SOCIETY OF ACTUARIES

Health Care Cost Trends

2021 Health Care Cost Model:

Documentation of Inputs and Assumptions

July 2020

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Introduction

The purpose of this document is to inform the user of the 2021 Health Care Cost Model about the sources of data, other reports, and assumptions which were used to populate this report and drive some of the key considerations. The model itself attempts to forecast the impacts of COVID-19 on future Health Care Costs for the purpose of rate filings and other health care cost projections. The model itself runs Visual Basic (VB) to generate outputs that measure the impact of various COVID-19 components.

At a high level, the 2021 Health Care Cost Model produces monthly cost estimates from January 2020 through December 2023. These estimates are generated from a variety of different data sources and assumptions and creates projected costs along with exhibits that demonstrate how different sets of factors determine the costs. In addition, the model consists of several main sections. They are as follows:

- Contents Tab
- Run Forecast Tab
- Forecast Output Tabs
- Outbreak Simulation Model
- Data tabs
- Visual Basic Code

In the document below, we will go into detail on the sources for data and assumptions as well as some general methodology.

Since there are a wide range of health care insurance rating areas, and correspondingly a unique set of paths each might have followed in March, April and May 2020, it becomes important to study how health care services have been deferred and potentially restarted. The issue becomes ever more important as actuaries at health carriers begin to consider rate filings for insured plans in 2021. With an unknown path of what level of health care services may play out over the rest of 2020 and into 2021, it can be helpful to additionally create a stage system to map current business, social and health care activities to each stage for a common discussion vocabulary and health care cost analysis.

In addition to this document, a user's guide has been put together to guide users through the main input and output tabs of this model. The user's guide heavily focuses on the Run Forecast Tab and the Forecast Output tabs. This document will provide a brief description of the input and forecast tabs and a more detailed focus on the sources of data and development of assumptions within the Data Tabs.

Contents Tab

The Contents Tab is a guide to the model user as to the functionality of each tab displayed in the model. The tabs within the model. A brief description of each tab is provided.

Inputs to the model are primarily housed in the “Run Forecast” tab which is located on the far left next to the contents tab. The Run Forecast tab includes a series of forecast model inputs and directions as to how to utilize different input options. The “Outbreak Simulation Model” tab is another tab where inputs can be provided to help drive different COVID infection spread scenarios.

The Forecasting tabs contain different forecast outputs and explanations for the impacts of different kinds of inputs on the final percentage change in claims as well as Per Member Per Month (PMPM) and total dollar changes. These tabs are organized at different levels of detail to help model users dive into more detailed causes of rate changes if they wish.

The Data tabs consist of raw data feeds that are used to populate the model. These include costs, rating factors, disease prevalence factors, and Deferral/Elimination/Recoupment cost assumptions.

Forecasting Tabs

There are five distinct forecasting tabs in the model. They include the following:

- Run Forecast Tab
- Forecast Tab
- Forecast - % of Baseline Tab
- Forecast - Annual % Increase Tab
- Forecast Detailed Tab

The Run Forecast Tab is the principal steering wheel which helps drives variations in different assumptions about Return Stage characteristics and certain other cost characteristics and distributions.

The Forecast Tab includes monthly PMPM estimates of total health care costs which are then added in total. Cost breakouts are done by Cost Category, Provider Service Category, and changes in claims characteristics.

The Forecast - % of Baseline Tab includes monthly PMPM estimates of total health care costs which are then added in total. Cost breakouts are done by Cost Category, Provider Service Category, and changes in claims characteristics related to Deferrals and Recoupments of Services.

The Forecast - Annual % Increase Tab includes annual percent changes of costs broken out by monthly PMPM estimates of total health care costs which are broken out by service categories.

The Forecast Detailed Tab includes every Service Category and Service Subcategory and also demonstrates how each of these cost categories is impacted by the different assumptions and inputs that are fed into the model. These include the following parameters:

- Trend
- Eliminated Services
- Deferred Services
- Recouped Services
- Direct COVID-19 Costs
- Behavioral Health and Substance Abuse costs due to social distancing and economic uncertainty
- COVID-19 Diagnostic Testing
- COVID-19 Antibody Testing
- COVID-19 Diagnostic Testing
- COVID-19 Vaccine

Outbreak Simulation Model

The Outbreak Simulation Model Tab includes the Susceptible, Infected Recovered (SIR) epidemiological model. This model is an optional component intended for use by anyone who wishes to introduce an epidemiological element to the incidence of direct COVID-19 costs. In order to utilize the SIR model, the user needs to run a separate Visual Basic macro. The inputs to the Macro can be found in the highlighted yellow cells in this tab. They include inputs on the following:

- State and Rating area – which is defined by a collection of counties
- Ratio of Total cases (Reported + Unreported) to Reported cases.
- Susceptible, Infected and Recovered parameters – which add up to 100% of the population
- Social activity – which is represented by a factor between 0% and 100% and is used to estimate the speed with which COVID-19 spreads
- Social distancing parameters – there are five potential different approaches provided. These include:
    - Entering a monthly series of social contact levels
    - Dynamically adjusting social distancing, as a function of new infections
    - Endogenize social distancing to hit a target rate of new infections
    - Keep distancing constant
    - Assume no social distancing.
- Specifying Return based on the population infection rate.
    - Entering a monthly series of social contact levels
    - Dynamically adjusting social distancing, as a function of new infections
    - Endogenize social distancing to hit a target rate of new infections
    - Keep distancing constant
    - Assume no social distancing.

In addition to the inputs provided above, the SIR model provides Monthly infections as a % of total population and the return stage for each month.

The SIR model is sourced from John's Hopkins University infected data and is updated monthly to reflect the most current data within the model.

Specific directions on how to incorporate the Outbreak Simulation Model are separately addressed in the User Guide.

The code used to run the Outbreak Simulation Model will be addressed in the Visual Basic section below.

Data Inputs

There are two main tabs that incorporate data inputs. These are intended to be exogenous data feeds from outside sources which are inputted into the model and periodically updated as data sources get refreshed. The data portions of the model consist of three main tabs. They are the Data – Costs tab and the Data - Rating Areas tab.

DATA COSTS

The Data costs tab consists of a combination of cost assumptions, assumptions surrounding disruption of underlying medical services due to the COVID-19 Epidemic, and other cost adjustment factors.

The Cost Assumptions fall contain six main categories of costs within this tab.

1. Underlying Base Costs
2. Direct COVID-19 Costs
3. Social Distancing Behavioral Health Costs
4. Diagnostic Testing Costs
5. Antibody Testing Costs
6. Vaccine Costs

In addition to the categories listed above, these Costs are broken out by Service Categories and Subcategories. Table 1 below lists out those different subcategories by main category

Table 1
HEALTH CARE COST SERVICE CATEGORY BREAKOUTS

Service Category	Service Subcategory
Inpatient	Hospice
Inpatient	Labor/Delivery/ Newborns
Inpatient	Medical
Inpatient	Mental Health
Inpatient	Other Inpatient
Inpatient	SNF
Inpatient	Substance Use
Inpatient	Surgical
Outpatient	Ambulance
Outpatient	DME
Outpatient	Lab
Outpatient	Radiology
Outpatient	Other Outpatient
Outpatient	ER
Outpatient	Observation
Outpatient	Surgery
Professional	Drugs
Professional	Anesthesia
Professional	ER
Professional	Immunizations
Professional	Lab/Pathology
Professional	Office Visits
Professional	Other Services
Professional	Physical Medicine
Professional	Psychiatry
Professional	Radiology
Professional	Surgical
Pharmacy	COVID-19 Related

Pharmacy	Non-COVID-19 Related

These cost categories are in line with the breakouts in the Health Care Cost Institute's (HCCI) 2020 Annual Trend report database which was used to populate our Large Group Base Costs. These field breakouts can be found in the "Main Findings" Exhibit of the HCCI 2020 Annual Trend Report Data Download.[1] Pharmacy costs were aggregated into a non-COVID total for base costs while COVID-19 pharmacy costs were brought in separately through the Direct COVID-19 cost development process.

