SOCIETY OF ACTUARIES

SOA 2021 Health Care Cost Model User Guide

July 2020

TABLE OF CONTENTS

1. Overview

The Society of Actuaries (SOA) created the SOA 2021 Health Care Cost Model (model) to enable users to estimate future U.S. health care insurance costs. As with any forward-looking health care cost model, future health care costs are a function of trending costs forward in time and recognizing new levels and timing of health care costs. The COVID-19 outbreak impacting the U.S. creates many new scenarios that impacts costs now and in the future. This model allows a user to consider a variety of scenarios and create inputs that can forecast the impact on the health care service system. Future scenarios in the model are created by establishing a path of "Return Stages" that a designated rating area being studied is presumed to be in over time. Return stages in the model aim to help identify potential levels of health care cost and utilization, such as the level of COVID-19 care being observed, the level of deferred health care services and the opportunity to recoup previously deferred services.

The model was developed for primary use by actuaries and other professionals involved in the rate filing process for health insurance lines of business within the United States. We anticipate some primary users will be state regulators who are charged with reviewing health insurance premium rates for reasonableness in light of the potential impact of COVID-19 on the direct and indirect costs that impact health insurance premiums. Additional primary users may also be insurance carriers reviewing their development and timing of health care costs for the current year, 2021 and beyond. The developers of this model recognize that users may have varying levels of sophistication with regard to understanding the assumptions and methodology. Therefore, the model was designed to accommodate both the most knowledgeable or expert users, who are expert health actuaries with significant understanding of the drivers of costs related to the COVID-19 epidemic, as well as users with a basic understanding of health insurance and the usual drivers of health insurance costs. This user guide is intended to provide guidance to both levels. In some sections of this user guide, material will be prefaced with the label **[Expert]** in order to highlight where assumptions and considerations may be made for deeper use of the model.

This User Guide provides information on how to use the model, a description of the inputs and outputs and details some of the flexibility in the model that users may want to consider in running the model. Details of the mechanics of the model can be found in an accompanying "Model Documentation" report. The aim of this user guide is to provide a base reference for users of the model to better understand the options that can be selected.

This User Guide was initially released on June 17, 2020 with the June version of the model, and this version is being released on July 13, 2020 with the July version of the model.

The model is designed for primarily for actuaries to gain a sense of the range of health care costs that may emerge in 2020 and in coming years. The model should not be used to create any singular answer for how health care costs in any line of business or in any rating area will specifically emerge, be a specific rating tool for use by any insurer or promote situations that would form the basis of antitrust for health care insurance markets.

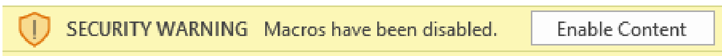
2. Getting Started

To get started, the user will need to download the model. The model in anticipated to be updated from time to time and the most current version will be posted on the SOA website. The Excel spreadsheet that contains the SOA 2021 Health Care Cost Model can be found at:

https://www.soa.org/resources/research-reports/2020/covid-19-cost-model/

The download process starts when the user clicks on the Microsoft Excel spreadsheet model link found on this page. The spreadsheet can be saved to a location desired by the user, and no specific computer or server directory requirements are required within the model. The model was constructed in Microsoft Excel 2016. The spreadsheet has a file extension of ".xlsm" due to macros within the model that enable easier running of calculations and tabulation and summary of model output.

Users may likely see the following Security Warning message from Excel when they initially open the model.



Users should click on the "Enable Content" button in order for the macros built within the spreadsheet to work and function as intended.

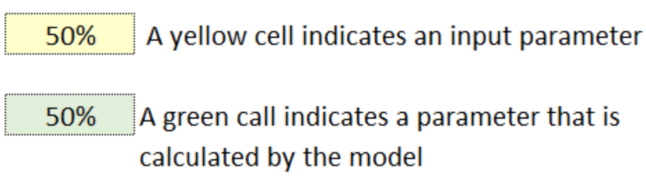
3. Model Worksheets

This section of the User Guide gives an overview of the different types of worksheets contained within the model and can help users gain familiarity with its structure for easier navigation. Worksheets within the model fall into these main categories:

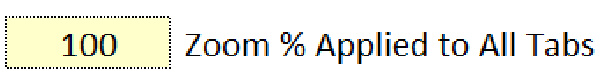
Contents Worksheet

The Contents worksheet gives descriptions and a general overview to the information within the full spreadsheet and covers what a user will find on other worksheets within the model.

