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Personalized Healthcare for Patients
Access to Price Transparency

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Abstract

We created an intelligent system that can accurately predict the price of an elective health care expense before the service is given. A database of paid health care claims is used to determine the price paid for elective services for each provider and insurance product. This is a difficult and important problem because the same service at the same provider can be a different price for people with different types of insurance, and the same service for a person with a given type of insurance can be a different price at different providers. The tool has been in use by Capital District Physicians' Health Plan, Inc. (CDPHP®) employees since August 2016, and it is part of a service called CDPHP Price Check, where customer care specialists work with this augmented intelligence system to educate members about health care prices. A review of actual costs for 18 people who got the price estimates and then followed through to get the service showed that the estimates were usually within 2 percent of the actual price paid. In September 2017, it was made available for use by 35,000 high deductible plan members.

Introduction to Health Care Pricing

The price of a health care-related service for someone with medical insurance is set by negotiations between the health care providers and insurers. The price could be a set amount per unit of service provided, a set amount for a bundle of services, a percent off from a provider's charged price (percent-off-charges), or other agreed-upon methods of determining a price. A single provider can have different prices with different insurers, and a single insurer can have different prices with different providers. For example, in 2016, the cost for an MRI of the brain at different participating providers in the same area of upstate New York was as low as $303 or as high as $3,594 for the same person using the same insurance. There was no difference in the quality of the MRI, but a large difference in the cost. It can be difficult for a provider to know all the possible prices for all services with all possible insurers, and it can be difficult for an insurer to know all prices for all services at all possible providers. However, people with high deductible plans can be responsible for all of these costs until they reach their deductible and a portion after that. One study of a transparency tool for MRI scans showed that the transparency resulted in a $220 cost reduction per test [Wu, et. al. 2014]. So, it would be in the interest of the person receiving the service to know what the price would be at their desired provider before the service is rendered. Consequently, we created a health care price transparency tool that can provide a price estimate for services such as medical imaging, elective surgery, joint replacement, and childbirth. This tool is used by trained customer care specialists to clearly inform and educate CDPHP members about the prices of these services.

This paper will describe other attempts at price transparency, the problem that this tool solves, the methods used to calculate the prices, the user interface used by the customer care specialists, and results from people who used the service to get an estimate and then had the service performed.

Other Price Transparency Efforts

Before we describe CDPHP Price Check, it would be helpful to describe other price transparency efforts. Healthcare Bluebook™ and UnitedHealthcare have had successful efforts related to health care price transparency [Beck 2014]. Healthcare Bluebook™, https://healthcarebluebook.com/, is a web page that allows people to find the fair price for a health care service in a given area. This is very useful and the site does a good job breaking the costs into components, like facility price, professional price, and anesthesia price that add up to the total price. This fair price is especially useful for insurance plans that use reference pricing, where the insurance plan limits its contribution to a health service to a fixed amount [Boynton and Robinson 2015]. However, there is no information on which providers are charging the

fair price. It would be more informative to know the fair price and the prices each provider is charging.

UnitedHealthcare created a web-based tool called myHealthcare Cost Estimator that allows their members to select health care services and get the prices for those services at various providers. A video describing the tool is available at http://www.welcometomyuhc.com/hcce-review/video/pre/. This self-service tool allows people to search for and compare prices that are calculated from contracts with the providers. This goes beyond what Healthcare Bluebook™ provides by giving provider-specific prices.

