TELEMEDICINE, TELEHEALTH, AND HOME TELEMONITORING SERVICES IN TEXAS MEDICAID

Cost Effectiveness Analysis Tool

https://vidal.tamu.edu/cea/

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TABLE OF CONTENTS

INTRODUCTION

This report is the fulfilment of the August 31, 2021 deliverable specified in contract number HHS000876300001 between the Health and Human Services Commission and the Texas A&M University Health Science Center. The purpose of the report is to write a methods manual as a companion to the Cost Effectiveness Analysis (CEA) Tool and Tutorial. The CEA tool is a public website (https://vidal.tamu.edu/cea/) that users can download:

- the excel CEA-basic-tool,
- the tutorial videos for the CEA-basic-tool,
- the various curated data products described above,
- links to other publicly available data sources
- and this document

The report consists of several sections that provide brief explanations of cost effectiveness concepts, the planning and implementation guidelines including a description of components of the software tool, and a description of the planned example case study for illustrative purposes.

OVERVIEW OF ECONOMIC EVALUATION CONCEPTS

Economic evaluation in public health entails the systematic assessment of costs and outcomes associated with health policies, programs, and interventions. Such studies help decision makers answer fundamental questions of whether a health intervention has been (or will be) worth the resources required to implement it. Costs are typically categorized as medical and non-medical and include expenditures on resources needed plus the value of required resources that are not paid for, such as volunteer time. Intangible factors, such as pain and suffering, can also be included in the analysis. Health outcomes are typically stated in terms of adverse conditions or events avoided due to the intervention, in terms of standardized measures such as the Quality Adjusted Life Year (QALY), or in some types of studies, in terms of monetary units using concepts such as Willingness to Pay and the Value of Statistical Life (VSL). Costs and health outcomes included in these studies are influenced by the perspective of the study, which is determined by the stakeholders involved (payers, providers, patients, government, societal etc.), with the 'societal' perspective being the broadest. It is also important to specify the time frames over which interventions are implemented (period that costs are incurred) and health outcomes are measured (period over which benefits are accrued). These periods are typically different, and thus costs and benefits must often be adjusted to account for both inflation and the time value of money (TVM).

COST EFFECTIVENESS ANALYSIS (CEA)

The CEA-basic-tool, which can be downloaded from the CEA website, implements the CEA framework for economic evaluations. The excel tool computes an Incremental Cost Effectiveness Ratio (ICER) that provides decision makers with an estimate of the costs required to attain a specific improvement in health outcomes with the intervention, compared to costs and health outcomes without the intervention (e.g., the cost per QALY gained). Typically, the concept of an ICER is represented as:

$$\text{ICER} = \frac{\left(Cost_{w/} - Cost_{w/o}\right)}{\left(Health\ Outcome_{w/} - Health\ Outcome_{w/o}\right)}$$

Here, "$Cost_{w/}$" represents the present value of the sum of all costs associated with intervention over the entire time frame specified for the evaluation ("present value" refers to the process of discounting the dollar amounts of costs occurring in the future to their dollar value now, before summing costs across time). The "$Cost_{w/}$" term includes the costs of the intervention itself and all costs of subsequent health events, including adverse effects of the intervention and clinical outcomes related to the condition targeted by the intervention (e.g., coronary heart disease events) over the time horizon for the evaluation. The term "$Cost_{w/o}$" represents the analogous present value of all costs that would have occurred without the intervention over the same time period.

The terms "Health $Outcome_{w/.}$" and "Health $Outcome_{w/o}$" represent the cumulative health outcomes with and without the intervention, respectively, over the time frame for the evaluation. Organizations that conduct formal health technology assessment reviews, such as the Institute for Clinical and Economic Review in the United States or the National Institute for Health and Care Excellence (NICE) in the UK, typically measure effectiveness in terms of cumulative QALYs, which summarizes the net impact of any adverse health effects of the intervention as well as mortality or morbidity benefits. However, due in part to conceptual and ethical objections to the use of QALYs as a global effectiveness metric, such organizations often include alternative health effectiveness metrics in their evaluation reports, in some cases including key clinical "events" avoided, such as major cardiovascular disease events (MACE) avoided. Further, from a payor perspective, and particularly for managed care payors, who often may be focused on making resource allocation decisions related to care management for specific clinical conditions or diseases, effectiveness measured in terms of specific clinical events avoided may provide more salience than broad, global health effectiveness measures such as QALYs.

Note that an ICER merely provides decision makers with a "price" associated with achieving a specific unit of improvement in health outcomes resulting from an intervention. One limitation associated with using "clinical events avoided" to measure effectiveness is the absence of well-established benchmarks or thresholds to assess the value represented by specific ICER estimates, such as the oft-cited "$50,000 per QALY gained" value threshold. But even when thresholds exist, they merely provide some element of guidance; they do not automate decisions. Ultimately, decision makers must exercise judgment when deciding whether an intervention is a prudent use of funds. Beyond the "price" of the intervention (ICER estimates), there are several considerations that may factor into such decisions.

One key factor is the impact of implementing an intervention on the overall societal health budget or health payor costs. For example, suppose the net cost of implementing a program at a clinic for 1,000 women was $8,750. This value may be a small enough amount to be easily absorbed into the clinic's operating budget. However, a testing or screening program entailing a more expensive test or focusing on a larger segment of the clinic's patient population, could have an overall budget impact that would be sufficiently large as to make its adoption financially infeasible, even if the intervention has a reasonable ICER.

Another key factor, from an ethical or equity perspective, may be the specific population or health conditions affected by the intervention. Does the intervention primarily affect the health of older, frail individuals, or younger, otherwise healthy individuals? Does the intervention primarily improve health by preventing mortality or serious morbidity, or by improving health-related quality-of-life associated with relatively "minor" health problems? In other words, payers often have priorities when it comes to the specific areas for improvements in population health. For

example, cosmetic surgery can improve self-esteem and result in improved health-related quality-of-life, but payers typically have higher priorities for the use of funds to improve health.

CEA PLANNING AND IMPLEMENTATION

The Plan sheet in the CEA-basic-tool uses the steps outlined below to help users design a well-thought-out cost effectiveness analysis.

PLANNING

1. Determine the study perspective (may be more than one): payor, provider, patient, community, societal, etc.

   The perspective taken will be influenced by the entity doing the study. Governmental organizations are likely to take a broader societal view while payers, such as Managed Care Organizations (MCO), are more likely to focus on their own costs and revenues.

2. Determine the intervention to be studied and the time period over which the intervention is to be implemented.

   Although it might seem obvious, it is important to clearly articulate what the intervention will entail. Additionally, it is important to consider when and how long the intervention will be implemented.

3. Determine the long-term health goals of the intervention.

Clearly identifying the long-term health goals of the intervention helps users consider how to go about *quantifying* this goal such that they can perform a CEA and calculate an ICER.