In addition to the Service Category breakouts, each of the cost categories have been developed for different lines of business. The following lines of business have been included as options in this model:

- Commercial - Large Group
- Commercial - Small Group
- Commercial – Individual
- Medicare Advantage
- Medicaid

UNDERLYING BASE COSTS

Underlying Base Costs are calculated separately for different lines of business and the data sources for each is described below:

Large Group Base Costs:

These costs were sourced from the Health Care Cost Institute's (HCCI) Annual Trend report database which was published in February of 2020 and includes data from Calendar Years (CY) 2014 - 2018. This report included the service area categories listed above in Table 1. The HCCI data consists of 40 million individuals covered by employer sponsored commercial health insurance. This cohort is represented by all 50 states and the District of Columbia. Roughly one third of the plan members are in Consumer Driven Health Plans (CDHPs), while two thirds are from traditional group insurance plans. For a point of reference, the average overall cost sharing for the high deductible CDHP cohort was 22% of allowed costs in 2018, while the average cost sharing for Non-CDPH members came in at 13% of allowed costs. The composition of this data is predominantly large group, with past historical studies of HCCI data indicating that over 75% of their employer sponsored coverage is in the large group market.[2,3] Base costs were trended forward to December 2019 using HCCI average observed trends from 2014 – 2018 broken out by main cost categories (inpatient, outpatient, professional and pharmacy). The overall large group base cost trend factor used was 5.2% for that period.

Small Group Base Costs:

Small Group base costs were sourced from data provided by Wakely Consulting Group. Wakely relied on their 2017 Wakely proprietary database called the Wakely ACA Database (WACA). WACA is an aggregated database based on de-identified EDGE Server input and output files (including enrollment, claims, and pharmacy data) from the 2017 benefit year submitted through April 2018, along with supplemental risk adjustment transfer and issuer-reported financial information, representing approximately 2 million lives from the small group ACA market. Wakely added in data published by CMS such as the 2017 plan finder data and MLR data. The de-identification applies to identifiers specific to enrollee, issuer, and location. Wakely performed reasonability tests on the data but did not audit or verify the data. The dataset is subject to change if issues are found or reported to Wakely. They may release updates to the base estimates if any significantly issues are found in the data that are impactful on the base cost estimates. The WACA database contains data in all 4 major US Regions (South, West, Midwest, Northeast) and represents a similar fraction of the ACA market in each of those regions. The database also includes roughly proportional number of

enrollees from each market's respective metal levels and enrollment in cost-sharing reduction variants to national averages.

Table 2 shows the 2017 WACA Small Group market data metal and subsidy levels distribution:

Table 2
HEALTH CARE COST SERVICE CATEGORY BREAKOUTS

Service Category	Service Subcategory
Bronze	10.3%
Silver	32.8%
Gold	41.6%
Platinum	15.4%

The data from Wakely was re-mapped to line up with the same cost categories as the HCCI Employer data. The Per Member Per Month (PMPM) costs for this data were trended forward to December 2019 - the beginning of the base period using trends provided by Wakely. The overall small group base cost trend factor used was 6.6%

Individual Base Costs:

Individual base costs were sourced from data provided by Wakely Consulting Group. Wakely relied on their 2017 Wakely proprietary database called the Wakely ACA Database (WACA). WACA is an aggregated database based on de-identified EDGE Server input and output files (including enrollment, claims, and pharmacy data) from the 2017 benefit year submitted through April 2018, along with supplemental risk adjustment transfer and issuer-reported financial information, representing approximately 2.9 million lives from the individual ACA market. Wakely added in data published by CMS such as the 2017 plan finder data and MLR data. The de-identification applies to identifiers specific to enrollee, issuer, and location. They performed reasonability tests on the data but did not audit or verify the data. The dataset is subject to change if issues are found or reported to Wakely. They may release updates to the base estimates if any significantly issues are found in the data that are impactful on the base cost estimates. The WACA database contains data in all 4 major US Regions (South, West, Midwest, Northeast) and represents a similar fraction of the ACA market in each of those regions. The database also includes roughly proportional number of enrollees from each market's respective metal levels and enrollment in cost-sharing reduction variants to national averages.

Table 3 shows the 2017 WACA Individual market data metal and subsidy levels distribution:

Table 3
HEALTH CARE COST SERVICE CATEGORY BREAKOUTS

Service Category	Service Subcategory
Catastrophic	1.3%
Bronze	28.5%
Silver	17.7%
Gold	7.9%
Platinum	4.4%
Silver 73%	6.5%
Silver 87%	13.5%
Silver 94%	20.3%

The data from Wakely was re-mapped to line up with the same cost categories as the HCCI Employer data which was used for the Large Group base costs. The Per Member Per Month (PMPM) costs for this data were trended

forward to December 2019 - the beginning of the base period using trends provided by Wakely. The overall individual base cost trend factor used was 6.0%

Medicare Advantage Base Costs:

Medicare Advantage base costs were sourced from the Medicare fee-for-service Limited Data Set (LDS) from 2018. This is a detailed claim and enrollment data set for a nationally representative sample of insured lives enrolled in Medicare fee-for-service. This sample includes over 3 million Medicare eligible lives. The claims include all Medicare covered medical services (inpatient, outpatient, and professional). The claims have details on CPT, DRG, revenue codes, ICD-10 (or ICD-9, depending on timing) diagnosis codes, and other claim diagnosis information. The claims have sufficient run out to be considered over 99% complete. The enrollment data contain demographic details such as age, gender, county, state, enrolled months, and other relevant information. The data was re-mapped to line up with the same cost categories as the HCCI Large Group data which was used for the Large Group base costs. The Wakely Medicare Source data PMPM costs for this data were trended forward to the beginning of the base period using trends from the National Health Expenditures trend reports. The overall Medicare Advantage base cost trend factor used was 4.1%

Medicaid Base Costs:

Medicaid base costs were sourced from data collected through databooks for Medicaid Managed Care programs in three separate states. The data reflects projected costs estimated by the rate-setting actuaries and trended based on the assumptions used in the rate developments. The data includes over 40 million member months. Wakely performed reasonability tests on the data but did not audit or verify the data. The dataset is subject to change if issues are found or reported to Wakely which may result in updates to the base cost factors if the changes are significant and relevant. Additional assumptions along with their considerations and limitations include but are not limited to the following:

- Delivery kick payment amounts are rolled into TANF costs.
- Foster Kids population were aggregated according to the programmatic definitions of respective states. They may differ from state to state.
- Wakely made assumptions to re-map the data to line up with the same cost categories as the HCCI Group data. Specific data were not available for each of the service categories.
- Rating periods in the base data used were projections by rate-setting actuaries for calendar year 2020 and on.

The Medicaid base PMPMs are using a combination of TANF and SSI with roughly 90% of the membership being in TANF and 10% being SSI. The Wakely Managed Medicaid PMPM costs for this data were trended back to the beginning of the base period. The overall Managed Medicaid PMPM trend used to get to the base period was 3.1%

The development of the base cost inputs was done in a designated spreadsheet titled “Build Cost Assumptions.”

DIRECT COVID-19 COSTS

Direct COVID-19 costs are calculated using a different methodology than base costs. In order to properly account for potential expected cost distributions, Direct COVID costs were tied to the infection percentage generated by the identified individuals with COVID-19 from the epidemiological SIR model. The Direct COVID-19 costs in the Data-Costs tab represent the weighted average of costs across various different disease severity scenarios.

Direct COVID-19 severity distributions of the COVID-19 diagnoses were determined for each line of business in addition to the associated unit costs and probabilities for each type of service. These disease incidences will be distributed between the following different disease states:

1. Mild Cases
    a. These cases have minor symptoms.
    b. The only costs associated with this state are related to diagnostic testing.
2. Moderate Cases include:
    a. Costs of testing
    b. Doctors' visits - including telehealth
    c. Therapeutic medication costs
    d. ER or Observation Visits
    e. Ambulance and diagnostic costs
3. Severe Cases include
    a. All expenses associated with a moderate case
    b. Hospital Stay
4. Critical Cases include
    a. All expenses associated with a moderate case
    b. Hospital Stay
        i. Standard stay +
        ii. ICU Costs +
        iii. Ventilator Costs (in most severe cases)

In addition to these levels of breakdowns, the model splits out hospitalized vs. non-hospitalized COVID-19 cases. This is done through a user input in rows 87-92 of the 'Run Forecast' tab.