A coloring system is used within the model, where yellow cells indicate parameters that the user can enter or change, and green cells are values that are calculated within the model.



The Contents worksheet also contains a cell that will automatically update the magnification level of cell values and text within all the worksheets. A user can user this to quickly make the model contents smaller or larger.



The Contents worksheet notes that the remaining worksheets in the model are divided into four main categories.

- A **Run Forecast** worksheet that controls the main model inputs and enables running of the model
- **Forecast** worksheets that display the output of the model in a variety of ways for the user
- An **Outbreak Simulation Model** worksheet that contains a basic epidemiological model that can be used to simulate future paths for COVID cases and scenarios to be used as inputs into the model.
- **Data** worksheets that contain a variety of model assumptions such as base health care costs, COVID treatment costs, population COVID case counts and others.

- **Calc Example** worksheets that demonstrate some of the key calculations within the model

Run Forecast Worksheet

This worksheet is the main input section of the model and the location where a user chooses the parameters for the model they would like to run. A description of the variety of inputs that a user can chose are described in the Selection of Inputs section of this User Guide.

Forecast Worksheets

Worksheets that start with the word “Forecast” are where model output is stored. These tabs give the user a variety of options to determine the level of detail that they would prefer to see and the time periods they would prefer to have displayed. A description of the levels of output that a user can chose are described in the Reviewing Model Outputs section of this User Guide.

Outbreak Simulation Model Worksheet

The full SOA 2021 Health Care Cost Model contains a modeling option for a user to simulate the current and future COVID-19 outbreak level in a health care insurance rating area to inform a progression through Return Stages. This Outbreak Simulation Model worksheet contains a susceptible, infected and removed (“SIR”) model for projecting the spread of COVID-19 forward in time. Output and graphs on this worksheet help a user visualize how new cases occur and the mapping of the outbreak progression to specific Return Stages. A description of the inputs and outputs of the model are described in the “Outbreak Simulation Model” section of this User Guide.

Data Worksheets

Worksheets that start with the word “Data” are places where data is stored within the overall model to help inform different parts of the model calculations. Data tabs include items such as:

- Demographic and health care cost information specific to local geographies within the U.S., such as states and counties

- Trends for COVID-cases within local geographies

- Health Care Cost assumptions for a variety of health lines of business, informed by research done on historical and current trends across insured plans. These cost assumptions use the input assumptions to drive estimates of future costs in an insured plan across future scenarios.

Example Calc Worksheets

For improved understanding and verification of model calculations with tangible inputs and outputs, the spreadsheet contains worksheets that demonstrate some of the key calculations. These include examples of how the deferral and recoupment of health care services operates across time, and the impact of COVID-19 costs arising from newly infected insureds.

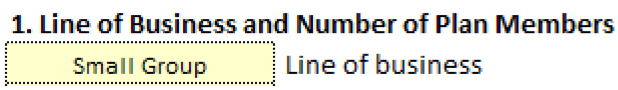
4. Selection of Inputs

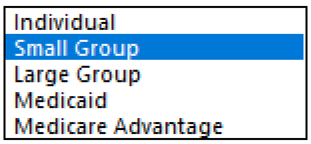
This section of the User Guide will highlight the model inputs needed in order to run the model.

The selection of inputs for assumptions in the model occur on the **Run Forecast** worksheet. For most users, the **Run Forecast** worksheet will be the only worksheet needed to input assumptions. Key inputs on this worksheet are as follows:

Line of Business

The user can specify one of the following health insurance lines of business that they would like to model.