4. Determine the *measurable* health outcomes to be studied and whether it should be maximized or minimized.

   This requires evaluating sufficient available information on the intervention's impact to make good estimates of how health outcomes of the target population will be impacted by the intervention. There are several approaches to this, including assessing the results of known clinical trials, evaluating the evidence that professional societies use in developing best practice guidelines, analyzing any available health data such as that collected and curated by the CDC, CMS, as well as state governments, and running a pilot program in the target population and then performing pre- and post-intervention analysis.

Identifying these health outcomes can be complicated by the fact that several different outcomes may be impacted by the same intervention. Thus, it is important to prioritize the most important outcomes. These will typically be those outcomes that generate the highest health delivery costs (this is a health outcome we would typically want to minimize) or have the greatest impact on patient quality of life (this is a health outcome we would typically want to maximize).

5. Identify the costs of the intervention and selected health outcomes.

a. Identify types of intervention costs germane to the study perspective: Medical / non-medical, direct expenditures, value of donated resources, productivity loss, patient co-pays and travel time, non-tangible costs, etc.

   Note that the intervention costs included will depend on the study perspective. For example, from the societal perspective, patient travel cost, lost productivity, and emotional distress due to the intervention might be very important, while a payor organization, such as an MCO, might only be interested in costs incurred by the organization itself.

b. Identify types of costs associated with the selected health outcomes.

   These costs are often related to health service usage due to undesirable health outcomes. For example, heart attacks typically incur emergency department treatment, hospital admission and readmission, medical treatment, pharmaceuticals, rehabilitation, possible disability, and so forth. It is important to estimate the level of these costs before the intervention is implemented. These baseline estimates provide a benchmark for determining how much overall costs change due to the intervention.

6. Identify data sources for implementing steps 4 & 5.

   These data sources might include insurance claims data, publicly available health data, data from EHRs and health information exchange organizations, research literature, etc. This step requires developing a working knowledge of each data set, including the context under which the data was generated (e.g., purpose, location, time period). Further, methods for synthesizing data sources must be identified. The next section of this document provides more details for this step.

7. Identify the keywords that could be useful in searching for relevant information online.

   If data sources are not available but need to be found via an online search, it is important to carefully consider the keywords that should be used in the search.

8. Determine the health outcome assessment period.

   Interventions and their impacts on health outcomes often occur over different time frames. For example, the impact of a two-year vaccination program may be measured over a period of 20 years.

9. Identify the criteria for evaluating the cost effectiveness ratio.

   The CEA will provide a ratio (CER) between the change in cost and the change in outcomes, as discussed above. But, the CER is only a number, whether it reflects acceptable cost effectiveness or not depends on the context of the study. Thus, the range of CER values that represents acceptable “cost effectiveness” for the given context of the study needs to be considered before the study begins.

10. Determine the intervention (i.e., treatment) and non-intervention (i.e., comparison) cohort sizes.

It is important to identify a large enough cohort, or sample size for both the intervention and non-intervention groups to generate statistically significant results.

11. Determine the inclusion and exclusion criteria for the study.

    It is important to identify the appropriate conditions to be used to admit clients to or exclude them from the study so as to generate the best possible study cohorts for the CEA.

12. Identify the team members who will assist with the study.

    This is useful when thinking through who will collect any necessary data and/or statistics from literature, who will interpret the results, and any other individuals who will be involved with the study.

IMPLEMENTATION

HOW TO MEASURE OR FIND THE REQUIRED DATA

Estimating cost and outcomes from MCO claims data

One source of data for estimating different health care costs is to use the claims data that the MCOs or HHSC have. As part of the CEA website, we created several curated data products that contain appropriate values for estimating common costs and outcomes from Medicaid encounter data in Texas. The Appendix, also available as the Definitions page on the website, details the measures we included in the curated data products.

Estimating cost for common hospitalizations in Texas

Hospital admissions are one of the main sources of high cost in health care. Thus, interventions are often designed with the goal of avoiding hospitalizations or reducing length of stay. Therefore, accurate estimates related to hospitalizations in Texas are often needed in cost effectiveness studies. A good source of data for estimating costs for hospitalizations is the Texas Inpatient Public Use Data File (IP-PUDF) maintained by the Texas Health Care Information Collection (THCIC) at the Texas Center for Health Statistics[1].

As part of the CEA website, we created two curated data products, the Mental Health Cost Lookup and the Heart Condition Cost Lookup, that contain information for various cost and health outcome estimates related to hospitalizations in Texas using the THCIC IP-PUDF. The unit of analysis for time and space was calendar year and the 13 Service Delivery Areas (SDA) in Texas respectively to provide the most accurate estimates. We identified the most common reasons for hospitalizations for mental health conditions and heart conditions based on the Healthcare Cost and Utilization Project (HCUP) report "National Inpatient Hospital Costs: The Most Expensive Conditions by Payer, 2017"[2]. These conditions are listed below.

[1] https://www.dshs.texas.gov/thcic/hospitals/Inpatientpudf.shtm
[2] https://www.hcup-us.ahrq.gov/reports/statbriefs/sb261-Most-Expensive-Hospital-Conditions-2017.jsp

Mental Health Conditions
- Alcohol-related disorders
- Depressive disorders
- Schizophrenia spectrum and other psychotic disorders

Heart Conditions
- Acute myocardial infarction
- Cardiac and circulatory congenital anomalies
- Heart failure
- Hypertension and hypertensive-related conditions complicating pregnancy; childbirth; and the puerperium
- Major cardiovascular disease events (MACE)[3]

Locating estimates in the literature

Peer-reviewed research literature is a primary source of information on the effectiveness of health interventions. Any health intervention of importance is likely to have an associated body of research literature reporting on its effectiveness. The most compelling evidence for an intervention's impact on health outcomes is often provided by research papers that report the results of clinical trials. Systematic reviews of such papers are particularly important, since they gather together evidence arising from many clinical trials into a single convenient source. Any intervention of interest is quite likely to have at least one published systematic review that summarizes most findings up to the date of publication. There are many other types of published studies that can provide important information on intervention effectiveness. These include meta-analyses, cohort studies, case-control studies, cross-section studies and many others. Gathering and critically assessing a relevant portion of this literature can reveal much about an intervention's potential impact on a target population.

Methods used to gather and assess published literature are very important. If a research literature assessment is being considered, it is best to consult a medical librarian. These librarians are skilled in planning and performing research literature reviews and their help is often essential. A good librarian can help assure that the literature review will:

1. Be based on a clearly defined research question
2. Include all relevant databases
3. Use literature from reliable, authoritative sources
4. Define key terms, terminology and definitions
5. Have a clear, well designed literature search query
6. Include all relevant information on the subject
7. Exclude all non-relevant information
8. Provide a critical assessment of the literature, its strengths, weaknesses, and gaps

[3] This category was manually added since it is a popular health outcome used in heart condition studies. It is based on the definition used in Miao, B., Hernandez, A. V., Alberts, M. J., Mangiafico, N., Roman, Y. M., & Coleman, C. I. (2020). Incidence and predictors of major adverse cardiovascular events in patients with established atherosclerotic disease or multiple risk factors. Journal of the American Heart Association, 9(2), e014402.