The hospitalization rates for identified COVID-19 cases are user inputs, however the model does provide default values for those inputs. These default COVID-19 hospitalization rates were derived from various literature sources that are tracking this type of information. For all sources of this type of information, there were changing hospitalization patterns. During the early phases of the COVID-19 epidemic, testing was much more limited, resulting in significantly higher hospitalization rates among COVID-19 patients. As higher COVID-19 testing rates became more broadly implemented, the hospitalization rates began to decline. This was also the case as the average age of COVID-19 diagnoses began to drop. The default COVID-19 hospitalization factors in the projection model represent observations seen in some of the more recent data which reflects the conditions above that are likely to continue in the future.

According to a study by the CDC, Hospitalization rates varied significantly by Age, with cumulative hospitalization rates per 100,000 population being roughly double for those 65 and over compared to ages 50-64. Individuals ages 18-49 came in at about one fifth of the over 64 levels, while cumulative hospitalizations of children were about one tenth of the rates of the adults ages 18-49. Table 4 below illustrates the differences referenced above. [4]

Table 4

CUMULATIVE COVID-19 HOSPITALIZATION RATES BY AGE GROUP

Age Group	Cumulative Hospitalization Rate per 100,000 Population
Overall	278.7
0-4 years	27.8
5-17 years	16.9
18-49 years	174.8
18-29 years	112.4
30-39 years	173.4
40-49 years	256.9
50-64 years	407
65+ years	811.1
65-74 years	599.6

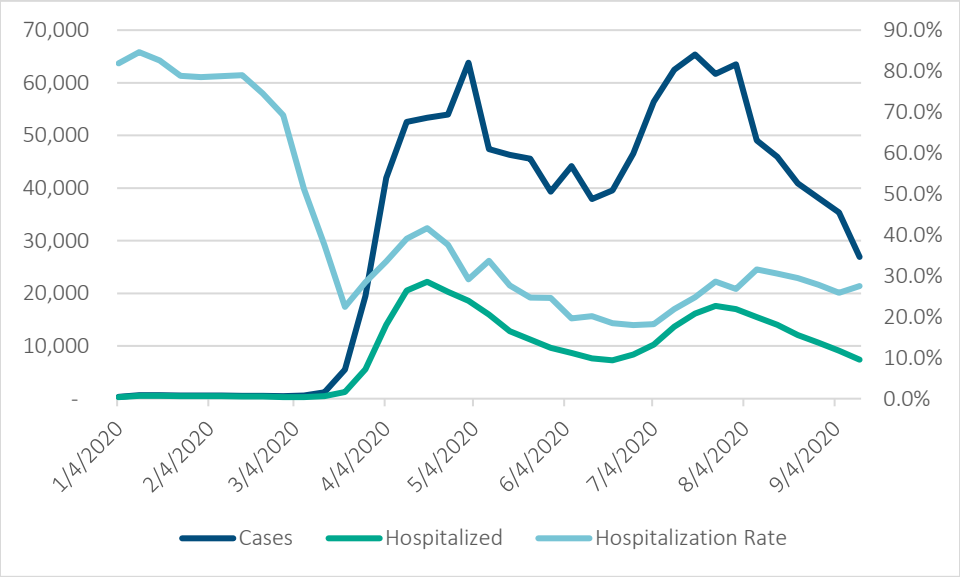
75-84 years	987
85+ years	1,452.8

It is important to emphasize that these numbers are cumulative, and they also reflect the hospitalization rate of the overall population. While they are helpful in reflecting the relative hospitalization rates of different populations, the hospitalization rates per positive COVID-19 identification are different and these have varied over time.

One good source of hospitalization data for the population aged 65+ came from CMS. CMS published a preliminary Medicare COVID-19 data snapshot which displays weekly COVID-19 counts and hospitalizations for Medicare populations from January through the mid-September of 2020. [5,6] Figure 1 below illustrates this comparison and shows that after stabilizing in early April, the hospitalization rates for COVID-19 positive Medicare populations has declined steadily. This Study was last updated on November 19th.

Figure 1

Medicare Population COVID-19 Hospitalization Rates by Date



We also examined data from a new source to help inform our estimates of Hospitalization rates which is a series of reports updated daily from the State of Florida. This data breaks out cases, hospitalizations, and deaths for the State of Florida broken out by different age groupings.[7] These reports help to show the differences in hospitalization per case by age as well tracking of how this has changed over time since the beginning of the pandemic. Table 5 below shows overall hospitalization by Age group for the State of Florida from March 16 - November 30, 2020.

Table 5

2020 OVERALL FLORIDA COVID-19 HOSPITALIZATION PER CASE BY AGE GROUP

Age Group	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Overall
0-4 years	4.0%	6.3%	7.4%	1.7%	1.7%	3.1%	2.9%	2.7%	1.2%	2.3%
5-14 years	4.5%	2.1%	2.9%	0.8%	0.5%	1.3%	0.9%	0.9%	0.2%	0.9%
15-24 years	2.3%	3.1%	4.3%	0.8%	0.7%	1.5%	0.9%	0.9%	0.5%	1.1%
25-34 years	3.7%	6.0%	6.6%	1.6%	1.2%	2.4%	2.3%	1.7%	0.8%	1.9%
35-44 years	7.8%	10.3%	10.0%	3.2%	2.0%	3.8%	3.7%	3.1%	1.3%	3.3%
45-54 years	10.7%	12.9%	15.7%	4.8%	3.1%	5.8%	6.0%	4.1%	2.3%	5.0%
55-64 years	15.2%	17.7%	24.9%	7.4%	5.3%	10.2%	9.5%	7.6%	3.7%	8.4%

Under 65	**7.5%**	**8.9%**	**11.0%**	**3.2%**	**2.2%**	**4.3%**	**4.0%**	**3.2%**	**1.5%**	**3.5%**
65-74 years	22.2%	32.1%	41.1%	13.1%	10.3%	19.1%	18.3%	14.0%	7.3%	16.0%
75-84 years	31.5%	45.0%	51.4%	21.0%	17.0%	31.9%	29.0%	25.1%	14.2%	25.9%
85+ years	38.3%	43.7%	57.9%	31.3%	22.1%	38.3%	34.3%	35.5%	19.6%	32.8%
65 and Over	**23.4%**	**30.0%**	**37.4%**	**17.1%**	**12.8%**	**23.0%**	**20.9%**	**19.6%**	**10.8%**	**19.3%**
Overall	**13.3%**	**18.0%**	**20.7%**	**4.6%**	**3.8%**	**8.0%**	**7.1%**	**5.6%**	**2.9%**	**6.2%**

The numbers were also broken out into those under 65 and those over 65. The over 65 population represents Medicare Advantage members, while the under 65 population represents commercial and Medicaid members. It is worth noting that these numbers have fluctuated significantly with much lower overall hospitalization numbers being caused by both a shift towards younger populations in the case rate distribution as well as generally lower hospitalizations for all populations. The Under 65 members from Florida have significantly reduced their hospitalization rates from 10% in April to 2.2% in July, with a slight bounce back up closer to 4% in August and September before coming back down in October and November. This pattern is reflected in all under 65 age brackets. Similarly, FL Medicare age individuals peaked at over 37% hospitalization in May followed by significant declines across all age bands in June and July. August – October hospitalizations have shown increases, but those levels are still significantly below what was observed in the first three months. November hospitalizations are much lower but represent a bit of an outlier at this time. It is worth noting that there is a general trend of hospitalization percentage rising during any surges that might be observed in a particular area. Hospitalizations tend to lag cases by 1-2 weeks.

These figures are fairly consistent with what we are seeing in the Atlantic's COVID Tracking Project. Data from the COVID Tracking Project was extracted to evaluate changes in cumulative hospitalizations over time relative to new COVID-19 cases. This was done for states with available cumulative hospitalization data and then aggregated across the United States. The data indicated that the average hospitalization rate through November 30th resided at 7.1%. This has been on a fairly consistent downward trend since mid-April. Daily examination of this trend shows that there has been a significant drop in hospitalization rates as the testing rate has increased. March and April averaged hospitalization rates of just over 20%. In May, the rate dropped to 14%, while June- August rates dropping to 8% and below. From September through November, hospitalizations dropped fairly consistently from 6% down to 4%. These continued drops are taking place despite a large increase in cases during October and November.