At CDPHP, our first effort at a tool to provide price estimates was to simply take a member's desired service at a provider, create a dummy claim for it, and price the dummy claim through our normal pricing algorithms, similar to the way myHealthcare Cost Estimator estimates prices. CDPHP prices thousands of claims per day, so using the existing claims-processing algorithms could be an accurate way to price services before they are performed. However, a couple of factors made this difficult. First, different providers could bill the same service in different ways. The providers can bill services using Current Procedure Terminology (CPT®) codes, which describe the unique non-divisible services rendered. A medical claim can have multiple claim lines, with each line having a different CPT® code. The providers could also bill using revenue codes that we convert to Diagnostic Related Groups (DRGs), which convert multiple facility claim lines or claims into a single bundle wherein the price is for the bundle instead of the individual procedures. Different providers can use different CPT codes, DRGs, or combinations of CPT codes and DRGs when submitting a claim. This strategy for estimating prices would require a list of all possible variations of codes and methods that a given provider could use to bill for a service. (The remainder of this paper will use the term "claim" for both claims and claim lines for simplicity.) Second, the prices for some CPT codes are a function of the price charged by the provider. A contract could specify a cap on the price or a percentage discount off the charged price as the price that will be allowed. To correctly price these claims, we would need to create and maintain a list of prices charged by each provider for each possible CPT code or DRG. Furthermore, some providers do not share their charged prices except when a claim is submitted, preferring to keep them a secret. These factors led us to look for an alternative method of creating a price transparency tool that would be more maintainable.

The Problem that CDPHP Price Check Solves

CDPHP Price Check is a recommender system that uses techniques including data mining, case-based reasoning, knowledge representation, knowledge-based systems and statistics to automate the calculation and updating of healthcare price estimates. It uses a database that stores a wide range of information about every medical claim where our insurance has been charged. The data includes a description of the CPT code or DRG used and the price allowed after our pricing algorithms have run, along with descriptive information, including the person getting the service, the service provider, the date of service, procedure modifiers or explanation codes, the person's plan type (Medicaid, Medicare, Commercial, etc.), and the type of contract the provider has for that type of insurance. This data is similar to the data collected by some states in their All-Payer Claims Databases [Porter et. al., 2015]. Instead of solving the problem of what the negotiated rate will be for a new claim with a specific provider, we can solve the problem, "what was the allowed price for the service at a specific provider in the last year?" If the variability in the allowed prices for the same service at the same provider is low enough, the historical allowed price can be used as a good estimate of the future price. You can think of this as being similar to an existing case-based reasoning system that comes up with a value for a house by finding sales prices for comparable houses [Cheetham and Bonissone 2001].

There are multiple types of questions a person can ask regarding the price of health care services. The ones that CDPHP Price Check addresses are:

- What is a typical good price for a service? [This is similar to what Healthcare Bluebook™ provides]
- What is the price of a specific service at a specific provider? [This is what myHealthcare Cost Estimator provides]
- What provider has the lowest price for a service?
- What are the prices for a service at a provider near me?

One limitation of our tool is that we currently only give prices for services without complications. A given service can cost different amounts depending on the complications found during the service and it is not always possible to predict when a service will have a complication. For example, a normal vaginal birth can have a much higher price if the baby is premature or there is a complication for the mother. To provide a fair comparison of providers, we priced only services that were done without complications. These is almost always the most common version of the procedure. The facts that procedures with complications are more expensive, and that it is not always possible to predict if there will be a complication during a service, prevented us from giving price guarantees. Instead of guaranteed future prices, we provide information based on historical costs of the services by provider.

Only services that people are most likely to have time and interest to price check were selected to be covered by CDPHP Price Check. A list of the services is in Table 1, along with the main CPT code for that service. Other CPT codes or revenue codes can be used to bill for some of these services, but the CPT code listed is the main code related to

the service. The services are roughly listed in order from lowest to highest billing complexity.

