PINR Research Disease-Based Price Indexes Technical Documentation

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This document is a technical user guide for the Disease-Based Price Indexes (DBPI). We provide a brief overview of the methodology behind the indexes, describe the different index options, and highlight some issues with index interpretation.

The section I provides an overview of the methodology and discusses how the indexes are calculated. The indexes are published in a spreadsheet with a number of different options. The next section (II) discusses the different versions of the disease-based price indexes. Section III discusses some issues relating to interpreting the indexes. Section IV provides some background on the history of disease-based price indexes, and section V provides references for further reading.

I. Index Construction and Calculation

The disease base price indexes (DBPI) measure changes in the price to treat specific diseases There are 2 components of this price change: the change in the price of medical goods and services and the change in the mix of services used to treat a given condition. Traditional service-based price indexes track the price changes of specific medical goods and services over time. The traditional price indexes will miss the change in cost from changes in the mix of services used to treat a given disease. For example, if the treatment of a given disease uses fewer medical services, then the cost of treating that disease falls even if the price of each service is unchanged.

The average utilization to treat a disease in a given year is calculated using the Medical Expenditure Panel Survey (MEPS). The DBPI for disease d in period t is given by:

$$I_{d,t}^{DBPI} = \frac{\sum_{k=1}^{K} p_{k,d,t} z_{k,d,y(t)}}{\sum_{k=1}^{K} p_{k,d,0} z_{k,d,y(0)}},$$

where p is the price of medical service type k to treat disease d and z is the number of units of k used to treat the disease.[1] The function, y(t) refers to the year used to calculate the utilization. Since MEPS data is published with a lag, the function y() refers to 3 years before the contemporaneous year for month t. The disease and service type price is calculated using the MEPS price in the base period inflated using the corresponding CPI or PPI service price index.[2] For example, the price of physician services for disease d in month t is the base period MEPS price times the change in the physician PPI since the base period.

For comparison, we also produce a fixed quantity Lowe index using the following formula:

$$I_{d,t}^{Lowe} = \frac{\sum_{k=1}^{K} p_{k,d,t} z_{k,d,y(0)}}{\sum_{k=1}^{K} p_{k,d,0} z_{k,d,y(0)}}$$

[1] The K types of medical goods and services are: inpatient hospitalizations, outpatient hospital visits, doctor's office visits, emergency room visits, home health care services, and prescription drugs.

[2] The PPI indexes are used for the medical services, while the CPI is used for prescription drugs.

The difference between the DBPI and the Lowe index is that the Lowe index uses the base period quantities in both the numerator and denominator.

II. Index Options

We publish the DBPIs with a number of different options and also publish standard errors. This section discusses the different published versions of the indexes and the preferred ones.

1. Main indexes vs. indexes for select specific conditions

We publish the indexes at 2 different levels of aggregation in 2 different spreadsheets. The main indexes are constructed and reported at the ICD-9 chapter level (i.e., 17 broad categories) in addition to an aggregate all-disease index. In addition, we report sub-chapter level indexes for 112 select specific conditions.[3] The indexes for select specific conditions should be interpreted with some caution as the sample sizes in the MEPS may be too small to reliably estimate the typical mix of services used to treat the condition. The preferred specification is the chapter level indexes.

2. Cumulative vs. monthly

The monthly indexes are the change from the prior month. The cumulative indexes are constructed as monthly chained series and represent the change since the base period (Dec. 1998 = 1).

3. Fixed quantity (Lowe) vs. Adjusted Quantity (DBPIs)

The fixed quantity indexes correspond to the Lowe indexes and hold the treatment basket fixed at the base period quantities. Changes in the Lowe index reflect price changes for the medical goods and services only. The adjusted quantity indexes are the DBPIs where changes in the treatment basket are counted as price changes. Comparing the DBPIs to the Lowe index shows the impact of the changing treatment basket. The adjusted quantity indexes are the preferred indexes and the fixed quantity indexes are presented for comparison purposes.

4. Comorbidity Adjusted vs. Unadjusted

A given medical treatment can be associated with the treatment of multiple diseases. In one version of the index, we assign the treatment to each of the diagnoses as one unit. This is the comorbidity unadjusted index. We also produce a comorbidity adjusted index that assigns the unit of treatment to each diagnosis using a simple pro-rationing method. For example, if the treatment bundle for heart disease has 2 doctors office visits and the bundle for diabetes has 1 office visit, then an office visit for both diabetes and heart disease would allocate 2/3^{rds} of a visit to heart disease and 1/3rd of an office visit to diabetes. These comorbidity adjusted units are then used when defining the treatment bundle for each disease. Generally, the comorbidity adjusted indexes are our preferred specification, however, they may be sensitive to the specific comorbidity adjustment method used.

[3] We initially produced indexes for 115 conditions, but had to drop some due to unreliable coverage in MEPS.