One area where the librarian is particularly helpful is in locating the relevant databases to search and constructing appropriate queries for those databases. There are many important health-related databases that maintain up-to-date information on published research. The National Institutes of Health (NIH) maintains one of the largest medical libraries, the National Library of Medicine (NLM), and this is an excellent place to begin looking for available literature on potential health interventions. The NLM provides online access to a number of important databases, including its database on clinical trials (http://clinicaltrials.gov), which is particularly important for gathering credible evidence on the impacts of health interventions. Further, NLM's PubMed Health (http://www.ncbi.nlm.nih.gov/pubmedhealth/) provides detailed information on systematic reviews of published clinical trial results, and the NIH Clinical Alerts and Advisories database (http://www.nlm.nih.gov/databases/alerts/clinical_alerts.html) provides expedited information from ongoing NIH clinical trials that could significantly impact disease and death.

Other types of literature that can be useful exist and are often termed "grey" literature. Such literature is typically not formally published and thus may lack independent peer review. Examples of grey literature include white papers, government reports, dissertations, committee reports, conference papers, and so forth. Grey literature is important and should not be dismissed off-hand, since it may include studies with negative findings (which often goes unreported), discussion of important industrial trends, contextual information hard to gather from peer-reviewed research literature, and more preliminary findings. However, information in grey literature must be approached with caution since reporting standards could be much lower.

Locating estimates in public data sources

With continuing investments by both public and private sector on the open data initiatives, more and more data are available on public data repositories every year. Here we briefly describe how to locate estimates from public data sources and provide some good sources to use. These links are available on the CEA website under the *Other Data Resources* page for easy access.

One benefit of using publicly available data may be that some fragments of relevant information useful for a CEA project may be available before all studies have been completed and confirmed about its effectiveness. This is because, unlike peer-reviewed literature, there is no mechanism for information quality control on the Web. Thus, typically information is published on the Web faster than peer-reviewed literature. The flip side to this is that websites are filled with misleading, inaccurate, outdated, constantly changing and potentially dangerous information, as well as sales pitches. So, when using public data sources, it is important to use reliable sources and understand exactly what the data mean (i.e., the measure definition).

Often using publicly available data is called secondary data analysis because we are using data that was not collected per say for the purpose of a CEA project, but rather the data is available as a by-product of data collected for other primary purposes such as billing. Thus, most often the exact data that would be optimal for a CEA is not available. But there may be many other data points available that are similar enough to be useful in a CEA as a proxy for certain measures. In secondary data analysis, it is important to fully appreciate the meaning of the data that is available and the potential gap in the data that is available versus what is ideally desired.

For example, for a CEA project you might want to use monthly cost of hospitalizations from congestive heart failure. But the only publicly available data that you can find is annual cost. It is key to appreciate that the unit of analysis differs and must be adjusted in some acceptable way (e.g., assume uniform monthly costs and divide by 12). Units of analyses have different

dimensions, as discussed in the planning steps above, that all need to be considered such as time (e.g., monthly, annual), space (e.g., city, county, hospital), and entity (e.g., per hospitalization, per patient, per hospital).

If the exact data for a CEA is not available, consider looking for similar data that can be used as a proxy or with adjustments (e.g., if cost for Texas is not available, maybe there is an overall USA based cost data). Finally, often there will be many sources for one data point that are not the same. In these cases, it is important to first identify all sources, consider the differences, the reliability and applicability of the different sources for the CEA and make a good judgement call on which data is best suited for the CEA.

We also note that some of these data sources may have some data use limitations, required training, and/or acknowledgement of the terms of use (e.g., agree to not attempt to link data to other sources). Many are freely available, but some data may have to be purchased for a fee. In this section, we list some reliable sources of health data repositories that include Texas data. We also recommend always citing the information source along with the date the website was accessed because information is dynamic (i.e., changing constantly) on the Web. We recommend citing a URL as follows:

Author's last name, Initial(s). (Year posted/last updated). *Title of work*. Retrieved [month day, year], from https://URL

Texas Center for Health Statistics (CHS)

The Texas Center for Health Statistics (CHS) has a plethora of health data that is specific to Texas and may be the best place to start looking for cost or utilization data. Below are three links that can get you started on exploring what data may be relevant to your CEA project.

Texas Center for Health Statistics (CHS), Department of Health State Services (DSHS) (n.d.). *Texas Health Data*. Retrieved [May 1, 2021] from http://healthdata.dshs.texas.gov/

Texas Center for Health Statistics (CHS), Department of Health State Services (DSHS) (2020). *Links to Health Related Data*. Retrieved [May 1, 2021] from https://www.dshs.state.tx.us/chs/links-to-health-related-data.shtm

Texas Center for Health Statistics (CHS), Department of Health State Services (DSHS) (2021). *Texas Health Care Information Collection (THCIC)*. Retrieved [May 1, 2021] from https://www.dshs.texas.gov/thcic/

Other Texas Health Data Repositories

Both the Texas Hospital Association and the Dallas Fort Worth Hospital Council (DFWHC) Foundation have a data repository that may be useful for your CEA project in Texas. The Texas PricePoint Website has pricing data on the most common inpatient services by hospitals in Texas using the same THCIC Inpatient data mentioned in the section above. Currently, the data repository has only data for 2017 calendar year. The Healthy North Texas Community Health Website is an initiative of the DFWHC Foundation through the work of the Community Health Collaborative that has comprehensive county level indicator data that covers topics in health (e.g., alcohol & drug use, cancer), community (e.g., demographics, domestic violence & abuse),

economy (e.g., poverty, housing), education (e.g., literacy, student performance), and environmental health (e.g., built environment, air). Healthy North Texas covers data for 17 counties in North Texas.

Texas Hospital Association (n.d.). *Texas PricePoint.* Retrieved [May 1, 2021] from https://www.txpricepoint.org/default

DFWHC Foundation (n.d.). *Healthy North Texas.* Retrieved [May 1, 2021] from http://www.healthyntexas.org/topiccenter

Federal Government Data Repositories with Health Data

There are many federal government health data repositories that may potentially be useful for a CEA project. Below we list the main agency data websites and some examples that may be more relevant for data on health care cost or utilization. Some datasets are available in multiple federal agency websites.

