COSTAWARE METHODOLOGY

Delaware Health Care Commission

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Delaware *CostAware* Data Sources and Methodology

Overview

The Delaware Health Care Commission (DHCC) is reporting estimates of the average cost of health care services for state residents generated based on data from the Health Care Claims Database (HCCD), a robust source of data for Delaware residents that includes claims submitted by the state's largest health insurance payers.

Cost estimates reflect the average amounts paid by the payer and the patient based on analysis of claims data from the HCCD. Cost estimates reflect both insurance payments and patient payments including copay, coinsurance, and deductible amounts.

The purpose of the *CostAware* website is to summarize the results of these cost analyses and highlight variation in payments for medical services in Delaware. Many factors contribute to health care cost variation including differences in clinical practice, billing practices, contractual relationships, and the payment systems used by health insurers. *CostAware* does not yet explore how these sources of variation impact Delaware's medical costs. In addition to cost analyses, *CostAware* also reports utilization measures for services where meaningful and appropriate. Quality measures were generated by the Centers for Medicare and Medicaid Services (CMS) and Centers for Disease Control and Prevention (CDC) from data reported by hospital systems and Accountable Care Organizations (ACO) operating in Delaware.

The initial April 2022 launch and 2023 updates to *CostAware* are important steps toward increasing the transparency of the Delaware health care system. Improving health care transparency is a direct outgrowth of Governor John Carney's 2018 [Executive Order](#) 25, which established health care cost and quality benchmarks in Delaware. Understanding variation in cost, utilization and quality is necessary to identify opportunities to improve patient experience and population health and identify opportunities to control health care costs and the rate of growth. These are Delaware's goals related to the Triple Aim.

This document provides an overview of the HCCD database, and the methods used to generate the cost, utilization, and quality measures reported on *CostAware*.

Data Source: The Delaware Health Care Claims Database (HCCD)

The Delaware Health Care Claims Database (HCCD) is powered by the Delaware Health Information Network (DHIN). The HCCD is a collection of health care claims, enrollment, and provider data from Medicare, Medicaid, and some of the larger commercial health insurers operating in Delaware. It is Delaware's All-Payer Claims Database (APCD) and the largest repository of claims data with over nine years of data for more than 800,000 Delaware residents. Visit the [APCD Council website](#) to learn more about APCDs from a national perspective.

The purpose of the HCCD is to facilitate data-driven, evidence-based improvements in access, quality, and cost of health care. The HCCD is a tool to promote and improve public health through increased transparency of claims data and information. The HCCD can also help lawmakers and decision makers identify areas for quality improvement and expanded access; understand and quantify health system performance and the impact of health care transformation; and provide meaningful comparisons and other actionable information to support policy and consumer decisions. The Delaware General Assembly

passed legislation in State Fiscal Year 2016 authorizing the Delaware Health Information Network to develop a health care claims database.

For more information on DHIN and the HCCD visit: Delaware Health Care Claims Database - Delaware Health Information Network (dhin.org).

Definitions and Acronyms

- **ACO:** Accountable Care Organizations are voluntary groups of doctors, hospitals and other health care providers who work together to provide coordinated, high-quality care to their patients. The ACO establishes financial incentives for providers to promote best practice care to the right persons at the right time while improving patients' overall health care experience. The ACO initiative is a major piece of Delaware's Road to Value. For more information on the Road to Value, visit: https://www.choosehealthde.com/Road-to-Value.
- **CC / MCC**: Complications or Comorbidities / Major Complications or Comorbidities. Used most often with Diagnostic Related Groups (see MS-DRGs)
- **CDC:** The Centers for Disease Control and Prevention
- **CMS**: The Centers for Medicare & Medicaid Services
- **CPT Codes**: Current Procedural Terminology (CPT) codes developed and maintained by the American Medical Association (AMA) and used as a standard to identify and categorize medical procedures.
- **EID:** The anonymous DHIN assigned Enterprise Identifier (EID) for individuals in the HCCD database. EIDs are assigned using DHIN's IBM Initiate person matching process.
- **Episode:** A *CostAware* episode includes all the health services that are provided during an inpatient stay. The inpatient stay is identified using several elements including: admission date, discharge date, and hospital care setting. Episodes capture the costs of all health care services associated with an inpatient stay, regardless of the billing provider. Common costs that might be separate from hospital charges are for the surgeon, anesthetist, or other specialty care providers.
- **MS-DRGs**: Medicare Severity-Diagnosis Related Groups – A system used to categorize hospital inpatient procedures for patients receiving the same service and with similar clinical characteristics. Each MS-DRG is defined by a particular set of patient attributes including principal diagnosis, up to 24 additional diagnoses, up to 25 procedures, sex, age, and discharge status. MS-DRGs account for the severity of illness, expected level of care, and associated costs of care. This allows for meaningful comparisons of episode costs across states, regions, health systems, and populations.
- **Outliers**: Cost outliers refer to values that do not reflect typical costs for a service, visit, or episode of care. Atypical costs may occur for reasons including incomplete data, human error, or extremely serious health care issues. Outlier values are either very high or very low relative to typical costs and could impact the accuracy and relevance of average cost estimates if not removed from the analysis.
- **Paid per Visit**: The paid per visit amount is calculated as the sum of the insurance paid amount and member paid amounts, divided by the number of visits to generate an average cost estimate. The insurance paid amount refers to the amount paid for the procedure or service by the insurer. The member paid amount refers to the sum of co-insurance, copay, and deductible amounts paid by the patient.
- **Utilization per 1,000**: Utilization per 1,000 persons is an industry standard calculation that allows for normalized comparisons. This rate is calculated by summing the utilization (either claims or visits depending on the analysis) and dividing by the relevant number of members in the HCCD database. This provides an average per-individual utilization count which is then multiplied by 1,000.

