specified bacterial pneumonias
CC 115	Pneumococcal pneumonia, emphysema, lung abscess
CC 117	Pleural effusion/pneumothorax
CC 135	Acute renal failure
CC 140	Unspecified renal failure
CC 141	Nephritis
CC 142	Urinary obstruction and retention
CC 144	Urinary tract infection
CC 164	Cellulitis, local skin infection
CC 168	Concussion or unspecified head injury
CC 175	Poisonings and allergic and inflammatory reactions
CC 176	Complications of specified implanted device or graft
CC 177	Other complications of medical care