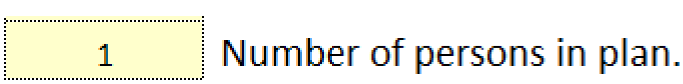




- **Individual** health insurance, commonly offered as comprehensive major medical coverage for commercial non-group consumers.
- **Small Group**, typically defined as employer-sponsored commercial health insurance plans with employee counts commonly limited to no more than 50 or 100 employees, as defined under State law. Often these coverages have limited rating factors defined by the Affordable Care Act, such as the location of the business, the ages of enrollees, and in some cases, tobacco usage among enrollees.
- **Large Group**, typically defined as employer-sponsored health insurance plans with employee counts above the Small Group thresholds.
- **Medicare Advantage**, a type of health plan offered by an insurer that contracts with Medicare to provide common Medicare hospital, medical and pharmaceutical benefits.
- **Medicaid**, the U.S. public health insurance program for people with low income offered through federal-state partnerships and in many cases are administered through private managed care or fee for service insurance plans that contract with states to provide comprehensive health care services.

Each line of business presumes that standard coverages are offered as described in the Model Documentation Guide.

Plan Size



Analysis can be done on a per person per month (PMPM) basis by entering a value of "1" into the cell. Alternatively, the model can transform the unit costs into dollars by entering the full size of the plan's population at the start of the projection.

Geographic Region

2. Rating Area

New York	Rating area: state
7	Rating area: number
1.589	Rating factor for selected area

The model allows the user to specify a Nationwide analysis or a specific rating area within a state that can be analyzed.

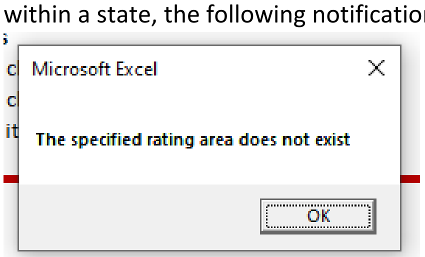
For commercial lines of business (individual, small group and large group), users may want to pick a specific rating area. For all lines but Medicare, commonly used rating areas have been pre-populated in the model, according to areas and data published by the Centers for Medicare and Medicaid Services' (CMS) Center for Consumer Information & Insurance Oversight (CCIIO). The user can designate a choice of state and rating area by making selections in the dropdown selectors.

A full set of the CCIIO State Specific Geographic Rating Areas and their descriptions can be found at https://www.cms.gov/CCIIO/Programs-and-Initiatives/Health-Insurance-Market-Reforms/state-gra

For Medicare, selection options are available at the state level.

As a rating area is selected, a rating factor is looked up within the model to transform national costs into levels for the rating area. If a user desires to look at a combination of multiple rating areas, such as a large group summary for an entire state, running different rating areas and combining in a spreadsheet outside of the model is recommended.

If a combination of state and rating area is not valid, such as choosing a numerical rating area that doesn't exist within a state, the following notification will occur:



An additional option is to choose the National Rating Area, which sets the rating factor to 1.000

Projection End Date

3. Forecasting Period

2020	First year of projection
2023	Project until December of this year

The user enters a calendar year through which the model will run. Users may want to simply consider a run through the end of 2020, or for looking at insured plan costs for next year run through the end of calendar year 2021. Users can choose to have the projection stop until December 2020, 2021, 2022 or 2023.

The model presumes that all health care costs have been trended forward to December 2019.

Portions of vaccines, diagnostic and antibody testing costs borne by the insurer

[Expert]

4. Portion of Unit Cost Borne by Insurer

0%	Vaccines (if included in scenario)
0%	Diagnostic Testing (if included in scenario)
0%	Antibody Testing (if included in scenario)

The model allows for the user to contemplate future impact of vaccines and types of diagnostic testing that may be implemented. While it is unknown currently if any vaccine may emerge to prevent against COVID -19 in the future, the model does all the user to make assumptions about this specific health care service being available. Details on the specifics of the timing of vaccines are covered further below. In this assumption, the user can designate what percentage of those costs will be covered by the insured plan.