5. Smooth vs. Unsmooth

In the DBPIs, new utilization data from MEPS enters in January of each year. This creates a jump in the indexes in January. The smoothed indexes spread the change in utilization over the entire year. So, 1/12 of the change in quantity is allocated to each month. In December of each year, the full quantity change is accounted for in the smoothed indexes and the smooth and unsmooth index values are the same. So, looking at December to December changes is one way to avoid the smoothing issue. We don't have a preferred specification.

6. Standard Errors

DBPIs are calculated using MEPS annual utilization data as quantities and CPI and PPI monthly medical service indices as prices. Thus, each of the data sources contribute to the variances of DBPIs. Calculating the total variance of a DBPI would require knowing the covariance between the MEPS quantities and CPI/PPI medical prices, which is unknown. We only attempt to address the variability from MEPS quantities, which is likely to be the largest source of variation for many of the indexes.

To estimate the variances of the indexes, we use the bootstrapping method. Each year, a total of 20 samples are created from MEPS quantities data using probability proportional to size (PPS) sampling with replacement. Sampling weights are personal weights in MEPS data and each sample is selected to have the same number of observations as the original sample. New DBPIs are then calculated using the 20 bootstrapped sample quantities and the same CPI/PPI prices in order to estimate sample variances each period. The standard deviation is calculated as the square root of the variance of one month price changes across the bootstrapped samples.

The reported values are the standard deviations of the month-to-month change in the index (i.e., they are not cumulative). Since MEPS quantities are updated each year, the standard deviations spike in January and are lower in the other months of the year. For dental diseases, we directly use the CPI dentist indexes as given thus the reported standard deviation is zero (so no variation arises from the use of MEPS data for the dental index).

III. Notes on Index Interpretation

1. Discontinuities in the Data: ICD9 to ICD10 changeover

Changes in the MEPS utilization data can create discontinuities in the price indexes. One example is the change from ICD-9 to ICD-10 and the resulting change in diagnosis classification in MEPS. This change affects the disease based price indexes starting in Jan. 2019. The indexes pre- and post-Jan. 2019 are not directly comparable. The 2018 indexes use 2015 MEPS data. The 2019 indexes use 2016 MEPS data. In 2015 and earlier years, MEPS categorized diagnoses based on the ICD-9 diagnosis codes into groups of similar conditions called clinical classification codes. Beginning in 2016, diagnosis codes switched to ICD-10 and MEPS switched from using the clinical classification codes to providing the 3-digit ICD-10 code (as a crosswalk from ICD-10 codes to clinical classification codes does not exist).[4] To produce the indexes after the switch to ICD-10, we manually mapped each 3-digit ICD-10 code to a single clinical classification

[4] Beginning in 2018, MEPS began to include a refined CCS code alongside the 3-digit ICD-10 code but has not provided a mapping between the original CCS codes and the refined CCS codes.

code using third party medical claims data. The full ICD-10 code is mapped to an ICD-9 code. Then, the most frequent clinical classification code associated with each 3-digit ICD-10 code is the one assigned to the 3-digit ICD-10 code when forming the 3-digit ICD-10 to clinical classification code crosswalk. This is a preliminary solution to addressing the ICD-9 to 10 changeover in the MEPS data and is limited by the full diagnosis code not being available in the MEPS data (due to confidentiality).

2. Changes in disease severity over time

In order for the DBPIs to be interpreted as pure price changes, the assumption is that average severity for each condition is constant over. If average severity changes over time, the DBPIs will reflect the resulting changes in utilization as a change in price. One factor that could drive a change in average severity over time is that the average utilization is calculated for those diagnosed with a given disease who receive some treatment. If, over time, minor cases are more likely to be diagnosed and receive treatment, this would cause the prevalence of the disease to increase but the average treatment intensity to decline over time, which would put downward pressure on the DBPI.

3. Lack of disease specific service price indexes

The price for a given type of service for a given disease is estimated using base period price inflated by the PPI or CPI index. A limitation of this method is that the same PPI and CPI indexes are used for all diseases (disease specific medical service price indexes are not available). This means that if prices for treatments of a specific disease are increasing faster or slower than the services for other diseases, it will not be reflected in the DBPI. For example, the price change for drugs used to treat diabetes in the DBPI will equal the change in the CPI prescription drug index even though the price of insulin may increase faster or slower than other prescription drugs. Also, since the PPI/CPI price indexes are used to estimate the price of the medical service to treat a specific disease, it will miss expenditure increases due to the introduction of new technologies.

4. Quality Adjustment

The DBPI, like the traditional service-based price indexes, are not quality adjusted for changes in outcomes over time. In order to fully understand how much we are getting for the additional medical spending, it is important to know how much this spending improves outcomes.

IV. Background and Development of Disease Based Price Indexes

In 2019, healthcare accounted for 17.7 percent of U.S. Gross Domestic Product (GDP).[5] Because healthcare is such a large sector, it is important that we measure its output and prices correctly. If published healthcare inflation rates are too high, then measured real output growth is too low and consumers are getting more for their healthcare dollar than the published estimates suggest. Similarly, if published healthcare inflation rates are too low, measured real output growth would be too high.