- **Visit**: Refers to a set of related claims for an individual on a specific date of service.

General Methodology Notes

Average Cost Comparisons: *CostAware* allows users to compare the average cost of medical procedures and episodes of care across Delaware hospitals, provider organizations, and other care settings.

- Average costs for episodes of care including knee/hip replacement, C-section and vaginal birth can be compared across Delaware hospitals. Episodes are assigned to hospitals based on the billing provider's National Provider Identifier (NPI) as submitted on an inpatient claim.
- Average costs for common medical services can be compared across care settings including offices, clinics, telehealth visits, independent/free-standing facilities, and hospital outpatient departments. Imaging procedure average costs can be compared across provider organizations. Care settings and provider organizations are identified using data submitted to DHIN by Delaware payers.

Outlier Methodology: Outliers refer to values that do not reflect typical costs for a service or episode of care and may occur for reasons including incomplete data, human error, or medically complex cases. Outlier values are either very high or low relative to typical costs and will impact the accuracy and relevance of average cost estimates if not removed from the analysis. Before calculating average costs, *CostAware* applies the following methods to remove outliers.

- Zero-dollar claims are removed because they are uncommon and the HCCD lacks complete information on uncompensated care.
- The remaining claims for each service or episode are grouped by provider (care setting, provider organization, hospital) and insurance type (commercial insurance, Medicare Advantage, Medicaid).
  - Medical services are grouped based on care setting or the site where the service was provided. Care settings include offices, urgent care facilities, telehealth, home, hospital outpatient, hospital emergency department, ambulatory surgery center, renal dialysis center, and outpatient lab. Imaging procedures are also grouped by the organization that provided the service. Care settings and provider organizations are identified based on data in the claim files submitted to DHIN by Delaware payers.
  - Episodes of care are assigned to Delaware hospitals based on billing provider identifiers, e.g., National Provider Identifier, or NPI.
- For each provider-insurance type group, claims/episodes are ordered from highest to lowest cost. A percentile rank is applied to each cost in the ordered list.
  - For groupings with more than 10 distinct cost values, claims/episodes with a cost equal to or below the 2.5 percentile rank and equal to or above the 97.5 percentile rank are removed from the analysis.
  - For groupings with 10 or fewer distinct cost values, the outlier methodology is not applied. This situation is uncommon and occurs most often in Medicare and Medicaid data where a standard rate is paid for a specific service.
- With the outliers removed, average costs for each service or episode are calculated for each provider and insurance type group. This process generates average cost estimates that reflect typical costs that can be meaningfully compared.

Out of State Residents: Results reported on *CostAware* reflect members or patients who live in Delaware; out-of-state residents are excluded.

Payer Information: Payers refers to and includes commercial health plans, Delaware Medicaid and Managed Care Organizations and Medicare Advantage Plans. Medicare Fee for Service (FFS) data will be added to *CostAware* when it becomes available. The following were excluded from *CostAware* measures because they do not provide comprehensive health care coverage: Medicare Supplemental (Medigap) plans, Qualified Medicare Beneficiaries (dually eligible members), and Vaccines for Children Recipients. *CostAware* average cost estimates also exclude entities reporting only pharmacy claims (CVS, Express Scripts), health plans no longer operating in Delaware, and claims for members living out of state.

Risk Adjustment: Average costs for specific medical services and episodes of care presented on *CostAware* are not risk-adjusted. They are actual average costs calculated based on HCCD data as submitted to DHIN by Delaware health care payers.

Methodology for Medical Services

CostAware includes estimates of average costs and service counts based on claims data from the Delaware Health Care Claims Database (HCCD) for 2019-2021. Calculations reflect data for Delaware residents and measures were generated for all payer types unless otherwise noted. Average cost estimates exclude denied claims and claims for services with a zero-dollar paid amount. Average cost estimates for medical services reflect the amounts paid on the claim line that includes the relevant Current Procedural Terminology (CPT) code. A provider organization must have 30 or more claims for a service after outlier removal to support reliable estimates of average costs. Results for provider organizations with fewer than 30 claims after outlier removal are not reported on *CostAware.*

Procedures Codes: Medical services reported on *CostAware* are identified based on American Medical Association (AMA) Current Procedural Terminology (CPT) codes. The CPT codes chosen are for common medical procedures and are not associated with complications or comorbidities. Individuals with clinical expertise were consulted to confirm code choices. The following CPT codes were used to identify the medical services reported on *CostAware.*

Service	Description	Procedure Code
Blood Tests	Blood Count: Complete (CBC) automated (Hgb, Hct, RBC, WBC, and platelet count) and automated differential WBC	85025
	Hemoglobin; glycosylated (A1C)	83036
	Hemoglobin, glycosylated (A1C) by device cleared by FDA for home use	83037
Cardiac-related	Electrocardiogram (ECG or EKG) With Report and Interpretation	93000
	Electrocardiogram (ECG or EKG) With Tracing	93005
	Electrocardiogram (ECG or EKG), Report and Interpretation Only	93010
	Cardiovascular stress test	93017
	Electrocardiogram (ECG or EKG) monitoring	93270
Colonoscopy	Colonoscopy without intervention	45378
	Colonoscopy with intervention	45380