As part of the evolving employment and insurance landscape in the U.S., employers may take steps to determine if employees entering the workplace have COVID-19 because an individual with the virus may pose a direct threat to the health of others. Employers may choose to administer COVID-19 testing to employees before they enter the workplace. If this situation occurs, insured plans may look to build these testing costs into covered health care services.

Similar to vaccines, the model is populated with assumptions for the timing of diagnostic testing and antibody testing costs should this occur, and the user can select the degree to what level the insurer will bear these costs. These costs will be added into to the total level of costs that are forecasted.

Monthly Adjustment Factors

[Expert]

5. Monthly Adjustment Factors

Yes	Include monthly changes in membership
Yes	Include monthly changes in morbidity
Yes	Include seasonality adjustments

Monthly Changes in Membership

[Expert]

Membership changes from time to time may occur in insured plans being considered and drive the overall cost levels expected for the future. The model allows the user to select whether a monthly array of membership changes will be applied when determining the final costs. If the user chooses **Yes**, then the Membership Volume Adjustment array will be applied to the calculations.

Monthly Changes in Morbidity

[Expert]

Overall morbidity levels within the participants in the insured plan may occur. This may occur when the population being insured exhibits large changes in behavior or the advent of any new or changing health care services being offered. For example, if a population defers health care services for long periods of time, such as common preventative care or treating emerging illnesses due to closures or strains in the health care system, then they may begin to except higher morbidity in the future. Alternatively, if a new vaccine were to emerge and prevent future illnesses, then the population may have some relative decrease in morbidity. The model allows the user to select whether a monthly array of morbidity adjustment will be applied when determining the final costs. If the user chooses **Yes**, then the Membership Morbidity Adjustment array will be applied to the calculations.

Seasonality adjustments

[Expert]

Base health care cost that are part of the core of the model are assumed to be at constant monthly levels within a year, save for any cost trend percentages that accrue monthly. Users, however, may want to apply seasonality factors to recognize a different monthly pattern, or to model the impact of how some plan designs incorporate different cost sharing arrangements such as annual deductible. If the user chooses **Yes**, then the Seasonality Factor array will be applied to the calculations.

Trend Increases for Baseline Costs

6. Annual Increase of Baseline Costs in the Absence of the Outbreak

	2020	2021	2022	2023
Inpatient	5.0%	5.0%	5.0%	5.0%
Outpatient	6.0%	6.0%	6.0%	6.0%
Professional	5.0%	5.0%	5.0%	5.0%
Pharmacy	7.5%	7.5%	7.5%	7.5%

One of the key assumptions for any projection of health care cost models in the level by which base costs are increased every year due to general trends of cost inflation. Default trend values for each line of business are included as a reference to assist with the development of user assumptions, which can be entered in this range. Details on the trends selected can be found in the Model Documentation Guide. If different levels of trend are desired to be tested the user can input alternative assumptions. This might be useful if a user may want to reflect the net interactions of increasing costs with how plan sponsors in small or large group coverages manage benefits to mitigate the overall cost levels incurred.

Social Distancing

7. Social Distancing Scenario For the selected region, how would you describe the level of social distancing thus far, and

						The Past	The Future	
	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07	2020-08
Level of social distancing	None	None	High	Max	Max	High	Medium	Medium
Translated into a model "return stage"	10	10	2	1	1	2	5	5

Return Stages

The model involves the concept of **Return Stages** which look to inform the model at each monthly time step on key health care cost drivers such as the level of COVID-19 activity, amount of health care services being deferred and the opportunity for deferred health care services to be recouped. Return Stages are identified by numeric values of 1 through 10. A Return Stage of 1 indicates the highest level of health care system stress due to COVID-19, and the lowest level of other health care services being consumed. A Return Stage of 10 indicates a health care system that has fully returned to normal operations, with capacity and ability to provide all typical types of services. Return Stages look to map the level of heath care system, business and public activity that are occurring and use research on observed health care system information to create informed model assumptions.