Table 1. List of Services

CPT®	Service
93000	Electrocardiogram with at least 12 leads
70551	MRI Scan Brain
70552	MRI Scan Of Brain With Contrast
70553	MRI Scan Of Brain Before And After Contrast
71250	CT Scan Chest
71260	CT Scan Chest With Contrast
72141	MRI Scan Of Upper Spinal Canal
72148	MRI Scan Of Lower Spinal Canal
72156	MRI Scan Of Upper Spinal Canal Before And After Contrast
72158	MRI Scan Of Lower Spinal Canal Before And After Contrast
72192	CT Scan Pelvis
72193	CT Scan Pelvis With Contrast
73221	MRI Scan Of Arm Joint
73721	MRI Scan Of Leg Joint
74150	CT Scan Abdomen
74160	CT Scan Abdomen With Contrast
74170	CT Scan Abdomen Before And After Contrast
74176	CT Scan Of Abdomen And Pelvis
74178	CT Scan Of Abdomen And Pelvis Before And After Contrast
29848	Release Of Wrist Ligament Using An Endoscope
42820	Removal Of Tonsils And Adenoid Glands Patient Younger Than Age 12
42821	Removal Of Tonsils And Adenoid Glands Patient Age 12 Or Over
42825	Removal Of Tonsils Patient Younger Than Age 12
42826	Removal Of Tonsils Patient Age 12 Or Over
43239	Biopsy Of The Esophagus, Stomach, And/Or Upper Small Bowel Using An Endoscope
47562	Removal Of Gallbladder Using An Endoscope
49505	Repair Of Groin Hernia Patient Age 5 Years Or Older
49650	Repair Of Groin Hernia Using An Endoscope
55250	Removal Of Sperm Duct
64721	Release And/Or Relocation Of Median Nerve Of Hand
66984	Removal Of Cataract With Insertion Of Lens
27130	Total Hip Replacement
27447	Total Knee Replacement
59400	Vaginal Delivery
59510	Cesarean Section

Method Used to Calculate the Prices

We created a knowledge-based system, using the programming language SAS, which takes historical medical claims as historical cases and uses these to calculate and periodically update tables with a standard price for each provider of each service based on paid claims from the previous year and also creates a list of counties serviced by each provider for each service. These tables are then combined with data on a member's type of insurance, deductible, and current contribution to their deductible to calculate a member responsibility for the service. Different services can have different ways that they are billed, and different providers can bill the service in different ways, so the software application needs to have a different algorithm for each service or group of services. As time passes, the software application can run periodically using newer claims as input data, and the standard prices can be updated to reflect pricing changes at the providers. This section will describe how those algorithms were created.

The output of the algorithm for a specific service is represented in a table with one provider per row and columns for the total price and each component of the price. A subset of the standard price table for electrocardiogram is in Table 2, with real prices from 2015 and the names of the providers changed. The providers can bill the electrocardiogram as one bundled service or as two related claims, one for the collection of the data (called the technical portion) and another for its interpretation (called the professional portion). If there is an empty cell in the technical and professional columns, the service was bundled by the provider so that only the total price was given.

Table 2. Output Table for Electrocardiogram w 12 Leads

Provider	Total Price	Technical	Professional
Provider 1	$22		
Provider 2	$22	$11	$11
Provider 3	$23		
Provider 4	$24		
Provider 5	$61	$50	$11
Provider 6	$242	$229	$13

The prices can be different for Medicaid, Medicare, and Commercial members. This paper will address the creation of tables for Commercial members. Commercial High Deducible members have the most motivation to search for fair prices. Medicaid members, who pay nothing out of pocket, may have less motivation to look for fair prices.

The steps for the initial creation of each table are:

1. Identify all the ways that this service can be billed, including all components of the charges.
2. Identify any other procedures that are commonly charged with this service or for the same member and day.
3. Calculate the median price and standard deviation for each provider and method of billing.

4. Inspect the data to make sure the standard deviation is low or the deviation is explained (e.g., one possible explanation is that there are multiple groups at one provider who bill differently and should be split into different providers).
5. Encode a knowledge-based system to create a table with one row per provider (or group) and method of billing that includes the total price of all components of the service and the price of each component, as is shown in Table 2.

The next subsections describe how the knowledge-based system was created and validated. Billing for some related types of services is similar, so only one example will be given for each type. The types are Electrocardiogram, Medical Imaging, Outpatient Surgery, Joint Replacement, and Childbirth.