Service	Description	Procedure Code
Diabetes-related	Glucose, quantitative, blood (except reagent strip)	82947
	Glucose, quantitative, blood, reagent strip	82948
	Glucose, quantitative, blood, post glucose dose (includes glucose)	82950
	Glucose, blood by glucose monitoring device(s) cleared by the FDA specifically for home use	82962
	Hemoglobin; glycosylated (A1c)	83036
	Hemoglobin, glycosylated (A1C) by device cleared by FDA for home use	83037
	Diabetes outpatient self-management training services, individual, per 30 minutes	G0108
	Diabetes outpatient self-management training services, group session (2 or more), per 30 minutes	G0109
Emergency Department Visits	ED Visit - Mild Severity	99281
	ED Visit - Mild Severity (expanded history and examination)	99282
	ED Visit - Medium Severity (expanded history and examination)	99283
	ED visit - Medium Severity (detailed history and examination)	99284
	ED visit - High Severity (comprehensive history and examination)	99285
Gallbladder Removal	Gallbladder Removal	47562
Head CT	Head CT - without contrast	70450
	Head CT - without contrast followed by contrast	70470
Lumbar Spine MRI	Lumbar Spine MRI - without contrast	72148
	Lumbar Spine MRI - with contrast	72158
Mental Health Services	Family Psychotherapy with Patient	90847
	Family Psychotherapy without Patient	90846
	Group Psychotherapy	90853
	Psychotherapy with Evaluation and Management, 45 Minutes with Patient	90836
	Psychotherapy, 30 Minutes with Patient	90832
	Psychotherapy, 45 Minutes with Patient	90834
	Psychotherapy, 60 Minutes with Patient	90837
	Psychiatric Diagnostic Evaluation	90791
	Psychiatric Diagnostic Evaluation with medical services	90792
	Psychotherapy for crisis, the first 60 minutes	90839
Screening Mammography	Screening Mammography, bilateral (2-view study of each breast)	77067
Urine Tests	Bacterial Culture, Quantitative Colony Count	87086
	Urinalysis, Automated with Microscope Examination	81001
	Urinalysis, Manual Test	81002
	Urinalysis, Automated	81003
	Drug Screen	80307
	Office Visit, New Patient - moderate complexity, 45-59 minutes	99204

Service	Description	Procedure Code
Adult Wellness Visits	Office Visit, New Patient - high complexity, 60-74 minutes	99205
	Office Visit, Established Patient - low complexity, 5 minutes	99211
	Office Visit, Established Patient - low complexity, 10-19 minutes	99212
	Office Visit, Established Patient - low complexity, 20-29 minutes	99213
	Office Visit, Established Patient - moderate complexity, 30-39 minutes	99214
	Office Visit, Established Patient - high complexity, 40-54 minutes	99215
Child Wellness Visits	New Patient Preventive Care Visit for Adolescent, Ages 12-17	99384
	New Patient Preventive Care Visit for Child, Ages 1-4	99382
	New Patient Preventive Care Visit for Child, Ages 5-11	99383
	New Patient Preventive Care Visit for Child, Under Age 1	99381
	Preventive Care Visit for Adolescent, Ages 12-17	99394
	Preventive Care Visit for Child, Under Age 1	99391
	Preventive Care Visit for Child, Ages 1-4	99392
	Preventive Care Visit for Child, Ages 5-11	99393

For individual services, the average cost was calculated based on the appropriate CPT code by payer type. Because individual services are coded separately, variation across payer types and providers is relatively low. The average cost estimates do not include costs for other, unrelated services received by the patient on the same day or as part of the same visit. Average cost estimates are presented by payer type and can be compared across care settings to highlight variation in Delaware. Results for imaging procedures can also be compared across provider organizations. Future versions of *CostAware* will add provider organization level detail for additional services to support comparisons across individual providers.

Methodology for Episodes

Some medical procedures require multiple services from different providers and episode of care analysis combines payments for these services to create a single estimate of average cost. *CostAware* presents estimates of average costs and the number of episodes performed by Delaware hospitals based on Health Care Claims Database (HCCD) data for calendar years 2019-2021. Calculations reflect services provided to Delaware residents and the measures were generated for all payer types unless otherwise noted. Average cost estimates exclude denied claims and episodes with a zero-dollar paid amount. The average cost per episode reflects claims for facility and professional services provided during the inpatient hospital stay, e.g., all services delivered between the admission and discharge dates. A hospital must have 11 or more claims for a particular episode to be included in the calculations to support reliable estimates of average costs.

Episodes were identified based on assignment of Medicare Severity-Diagnosis Related Groups (MS-DRGs) to hospital inpatient claims data using the 3M MS-DRG software. Procedures often have multiple MS-DRGs to reflect the presence (or absence) of Complications or Comorbidities or Major Complications or Comorbidities (CC / MCC) and other clinical differences. For purposes of *CostAware,* episodes were identified based on MS-DRGs without CC / MCC because these reflect typical patient experience and

average costs. The following MS-DRGs were used to identify and define the episodes of care reported on *CostAware*.