Given the developments in the COVID tracker and Florida COVID data repositories, the current overall default hospitalization rate was targeted at 6.0% overall. A 3.5% default hospitalization factor was chosen for Commercial and Medicaid Lines of business this based on relative hospitalizations demonstrated by the Florida data and the COVID tracker. Medicaid populations do have a higher proportion of high-risk populations than on the commercial side – particularly dual eligible and SSI members. However, these are offset by a larger proportion of children. Overall, it seemed reasonable to use the same 3.5% hospitalization factor for all non-Medicare populations.

While the CMS' Medicare Hospitalization data indicated a hospitalization rate above 30% in April, this number fell steadily reaching values close to 20% by the end of June. Medicare Hospitalization did rebound back into the mid-20s later in the summer. This is somewhat higher that the most recent data from both the COVID tracker and the Florida COVID reports that show this rate dropping. Reductions in hospitalization rates relative to the beginning of the pandemic can be attributed to older and sicker patients getting COVID during the earlier periods as well as improved treatment protocols. Due to consistently lower hospitalizations plus the uptick in Medicare hospitalizations, the default hospitalization rate for the Medicare population was set to 22% in the model.

Different levels of hospitalization were also assigned to the hospitalized cohort. The methodology for these assignments was based on the different proportions of ICU and Ventilated members emerging from the Atlantic's COVID Tracking Project[8] as well as observations from the published FL COVID data. Per the COVID tracking project,

the rate of ICU admission among hospitalized rates initially hovered around the 30% mark. However, since late June, this rate dropped to around 28% for the period of late June through early August, with a slight uptick in August and September. October and November ICU rates continued to decrease reaching levels consistently below 25%. The rate of ventilator use has also continued to decrease over time according to the same source. In mid-April, ventilators were used for 75% of ICU cases. This number has been dropping by significant amounts in each month. By early August, the % of ventilator use in all ICU cases dropped to 53%. This trend continued into the fall with November ventilator rates coming in at 47% of all ICU cases. Improvements in treatment protocols make it unlikely that this trend will reverse itself, although there was a slight uptick in late November. We are currently assuming 47% in this model. Another factor that we re-examined was the ICU rate of hospitalization by block of business. While the overall factor remained at 25% ICU for overall hospitalizations, the Florida data gave us an opportunity to examine differences by age. The Florida data also included deaths by Age group which allowed us to calculate a case fatality rate. Given the assumption that deaths are most likely to come from individuals hospitalized in the ICU, we examined the death rate per hospitalization for the under 65 and over 65 populations. The over 65 populations had a death rate of 45% of those hospitalized vs. 10% of the under 65 population hospitalized through early August. This indicates a much higher likelihood of more severe conditions of hospitalization among older members and thus a higher probability of ICU. In our model, we assumed a 19% ICU rate for our commercial and Medicaid membership and a 60% Medicare ICU rate among our hospitalized populations. Slightly less than half of those ICU admissions were assumed to include a ventilator.

We examined but did not use Wakely data for relative hospitalization frequencies or differences between frequencies of different severity levels of COVID-19. As Wakely mentioned in their documentation, their number of hospital admissions, compared to the number of COVID-19 diagnoses, was relatively smaller than national averages as of the end of June. This may be a result of the national average being influenced by a significant portion of hospitalizations being for those above 65 and generally absent from commercial data. It may also be that data collected does not include sufficient cases from certain geographic locations. Additionally, the frequency of severe hospital admissions relative to hospital admissions may also have been caused by the same factors of differences between commercial population and the overall population and geographic differences. The average costs of hospitalizations are included in the model as weighted averages of different hospitalization states. Different levels of hospitalization costs are included in Appendix A below.

Another combined set of parameters was calculated for COVID-19 cases that did not require hospitalization. The relative probabilities of the non-hospitalized COVID-19 disease states is a function of age and co-morbidities within the group. In general, the commercial population is the healthiest with some of the younger age distributions resulting in lower probabilities of hospitalization and higher probabilities of mild cases. The model uses an assumption of 50% mild cases for the commercial cohorts among all non-hospitalized cases. Medicare Advantage populations have a greater likelihood of showing symptoms due to their older age and more frequent co-morbidities. The model uses an assumption of 20% mild cases for the non-Hospitalized commercial cohorts. The Medicaid population represents a mixture of younger and healthier TANF members and older SSI members who tend to have significant co-morbidities and higher medical costs. The Medicaid probabilities factors represent a mixture of individual as a proxy for TANF and Medicare Advantage as a proxy for the SSI population. The model uses a 45% mild case assumption for the current mix of non-Hospitalized Medicaid cohorts.

Using the methodology described above, a distribution of different severities of COVID-19 cases was created for each Line of Business.

Utilization Assumptions for Direct COVID-19 costs.

Another key assumption is related to utilization of certain services. For Mild COVID-19 cases, the model assumes that the only costs included are those for testing. These members represent individuals who sought out testing but

subsequently quarantined at home while recovering from the disease without incurring any additional costs. The assumption used was to assign 100% of testing costs to that cohort.

For Moderate Cases – those who sought care but did not require an inpatient hospital stay, we are assuming a different set of assumptions. Amongst those cases, we are dividing individuals who limited themselves to physician office or telehealth visits, and those who showed up at the hospital, resulting in an ER or Outpatient Observation encounter. We assumed that half of our patients would fall into the Outpatient cost category and half would only receive physician care. For those that only received physician care, we assumed that 20% of them would incur radiology costs. For those with outpatient hospital care, we assumed that 60% of those would incur ER costs, while 40% would incur observation costs. In addition, half of those were assumed to incur radiology costs and 20% of those in the outpatient would incur ambulance costs. Finally, with regards to therapeutics, we are assuming that 25% of the patients will seek out a therapeutic option through a pharmacy (such as Hydroxychloroquine), while 2% will receive an intravenously administered drug (such as Remdesivir).

For hospitalized members, the same utilizations for non-inpatient services are assumed to have taken place. Hospital costs themselves are determined by examining both average DRG reimbursement methodologies as well as average daily costs multiplied by expected lengths of stay. The utilization of hospital services is assumed to take place for all individuals, with different levels of care with their associated costs being applied to the different hospitalization circumstances.

The remaining members who were not assigned to either mild or hospitalized cases were assigned to the moderate cases. This number ranges from just under 50% of commercial members to over 70% for Medicare Advantage members.

Unit Cost Assumptions for Direct COVID-19 costs.

Unit Cost Assumptions were another key element used to derive Direct COVID-19 costs. These types of assumptions were included for all services provided for treatment of COVID-19. On the Hospitalization side, we utilized a methodology that involves applying an expected number of days to a per diem in order to get at an average cost per stay. We also compared that to typical DRGs generating costs per admission.

For non-ICU hospital stays, we looked at unit costs derived from Wakely data that was provided along with historical costs per admission from the HCCI data used to build their 2020 trend report. Both of these were for commercial lines of business. HCCI's data was for a mix of roughly 75% large group and 25% small group membership. It's important to note that the HCCI data predates COVID-19 and as such would only represent a proxy for COVID-19 like costs and do not reflect actual COVID-19 expenses. The Wakely data used to calculate COVID-19 Hospital Unit costs consisted of 11% Small Group ACA membership, 44% Individual ACA membership and 42% Large Group membership. In addition, there was another 4% of unspecified members with 3% of them being in the ACA category but not specifying Individual or Small Group.