Electrocardiogram with At Least 12 Leads

An electrocardiogram (EKG or ECG) tests the electrical activity of a person's heart. This subsection will describe how Table 2 was created. Step 1 is to identify all the ways that this service can be billed. An electrocardiogram can be billed using CPT code 93000, which covers data collection and interpretation, or with two CPT codes, 93005 for the collection of the data and 93010 for its interpretation. These are the only ways an EKG with at least 12 leads is billed. Other forms of EKGs can be billed with different CPT codes. Step 2 is to identify any other procedures besides 93000, 93005, and 93010 that are commonly charged with the electrocardiogram. After reviewing all claims for the same person and day as the 93000, 93005, or 93010 claims, we didn't find any other common claims. Step 3 is to calculate the median price and standard deviation for each provider and method of billing. Before calculating these statistical properties, we need to exclude any claims that would not be paid at the typical price. Excluding these will allow for a fair comparison between providers. We use only claims with a place of service equal to Office or Outpatient, that are for Commercial members (not Medicaid or Medicare), are not self-funded groups (they can have special prices only available to themselves), where CDPHP is the only insurer paying the claim, where CDPHP does have a direct contract with the provider, where there were no special modifiers on the claim, and the claim was from 2015. Even with all these constraints, there were still 34,000 paid claims found for CPT 93000. Next, we calculate the median price and standard deviation for each provider using just CPT 93000. Before we can calculate the statistics for the claims that used CPT codes 93005 and 93010, we keep only claims with both 93005 and 93010 for the same person on the same day and match those claims together. Next, from the matched claims we calculate the median price and standard deviation for 93005 and 93010 for each provider. The total cost for each provider is the sum of the median price for 93005 and the median price for 93010 for that provider. Step 4 is to inspect the data to make sure the standard deviation is low or the deviation is explained. The standard deviations were low because most providers billed consistently. One source of variation was that a subgroup at a provider could sometimes bill using 93000 at a low price, and a different subgroup at the same provider would use a combination of 93005 and 93010 at a combined price that is higher than the cost of the subgroup using 93000. For situations like this, we keep the price information for each subgroup separate and have two rows in the output table for that provider, with an added description of the subgroup. Step 5 is to create a table with one row per provider (or group) and method of billing that includes the total price of all components of the service and the price of each component. Two non-final tables are created: one for billing with 93000 and another for billing with the combination of two CPT codes. The two tables are concatenated and sorted by total price to produce the final table, Table 2. The resulting table has four columns, Provider, Total Price, Technical, and Professional. Finally, a list of each county that the providers deliver the service is created.

Medical Imaging

The medical imaging services that were included in CDPHP Price Check included multiple types of magnetic resonance imaging (MRI) and computed tomography (CT). MRI and CT scan price estimates can be created in a similar way. Each different MRI or CT scan has a different CPT code, as listed in Table 1, but the rest of the process is the same. They can have one claim for the entire service or two claims for different subparts of the service - a claim for the technical component (i.e., taking the image) and a claim for the professional component (i.e., reading the image). Unlike the billing for an electrocardiogram, which had different CPT codes for the subparts of the bill, medical imaging uses the same CPT code and different CPT modifiers. CPT modifiers are two-digit codes that are added to the end of a CPT code. A bill for the full technical and professional claim would have no modifier. A claim for just the technical portion of the service would have a "TC" modifier, and the bill for just the professional portion would have a modifier of "26" [Abraham, 2012]. That concludes Step 1. Step 2 showed that there are common procedure codes that are often claimed on the same day as medical imaging. Providers will often do multiple MRI or CT scans on the same day, so when giving a quote, it is important to make sure the patient knows which scans will be performed so they get the correct price estimate. Steps 3 and 4 are similar to the electrocardiogram. One difference when matching the technical and professional claims was that we also checked for improperly billed claims that lacked a modifier and a bill with a modifier for the same member and day. There were two providers that

consistently billed incorrectly. Their claims were reviewed and adjusted from the price without a modifier to the lower price for the "26" modifier. The providers were also informed of the correct billing practice. Step 5 produced the final tables. One of the tables, "70553 – MRI Scan of Brain before and after Contrast," is shown in Table 3. Where there were hundreds of providers who could perform an electrocardiogram, there were only 27 in-network providers who performed MRI scans of the brain before and after contrast. Table 3 shows the prices for every third provider sorted by total price and gives a good representation of the distribution of prices at the various providers, with many performing the service at a fair price, while a few are paid much more.