Episodes	Codes and Description	MS-DRG
Cesarean-Section	Cesarean section with sterilization without CC / MCC	785
	Cesarean section without sterilization without CC / MCC	788
Knee and Hip Replacement	Major Joint Replacement or Reattachment of Lower Extremity Without MCC	470
Vaginal Delivery	Vaginal Delivery without Sterilization/D&C without CC / MCC	807

For episodes, average costs were estimated based on MS-DRG assignments and reflect multiple services associated with the procedure that were performed and billed during the inpatient hospital stay (e.g., between the admission and discharge dates) by payer type. Because episode cost estimates reflect payments for multiple services and providers, variation across payer types and hospitals is generally larger than that for medical services.

MS-DRG assignments identify patients who had a particular episode (or procedure) on a specific date. Each episode is further identified by a "common key," which is a combination (or concatenation) of patient EID, date of service and place of service. This common key is used to identify claims for all services the patient received between the hospital admission and discharge dates. The cost of all services provided during this period are added together to generate a total cost estimate for each episode.

The common key is also used to assign episodes to payers (commercial insurance, Medicare Advantage, Medicaid) and to the hospital where the procedure was performed using National Provider Identifiers (NPIs). The outlier methodology is applied after episodes are assigned to hospitals and grouped by payer type. The total cost for episodes by hospital and payer is calculated and divided by the corresponding number of episodes to generate the average cost estimates. Results are reported on *CostAware* If 11 or more episodes remain after outlier removal for a particular payer and hospital combination.

Average cost estimates are presented by payer type, highlight variation in the Delaware health care marketplace, and can be compared across hospitals. The average cost estimates do not distinguish between what is paid to the hospital, physicians or other providers who treated the patient. Episodes for patients with multiple types of insurance coverage were excluded from the analysis to reduce the number and impact of low-cost outliers.

Methodology for Prescription Drugs

CostAware includes estimates of the average daily cost for brand and generic drugs based on claims data from the Delaware Health Care Claims Database (HCCD) for the most recent complete year. Estimates reflect pharmacy claims for Delaware residents and average costs were calculated for all payer types. Average daily cost estimates exclude denied claims and claims with a zero-dollar amount, and reflect the amount paid on the claim line that includes the relevant National Drug Code (NDC). The outlier removal methodology was *not* applied in estimating the average daily cost for prescription drugs.

Prescription drug claims were grouped by NDC and cost estimates are presented based on the US Pharmacopeia (USP) drug classification system. At the highest level, 51 categories are used to group drugs based on the condition they are intended to treat. Individuals with clinical expertise were consulted to review the category groupings and a list of the 51 USP drug categories with brief descriptions is included as an appendix.

Pharmacy claims submitted to the HCCD by Delaware payers include the total paid (or allowed) amount and number of days supply. *For each pharmacy claim*, the cost per day is calculated by dividing the total paid amount by the number of days supply.

Cost per Day (for each pharmacy claim) = Total Paid Amount / Days Supply

Cost per day was then aggregated by NDC both overall and by payer type. Average daily cost for each NDC/payer type is calculated by dividing the aggregate total cost per day by the corresponding number of claims.

Average Daily Cost (for each NDC/payer) = Total Cost per Day / Number of Claims

Average daily cost estimates by NDC/payer are grouped by drug class and can be compared across payer types and brand/generic status to highlight cost variation in Delaware. Future versions of *CostAware* will include information on average plan paid amounts and patient out of pocket spending, and additional filters for age group, gender, and other dimensions.

Quality Measures

Quality measures are tools that help measure or quantify healthcare processes, outcomes, patient perceptions, and organizational structure and/or systems associated with the provision of high-quality care and/or that relate to one or more quality goals for healthcare. These goals include: effective, safe, efficient, patient-centered, equitable, and timely care. This information can help consumers make better informed decisions about where to seek high-quality healthcare. *CostAware* includes publicly available quality measures for hospitals and Accountable Care Organizations (ACOs) generated and published by the Centers for Medicare and Medicaid Services (CMS) and Centers for Disease Control and Prevention (CDC). These sources are described in additional detail below.

Hospital Quality Measures

Patient Experience Measures: Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). The Centers for Medicare and Medicaid Services (CMS) provide public information on patient perspectives of their hospital care collected through surveys. The CMS HCAHPS measures reported on *CostAware* are summarized in the table below. For more information, see: https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/HospitalHCAHPS.

HCAHPS Response	HCAHPS Identifier	Notes
Nurses "always" communicated well	H_COMP_1_A_P	Percentage of patients who reported that their nurses "Always" communicated well

HCAHPS Response	HCAHPS Identifier	Notes
Doctors "always" communicated well	H_COMP_2_A_P	Percentage of patients who reported that their doctors "Always" communicated well
Patients "always" received help as soon as they wanted	H_COMP_3_A_P	Percentage of patients who reported that they "Always" received help as soon as they wanted
Patients who gave a rating of "9" or "10" (high)	H_HSP_RATING_9_10	Percentage of patients who gave their hospital a rating of 9 or 10 on a scale from 0 (lowest) to 10 (highest)
"YES", patients would definitely recommend the hospital	H_RECMND_DY	Percentage of patients who reported YES, they would definitely recommend the hospital

CMS Patient Safety Indicators (PSI): Complications and Deaths. The Centers for Medicare and Medicaid Services (CMS) provide public information on rates of complications and deaths occurring in hospitals. The PSIs were developed by clinical experts and reflect hospital quality of care for adult patients; many are endorsed by the National Quality Forum (NQF). *CostAware* includes CMS measures of the rates of elective deliveries, complications for hip and knee replacements, and readmissions after hip/knee replacement and hospital discharge. For more information on the CMS Patient Safety Indicators, see: https://qualitynet.cms.gov/inpatient/measures/psi.