- Centers for Disease Control and Prevention (CDC)
  - The National Center for Health Statistics
  - http://www.cdc.gov/nchs/
- Center for Medicare and Medicaid Services (CMS)
  - https://www.cms.gov/newsroom/data
  - Medicare hospital cost report data (HCRIS)
    - https://www.cms.gov/Research-Statistics-Data-and-Systems/Downloadable-Public-Use-Files/Cost-Reports
- Agency for Healthcare Research and Quality (AHRQ)
  - http://www.ahrq.gov/data/
  - Healthcare Cost and Utilization Project (HCUP)
    - https://www.hcup-us.ahrq.gov/
  - Medical Expenditure Panel Survey (MEPS): MEPS is one of the most complete sources of data on the cost and use of health care and health insurance coverage.
    - https://www.meps.ahrq.gov/mepsweb/
- Health Resources & Services Administration (HRSA)
  - https://data.hrsa.gov/data/about
  - Area Health Resource File (AHRF): AHRF is a collection of data from numerous sources, measured at the county level, by year, for 'recent' years including (1) Population socioeconomics and demographics, (2) Hospital & nursing home capacity & utilization, (3) Health workforce (physicians, pharmacists, etc.)
    - https://data.hrsa.gov/topics/health-workforce/ahrf
- The US Census Bureau
  - http://www.census.gov/
  - Survey of Income and Program Participation (SIPP): SIPP Collects data related to source and amount of income, labor force information, various poverty program participation and eligibility data, and general demographic characteristics. It is a series of panel datasets, with monthly data for 2.5 to 4 years per panel, for 14,000 to 37,000K households. Detailed information is available about household income and assets, and "in-kind" income via assistance programs. It also includes good health insurance coverage data and some health services utilization data
    - https://www.census.gov/programs-surveys/sipp.html

- Bureau of Labor Statistics (BLS)
  - BLS has detailed national and some state/local data relating to Prices (overall, health care, etc.), Wages & employment (by industry or occupation), and occupational injury
  - https://www.bls.gov/
- US Department of Health and Human Services
  - https://healthdata.gov/
- National Institutes of Health (NIH)
  - https://www.nih.gov/health-information
  - Value Sets: Validated health measure definitions such as ICD code sets or procedure code sets.
    - https://vsac.nlm.nih.gov/
- The main federal government open data initiative managed by the US General Services Administration which also includes many health data.
  - https://www.data.gov/

Other Health Data Repositories

There are many more health data repositories online that cannot all be covered in this document. Below we list two more websites that can provide a more comprehensive list of reliable sources that may be helpful in a CEA.

- Partners in information access for the public health workforce: This is a public and private partnership of over 10 organizations to facilitate public health workforce to access and use data for public health and contains many health data at the local, state, national, and global level.
  - https://phpartners.org/ph_public/health_stats

- The Library of Congress Science Reference Guide No 34: Locating Health and Medical Information (Aug 2010) contains a very comprehensive list of websites including many of those discussed above.
  - https://www.loc.gov/rr/scitech/SciRefGuides/medicalinfo.html

PERFORM THE CEA

After the CEA has been planned, data gathered, and required cost and outcome estimates derived and stored in the data product, the next step will be to compute the ICER. This will be done automatically by executing methods programmed into the Excel CEA-basic-tool workbook (CEA-basic-tool-v16.xlsx) once the necessary information is entered. The ICER will then be computed and provided as output to the user.

Finally, after completing the CEA, it will be necessary to interpret the results. Interpretation will depend on decisions made during the planning phase, specifically step 4, where we determine whether the health outcome should be minimized or maximized, and step 9, where the criteria for evaluating the cost effectiveness ratio was determined. In other words, does the computed ICER fall within a range that the analyst would judge to be cost effective? To answer this, the user should use the CEA Plan and Interpretation sheets as illustrated in Tutorial Video #6.

OTHER COST STUDY STATISTICAL APPROACHES

In this section, we briefly describe two more approaches to cost studies that are often used in the literature. Basic understanding of these methods will facilitate better understanding and judgement in what data from the literature are most applicable to the CEA. The first is a baseline analysis using regression techniques to compare the post-costs of the treatment and comparison groups; the second is a "difference of differences" approach that compares the growth trend of costs for the treatment group with the growth trend of costs for the comparison groups.

BASELINE POST-COST ANALYSIS

Regression analysis is a well-known data analysis method used to examine how a set of independent (input) variables act together to influence the value of a dependent (output) variable. While there are many varieties of regression models, those applied in this work will be based on the following form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon$$

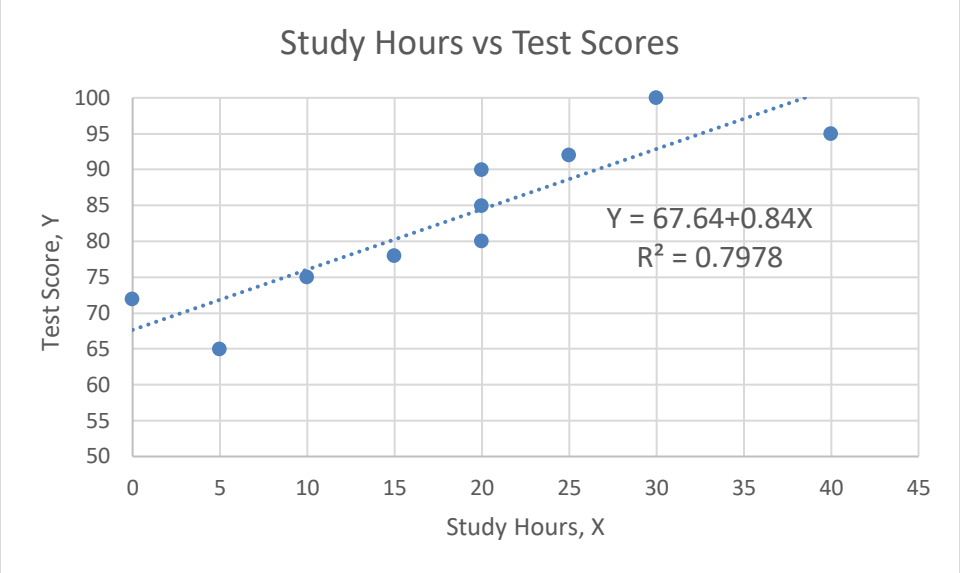
Here, Y is the dependent variable (in our case, the client post-cost); the $X_1 \ldots X_n$ represent independent variables (discussed below); the $\beta_0, \beta_1, \ldots, \beta_n$ represent the effects the independent variables have on the dependent variable; and ε represents inherent randomness.

Note that the values $\beta_0, \beta_1, \ldots, \beta_n$ are unknown and must be estimated from data. For example, Figure 1 shows a plotted data set consisting of student test scores (the dependent variable or Y) and hours of study (the independent variable or X). Each small blue circle on the graph represents an observed data point. Clearly, the test scores increase as the number of hours studied goes up. The regression equation estimated from the data (Y = 67.64+ 0.84X) captures this relationship quantitatively.