The non-ICU Hospital unit cost for Direct COVID-19 expenses used for commercial estimates was reduced for Individual, Medicare and Medicaid lines of business due to generally lower contracting cost standards. An estimate of $42,000 per hospital was used for Group Commercial insurance and $32,550 for Individual coverage. These values are consistent with Wakely's COVID-19 direct cost data and HCCI's cost per Inpatient Medical Respiratory admissions.[9] They also are consistent with an alternative computation of a seven day stay with a $6,000 per diem for Group Commercial and a $4,650 per diem for Individual plans. Medicare Advantage unit costs were reduced further and generally fell in line with estimated DRG payments for COVID-19 related diagnoses. Medicaid had additional unit cost reductions built in. All of those unit costs were consistent with a recent study published by AHIP which was done by Wakely Consulting Group. [10]

ICU admissions were based on higher reimbursements and informed by the same data sources from Wakely and HCCI. Wakely's data was less populated for what they termed "severe" cases which included both ventilated and not

ventilated. In the model, non-ventilated ICU cases and cases on ventilators were combined and a comparison was done to other data sources for reasonability. Wakely's completed COVID-19 ICU admit costs ranged from below $100,000 to $200,000, while their AHIP analysis generated values of just over $100,000 for ICU stays.[11] The model ended up a weighted average unit cost of $136,000 for ICU and Ventilator hospital stays in the group and individual commercial markets. The Medicare advantage estimates were just under $50,000, while the Medicaid estimates were slightly above $40,000 for similar hospital stays. These were consistent with estimates from the AHIP study. [12]

Unit Costs for Moderate COVID-19 cases were mainly based on average costs per service from the HCCI Group Commercial data.[13] This includes, Ambulance, Radiology, ER, Observation, and office visits. The average unit costs for those types of services were trended to 2020 and included in the COVID-19 direct cost calculations. Testing costs were derived from Wakely data and were set at $91 per test for commercial lines. For Medicare, the estimate was set at $79, while Medicaid used a $50 estimate. These were based on a study published by Axios on COVID-19 testing costs.[14] Pharmacy costs for therapeutics were based on articles published on expected Remdesivir costs and Hydroxychloroquine costs on a pharmacy marketing website.[15, 16] These were set at $4,500 and $50 per case respectively, with reductions for non-group lines of business. Table 6 below shows the Unit costs that were used for Group Commercial Medical, non-Inpatient COVID-19 expense categories.

Table 6

MODERATE COVID-19 GROUP COMMERGIAL UNIT COST ESTIMATES BY SERVICE CATEGORY

Service Category	Service Subcategory	Group Commercial Unit Costs
Outpatient	Ambulance	$800
Outpatient	Lab	$87
Outpatient	Radiology	$650
Outpatient	ER	$2,300
Outpatient	Observation	$3,000
Professional	Drugs	$4,500
Professional	ER	$450
Professional	Lab	$87
Professional	Office Visits	$125
Professional	Radiology	$150
Pharmacy	COVID-19 Related	$50

Note that the unit costs were scaled down to reflect lower expected unit costs for Individual, Medicare Advantage and Medicaid coverages. Individual reductions were generally around 15%, while Medicare advantage was around 70% of Group commercial and Medicaid came in around 50% of commercial. Total Non-Inpatient costs for Moderate COVID-19 cases were calculated by multiplying the unit costs above by the probability of each service referenced earlier. Moderate COVID cases were assigned costs of:

- $1,972 per case for Group Insurance
- $1,718 per case for Individual Insurance
- $1,476 per case for Medicare Advantage
- $1,016 per case for Medicaid

These results are consistent with the AHIP's paper on COVID-19 Cost Modeling Scenarios.[17]

Overall Direct COVID-19 costs were then calculated by multiplying the expected cost for each disease scenario by the probabilities of those services and the disease scenarios. This was done separately for each line of business. In addition, costs of hospitalized members were calculated separately from costs of non-Hospitalized identified COVID-19 cases. The final model inputs were the result of a summary of the hospitalized and non-hospitalized costs. Appendix A includes additional summaries of the distributions of Direct COVID-19 costs by service category and relative costs per identified case for different COVID-19 severities in different insured populations.

Wakely acknowledged the following limitations with their data as it relates to both ICU and non-ICU admissions as well as testing costs:

- The cost of COVID admits is lower than other publicly available estimates. Wakely believes the lack of run-out may be causing truncation, particularly in the more severe cases. Once Wakely applied completion factors, costs aligned with other publicly available estimates, if not were higher.
- Because COVID impacts are fairly new and still emerging, the Wakely data only includes paid claims through June. Since there is no runout beyond June, there is significant uncertainty in emerging results and estimates of completion for more recent months is highly uncertain and may vary significantly from the estimates included in their analysis. Also, long stay Inpatient claims may be truncated or disproportionately excluded from their dataset.
- While the number of tests in the data is lower in the national average of tests, as of the end of June, Wakely is uncertain of any data on the national average of commercial enrollees of tests. The unit costs for tests is approximately in line with publicly available data.

SOCIAL DISTANCING BEHAVIORAL HEALTH COSTS

Social Distancing Behavioral Health Costs are calculated based on the anticipated increases in Behavioral Health and Substance Abuse claims due to COVID-19 induced isolation and fear.

For this piece, we will use assumptions about levels of increased Behavioral Health (BH) and Substance Abuse (SA) services. These assumptions will be informed by emerging data or other studies on this matter. The current model assumes peak Social Distancing Behavioral Health and Substance Abuse Costs will exceed the baseline by 50%. Pharmacy Costs are also expected to increase, but only by 5% since drugs associated with BH & SA are typically about ten percent of total pharmaceutical spending.[17]

DIAGNOSTIC TESTING COSTS

Diagnostic Testing Costs are estimated based on expected volume of COVID-19 testing for the general population as a preventive or precautionary measure. In general, they would be done on asymptomatic individuals as part of a job requirement (i.e. for Health Professionals or meat packing plants). These costs are likely to be recurring until an effective vaccine is found or herd immunity is achieved. A distribution of monthly percentages of populations being given diagnostic tests is applied to the average cost of a test for each line of business. The average cost per test is the same as what was used for testing costs in the Direct COVID-19 section.

ANTIBODY TESTING COSTS

Antibody Testing Costs are estimated based on expected levels of antibody testing for the general population to determine if certain individuals may have immunity. These tests will likely continue until a vaccine is found or herd immunity is achieved.

The antibody testing calculation is based on data from Wakely which includes a significant sample from April – September. The cost of testing was estimated at $47 for commercial populations and $42 for Medicare and $30 for Medicaid populations.

VACCINE COSTS

The vaccine cost calculation is based on the product of the average cost of a vaccine by the anticipated utilization level. Adjustments to the utilization will be done through a separate input which assumes a specific start date for

vaccine availability. Average vaccine costs are determined separately by line of business for the model and are currently based on educated estimates. These estimates are based on published estimates of the COVID-19 cost that are being circulated. Although new vaccines typically tend to be much higher, the US government has committed to buying significant volumes of vaccines. The result of this is that many of these vaccine companies now have the ability to charge less due to this financial backing. Per an article from The Observer, potential vaccine prices are estimated for different existing vaccines. Each vaccine will include a cost per dose and some will also include administration costs depending on the setting where they are administered. Pfizer's vaccine has an estimated cost of $20 per dose, while Moderna vaccines were estimated at $15 for Government payers and $35 for commercial payers. Astra-Zeneca vaccine costs were estimated at $5 per dose [18] CMS indicated that they will reimburse vaccines at $16.94 for the first dose and $28.39 for the second dose.[19] So far, each of the approved or soon to be approved vaccines are involve an initial vaccine plus a subsequent booster shot. As a result of these government subsidies combined with some potential differences in administration costs, vaccine costs were set at the following rates for each coverage type:

- $100 for Commercial
- $45 for Medicare Advantage
- $45 for Medicaid

Vaccine costs reflected include the cost for both doses under the assumption that the delay between the two will be relatively small and that the vast majority of all individuals getting the vaccine will get the full double dose.

Antibody Costs and Vaccine costs are likely to be offsetting due to each one presumably removing the need for the other.

AGE/SEX AND RISK FACTORS

The Age/Sex factor is used to adjust the base costs to account for membership which is either older or younger than the implied average in the base costs. In general, older members have higher factors, while younger ones are lower. Females tend to have higher costs during early adulthood to middle age, while men tend to have higher costs in their youth and old age. This factor can and should vary between different cost components of the model. For instance, an older and more male population would have a more skewed COVID-19 cost profile, so it would make sense to have higher Age/Sex factors for COVID-19 costs than for base costs. Similarly, a younger population could be expected to have higher Behavioral Health and Substance abuse costs, which could skew those Age/Sex factors. The Age/Sex factors would be set to a standard 1.0 value as a default.