Measure Name	Measure Identifier	Notes
Maternal Health – Elective Delivery	PC_01	Percentage of mothers whose deliveries were scheduled early (1-2 weeks early) by induction or Cesarean Section prior to 39 weeks gestation without medical necessity. Lower rates indicate higher quality. These procedures carry significant health risks to both the mother and baby, and can also result in NICU admissions, increased length of stay, and higher costs for patients and payers. Sometimes pregnant individuals go into early labor on their own, and early deliveries cannot be prevented.
Rate of Complications for Hip/Knee Replacement Patients	COMP_HIP_KNEE	The rate of complications for hip and knee replacement patients. This measure reflects the hospital level risk-standardized complication rate (RSCR) following elective primary total hip arthroplasty (THA) and total knee arthroplasty (TKA). Lower rates indicate higher quality. During or after hip/knee replacement surgery, a patient may experience complications from the procedure that could be avoided. This measure includes Medicare FFS beneficiaries 65 or older undergoing elective hip/knee

Measure Name	Measure Identifier	Notes
		replacement and continuously enrolled for 12 months prior to hospital admission.
Unplanned Visits – Rate of Readmission After Hip/Knee Replacement	READM_30_HIP_KNEE	The rate of hospital readmission after hip or knee replacement. This measure reflects the 30-day hospital readmission rate following elective primary total hip arthroplasty (THA) and/or total knee arthroplasty (TKA). Lower rates indicate higher quality. Following discharge for knee/hip replacement, a patient may experience complications from the procedure that requires unplanned readmission to a hospital within 30 days. Hospitals with lower rates of unplanned hospital visits or readmissions following knee/hip replacement surgery may do a better job avoiding complications and providing follow-up care.
Unplanned Visits – Rate of Readmission After Discharge from Hospital (hospital-wide)	READM_30_HOSP_WIDE	The rate of readmission after discharge from hospital (hospital-wide). This measure reflects the 30-day hospital-wide all-cause unplanned readmission (HWR) rate. Lower rates indicate higher quality. This measure reflects discharged patients who were hospitalized again within 30 days for any cause. Patients may have returned to the same hospital or been admitted to a different hospital. The readmission may be related to their recent hospital stay or for an entirely different reason. The hospital-wide rate indicates whether a hospital is effective in preventing complications, providing clear discharge instructions to patients, and helping to ensure smooth transitions to home or another care setting like a nursing home.

Accountable Care Organization Quality Measures

Medicare Shared Savings Program – The Shared Savings Program is a voluntary initiative that encourages groups of doctors, hospitals, and other health care providers to come together as an Accountable Care Organization (ACO) to provide coordinated, high-quality care to their Medicare beneficiaries. Participating ACOs must report quality data to CMS after the close of every performance period and quality performance is measured using standard methods. Quality measures span four domains: patient/caregiver experience, care coordination/patient safety, preventive health, and at-risk populations. Medicare Shared Savings Program quality measures for ACOs reported on *CostAware* are summarized in the table below. For more information on the Medicare Shared Saving Program, visit: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/sharedsavingsprogram/program-data.

Measure Name	Measure Identifier	Notes
Getting Timely Care, Appointments, and Information	CAHPS_1	The percentage of patients reporting they were usually or always able to get care, appointments, and information when it was needed.
Statin Therapy for the Prevention and Treatment of Cardiovascular Disease	QualityID_438	The percentage of the following patients—all considered at high risk of cardiovascular events—who were prescribed or were on statin therapy during the measurement period: • Adults aged ≥ 21 years who were previously diagnosed with or currently have an active diagnosis of clinical atherosclerotic cardiovascular disease (ASCVD); OR • Adults aged ≥ 21 years who have ever had a fasting or direct low-density lipoprotein cholesterol (LDL-C) level >190 mg/dL or were previously diagnosed with or currently have a diagnosis of familial or pure hypercholesterolemia; or • Adults aged 40-75 years with a diagnosis of diabetes with a fasting or direct LDL-C level of 70-189 mg/dL.
Depression Remission at Twelve Months	QualityID_370	The percentage of adolescent patients 12 to 17 years of age and adult patients 18 years of age or older with major depression or dysthymia who reached remission 12 months (+/- 60 days) after an index event.
Breast Cancer Screening	QualityID_112	The percentage of women 50 - 74 years of age who had a mammogram to screen for breast cancer in the 27 months prior to the end of the measurement period. Higher rates indicate better quality.
Diabetes: Hemoglobin A1c (HbA1c) Poor Control (>9%), WI	QualityID_001_WI	The percentage of patients 18 - 75 years of age with diabetes who had hemoglobin A1c > 9.0% during the measurement period. Lower rates indicate better quality.
Controlling High Blood Pressure, WI	QualityID_236_WI	The percentage of patients 18 - 85 years of age who had a diagnosis of hypertension overlapping the measurement period and whose most recent blood pressure was adequately controlled (< 140/90 mmHg) during the measurement period.
Patients' Rating of Provider	CAHPS_3	Average patient rating of provider on a scale of 0 to 10 expressed as a percentage.
Hospital-Wide 30-Day Readmission Rate	Measure_479	Risk-adjusted percentage of ACO assigned beneficiaries who were hospitalized and readmitted to a hospital within 30 days of discharge from the

Measure Name	Measure Identifier	Notes
		index hospital admission. Lower rates indicate better quality.
Screening for Depression and Follow-up Plan	QualityID_134_WI	The percentage of patients aged 12 years and older screened for depression on the date of the encounter or 14 days prior to the date of the encounter using an age-appropriate standardized depression screening tool AND if positive, a follow-up plan is documented on the date of the eligible encounter.
Colorectal Cancer Screening	QualityID_113	The percentage of adults 50 - 75 years of age who had appropriate screening for colorectal cancer.