Here 67.64 is our best estimate of β_0 (the expected score for zero hours of study) and 0.84 is the best estimate of β_1 (the expected increase in test score for every additional hour of study). This equation can be interpreted as follows: those who do not study will, on average, make around 67 on the test. We expect that every additional hour of study will raise the test score by 0.84 points. Thus, those students who study about 15 hours can expect to make around 80 on the test (80 = 67.4 + 0.84x15).

Clearly, this equation is not exact since, as reflected in the data, some students make above what is expected (the dotted line) and some make below. Further, some important variables may not be included in the model, for example, the student's IQ, which results in some bias. The R^2 value shown on the graph is a statistic computed from the model errors (differences between the model prediction and the data) that tells us how much of the variation in test scores is explained by hours study. R^2 values close to 1 indicate that the behavior of the dependent variable is well captured by the fitted model. An R^2 value of 0.79 might indicate that there are factors affecting the test scores that are not included in the model.

Figure 1 Example Regression



In this work, we created a regression equation for each treatment / comparison group pair. Note that, by design, all clients in a treatment / comparison group pair have the same SFY and risk class. Further, all clients in the same treatment group have the same teleservice type. Thus, these variables, already used to structure the data, will not be included in the regression models.

The dependent variable, Y, will be client post-cost. The independent variables accounted for in the regression are:

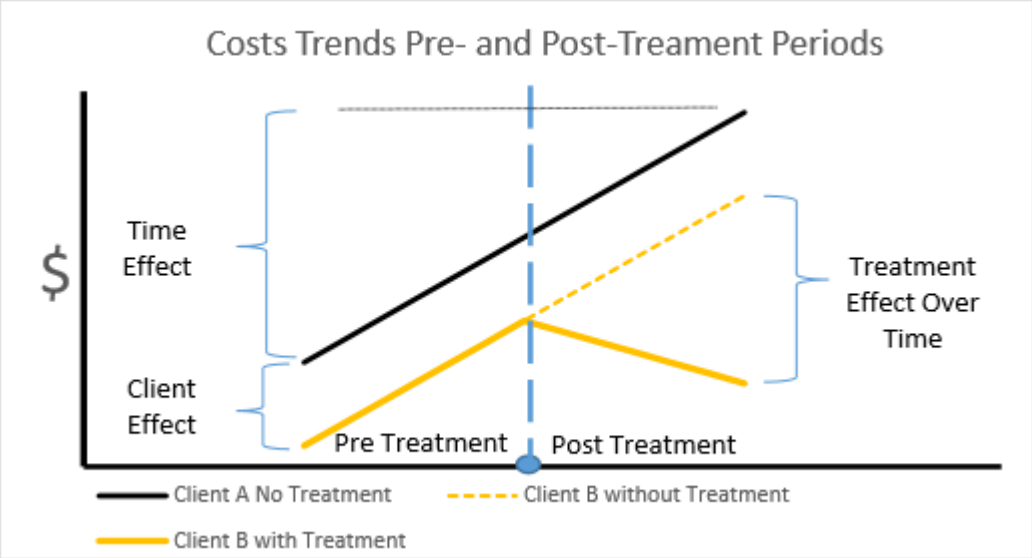
1. Type of client: tele client or non-tele client;
2. Comorbidity index six months prior to the index month (the overall burden of chronic disease on the client's health state during this time);
3. Specified diseases in the Elixhauser Comorbidity Index (diabetes, hypertension, etc.);
4. Dual eligibility (Medicaid and Medicare);
5. Demographics and Medicaid plan (age, gender, race, FFS plan, TANF, foster care, and AFDC child);
6. Geography (county of residence);
7. Seasonality (indexdate).

The resulting regression provides estimates of how much each of these independent variables impacts post-cost for the given sample. Variables 2-7 are included to account for variation not due to client type (variable 1). This reduces bias and makes the estimate of client type (impact of teleservices) more precise. In other words, the regression procedure adjusts the estimates of teleservice impact to account for variation in the data resulting from other client differences and uncontrollable randomness, thus providing an adjusted estimate of how much the use of teleservices impacts post-cost.

DIFFERENCE IN DIFFERENCES (DID) ANALYSIS

Additionally, we compare the difference in pre- and post-costs of tele and non-tele clients to determine whether the trend in cost growth changes in the six-month period after a client initiates teleservices. . Figure 2 is useful in understanding the motivation for this.

Figure 2 Difference in Differences Analysis



Notice in the period preceding the treatment, the costs of the Clients A and B are different but trending in the same way. But, during the period following the treatment, the costs of Client B, who received the treatment, trend differently and are eventually much different than they might otherwise have been. The "difference in differences" analysis attempts to estimate the time, client, and the treatment over time effects in order to capture this trending difference. The underlying assumption is that, had Client B not received the treatment, then Client B's trend would have proceeded as in the pre-treatment period.

To perform this study, we compute the difference in pre- and post-cost for every client in each cohort. We will then statistically compare the difference in pre- and post-costs for each tele client cohort with the pre- and post-costs of non-tele clients in the comparison group. Results are reported and discussed in subsequent sections.

CEA CASE STUDY

The following case study was designed to illustrate how to compute an ICER and interpret it with respect to an economic evaluation based on the procedures outlined in the previous sections of this document.

A safety net clinic is considering starting a program to test asymptomatic women at risk for chlamydia and treat them if a positive screening is observed. Currently, the clinic does not test asymptomatic women who are at risk for chlamydia. Each year, it sees an average of 22 cases

of pelvic inflammatory disease per 1,000 women due to untreated, asymptomatic chlamydia. Because of budgetary restrictions, the clinic is able to spend at most $800 to avoid one case of PID. They have put together the table below with all relevant program costs. They have asked us to determine if this program would be feasible given their budget.

Procedure	Cost Per Patient
Chlamydia Screening	$50.00
Chlamydia Treatment	$15.00
PID Treatment	$3,500.00

(Hypothetical) Research findings relevant to this study:
- 1 in 20 women have asymptomatic chlamydia
- 1 in 100 women develop PID due to untreated, asymptomatic chlamydia

Because the safety net clinic has asked us to perform the economic evaluation, we will perform the study based on their perspective. For simplicity, we will assume the program (i.e., the intervention) will be implemented for a one-year trial period. Before we dive into the details of the calculations, we must first identify the long-term health goal of this program. For the clinic, we will assume that they want to reduce the complications associated with untreated chlamydia. Now we must identify how we will quantify this long-term goal such that we can perform a CEA and calculate an ICER. We will first identify the costs associated with the program. If we assume that 1,000 clients are included in the treatment group, then using the values in the case study text above, we can compute the total cost for the program during the intervention period.