Table 3. Output Table for MRI Scan of Brain Before and After Contrast

Provider	Total Price	Technical	Professional
Provider 1	$488		
Provider 2	$497	$342	$155
Provider 3	$498	$343	$155
Provider 4	$499	$344	$155
Provider 5	$500		
Provider 6	$500	$345	$155
Provider 7	$536		
Provider 8	$599		
Provider 9	$994		
Provider 10	$3,488	$3,333	$155

Outpatient Surgery

Outpatient surgery does not require an overnight stay in a hospital. The billing of an outpatient surgery service will consist of a provider charge for the person doing the surgery, a facility charge for the location of the surgery, and usually an anesthesia charge. All of the services in Table 1 from "Release of Wrist Ligament Using an Endoscope" to "Removal of Cataract with Insertion of Lens" are outpatient surgery services. The provider and facility charges will have the same CPT code, but the former will be marked as a professional claim and the latter as a facility claim. Medical claims can be one of multiple types (Facility, Professional, Pharmacy, etc.). If a claim with a surgery CPT code is classified as Professional, it is for the provider performing the surgery. If a claim with a surgery CPT code is classified as Facility, it is for the facility where the surgery was performed. Anesthesia can be billed in a variety of ways, such as a claim with a CPT code between 00100 and 01999. Providers can charge zero, one, or multiple claims for anesthesia for a single surgery depending on if or how the anesthesia is administered. For anesthesia we take the sum of all anesthesia costs for the member on the day of the surgery. The result of Step 1 is the determination that the outpatient surgery price is always the sum of the professional claim, the facility claim, and the sum of all anesthesia claims. For Step 2, each type of surgery needs to be investigated individually to determine if there are other common charges. For example, "66984 - Removal of Cataract with Insertion of Lens" will often have an extra price for the lens to be inserted. The other surgeries would not have this added price, but could have some price specific only to them. In addition to common charges, there can be common discounts. For example, the service "Release of Wrist Ligament" could be done on both wrists and the second procedure would be eligible for a multi-procedure discount of 50 percent. We removed all services that had a multi-procedure discount. For Step 3, we took the median facility price, median professional price, median of the sum of all anesthesia on that day, and median cost of a lens. These four prices were then added to obtain the total price. In Step 4, we found that the professional price did not have much variance. The facility price had a large difference among different facilities but was consistent within a facility. The anesthesia price did vary within a facility because it is based on the time of the surgery, which can also vary. However, the median of the anesthesia was still the best price estimate possible given the variance. Some facilities charged a separate price for the lens and some did not, so we needed to add the price for the facilities that did charge it. The table that was created in Step 5 is shown in Table 4. The tables for the other outpatient services have a similar format, with the facility and anesthesia prices showing the most variation among providers.

Table 4. Output Table for Removal of Cataract with Insertion of Lens

Provider	Total Price	Facility	Professional	Anesthesia	Lens
Prov 1	$2,552	$1,328	$853	$371	$0
Prov 2	$2,966	$1,490	$853	$445	$178
Prov 3	$3,679	$1,810	$853	$1,016	$0
Prov 4	$4,592	$2,389	$1,003	$960	$240
Prov 5	$5,829	$4,457	$853	$519	$0
Prov 6	$5,885	$4,552	$853	$480	$0
Prov 7	$5,897	$4,480	$897	$519	$0
Prov 8	$6,080	$4,663	$863	$555	$0
Prov 9	$12,174	$9,900	$1,003	$967	$304

Joint Replacement

The joint replacement services covered are for the removal and replacement of a knee or hip. In Step 1, it was found that these services require an inpatient stay that is usually billed with a revenue code, a professional charge for the provider, and a charge for anesthesia. Different providers can use different DRG systems. Our providers can either use Medicare DRGs from the Centers for Medicare & Medicaid Services