Data Quality for the Health Care Claims Database

DHIN manages quality assurance processes throughout the data life cycle and reviews quality before files are ingested, following application of each data enhancement, and prior to use by analysts. Beginning with monthly claims data submissions, a 5-step data validation process occurs over several weeks. Incoming files are checked for integrity and compliance with specifications, values are assessed for reasonableness, and specific validations are performed for each data enhancement applied. All outputs and results based on analysis of HCCD data, including CostAware measures, are subjected to a final quality evaluation prior to release. These quality assessments are conducted by a team of analysts, claims data experts, and a medical doctor. Automated processes are used to aid in the calculation of data quality measures, creation of reports, and review of results. National and regional data sources are consulted in assessing the reasonableness of outcomes where available and appropriate.

5 Step Data Submission Validation Process

The 5-step data submission validation process includes: Staging, Level 1, Claims Versioning, Level 2, and Data Enhancements; the focus of each step is listed in the table below. If any step identifies invalid or unexpected results, DHIN and the payer collaborate to understand and reconcile the issue impacting the unexpected result. Most issues can be explained due to normal variation in the claims data. Sometimes data must be corrected and resubmitted by the payer to address a data quality issue. These data quality processes produce accurate and stable claims data within 90 days of health care events represented in submitted claims.

Staging	Level 1	Versioning	Level 2	Data Enhancements	Analytic Warehouse
File Integrity • File reconciliation • Processing viability	File Specification Compliance • Data type • Format • String length • Code sets • % complete • Orphaned claims	Many Adjudications to one claim • Medical • Pharmacy	Reasonableness Check • Descriptive statistics • Distributions • Critical reporting elements • National and state comparisons	Calculated Elements (open source and proprietary) • Age groups • Care settings • Johns Hopkins ACG risk score • Episode grouper • 3M MS-DRG	Move to Production

Validating the Data Enhancements

Application of data enhancements occurs prior to the 5th step of the data quality process. The purpose of the enhancements is to expand the availability of calculated elements with repeatable, reliable, and consistent results for all HCCD data. DHIN applies both open-source and proprietary enhancements to the HCCD data. Open-source enhancements include calculated data elements like age groups, service categories, time periods, length of stay and other groupings. The patient attribution to primary care provider enhancement is consistent with parameters developed by Delaware's Primary Care Reform Collaborative.

The DHIN Analytics team also leveraged the 3M MS-DRG episode grouper (a component of the 3M™ Core Grouping Software) to develop inputs to generate the *CostAware* episode of care measures. To create the enhancement output files, a data engineer followed instructions provided by the software developer to install the required software and extract input data files from the HCCD according to vendor specifications using Amazon Redshift.

The data engineer created the input files based on the developer's instructions by aggregating the member eligibility, pharmacy, medical claim, and provider data and capturing primary diagnoses, admission and discharge dates, date of service through, date of service from, procedure codes, cost or reimbursement data, patient EID, and provider NPI number. Once the input files were created according to specifications, the data engineer uploaded the input files to the MS-DRG enhancement software to generate output files which in turn were used as inputs to produce the *CostAware* episode of care measures and reports.

After the output files were generated, Quality Assurance analysts followed a QA checklist to review the output files and compare results against expected values based on validation criteria established by the software developers. Examples of validation steps performed by the QA analysts included:

• Researching instances where a discharge date is not associated with an admission date suggesting the patient may not have undergone an inpatient procedure.

- Ensuring that episodes assigned an MS-DRG had valid admission and discharge dates to support accurate calculations of associated costs.
- Identifying records that should be removed from the input files due to missing or incomplete data, invalid procedure or diagnosis codes, or secondary payer claim status.
- Validating the accuracy of enhancement outputs against direct queries of the HCCD data and verifying that key values align across platforms and are within expected ranges.
- Validating enhancement output files against external sources to ensure consistency with similar analysis projects and established industry benchmarks (e.g., verify that results based on HCCD data align with the distribution of DRGs in other databases).

Validating the Cost Measure Output

All output was reviewed for consistency and quality by multiple data analysts before and after being displayed on the *CostAware* site. Structured Query Language or SQL code used to extract the data needed to calculate *CostAware* measures from enhancement output files and the HCCD was reviewed by multiple project analysts to ensure accuracy. The reasonableness of measure outputs was assessed by comparing values to results generated based on other sources of similar information and established benchmarks when available. When suspected anomalies were identified, investigation into potential causes was performed and corrections applied where appropriate. Measures were also compared to similar results generated based on direct queries of the HCCD database to assess alignment and the reasonableness of values.