The Risk factor is an input which reflects specific plan characteristics that go beyond Age/Sex and Regional factors. This includes parameters concerning the general health of the block of business being evaluated. The relative level of co-morbidities and underlying conditions would be reflected in this factor. In addition, other aspects such as plan design can be incorporated into these factors as the user sees fit. Like the other factors, the Risk Factors may vary between different cost components if there is an expectation of disparate impacts of risk factors on COVID-19 treatment and behavioral health costs. These factors are set at a default 1.0 value.

Age/Sex Factors and Risk Factors are considered to be inputs for expert users. As such they are included within the Data – Costs tab rather than in the run forecast tab. Along with the Cost estimates, these amounts are provided with default values in the model and documented. Members who are utilizing the model may make changes to those values and make their own input selections. These can be considered as additional levers for model users to use in order to target certain cost distributions and relative cost values that a particular user may wish to simulate.

DATA – RATING AREAS

Rating area factors are adjustments based on characteristics that are unique to a particular geography. These factors incorporate components of both State – specific and region-specific differences. Rating area factors in the model are pre-populated based on existing publicly available parameters. Geographical variations are generally based on rating areas which vary by product type. Users are free to adjust these factors based on their own experience or understanding. Regional factors can also vary by all types of cost categories – reflecting the potential for different factors for base costs vs. COVID-19 or other types of costs.

For Commercial lines of business, we utilized factors base off on publicly available files from 2020 rate filings provided by Dave Dillon.[20,21] These files include Statewide averages of premiums with their underlying average rating factors. In addition, there are also files which include Risk Adjusted Geographic Cost factors. These factors were normalized to an average factor of 1.0 by weighting with billable member months. The intrastate and interstate factors were combined to generate overall Small group and Individual rating factors. Small group factors were applied to Large Group as a proxy.

For Medicare Advantage(MA) lines of business, we used publicly available 2021 rate calculation data which includes MA eligible members, County rates, and Regional rates at different bonus levels.[22] For this model, we used regional rates with no bonus and normalized these to an average factor of 1.0 using eligible membership for weighting. These factors map into one of 26 Medicare rating regions which are then applied to the model.

ANNUAL PROJECTION TREND FACTORS

Annual Trend Factors are included in the Run Forecast tab and are one set of key assumptions that dictate future costs in the model. These factors apply to all types of expenses in our model including base costs, direct COVID-19 costs, testing, and vaccine costs. The trend factors were originally included as “expert user” guidelines in the Data-Costs tab. However, now they were moved in order to encourage more user input on this front since they are a key component of what drives medical expenses and are one of the key factors that regulators evaluate when reviewing proposed insurance carrier rates.

These trend factors are labeled as: ‘Annual Increase of Baseline Costs in the Absence of the Outbreak’. These factors are broken out by major service categories. These are inpatient hospital, outpatient, professional and pharmacy. They are also allowed to vary by calendar year, as near term projected trends often vary from longer term trends for different reasons.

These factors have been pre-populated using trend factors from different sources. Dave Dillon provided some insights into typical Individual and Small Group trend factors to use as placeholders. These range from 5% annual trend for inpatient services up to 7.5% for pharmacy. Those are in line with some of the trend assumptions provided by Wakely in building up their small group and individual base costs which are incorporated into the projection model and referenced in the base costs area.

Large Group trend factors were derived from HCCI’s annual trend report extract.[23] Trends were derived from historical PMPMs from 2014 – 2018 broken out by main service categories. Large group trends inputted into the model ranged from 3% for inpatient services to 6% for pharmacy services. These trends tend to be lower for large group coverages and can be attributed to less adverse selection in the large group setting, due to higher population turnover within the group along with more benefit and plan design adjustments that help to drive lower utilization.

Medicare trend factors came from CMS observed and projects from 2016 to 2021. These generated trend factors of roughly 3% for Part A (inpatient) and 6% for Part B (outpatient and professional). Medicare Part D cost estimates were excluded from the projection Model. These were also roughly in line with overall projected trends from the National Health Expenditures (NHE) 2020 report. [24]

Medicaid Trends are populated with trends provided by Wakely. These factors range from 1.5% to 3.5% for medical services and 7% for pharmacy based on the block of Business that Wakely provided for the Medicaid base data. These are also in line with NHE projections.[25]

The evaluation and estimation of base trend assumptions were developed in a separate spreadsheet called "Trend default settings". This spreadsheet aggregates the different sources of trend data that were provided and utilized to generate the starting trends for non-expert users. Projection trends by Line of Business are displayed in Appendix

DEFERRAL / FOREGONE / RECOUPMENT FACTORS

The Deferral / Foregone / Recoupment factors are used to model the effects of the Shelter in place and social distancing policies on underlying base medical costs. The concept here is that as the country entered into this phase, there was a significant decrease in non-COVID-19 related elective services. This represents a combination of deferred and foregone services. The deferred and foregone reduction to cost factors included within the model in the Data – Costs tab represent an extreme scenario of the maximum possible deferrals and foregone services in a Return Stage of 1 within a high hotspot region.

The true differentiation between deferrals and foregone services is not clearly evident within this extreme case scenario from the data. As some of the restrictions ease, individuals start to re-evaluate their previous decisions to defer care. In some cases, the replacement services for the deferred care end up never being rescheduled or provided. This represents the Elimination of Services. Other services which end up being rescheduled or provided at a later date would be classified as deferrals with recoupment. Some of these services may in fact end up being of a higher severity of conditions worsen.

In the projection model, the starting point for the collected data and studies examined is the combination of deferrals and foregone services.

Deferred and Foregone Services Assumptions:

The Deferred and Forgone Services assumptions are based on maximum expected cost reductions of medical services during the course of the pandemic. These factors are only applied to base costs. The projection model allows underlying deferrals to vary by service categories and subcategories. Paid claims data was being provided by Wakely Consulting Group to help provide the basis for some of these assumptions. In addition, we are using several different studies recently published to help inform our assumptions. These include studies by the Commonwealth fund focusing on Outpatient and Professional Services[26] and one by Strata focusing on Inpatient services.[27] These studies generally focus on overall factors, with some limited level of differentiation between more detailed service category levels. Below are links to those studies

https://www.commonwealthfund.org/publications/2020/apr/impact-covid-19-outpatient-visits

https://www.stratadecision.com/national-patient-and-procedure-volume-tracker/

We also examined the effects of Hurricane Harvey on deferrals and recoupments between different subcategories to help drive some of the relative deferrals such as Medical vs. Surgical vs. Maternity Inpatient services. These are described in the SOA's [28] Finally, we received input from several POG members on what levels of deferrals they are seeing.

For each of the different services, these factors are calculated based on the maximum deferral amount during the height of the pandemic while the change in deferrals over time is addressed by the Return Stage assumptions.

The level of deferrals and eliminations differs significantly by service category and subcategory within the model.

For Inpatient services, the Strata Study indicates a peak reduction of services of roughly 35%. However, it is worth noting that COVID-19 services are included within those totals. Since COVID-19 direct costs are being projected separately within the model, it is important to take this into account and eliminate those costs from the deferrals. The effect of this is to increase maximum inpatient reductions. Members of the research Project Oversight group have indicated seeing values of closer to 50% for individual lines of business, particularly in California. As a result, we adjusted our deferral and elimination of services to be more in the 45-50% range. Differentiations between subcategories are based on Strata findings as well as on findings from Hurricane Harvey cost reductions.[29,30] Overall inpatient foregone and maximum deferral percentages are shown below in Table 7. The highest levels of deferrals were in surgical stays, while Medical and Other Inpatient had the highest rate of foregone services. Labor/Delivery assumes a 8% reduction due to a combination of decreased hospital stays, a slight shift to home births and a confirmed decrease in overall births – likely related to the pandemic.

Table 7

INPATIENT HOSPITAL FORGONE AND MAXIMUM DEFERRAL ESTIMATES

Service Category	Service Subcategory	Forgone %	Maximum Deferral %
Inpatient	Hospice	70%	0%
Inpatient	Labor/Delivery/ Newborns	8%	0%
Inpatient	Medical	35%	5%
Inpatient	Mental Health	30%	15%
Inpatient	Other Inpatient	30%	10%
Inpatient	SNF	35%	5%
Inpatient	Substance Use	30%	15%
Inpatient	Surgical	15%	50%

For Outpatient services, there was quite a bit of detail provided by both the Strata and Commonwealth Studies. The Commonwealth Study provided more of an overall picture, with some variations by age, geography, provider distributions, and service categories. Overall maximum Outpatient deferrals and foregone services come in around 65% in the Northeast part of the US, which was the hardest hit by COVID-19 cases and deferrals.[31] The Strata Study provided more detail on differentiation between service types.[32] Based on these studies, the following Foregone and Maximum Deferral percentages were used in the model as shown in Table 8. The highest levels of deferrals are associated with Surgery and Observation / ER. The lowest levels of deferrals and foregone services were related to equipment and diagnostics.