An SOA Research Brief on the Return Stage concept that provides general definitions of Return Stages can be found at https://www.soa.org/resources/research-reports/2020/covid-19-return-stages/ The brief on Return Stages also highlights emerging literature on what is currently being observed for deferring and restarting health care services. Additional information on the definitions of Return Stages are located in the appendix of this report.

Alternatively, the user may prefer written descriptions of the level of social distancing instead of a numerical Return Stages. Five written descriptions are included and map to Return Stages according to the following table.

Level of Social Distancing	Return Stage
None	10
Low	8
Medium	5
High	2
Max	1

COVID-19 Case Trends

[Expert]

Cumulative end-of-month coronavirus cases based on Johns Hopkins University's COVID-19 data through June 30, 2020

	For the selected rating area					
	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06
For the selected rating area						
Reported	0.00%	0.00%	0.06%	0.34%	0.56%	0.80%
Unreported	0.00%	0.00%	0.06%	0.34%	0.56%	0.80%
Total	0.00%	0.00%	0.11%	0.67%	1.11%	1.60%
For the country as a whole						
Reported	0.00%	0.00%	0.06%	0.34%	0.56%	0.80%
Unreported	0.00%	0.00%	0.06%	0.34%	0.56%	0.80%
Total	0.00%	0.00%	0.11%	0.67%	1.11%	1.60%

Unreported Cases

1.0	Number of unreported
50%	Unreported (i.e. unide
50%	Reported (i.e. identifie

Yes	Whenever the infection rate data on rows 17 and 18 above changes, automatically adjust the assumed infection rate time series on rows 48

As a rating area is chosen, additional pieces of information on the trend of COVID-19 cases will be populated into the worksheet. The additional pieces of information include the general population proportion of reported cases specific to the rating area from recent history. This data is sourced from the Johns Hopkins University of Medicine (JHU) Coronavirus Resource Center at https://coronavirus.jhu.edu/map.html Successive versions of the model will be released periodically that continue to update this data to current points in time.

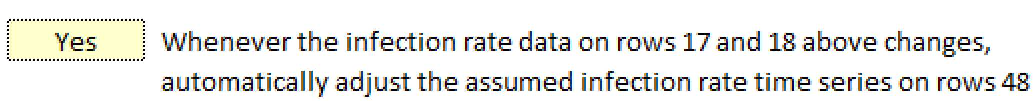
Since the level of reported cases are limited to those identified and observed by health care systems and may not include cases that are asymptomatic and not captured by the health care community, the user can input the number of unreported cases per each reported case. This will inflate the total amount of cases in the population to include both reported and unreported cases. Recently, the U.S. Centers for Disease Control and Prevention (CDC) issued a report on COVID-19 Pandemic Planning Scenarios, located at https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html# In the scenarios created by the CDC the percentage of infections that are asymptomatic are highlighted in their modeling as a variable to test for sensitivity. Additionally, the CDC notes that "*Asymptomatic cases are challenging to identify because individuals do not know they are infected unless they are tested, typically as a part of a scientific study.*"[1] In the CDC sensitivity tests, they use estimates for the percent of infections that are asymptomatic at 20% and 50%. These values would imply the number of unreported cases per each reported case at 0.25 and 1, respectively. Recent research papers have been published to research this question, with references including the following article "How many people actually have Covid-19?", Max Planck Institute for Demographic Research at *https://www.demogr.mpg.de/en/news_events_6123/news_press_releases_4630/press/how_many_people_actually_have_covid_19_8007*

Data from the JHU database include reported data, and this proportion of the population is presumed to be those who need receive level of medical care, even if basic. Unreported cases are presumed to be asymptomatic and do not enter into the health care system to produce insured costs. It can be beneficial, however, to view the total cases in order to ensure scenarios are consistent with how the user might expect the scenario to play out. Examples of these impacts are shown on some **Example Calc** worksheets.

Infection Rate for Scenario

[Expert]

The user also has the option to have the model use the COVID case data in the forecast. When this variable is selected as **Yes,** the model will link the data to automatically update the infection rate used in the forecast.