Chlamydia Screening	($50/client)*(1000 clients) = $50,000
Chlamydia Treatment	($15/client)*[(1000 clients)*(1/20 women with asymptomatic chlamydia)] = $750
PID Treatment	($3,500/case of PID)*[(1000 clients)*(1/100 women develop PID due to untreated, asymptomatic chlamydia)] = $35,000
TOTAL	$85,750 per year (of intervention implementation)

To accurately perform the CEA, we must also identify the cost of not implementing this program during the same length of time as the intervention period. To do this, we must establish a comparison group with similar demographics. If we assume that 1,000 clients are included in the comparison group, then using the values in the case study text above, we can compute the total cost incurred in this group during a one-year period.

Chlamydia Screening	($50/client)*(0 clients) = $0
Chlamydia Treatment	($15/client)*[(0 clients)*(1/20 women with asymptomatic chlamydia)] = $0
PID Treatment	($3,500/case of PID)*(22 clients who developed PID due to untreated, asymptomatic chlamydia) = $77,000
TOTAL	$77,000 per year

Taking the difference of the cost in these two groups, we can see that the net cost of implementing the program is $8,750.

Next, we must consider the measurable health outcome we want to use as the basis for our economic evaluation. Based on the case study text, there is only one outcome we need to consider: the number of PID cases avoided due to the intervention. Because we want to *avoid* PID cases, our objective will be to minimize the health outcome. For this example, we will assume that this health outcome will be assessed during a one-year time period. (Note that the health outcome assessment period and the intervention period are *not required* to be the same.) Now, we can determine the total health outcome for the treatment and comparison groups described above. We are told in the case study that the clinic sees an average of 22 cases of pelvic inflammatory disease per 1,000 women each year due to untreated, asymptomatic chlamydia. Based on the (hypothetical) research findings, we know that 1 in 100 women develop PID due to untreated, asymptomatic chlamydia. Thus, the treatment program will prevent (1000 clients)*(1/100 women develop PID due to untreated, asymptomatic chlamydia) = 10 cases of PID each year. Taking the difference of the health outcome in these two groups, we can see that the net (difference in) health outcome from implementing the program is 12 fewer cases of PID each year.

To calculate the ICER, we use the formula given in the previous section,

$$\text{ICER} = \frac{\left(Cost_{w/} - Cost_{w/o}\right)}{\left(Health\ Outcome_{w/} - Health\ Outcome_{w/o}\right)} = \frac{\$8{,}750}{-12} = \$(729.17)$$

Using the Interpretation sheet in the CEA-basic-tool, we know that this value can be interpreted as follows:

> Under the intervention, we spent more money and bad outcomes (i.e., the number of PID cases) decreased. The ICER indicates how much more we had to spend to get one less unit of bad outcome. The intervention might or might not be cost effective, depending on the purpose of the study and judgement of the analyst.

The case study text told us that the clinic could spend at most $800 to avoid one case of PID. Thus, we conclude that the intervention of interest is both beneficial to patients and financially feasible for the safety net clinic to implement.

■

APPENDIX

Cost Effectiveness Analysis Tool

https://vidal.tamu.edu/cea/

Data Product Definitions

version 1

AUGUST 31, 2021

POPULATION INFORMATICS

Center for Remote Health Technologies & Systems
TEXAS A&M ENGINEERING EXPERIMENT STATION

TABLE OF CONTENTS

COST STUDY PURPOSE

The TAMU Cost report presents the results of an analysis of Texas Medicaid claims for 2012-2018. The objective was to determine how teleservices impact Medicaid spending in Texas. Medicaid clients were divided into five groups that are commonly eligible for the Medicaid programs to analyze televisits (i.e., a virtual visit): Aged, Pregnant, Child, Blind/Disabled, and Parents. In addition, we added a separate group of anyone who received Telemonitoring services which is fundamentally a different remote service from the televisits. Treatment cohorts (clients receiving teleservices) and comparison cohorts (clients not receiving teleservices) were established for each.

The purpose of this website is to expand the Texas-wide study to include the more detailed 13 Service Delivery Areas (SDA). A few notes we would like to make:

- To ensure privacy protection for aggregate data, a threshold of 5 patients per Medicaid risk group was applied to each table included on the website. If less than 5 patients were included in a particular Medicaid risk group for a given state fiscal year, all of the values related to that particular group were suppressed by replacing them with the symbol "---".
- The Aged, Pregnant & Parents Medicaid risk groups were combined into an "Other" group because, on their own, these groups did not typically exceed the threshold across most years.
- All of the Cost Study tables on this website group the Child, Blind/Disabled and Other Medicaid risk groups under the umbrella term "Tele Visits" and the Telemonitoring Medicaid risk group is left on its own.

For the explicit definitions of the terms used above, see the Cost Study Term Definitions section.

COST STUDY TERM DEFINITIONS

GENERAL COST STUDY TERM DEFINITIONS

The Health Services Resource Agency (HRSA) defines telehealth as "the use of electronic information and telecommunication technologies to support long-distance clinical health care, patient and professional health-related education, public health, and health administration" [22]. Technologies used typically include store and forward imaging, internet-based applications, interactive video conferencing, wireless communications, and so forth.

By legal statute, the state of Texas identifies three types of services distinguished by the licensing qualifications of the provider:

Telemedicine: defined in Texas Government Code §531.001(8) as "Health care service[s] delivered by a physician licensed in this state, or a health professional acting under the delegation and supervision of a physician licensed in this state, and acting within the scope of

the physician's or health professional's license to a patient at a different physical location than the physician or health professional using telecommunications or information technology."

Telehealth: defined in Texas Government Code §531.001(7) as "Health service[s], other than telemedicine medical service[s], delivered by a health professional licensed, certified, or otherwise entitled to practice in this state and acting within the scope of the health professional's license, certification, or entitlement to a patient at a different physical location than the health professional using telecommunications or information technology."

Telemonitoring: defined in Texas Government Code §531.001(4-a) as the "...scheduled remote monitoring of data related to a patient's health and transmission of the data to a licensed home and community support services agency or a hospital." In the Texas Medicaid program, home telemonitoring requires an RN or other qualified healthcare professional.

Additional terminology developed for the TAMU Cost report and referenced in the Cost Study pages on this website is given below. Note that for terminology developed for this work, the prefix "tele" will typically be followed by a blank space. This will help to distinguish it from Texas statute terminology such as "telemedicine" and "telehealth."

SERVICE-RELATED DEFINITIONS:

Teleservices: Service delivered through telemedicine, telehealth, and telemonitoring, as defined by the state of Texas.

Tele visit: Category of teleservices in which the client's visit with a provider or health care professional is done virtually rather than in person. Tele visits encompass *both* telemedicine and telehealth services but *not* telemonitoring. Telemonitoring is a separate category since the mode of service provision is significantly different.