Quality processes, beginning with 5-step data submission validation and continuing through application of data enhancements and generation of *CostAware* measures, is absolutely necessary. Claims data quality and completeness are impacted by factors including changes in providers, payers, and data systems. Repeatable and reliable data quality processes identify issues early and enable corrections before the data are used to support reporting and decision-making. They ensure that analytic results based on the HCCD accurately reflect health care spending, utilization, and quality in Delaware. Careful attention to data quality supports accurate reporting on the cost of healthcare services for state residents. In turn, healthcare cost and quality transparency assists Delaware in identifying opportunities for health system performance improvement and in making evidenced-based policy decisions.

Appendix: US Pharmacopeia Drug Classes and Descriptions

Drug Category	Description
Analgesics	Analgesics are medicines used to relieve different kinds of pain. There are two main types: non-narcotic analgesics for mild pain, and narcotic analgesics for severe pain.
Anesthetics	Anesthetics are the medications used to block sensation. They are used during tests and surgical operations to numb sensation in certain areas of the body or induce sleep. Local anesthetics and general anesthetics are two commonly used types of anesthetics.
Anti-Addiction/Substance Abuse Treatment Agents	These agents are intended to counteract the damaging effects of illicit substances or promote abstinence.
Antibacterials	Drugs used to treat infections.

Drug Category	Description
Anticonvulsants	Drugs that prevent epileptic seizures.
Antidementia Agents	Drugs that may slow the progression or otherwise benefit patients with dementia of the Alzheimer's type. Other types of dementia will not normally respond to these treatments.
Antidepressants	Antidepressants may help relieve the symptoms of depression, such as low mood, anxiety, worthlessness and others. Antidepressants are classified into different types depending on their structure and the way that they work.
Antiemetics	Drugs used to treat nausea and vomiting.
Antifungals	Antifungals are used to treat fungal infections, the most common of which affect the hair, skin, nails, or mucous membranes.
Antigout Agents	Antigout agents work to either correct overproduction or underexcretion of uric acid. These agents are also called antihyperuricemic agents.
Antimigraine Agents	Antimigraine agents are used for the treatment of migraine headaches. There are two types of antimigraine agents: abortive agents, which are used to abort an established migraine attack, and preventive antimigraine agents, which are given prophylactically to reduce the number of migraine attacks.
Antimyasthenic Agents	Antimyasthenics agents are used to treat myasthenia gravis (characterized by weakness and rapid fatigue of any of the muscles under voluntary control).
Antimycobacterials	Antimycobacterial agents are compounds that have activity against mycobacterial infections, including tuberculosis, leprosy and Mycobacterium avium complex (MAC) disease.
Antineoplastics	Antineoplastics are drugs used to prevent, inhibit or halt the development of a neoplasm (a tumor).
Anti-Obesity Agents	Anti-obesity agents are prescription drugs that reduce appetite and food cravings. Some anti-obesity medications also help decrease cravings and control compulsive eating, especially for sweets and fatty, salty, high-calorie foods.
Antiparasitics	Antiparasitic agents are a class of medications used in the management and treatment of parasitic diseases, such as those caused by helminths, amoeba, parasitic fungi, protozoa, and ectoparasites. These medications work by killing parasites, stopping their growth or paralyzing them. There are many types of antiparasitic drugs and each drug targets specific parasites.
Antiparkinson Agents	Antiparkinson agents aim to replace dopamine either by drugs that release dopamine or those that mimic the action of dopamine and treat or halt the symptoms such as tremor or hypokinesia. Most antiparkinson drugs either fall into the category of dopamine agonists or anticholinergics.
Antipsychotics	Antipsychotics used to treat symptoms of severe psychiatric disorders such as schizophrenia. These drugs are sometimes called major tranquilizers.
Antispasticity Agents	Antispastic agents are one class of muscle relaxers which directly affect the spinal cord or the skeletal muscles with the aim of improving muscle

Drug Category	Description
	tightness and spasms. These are slightly different than antispasmodics, the other class of muscle relaxers.
Antivirals	Antivirals are drugs used to treat viral infections or to provide temporary protection against infections such as influenza.
Anxiolytics	Anxiolytics are used to prevent or treat anxiety symptoms or disorders. They are sometimes called anti-anxiety medications or minor tranquilizers.
Bipolar Agents	Bipolar agents are mood-stabilizing medications that are prescribed to manage both manic and depressive moods of bipolar disorder, and schizophrenia. Some bipolar disorder agents have anticonvulsant properties and are also used to treat neurological conditions such as epilepsy and trigeminal neuralgia.
Blood Glucose Regulators	Blood glucose regulators are intended to help balance and stabilize blood sugar levels, for example, by replacing insulin, helping the body better use insulin, or ridding the body of excess glucose.
Blood Products and Modifiers	Blood products and modifiers are agents that can replace, stimulate the production of, or modify the function of natural blood components. They may stimulate the production of white or red blood cells or prevent or promote blood clotting.
Cardiovascular Agents	Cardiovascular agents are medicines used to treat medical conditions associated with the heart or the circulatory system (blood vessels), such as arrhythmias, blood clots, coronary artery disease, high or low blood pressure, high cholesterol, heart failure, and stroke.
Central Nervous System Agents	Central nervous system agents are medicines that affect the central nervous system (CNS). These may include anesthetics, anticonvulsants, antiemetics, antiparkinson agents, CNS stimulants, muscle relaxants, narcotic analgesics (pain relievers), nonnarcotic analgesics (such as acetaminophen and NSAIDs), and sedatives.
Contraceptives	Contraceptives, also referred to as birth control, is the name given to medicines and devices that are used to prevent unwanted pregnancy.
Dental and Oral Agents	Dental and oral agents are used to treat conditions and disorders relating to the mouth. They may be intended to alleviate pain, infections or other symptoms.
Dermatological Agents	Dermatological agents (topical) are applied directly on the skin to treat skin conditions. They may prevent or treat skin disorders or may be inert creams and ointments for routine skin care to maintain the skin.
Electrolytes/Minerals/Metals/Vitamins	These agents may be used to supplement and / or balance the levels of electrolytes, minerals, metals and vitamins in the body, when diet alone is insufficient.
Gastrointestinal Agents	Gastrointestinal (GI) agents include many different classes of drugs that are used for their effects on the gastrointestinal system, as to control gastric acidity, regulate gastrointestinal motility and water flow, and improve digestion.
Genetic, Enzyme, or Protein Disorder:	These agents are intended to address genetic, enzyme or protein disorders by modifying or replacing enzymes and / or proteins in the body