Table 8

OUTPATIENT FORGONE AND MAXIMUM DEFERRAL ESTIMATES

Service Category	Service Subcategory	Forgone %	Maximum Deferral %
Outpatient	Ambulance	65%	0%
Outpatient	Durable Medical Equipment	15%	30%
Outpatient	Lab	40%	5%
Outpatient	Radiology	50%	5%
Outpatient	Other Outpatient	15%	45%
Outpatient	Emergency Room	60%	0%
Outpatient	Observation	65%	0%
Outpatient	Surgery	10%	60%

Professional Services were generally informed by the Commonwealth Study results on an overall basis but also by some comparisons to outpatient services where there are some similarities. Overall Professional service reduction was set slightly lower than outpatient services due to some dependency on Hospital based services which would have seen lower reduction rates than many of those in outpatient. In addition, there is slightly less of an 'elective' element on the professional side relative to outpatient. Overall maximum professional services were set between 55% and 60%. Table 9 below illustrates the foregone and maximum deferral percentages that were used in the SOA projection model. The highest levels of cost reductions are related to surgeries, immunizations, and office visits. The lowest reductions were assumed to be in Psychiatry and administered drugs.

Table 9

PROFESSIONAL FORGONE AND MAXIMUM DEFERRAL ESTIMATES

Service Category	Service Subcategory	Forgone %	Maximum Deferral %
Professional	Drugs	10%	20%
Professional	Anesthesia	10%	20%
Professional	Emergency Room	60%	0%
Professional	Immunizations	35%	60%
Professional	Lab/Pathology	30%	25%
Professional	Office Visits	35%	30%
Professional	Other Services	35%	20%
Professional	Physical Medicine	35%	20%
Professional	Psychiatry	25%	20%
Professional	Radiology	30%	25%
Professional	Surgical	10%	60%

Pharmacy services have generally shown very little decline due to deferrals or foregone services. A health system tracker from the Kaiser Family Foundation published on May 29th shows some reductions in certain pharmaceutical categories, although these tend to be smaller reductions in some of the lower utilized areas. The observed KFF reduction factors were applied to certain drug categories as designated by HCCI's subcategories.[33] The result was an assumption the use of 1% foregone services and 1% maximum deferrals for overall non-COVID-19 pharmacy costs.

Recoupment of Services:

The assumptions related to recoupment of services are based on the ability of providers to make up for services that were deferred during periods of high COVID-19 infections. The general assumption is that a 30% increase in volume is feasible to help providers catch up on the services that were previously deferred and have accumulated over time. This is based on observed data from the Strata study where some of the later months saw volumes approaching values that were 30% greater than the previous year for Outpatient services. [34] Thus, a provider that normally works 40-hour weeks would then be working 52-hour weeks in order to address this additional demand. Much of this recoupment took place on the weekends for these Outpatient Services. In addition, if certain providers are still operating below capacity full capacity during one of the lower return stages, then they can recoup additional previously deferred services. This assumption will be revisited as more data around recoupments begins to emerge and as infection rates drop and States start opening up more.

Visual Basic for Applications Code

The model's calculations are programmed in Visual Basic for Applications (VBA) as opposed to spreadsheet cell formulas. This section provides a bird's eye view of the VBA code.

The model is, in fact, two separate calculation tools: (1) a tool for projecting health care costs forward in time, and (2) a tool for projecting the propagation of the virus through the population. The second tool is not essential for the operation of the first. Rather, it is provided for those users who wish to develop a better understanding of the potential interplay between social distancing and infection rates. The outbreak simulation tool is best thought of an "illustrative" or "stylized" model, rather than a model that produces robust results. Many research groups have developed COVID-19 outbreak models over the last few months, with simulation results varying widely across models. Thus, no single outbreak model should be viewed as providing a clear and reliable vision of the future.

THE COST FORECASTING MODEL

The cost forecasting tool consists of a several nested VBA "loops" which cycle through 38 health care service categories, and also cycle forward in time in monthly increments. Within each cycle of these loops, calculations are performed to determine the cost for a particular service category, year and month:

Figure 2
OUTLINE OF THE COST PROJECTION MODEL'S VBA CODE

```
Read Baseline Data
Read Assumptions
For cost category = 1 to Total Cost Categories (there are 38 cost categories in the model)
    For each year = 2020 to 2023
      For each month from 1 to 12
          Calculate cost for this particular year, month and cost category
      Move forward to next month
 Move forward to next cost category
Aggregate Results Across Cost Categories
Output Results
```

The model begins by reading

(a) baseline data that reflects 2019 health care costs and
(b) (b) assumptions that guide the model's forward projection.

The baseline data is subdivided into 38 cost categories that collectively capture the universe of insured health care costs. The model loops through each of these 38 categories, and, for each category, performs a projection across the forecast time horizon. Total projected costs are computed by aggregating across the 38 cost categories.

The cost projection involves three steps:

1. Project baseline costs in the absence of the outbreak

2. Project the effects of deferrals and recoupments on non-urgent and elective services
3. Project treatment, indirect impacts*, testing and vaccine costs for COVID-19

*Indirect impacts include behavioral health and substance abuse costs impacted by increased social distancing and isolation of the insured population.

While the model is programmed in VBA, three worksheet tabs are provided that illustrate the calculations using Excel cell formulas: (i) "Example Calc – Defer & Recoup", (ii) "Example Calc – Treatment Costs" and (iii) "Example Calc – Vaccine Costs". Therefore, please refer to these tabs if you are seeking a detailed understanding of the cost calculations.

THE OUTBREAK PROPAGATION MODEL

The outbreak projection tool is a "SIR" model, which stands for "susceptible", "infected" and "removed". The SIR model assumes that immunity is conferred to survivors of an infection. Once infected, an individual cannot become infected a second time, and they are "removed" from the simulation. Thus, the flow between compartments in a SIR model is unidirectional: the simulated population gradually shifts from susceptible to infected, and from infected to removed (i.e. deceased or recovered).

The SOA model operates in discrete time, projecting forward in one-day steps. The projected population state on day "N" is a deterministic function of the projected state on day "N - 1". The model begins its projection on June 1, using data from Johns Hopkins University's COVID-19 database to determine the reported percentage of the population in a health rating area that has already been infected and thus "removed" from the simulation. Total cases might exceed reported cases, given that researchers believe that many infected individuals might be asymptomatic. The user may enter an estimate for the ratio of unreported to reported cases in cell B12 of "Outbreak Simulation Model" (note that a corresponding parameter is shown in cell P16 of "Run Forecast").

Figure 3
OUTLINE OF THE OUTBREAK PROJECTION MODEL'S VBA CODE

Read the State of the Population as of June 1, using Data from Johns Hopkins University

Read User-Specified Social Distancing Assumptions

For Day = 1 to Total Number of Days in Forecasting Time Horizon

$\text{Newly Removed}_N = I_{N-1}$ / Average Duration of Infection (assumed to be 14 days)

$\text{Newly Infected}_N = S_{N-1} * [I_{N-1} - \text{Newly Removed}] * \text{Daily Transmission Rate per Infected Person}$

$S_N = S_{N-1} - \text{Newly Infected}_N$

$I_N = I_{N-1} - \text{Newly Removed}_N + \text{Newly Infected}_N$

$R_N = R_{N-1} + \text{Newly Removed}_N$

Move forward to next day

Output Results for each simulation day, and also aggregated to monthly time units

Note that $S_N + I_N + R_N = 100\%$ and note also that the daily transmission rate per infected person (DTRPIP) is assumed to vary as a function of the user-specified level of social distancing. If social distancing is set at 100% of normal levels, then DTRPIP is set equal to 0.195, which, applied across an assumed 14-day infectious period, translates into an R-naught of 2.75. R-naught is the average number of persons to whom an infected person transmits the virus, assuming that all individuals in a population are susceptible to infection. The simulated transmission rate is reduced

as a function of the assumed level of social behavior. For example, if the level of social contact is set at 50% of normal levels, then DTRPIP will be cut from 0.195 to half of that level, or 0.0975. Note that DTRPIP is not a constant; rather, the model permits the user to vary DTRPIP across time.