[1] https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html#

8. Infection Rate Scenario Fill in row 48 below. Alternatively, you may calculate these values as a function of the assumed return

	The Past						The Future		
	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07	2020-08	2020-09
New infection rate, reported + unreported	0.00%	0.00%	0.11%	0.56%	0.44%	0.50%	0.50%	0.50%	1.50%
New infection rate: reported (i.e. clinical cases)	0.00%	0.00%	0.06%	0.28%	0.22%	0.25%	0.25%	0.25%	0.75%
Cumulative reported + unreported infections	0.00%	0.00%	0.11%	0.67%	1.11%	1.60%	2.10%	2.59%	4.05%
Cumulative reported infections (i.e. clinical cases)	0.00%	0.00%	0.06%	0.34%	0.56%	0.80%	1.05%	1.29%	2.02%

Note: the new infection rate is expressed as a percentage of the uninfected population, while the cumulative infection rates are expresse

For future time steps in the forecast, new infection rates drive the level of future COVID health care costs that will be generated in the model and can be input in one of two ways.

First, the user may prefer to input presumed new general population infection rates and the model will use these assumptions to drive COVID costs that emerge in the model.

Alternatively, the model has infection rates loaded for COVID that are driven by Return Stage levels. When the user clicks on the Calculate Infection Rates button, the model will bring in new infection rates dependent upon the presumed Return Stage.

Calculate Infection Rates

Vaccinations and Testing

[Expert]

9. Vaccinations and Testing The assumptions below are expressed as a percentage of the covered population

	The Past						The Future	
	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07	2020-08
Diagnostic Testing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Antibody Testing	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Vaccinations	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cumulative Vaccinations	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

The model has an ability for users to input, if desired, the percentage of the insured population that would be using diagnostic testing services for COVID at varying points in time. The user can input this assumption using this variable. This utilization percentage, along with the previous variable noting how much of this cost will be borne by the insurer, will drive the total amount of cost in the forecast.

Similarly, the percentage of the insured population that would be using antibody testing services for COVID at varying points in time. This utilization percentage, along with the previous variable noting how much of this cost will be borne by the insurer, will drive the total amount of cost in the forecast.

The model also has an ability for users to input, if desired, the percentage of the insured population that would be receiving vaccination services for COVID at any point in time. The user can input this assumption using this variable. This utilization percentage, along with the previous variable noting how much of this cost will be borne by the insurer, will drive the total amount of cost in the forecast. The model will keep track of total vaccinations in the population.

Monthly Adjustment Factors

10. Monthly Adjustment Factors These factors are applied multiplicatively, so a value of 100% means that there is no effect,

	The Past						The Future	
	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07	2020-08
Membership Volume Adjustment	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Membership Morbidity Adjustment	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Seasonality Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

If desired, the user can input adjustment factors on a month by month basis that will adjust costs for membership volume, membership morbidity and seasonality. These factors are applied multiplicatively, so a value of 100% means that there is no effect. A value of 105% would indicates a 5% increase in costs and a value of 95% indicates a 5% decrease in costs.

Maximum Accumulated Deferrals of Health Care Service

200%	Cap on Accumulated Deferred Costs as a % of Monthly Baseline Cost

If a scenario is modeled where there is presumed to be a large number of health care services that are deferred, the question then becomes how much of those services may eventually work back into completed services. The model has overall parameters, according to the level of the Return Stage and the type of healthcare service, to recognize fully foregone services, defer services and recoup services in the future.

This variable will cap the level of deferred services that enter back into the health care system as a function of the baseline monthly cost for the service. If set to 0%, no costs deferred will ever be recouped, and will be fully foregone from costs. A level of 100% indicates that up to one month's level of deferred services will return at a future date, and any accumulation beyond 100% will be foregone. A level of 500% would indicate that up to 5 months of deferred services will eventually re-enter the insured costs, and anything accumulated higher than that will be foregone.