(CMS-DRG) or All Patient Refined DRGs (APR-DRG), which are designed for non-Medicare patients. So, for a hip replacement, the inpatient facility can bill using CMS-DRG 470 or either of the APR-DRGs, 3011 or 3012. Any of these DRGs would be for a hip replacement without complications. In Step 2, there were not any other common procedures for the same day, but there were always about a dozen claims for physical therapy after the surgery. Since these are not for the actual surgery and the number can vary, we price the joint replacement without the physical therapy and mention there will be an additional cost for the physical therapy. In Step 3, we calculated the median for the DRG, professional charge, and anesthesia. In Step 4, it was detected that there was a high variability in the payment rate at some providers. Most of this variation was related to the number of days the patient spent in the hospital when the contract had a per diem rate. When we limited the claims to ones with the typical two-day stay, the variability decreased dramatically. There could be a significant price increase, varying by facility, for each additional day. Table 5 shows the resulting prices for a hip replacement.

Table 5. Output Table for Total Hip Replacement

Provider	Total Price	Facility	Profes-sional	Anes-thesia
Prov 1	$15,830	$12,668	$1,827	$1,335
Prov 2	$20,959	$17,718	$1,815	$1,427
Prov 3	$24,322	$21,032	$2,010	$1,280
Prov 4	$25,499	$22,302	$2,010	$1,187
Prov 5	$28,866	$25,694	$1,905	$1,268
Prov 6	$32,701	$29,125	$1,961	$1,615
Prov 7	$41,169	$35,499	$2,433	$3,238
Prov 8	$53,931	$49,580	$2,458	$1,893

Childbirth

Our childbirth prices include either vaginal or cesarean section births at a facility. Steps 1 and 2 showed that these services consist of an inpatient facility claim, a professional claim billed with a CPT code, and one or more anesthesia claims. There could also be a claim for the newborn nursery, but a newborn nursery claim has special billing properties, including no member responsibility after they have met their deductible, so there is seldom any cost to the parents for the newborn nursery. Pre and post-delivery procedures can have member cost-share if they are more frequent than normal, but this is not typical. Steps 3 and 4 showed that there is a price increase of $2,000 or $3,000 for every extra day on the inpatient stay, so we limited the claims to those with a two-day stay.

Table 6. Output Table for Vaginal Delivery

Provider	Total Price	Facility	Profes-sional	Anes-thesia
Prov 1	$8,135	$3,986	$2,643	$1,506
Prov 2	$8,827	$4,712	$2,627	$1,488
Prov 3	$9,370	$5,287	$2,680	$1,402
Prov 4	$9,929	$5,939	$2,740	$1,250
Prov 5	$10,187	$6,002	$2,639	$1,547
Prov 6	$11,388	$6,711	$2,707	$1,971
Prov 7	$14,168	$8,912	$4,030	$1,225
Prov 8	$18,086	$11,569	$4,524	$1,993

Price Changes

The price tables are only a good predictor of future prices if they remain stable (allowing the tables to be used directly) or if the future price can be determined from these price tables. When comparing the price tables from multiple years, we found that the prices for a given service at a given provider usually increase a similar percentage for all providers of that service unless a radically different contract is negotiated by the provider and CDPHP. An example of this contractual change is when a provider changes from being paid a percent-off-charges to being paid a set amount for a service. An example of the price differences from 2015 to 2016 for an electrocardiogram is shown in Table 7. Even though the prices did change by different amounts, the low-cost providers remained low and the high-cost ones increased the most to remain high.

Table 7. Yearly Price for Electrocardiogram

Provider	Total Price 2015	Total price 2016
Provider 1	$22	$23
Provider 2	$22	$23
Provider 3	$23	$24
Provider 4	$24	$27
Provider 5	$61	$66
Provider 6	$242	$258

User Interface

The price tables are used in the CDPHP Price Check tool. This tool is used by trained customer care specialists to clearly inform and educate members of CDPHP about the prices of these services. Instead of having the members try to understand the tables, our specialists explain the tables, related information, and how the information can be used. The complexities of health care billing could make it difficult for a member to understand without this assistance.