CLIENT-RELATED DEFINITIONS:

Client: An individual engaged in Medicaid services.

- Non-tele client: Medicaid client with no teleservice-related Medicaid claims.
- Tele client: Medicaid client with at least one teleservice-related Medicaid claim.

Comorbidity: Presence of more than one disease or disorder in the same client, for example, diabetes and hypertension.

Comorbidity Index: Measure that indicates the overall burden of disease that an individual client suffers from. The index used in this work is the Elixhauser index [19,26], which counts the total number of conditions (out of 31 considered) present in a given client. For example, a client with 5 out of the 31 conditions present would have a comorbidity index of 5.

Medicaid Risk Groups: Specified groups of clients of particular interest to policy makers. Risk groups are created based on the Medicaid category of assistance program. Risk groups distinguished in the Cost Study data set (based on the TAMU Cost Report) include:

- Blind/Disabled – Medicaid clients identified as blind and / or disabled in the Medicaid assistance program and those identified with coverage in the breast and cervical cancer program (BCCP)
- Child – Medicaid clients aged 21 years or younger and those in the foster care, adoption, and those that have coverage in the Texas Temporary Assistance for Needy Families (TANF) program
- Other – Combines the following groups
    - Parents – Medicaid clients 21 to 65 years of age enrolled in any program for any type for parental reasons.
    - Aged – Medicaid clients aged 65 and older in the aged assistance program
    - Pregnant – Medicaid clients in the pregnant program

Treatment Group: Group of tele clients with shared common characteristics (for example, they received services in the same state fiscal year, used the same teleservice types, belonged to the same Medicaid risk groups, had similar comorbidity indices, had the same specified chronic diseases, had similar demographics, etc.).

Comparison Group: Group of non-tele clients who closely match the tele clients of a treatment group.

COST-RELATED DEFINITIONS:

Index month: A client's index month is any month that satisfies these conditions:

1. The client's index month must have continuous Medicaid eligibility in the six months before (pre-period) and in the six months after (post-period) the index month;
2. The client's index month must have positive pre-costs (defined below);
3. For non-tele clients, the client's index month is the first month satisfying 1 & 2 above;
4. For tele clients, the client's index month is the month of the first teleservice encounter.

Note that clients without a definable index month are excluded from the study. These are clients who have no month of eligibility that satisfies the conditions above. More explicitly, these are clients who either do not have at least 13 months of continuous eligibility, or, if they do, have no claims in any of those months of eligibility, except perhaps in the last seven months of eligibility (implying zero pre-cost, as defined below). Clients who do not have an index month cannot be accurately assessed and are thus not included in the study.

Pre-cost: Average of the total medical or pharmaceutical costs per client per month for the six-month period preceding an index month. Does not include the index month.
Post-cost: Average of the total medical or pharmaceutical costs per client per month for the six-month period following an index month. Does not include the index month.

*Note: All references given above are in the TAMU Cost Report (found under the Documents tab at the top right side of the webpage).

DEMOGRAPHICS TERM DEFINITIONS

The tables on this webpage have 3 levels of headers. We will break down each header, from top to bottom. Note: (1) All of the Cost Study tables on this website group the Child, Blind/Disabled and Other Medicaid risk groups under the umbrella term “Tele Visits” and the Telemonitoring Medicaid risk group is left on its own. (2) The tables on the Demographics webpage do not include the Other Medicaid risk group.

- Top-Most Headers: Separates the Medicaid risk groups into Tele Visits and Telemonitoring categories.
- Mid-Level Headers: Specifies the Medicaid risk group of interest. The Total column under the Telemonitoring row only contains values for that Medicaid risk group.
- Bottom-Most Headers:
    - The Treatment and Comparison columns specify the treatment and comparison cohorts for each Medicaid risk group of interest.
    - The Year column specifies the state fiscal year (defined as September 1 of a given calendar year to August 31 of the following calendar year (e.g., 09/01/2020 - 08/31/2021)) used to group the data when computing the given statistics.
    - The Patient Characteristics column specifies the statistic given in that row for each (column) header. The possible statistics are defined below:
        - Number of Clients: the total number of clients under the (column) headers in the given year. For example, The integer (3,525) in the first non-header row & first non-header column of the table “Demographics for Texas” is interpreted as: There were 3,525 clients in the Child Medicaid risk group (which was defined as being under the Tele Visits category) in the treatment cohort in state fiscal year 2013.)
        - Age - average age of client in the specified header category
        - Female - percentage of females under the (column) headers in the given year
        - White - percentage of clients who identified as white under the (column) headers in the given year
        - Black - percentage of clients who identified as black under the (column) headers in the given year
        - FFS - percentage of clients who were under a Fee-For-Service healthcare plan under the (column) headers in the given year
        - Dual Eligible - percentage of clients who were dual eligible under the (column) headers in the given year
        - Comorbidity Index - Average comorbidity index of all clients under the (column) headers in the given year

TOTAL MEDICAL COST TERM DEFINITIONS

The tables on this webpage have 3 levels of headers. We will break down each header, from top to bottom. Note: (1) All of the Cost Study tables on this website group the Child,

Blind/Disabled and Other Medicaid risk groups under the umbrella term “Tele Visits” and the Telemonitoring Medicaid risk group is left on its own.

- Top-Most Headers: Separates the Medicaid risk groups into Tele Visits and Telemonitoring categories.
- Mid-Level Headers: Specifies the Medicaid risk group of interest. Note: The Total column under the Tele Visits row is an aggregate of the Medicaid risk groups: Child, Blind/Disabled, Aged, Pregnant and Parents. The Total column under the Telemonitoring row only contains values for that Medicaid risk group.
- Bottom-Most Headers:
    - The Treatment and Comparison columns specify the treatment and comparison cohorts for each Medicaid risk group of interest.
    - The Year column specifies the state fiscal year (defined as September 1 of a given calendar year to August 31 of the following calendar year (e.g., 09/01/2020 - 08/31/2021)) used to group the data when computing the given statistics.

- Table: Number of Clients
    - Row-level detail: the total number of clients under the (column) headers in the given year

- Table: Pre Cost Table
    - Row-level detail: The average of the total cost per client per month for the six-month period preceding an index month (Does not include the index month.) under the (column) headers in the given year

- Table: Post Cost Table
    - Row-level detail: The average of the total cost per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the given year

INPATIENT CARE COST

- Table: Number of Clients
    - Row-level detail: the total number of clients under the (column) headers in the given year
- Table: Post Cost Table
    - Row-level detail: The average of the total cost per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the given year
- Table: Inpatient Encounters Table
    - Row-level detail: The average of the total number of inpatient encounters for all hospital admissions per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the

given year. Note: Each inpatient encounter represents a distinct inpatient stay but does not measure the length of stay of the inpatient visit.