Matrix of Assumptions Driven by Return Stage

The model has a set of assumptions that can be dependent on the level of the Return Stage at any point in time.

6 Use Default Settings

Use Default Settings

Use Your Own Settings

Two options exist in the model. The default levels of these variables can be used, or alternatively the user can enter their own assumptions and use those settings.

Use Default Settings

		Default Settings						
Return Stage		1	2	3	4	5	6	7
Behavioral / Subst. Abuse	as % of max level	100%	90%	80%	70%	60%	50%	40%
Deferrals	as % of max level	100%	85%	75%	60%	40%	30%	10%
Recoupment	as % of max level	0%	15%	30%	45%	60%	80%	100%
Infection Rate	as % of uninfected	3.00%	1.80%	1.00%	0.80%	0.60%	0.40%	0.30%

Behavioral Health / Substance Abuse Increases

The use of these types of services tend to increase in severe Return Stages where there is increased social isolation, threat to public health and wellness and potentially higher levels of financial stress or unemployment. This variable increases the base health care costs attributable to these causes by the factor indicated. For example, a level of 50% would imply that 50% additional costs would be incurred in the model.

Deferral of Health Care Services

In severe health care system stress Return Stages, many health care services may be limited or unavailable. This variable determines the amount of non-COVID related services, as a percentage of all non-COVID services, that would be deferred during the month. The deferral of services has been studied as emerging information has been released, and values for Return Stages have been estimated from growing empirical data. This factor is applied to a maximum deferral factor for each unique service type that is contained within the model. For example, it may be challenging to fully defer inpatient medical services so the maximum deferral factor for that service may be low. Conversely, the maximum deferral factor for outpatient surgery services may be much higher. Values for this variable are very high in low numerical Return Stages, noting that near or all full deferral of the maximum may occur. Values for this variable are low or 0% in high numerical Return Stages, noting that no deferrals may be occurring.

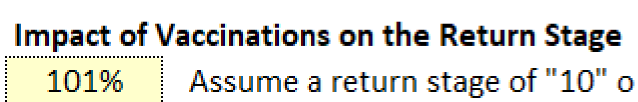
Recoupment of Deferred Health Care Services

Similarly, as Return Stages improve, the accrued deferred health care services have an opportunity to return back into the health care system, and costs may remerge. This factor is applied to a maximum recoupment for each unique service type that is contained within the model. Many maximum recoupment percentages are set at 25% to recognize that at full capacity, there is an ultimate limitation on facility time and resources that could be used to recoup services. Values for this variable are very low in low numerical Return Stages, noting that COVID and other priority services are taking priority. Values for this variable are high in high numerical Return Stages, nothing that health care service operations are operating at full capacity and can absorb past deferred services.

Infection Rate

As noted above, the rate at which monthly COVID infections occur may be generally tied to the level of the Return Stage. In March through May 2020, high levels of COVID infections have been seen when low Return Stages are experienced or have been the cause of these low Return Stages. This situation may have the potential in the future, so the user is encouraged to review experience as it emerges.

Impact of Vaccinations



The model can recognize the level of vaccinations in the population and adjust the Return Stage to a level of 10 when a sufficient level of the population has been vaccinated. The user can enter a value at which this reversion to Return Stage would occur. Any value entered over 100% in this field will deactivate this feature.

Hospitalization Rates for Identified COVID Cases

Hospitalization Rates for Identified COVID Cases

6.00%	Individual
6.00%	Small Group
6.00%	Large Group
6.00%	Medicaid
32.00%	Medicare Advantage

Identified COVID cases have a range of severity to them and with the July model an additional variable is included to identify the proportion of COVID cases that require hospitalization. This variable was added in July as more tangible data began emerging on the utilization and cost levels across lines of business, and also enable the user to fine tune the assumption as they see fit. In the previous version of the model, this assumption was wore rigidly built in into the overall per member per month costs. Default variables for each line of business are set based on data studied with results further documented in the Model Documentation Guide.