The first screen of the tool is shown in Figure 1. It allows the specialist to select one of the services from a list. The list

of services can be filtered by selecting only services in a category or provided in a specific region. After a service is selected, the data table for that service is displayed to the specialist, along with some notes about the billing of the service. The specialist uses this table to answer the caller's pricing questions. A data table for MRI of the Knee is shown in Figure 2. The table in Figure 2 includes the median amount that the provider was paid for that service in the past, not the amount the member will need to pay for the service in the future. To determine the amount the member would need to pay, there is a member responsibility calculator, shown in Figure 3, which takes the total price of the service, the member's current remaining deductible, the member's coinsurance after meeting their deductible, and the member's remaining contribution until they hit their out-of-pocket maximum. All of this information is available to the specialist and is used to calculate the member responsibility.

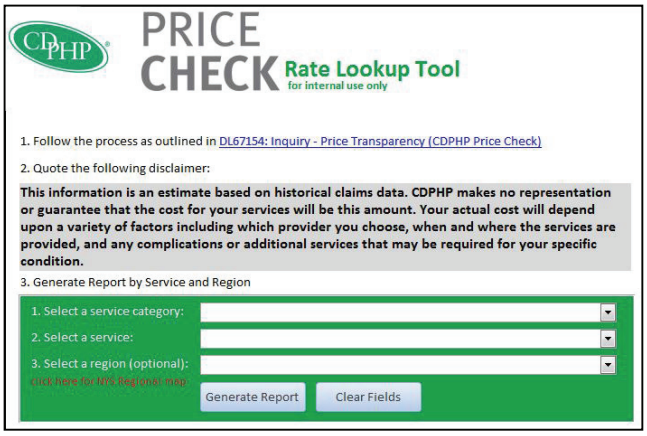

Figure 1. User Interface Home Screen

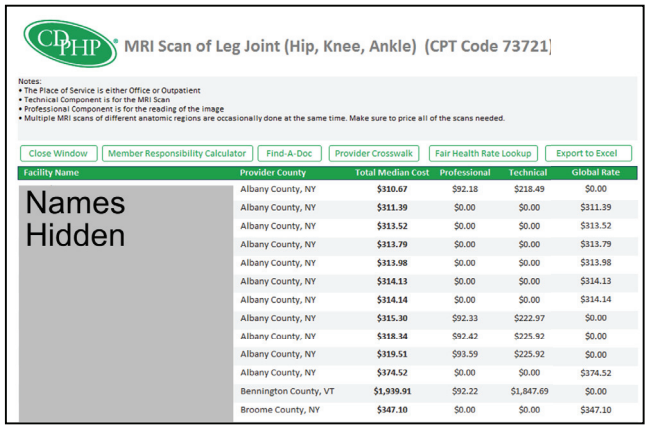

Figure 2. User Interface for MRI of Knee

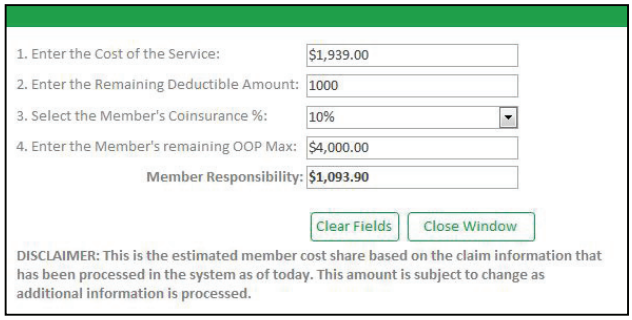

Figure 3. Member Responsibility Calculation

Results

Beginning in August 2016, the evaluation of the tool was done by checking how similar the actual prices for the services were to the estimates provided for the total cost of the service during a proof of concept, where the tool was available to all employees of CDPHP, about 1,100 people. The difference from the price estimate to the actual price was usually within 2 percent of the price estimate.

The evaluation process consisted of recording data from each caller and then tracking the caller's claims for ones that matched the service where they requested a price estimate. The data collected from each inquiry included the member ID of the member who called to get price estimates, what service(s) they called about, the price estimate(s) they were given, and if the member was calling to check prices at multiple locations or just one location. The claims data consisted of member ID, start and end date of service, CPT code, CPT modifiers, DRG, allowed cost, provider, and if a multi-procedure discount was applied. The analysis did not include cost before and after the service (e.g., laboratory tests, physical therapy).