ED COST

- Table: Number of Clients
    - Row-level detail: the total number of clients under the (column) headers in the given year
- Table: Post Cost Table
    - Row-level detail: The average of the total cost per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the given year
- Table: Emergency Department Visits Table
    - Row-level detail: The average of the total number of outpatient ED visits that did not lead to an inpatient stay per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the given year.

OUTPATIENT CARE COST

- Table: Number of Clients
    - Row-level detail: the total number of clients under the (column) headers in the given year
- Table: Post Cost Table
    - Row-level detail: The average of the total cost per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the given year
- Table: Outpatients Visits Table
    - Row-level detail: The average of the total unique number of medical visits to providers that do not include visits identified during a hospital inpatient stay or ED visit per client per month for the six-month period after an index month (Does not include the index month.) under the (column) headers in the given year. Note: The physician review of the weekly monitored vital sign data is mostly counted as part of an outpatient visit. Thus, for the telemonitoring group, there is an expected increase of approximately 4 additional outpatient visits per month by definition.

INPATIENT DATA TERM DEFINITIONS

Reference for Data:

Texas Hospital Inpatient Discharge Public Use Data File, Q12016-Q42019. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas. 2017-2020.

MENTAL HEALTH TERM DEFINITIONS

Condition: The classification system used for this table is the Clinical Classifications Software Refined (CCSR) v2021.2. In particular, the Default CCSR for Principal Diagnosis is used, which groups ICD-10 CM codes into common medical conditions. The ICD-10 CM groupings of each condition are given below.

- Alcohol-related disorders: F1010, F10120, F10121, F10129, F10130, F10131, F10132, F10139, F1014, F10150, F10151, F10159, F10180, F10181, F10182, F10188, F1019, F1020, F10220, F10221, F10229, F10230, F10231, F10232, F10239, F1024, F10250, F10251, F10259, F1026, F1027, F10280, F10281, F10282, F10288, F1029, F10920, F10921, F10929, F10930, F10931, F10932, F10939, F1094, F10950, F10951, F10959, F1096, F1097, F10980, F10981, F10982, F10988, F1099, G312
- Depressive disorders: F0631, F0632, F320, F321, F322, F323, F324, F328, F3281, F3289, F329, F330, F331, F332, F333, F3341, F338, F339, F341
- Schizophrenia spectrum and other psychotic disorders: F060, F061, F062, F200, F201, F202, F203, F205, F2081, F2089, F209, F21, F22, F23, F24, F250, F251, F258, F259, F28, F29

Year: Calendar year in which inpatient discharges occurred.

Hospitalization Count: The total number of inpatient discharges that occurred during the specified year for the given condition. Note: This count does not count unique patients, but rather discharges themselves.

Avg Length of Stay: The average length of stay (in days) per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Length of Stay in days *equals* Statement covers period through date minus Admission/start of care date. The minimum length of stay is 1 day. The maximum is 9999 days.

Std Dev Length of Stay: The standard deviation of the length of stay (in days) per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Length of Stay in days *equals* Statement covers period through date minus Admission/start of care date. The minimum length of stay is 1 day. The maximum is 9999 days.

Avg Charges: The average of the total charges per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Total Charges is the sum of accommodation charges, non-covered accommodation charges, ancillary charges, non-covered ancillary charges.

Std Dev Charges: The standard deviation of the total charges per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data

Dictionary, Total Charges is the sum of accommodation charges, non-covered accommodation charges, ancillary charges, non-covered ancillary charges.

HEART CONDITIONS TERM DEFINITIONS

Condition: The first four categories listed below use the Clinical Classifications Software Refined (CCSR) v2021.2 classification system. In particular, the Default CCSR for Principal Diagnosis is used for these categories, which groups ICD-10 CM codes into common medical conditions. The last category listed below uses the definition used in Miao, B., Hernandez, A. V., Alberts, M. J., Mangiafico, N., Roman, Y. M., & Coleman, C. I. (2020). Incidence and predictors of major adverse cardiovascular events in patients with established atherosclerotic disease or multiple risk factors. Journal of the American Heart Association, 9(2), e014402.The ICD-10 CM groupings of each condition are given below.

- Acute myocardial infarction: 2101, I2102, I2109, I2111, I2119, I2121, I2129, I213, I214, I219, I21A1, I21A9, I220, I221, I222, I228, I229
- Cardiac and circulatory congenital anomalies: Q200, Q201, Q202, Q203, Q204, Q205, Q206, Q208, Q209, Q210, Q211, Q212, Q213, Q214, Q218, Q219, Q220, Q221, Q222, Q223, Q224, Q225, Q226, Q228, Q229, Q230, Q231, Q232, Q233, Q234, Q238, Q239, Q240, Q241, Q242, Q243, Q244, Q245, Q246, Q248, Q249, Q250, Q251, Q252, Q2521, Q2529, Q253, Q254, Q2540, Q2541, Q2542, Q2543, Q2544, Q2545, Q2546, Q2547, Q2548, Q2549, Q255, Q256, Q2571, Q2572, Q2579, Q258, Q259, Q260, Q261, Q262, Q263, Q264, Q265, Q266, Q268, Q269, Q270, Q271, Q272, Q2730, Q2731, Q2732, Q2733, Q2734, Q2739, Q274, Q278, Q279, Q280, Q281, Q282, Q283, Q288, Q289
- Heart failure: I0981, I110, I130, I501, I5020, I5021, I5022, I5023, I5030, I5031, I5032, I5033, I5040, I5041, I5042, I5043, I50810, I50811, I50812, I50813, I50814, I5082, I5083, I5084, I5089, I509
- Hypertension and hypertensive-related conditions complicating pregnancy; childbirth; and the puerperium: I119, I150, I151, I152, I158, I159, I160, I161, I169, I674
- MACE Event: visit this link.

Year: Calendar year in which inpatient discharges occurred.

Hospitalization Count: The total number of inpatient discharges that occurred during the specified year for the given condition. Note: This count does not count unique patients, but rather discharges themselves.

Avg Length of Stay: The average length of stay (in days) per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Length of Stay in days *equals* Statement covers period through date minus Admission/start of care date. The minimum length of stay is 1 day. The maximum is 9999 days.

Std Dev Length of Stay: The standard deviation of the length of stay (in days) per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Length of Stay in days *equals* Statement covers period through date

minus Admission/start of care date. The minimum length of stay is 1 day. The maximum is 9999 days.

Avg Charges: The average of the total charges per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Total Charges is the sum of accommodation charges, non-covered accommodation charges, ancillary charges, non-covered ancillary charges.

Std Dev Charges: The standard deviation of the total charges per hospitalization during the specified year for the given condition. Note: According to the Inpatient Public Use Data File Data Dictionary, Total Charges is the sum of accommodation charges, non-covered accommodation charges, ancillary charges, non-covered ancillary charges.