[5] National Health Expenditure Accounts (NHEA) by the Centers for Medicare & Medicaid Services, CMS

The Bureau of Labor Statistics (BLS) is committed to producing and publishing the most accurate medical price indexes possible. BLS has constructed research disease-based price indexes to find a better way to estimate inflation, real medical output, and real consumption.

Federal statistical agencies currently report medical data for goods and services. The National Health Expenditure Accounts (NHEA), the National Income and Product Accounts (NIPA), the Producer Price Index (PPI), and the Consumer Price Index (CPI) all report their medical statistics for physician services, hospital services, pharmaceuticals and other types of medical goods and services. However, many economists and others who analyze healthcare data believe this is not the best way to report medical statistics. In 1967, the U.S. Department of Health, Education, and Welfare noted:

"...the average consumer of medical care is not as interested in the price of a visit or hospital day as he is in the total cost of an episode of illness."[6]

Starting with the pioneering work of Anne Scitovsky (1967), many analysts found that reporting medical statistics on a disease basis rather than a goods and services basis could provide better information on well-being. There can be large differences between the two methods because reporting on a disease basis can account for new technology that changes the use of medical resources. For example, in the 1990s a new generation of antidepressants could treat depression with fewer therapy visits. A disease-based price index for depression could account for this change in treatment, but indexes produced under the traditional approach of using medical goods and services could not.

Studies completed in the 1990's and early 2000's compute price indexes for cataracts, heart disease and depression.[7] These studies find that their disease-based price indexes grow less rapidly than indexes based on goods and services. The reason is that innovations changed how medical goods and services are used to treat these diseases. As a result, the Committee on National Statistics (CNSTAT) in 2002 published a recommendation that BLS create research disease-based price indexes.[8] This recommendation calls on BLS to use medical claims data to determine the quantity of physician visits, hospital visits and other inputs and use these quantities as weights in the construction of disease-based price indexes. The prices for these indexes would continue to come from the current price-collection system. While BLS would continue to generate monthly research disease-based price indexes from its monthly price collection system, the quantities would only be updated every year or two. The information on this page results from the CNSTAT recommendation.

When BLS set out to implement the CNSTAT recommendation, we established several criteria. First, the indexes had to be timely. Second, they needed to have a cost-of-living basis. Third, they could be used as an input for the All-Items Consumer Price Index. Fourth, there could be no additional costs or any disruption to existing statistical programs when constructing these indexes. Finally, the methods must be transparent.

Because of the criterion for no additional costs, BLS could not use medical claims for inputs because medical claims data are expensive. Instead, we use the publicly available Medical Expenditure Panel

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[6] US Department of Health, Education and Welfare (1967), A Report to the President on Medical Care Prices, U.S. Government Printing Office, page 13.

[7] For heart disease, see Cutler et. al. (1998). For depression, see Berndt et. al. 2002. For cataracts, see Shapiro and Wilcox (1996).

[8] This is recommendation 6.1 in Mackie and Schultze (2002).

Survey (MEPS). We then get a blended data result, with prices from the BLS price index programs and quantities from MEPS.

One challenge in constructing disease-based price indexes is the choice of a method that accounts for comorbidities. Comorbidities occur when a physician office visit or a hospital visit treats a patient for more than one disease. We construct two types of disease-based price indexes that account for comorbidities differently.

Similar to BLS's currently published Lowe medical indexes, the research disease-based price indexes need a representative sample of medical transaction prices. The sampling of medical prices is a challenging task. Respondent participation in our price-collection programs is voluntary, and the reimbursement rates negotiated between insurers and medical providers often are proprietary. These rates are not posted for all customers to observe in the same way as, say, coffee prices in a grocery store. This puts more burden on respondents for the medical providers and on the BLS field economists who collect these prices. BLS has reduced respondent burden, and we are trying to reduce it even more. We appreciate the cooperation of the medical providers who participate in our price-collection program.

It is a great accomplishment to release these indexes in timely manner without increasing costs or disrupting our current statistical programs. BLS has found a way to use our existing products better.

Yet, there is still much to do. Patients consume medical goods and services to heal or be protected from disease. However, there currently is no reliable data source on the healing and prevention outcomes from medical spending. Many data users have suggested that BLS adjust our healthcare price indexes to reflect changes in the quality of the treatment outcomes that result from new technology. There are many challenges to quality adjustment, and we outline them in our methods.

Disease-based price indexes are in their infancy. We regard them as research indexes because we still need to learn more from the research that we and others will conduct. As we learn and improve these indexes, BLS hopes that they will greatly enhance our understanding of the healthcare sector.

We list below additional research about healthcare price indexes. Not all the authors of the research papers and conference presentations are affiliated with BLS. We provide this information for your convenience, and this research does not necessarily reflect the views or policies of BLS.

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