Drug Category	Description
Replacement, Modifiers, Treatment	
Genitourinary Agents	Genitourinary agents are mainly used to treat conditions of the reproductive organs and excretory system or urinary tract. They include medicines used for bladder spasms, urinary pH modifiers, medicines for erectile dysfunction in men and medicines that suppress uterine contractions to prevent preterm labor.
Hormonal Agents, Stimulant/Replacement/Modifying (Adrenal)	These agents can be used to treat conditions including inflammation, autoimmune conditions and allergy symptoms. They may be taken orally as a systemic treatment to treat the body as a whole or it can be applied to the affected area for a local effect as creams, inhalations, nasal sprays, eye drops, ear drops or injections.
Hormonal Agents, Stimulant/Replacement/Modifying (Pituitary)	These agents are intended to replace the human growth hormone and stimulate skeletal growth, growth of internal organs, and protein synthesis.
Hormonal Agents, Stimulant/Replacement/Modifying (Prostaglandins)	These agents can be used to increase prostaglandin levels in the body under certain circumstances. Administration of these agents can be used to induce labor at the end of pregnancy or abortion in the case of an unwanted pregnancy. They can also be used to treat stomach ulcers, glaucoma and congenital heart disease in newborn babies.
Hormonal Agents, Stimulant/Replacement/Modifying (Sex Hormones/Modifiers)	These agents specifically modulate the effects of sex hormones and of their biological targets, the sex hormone receptors. The sex hormones include androgens such as testosterone, estrogens such as estradiol, and progestogens such as progesterone.
Hormonal Agents, Stimulant/Replacement/Modifying (Thyroid)	These agents are used to supplement low thyroid hormone levels in people with hypothyroidism.
Hormonal Agents, Suppressant (Adrenal)	These agents inhibit key steps in the biosynthesis of hormones produced by the adrenal context, such as mineralocorticoids, glucocorticoids, estrogen and androgens. They are used to treat Cushing's syndrome and some types of cancers. They are also used as diagnostic tools, such as in procedures to check pituitary function.
Hormonal Agents, Suppressant (Pituitary)	These agents are intended to act directly on postsynaptic dopamine receptors in the brain to inhibit growth hormone secretion.
Hormonal Agents, Suppressant (Thyroid)	These agents prevent or suppress the biosynthesis of thyroid hormones. They are used to treat hyperthyroidism by inhibiting the excessive production of thyroid hormones or by decreasing thyroid hormone activity.
Immunological Agents	Immunological agents are drugs that can modify the immune response, either by enhancing or suppressing the immune system. They are used to fight infections, prevent and treat certain diseases, and protect transplanted organs from rejection
Infertility Agents	Infertility agents are used to prepare the body for fertility treatment, to increase the probability that an adequate number of healthy eggs will be released from the ovaries, and to improve the chances of establishing and maintaining a pregnancy.

Drug Category	Description
Inflammatory Bowel Disease Agents	Inflammatory bowel disease (IBD) agents are intended to relieve the symptoms and /or prevent progression of inflammatory bowel disease conditions, such as Crohn's disease or ulcerative colitis.
Metabolic Bone Disease Agents	Metabolic bone disease agents are used to treat metabolic bone disorders, such as osteoporosis, osteomalacia, Paget's Disease, etc. They are often intended to reduce the rate at which bones break down and / or speed up the bone-building process.
Ophthalmic Agents	Ophthalmic agents are used to treat and address conditions or symptoms affecting the eye.
Otic Agents	Ophthalmic agents are used to treat and address conditions or symptoms affecting the ear.
Respiratory Tract/Pulmonary Agents	These agents are used to relieve, treat, or prevent respiratory diseases such as asthma, chronic bronchitis, chronic obstructive pulmonary disease (COPD), or pneumonia. They are available in many different forms, such as oral tablets, oral liquids, injections or inhalations.
Sexual Disorder Agents	These agents used to treat sexual function problems, such as impotence or erectile dysfunction.
Skeletal Muscle Relaxants	Skeletal muscle relaxants are drugs that are used to relax and reduce tension in muscles. They are more simply referred to as muscle relaxants. Some work in the brain or spinal cord to block or dampen down excessively stimulated nerve pathways.
Sleep Disorder Agents	Sleep disorder (also called sedative-hypnotic) agents are used to induce and/or maintain sleep. They are sometimes used to treat anxiety and seizures as well.