Appendix A: Direct COVID-19 Cost Distributions

Table A-1 through A4 below demonstrate the projected average cost for each COVID-19 disease State for each insured category that were used in the SOA projection model. The Mild state represents a situation where only COVID-19 testing costs were incurred. Moderate disease state assumes that treatment was received in either an outpatient or professional setting. Severe states assume hospitalization in an inpatient setting along with associated professional or outpatient costs. Critical states include hospital stays with an ICU component. Ventilated stays are ICT stays which include a ventilator. The probabilities of each disease state vary by the ages of each insured population. Individual, Medicare Advantage, and Managed Medicaid costs are lower than Group costs mainly due to unit cost differences for provided services.

Table A-1

DIRECT COVID-19 COSTS PER SERVICE CATEGORY BY DIFFERENT ILLNESS SEVERITY FOR GROUP INSURANCE

Service Category	Service Subcategory	Mild	Moderate	Severe	Critical	Ventilated
Inpatient	Medical	$0	$0	$42,000	$112,500	$180,000
Outpatient	Ambulance	$0	$80	$80	$80	$80
Outpatient	Lab	$44	$44	$44	$44	$44
Outpatient	Radiology	$0	$163	$163	$163	$163
Outpatient	ER	$0	$690	$690	$690	$690
Outpatient	Observation	$0	$600	$600	$600	$600
Professional	Drugs	$0	$90	$90	$90	$90
Professional	ER	$0	$135	$135	$135	$135
Professional	Lab	$44	$44	$44	$44	$44
Professional	Office Visits	$0	$63	$63	$63	$63
Professional	Radiology	$0	$53	$53	$53	$53
Pharmacy	COVID-19 Related	$0	$13	$13	$13	$13
Total Costs	Combined	$87	$1,972	$43,972	$114,472	$181,972

Table A-2

DIRECT COVID-19 COSTS PER SERVICE CATEGORY BY DIFFERENT ILLNESS SEVERITY FOR INDIVIDUAL INSURANCE

Service Category	Service Subcategory	Mild	Moderate	Severe	Critical	Ventilated
Inpatient	Medical	$0	$0	$32,550	$97,500	$150,000
Outpatient	Ambulance	$0	$70	$70	$70	$70
Outpatient	Lab	$44	$44	$44	$44	$44
Outpatient	Radiology	$0	$150	$150	$150	$150
Outpatient	ER	$0	$600	$600	$600	$600
Outpatient	Observation	$0	$500	$500	$500	$500
Professional	Drugs	$0	$80	$80	$80	$80
Professional	ER	$0	$120	$120	$120	$120
Professional	Lab	$44	$44	$44	$44	$44
Professional	Office Visits	$0	$55	$55	$55	$55
Professional	Radiology	$0	$45	$45	$46	$45
Pharmacy	COVID-19 Related	$0	$10	$10	$10	$10
Total Costs	Combined	$87	$1,718	$34,268	$99,219	$151,718

Table A-3

DIRECT COVID-19 COSTS PER SERVICE CATEGORY BY DIFFERENT ILLNESS SEVERITY FOR MEDICARE ADVANTAGE

Service Category	Service Subcategory	Mild	Moderate	Severe	Critical	Ventilated
Inpatient	Medical	$0	$0	$14,000	$37,500	$60,000
Outpatient	Ambulance	$0	$60	$60	$60	$60
Outpatient	Lab	$38	$38	$38	$38	$38
Outpatient	Radiology	$0	$138	$138	$138	$138
Outpatient	ER	$0	$510	$510	$510	$510
Outpatient	Observation	$0	$440	$440	$440	$440
Professional	Drugs	$0	$50	$50	$50	$50
Professional	ER	$0	$105	$105	$105	$105
Professional	Lab	$38	$38	$38	$38	$38
Professional	Office Visits	$0	$50	$50	$50	$50
Professional	Radiology	$0	$39	$39	$39	$39
Pharmacy	COVID-19 Related	$0	$9	$9	$9	$9
Total Costs	Combined	$76	$1,476	$15,476	$38,976	$61,476

Table A-4

DIRECT COVID-19 COSTS PER SERVICE CATEGORY BY DIFFERENT ILLNESS SEVERITY FOR MANAGED MEDICAID

Service Category	Service Subcategory	Mild	Moderate	Severe	Critical	Ventilated
Inpatient	Medical	$0	$0	$14,000	$30,000	$50,000
Outpatient	Ambulance	$0	$40	$40	$40	$40
Outpatient	Lab	$28	$28	$28	$28	$28
Outpatient	Radiology	$0	$88	$88	$88	$88
Outpatient	ER	$0	$360	$360	$360	$360
Outpatient	Observation	$0	$300	$300	$300	$300
Professional	Drugs	$0	$30	$30	$30	$30
Professional	ER	$0	$75	$75	$75	$75
Professional	Lab	$28	$28	$28	$28	$28
Professional	Office Visits	$0	$35	$35	$35	$35
Professional	Radiology	$0	$26	$26	$26	$26
Pharmacy	COVID-19 Related	$0	$6	$6	$6	$6
Total Costs	Combined	$55	$1,016	$15,016	$31,016	$51,016

Table A-5 below demonstrates the average direct COVID-19 costs by service category for hospitalized cases by line of business. Table A-6 includes the costs by service category

Table A-5

DIRECT COVID-19 COSTS PER IDENTIFIED HOSPITALIZED CASE BY LINE OF BUSINESS

Service Category	Service Subcategory	Large Group and Small Group	Individual	Medicare Advantage	Managed Medicaid
Inpatient	Medical	$61,470	$49,616	$34,850	$18,840
Outpatient	Ambulance	$80	$70	$60	$40
Outpatient	Lab	$44	$44	$38	$28
Outpatient	Radiology	$163	$150	$138	$88
Outpatient	ER	$690	$600	$510	$360
Outpatient	Observation	$600	$500	$440	$300
Professional	Drugs	$90	$80	$50	$30
Professional	ER	$135	$120	$105	$75
Professional	Lab	$44	$44	$38	$28

Professional	Office Visits	$63	$55	$50	$35
Professional	Radiology	$53	$46	$39	$26
Pharmacy	COVID-19 Related	$13	$10	$9	$6
Total Costs	Combined	$63,442	$51,333	$36,326	$19,855

Table A-6

DIRECT COVID-19 COSTS PER IDENTIFIED NON-HOSPITALIZED CASE BY LINE OF BUSINESS

Service Category	Service Subcategory	Large Group and Small Group	Individual	Medicare Advantage	Managed Medicaid
Inpatient	Medical	$0	$0	$0	$0
Outpatient	Ambulance	$40	$35	$48	$22
Outpatient	Lab	$44	$44	$38	$28
Outpatient	Radiology	$81	$75	$110	$48
Outpatient	ER	$345	$300	$408	$198
Outpatient	Observation	$300	$250	$352	$165
Professional	Drugs	$45	$40	$40	$17
Professional	ER	$68	$60	$84	$41
Professional	Lab	$44	$44	$38	$28
Professional	Office Visits	$31	$28	$40	$19
Professional	Radiology	$26	$23	$31	$14
Pharmacy	COVID-19 Related	$6	$5	$7	$3
Total Costs	Combined	$1,030	$902	$1,196	$583

Appendix B: Default Projection Trends

Table B-1

DIRECT COVID-19 COSTS PER IDENTIFIED CASE BY LINE OF BUSINESS

Service Category	Large Group	Small Group	Individual	Medicare Advantage	Managed Medicaid
Inpatient	3.0%	5.0%	5.0%	3.0%	1.5%
Outpatient	5.0%	6.0%	6.0%	6.0%	3.5%
Professional	4.0%	5.0%	5.0%	6.0%	3.5%
Pharmacy	6.0%	7.5%	7.5%		7.0%

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