The proof of concept took place for a few months when we sent emails to all employees with a list of services and asked them to call if they were planning on getting any of them. There were 37 calls in which 16 of the callers were looking for price comparisons at multiple providers, while 21 only wanted the price at a specific provider. As of April 2017, 18 callers got the service where they requested the price estimate. Table 8 has a short name for the service, the price estimate for the service provided, the actual cost, and a percentage difference for each member who got the service. The estimated price is the sum of estimates for all services that were actually performed. For example, if a member called about the cost of a vaginal delivery (which includes facility, professional, and anesthesia prices) and they did not get anesthesia, the estimate is the sum of the facility and professional prices. The estimate listed in the table would not include the anesthesia price. This shows why it is important for the customer care specialists to provide the

components of the price, along with the total price. Another example is if the member called about an MRI and did not know if it was to be with contrast or not. In this case, we can give them both price estimates. Table 8 uses the price for the version of the MRI that the member received as the estimate. This shows that the specialist should give the caller the different prices for the different services if the caller is not sure what service they are getting.

Table 8. Comparison of Estimates and Actual Prices

Member	Service	Estimate	Actual	Percent Diff
Mem 1	Vaginal Delivery	$7,349	$7,534	2.51%
Mem 2	Vaginal Delivery	$8,827	$8,955	1.45%
Mem 3	Vaginal Delivery	$9,372	$9,464	0.98%
Mem 4	Vaginal Delivery	$7,349	$7,652	4.12%
Mem 5	Cesarean Deliver	$12,037	$11,853	-1.52%
Mem 6	MRI Brain	$304	$307	0.84%
Mem 7	MRI Brain	$306	$307	0.18%
Mem 8	MRI Brain w con	$498	$502	0.81%
Mem 9	MRI Brain w con	$498	$502	0.81%
Mem 10	MRI of Arm, Leg	$630	$628	- 0.37%
Mem 11	CT of Ab	$267	$268	0.28%
Mem 12	CT of Ab w con	$463	$436	-5.79%
Mem 13	Tonsil Removal	$2,227	$2,538	13.97%
Mem 14	Vasectomy	$507	$516	1.86%
Mem 15	Vasectomy	$507	$516	1.86%
Mem 16	Upper Endoscopy	$1,381	$1,592	15.28%
Mem 17	Upper Endoscopy	$1,393	$1,365	-2.03%
Mem 18	Upper Endoscopy	$2,266	$2,267	0.04%

The actual price is usually a little higher than the historical price from the previous year. The bias for slightly higher prices is most likely due to inflation, and future versions of the tool could correct for this. The members who had a high percentage difference from the estimate had some explainable reason for the larger difference. For example, Member 12 got a slightly different version of the CT of the Abdomen (CPT 74177) from what we quoted (CPT74178). Member 16 was also billed a slightly different CPT code from what we quoted (43249 instead of 43239). Member 17 got the service at a different facility from the one where we quoted the price, so the table includes the price we would have quoted at that facility. Members 13 and 16 had multiple procedures on the same day and we only quoted one. The actual costs for them are the subset of the claims that are for the service that we quoted. A multi-procedure discount was applied to these actual costs, so the quoted price in the table is modified to reflect that discount. Even with these corrections, the quoted price for these two members still has the highest percent difference.

Conclusion

The CDPHP Price Check tool was able to provide accurate price information on the services it covers. The proof of concept has shown that historical claims can be a good indicator of future prices if those prices are calculated for a specific service at a specific provider. The tool can be part of a strategy for the best possible customer service that includes education on price transparency. This could improve the affordability of health care by helping people find the best care at the best price. Future work can expand the set of services covered, add pricing on related claims such as laboratory tests, find ways to increase usage of the tool, and add quality information. In September 2017, it was made available for use by 35,000 high deductible members. Media coverage of its release has been very positive [Hughes 2017].

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