Assumption Set Library

List of Saved Assumption Sets

1	COVID Never Happened
2	Successful Suppression of Outbreak
3	Large Second Wave

The model provides the user the ability to use provided scenarios saved within the worksheet, and to create and save assumptions sets for easier loading and use. The pre-loaded scenarios may be helpful to give a general sense of the impact of deferred health care services and COVID costs in a variety of ways Return Stages may play out. Scenarios pull in a suggested progression of Return Stages and levels of new COVID infections. Several starting assumption sets have been saved in the model, including a No-COVID assumption set that consistently assumes Return Stage 10 and eliminates any COVID specific costs.

Retrieve An Assumption Set

To use this functionality on the **Run Forecast** tab, the user can click on the Retrieve An Assumption Set box. A prompt will appear asking the user to enter the number of the scenario to be retrieved.

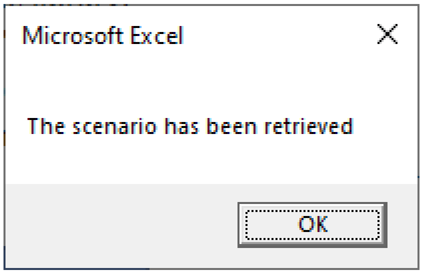
Microsoft Excel

Please enter the number [1 to 20] of the scenario you wish to retrieve

OK

Cancel

When the scenario is loaded, an affirmation of the retrieval will appear.

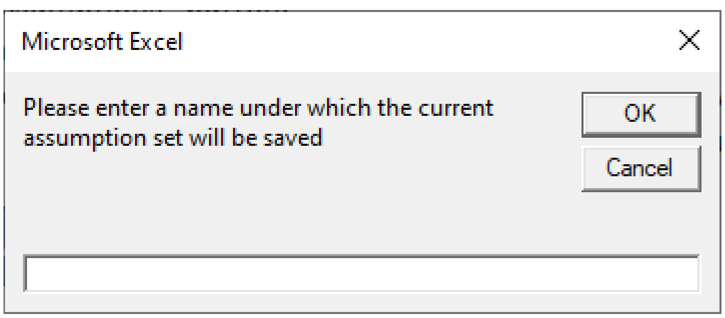


By clicking on the arrow next to the box, a scenario can be retrieved and the full Assumption Matrix can be quickly populated.

Adding a Scenario to the Library

[Expert]

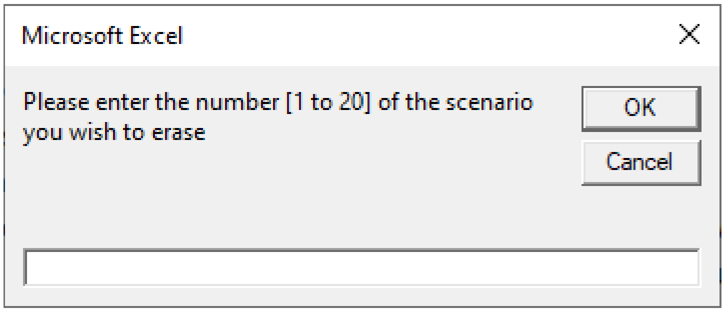
Other assumption sets may be created by a user and stored as well. For example, a user might want to create an additional assumption set where Return Stage levels are impacted by future events, such as a potential resurgence of COVID-19 in Winter 2020 and into 2021. When a scenario has been created with the desired Return Stages and infection rates, a user can click on the button labeled “Save the Current Set of Assumptions”. A dialogue box will appear:



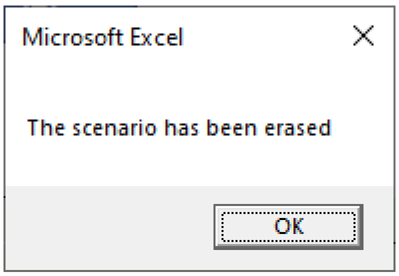
By entering a name, the scenario will then be saved among the library and can be retrieved for future use. The model can store up to 25 different assumption sets. Users should save the spreadsheet in order to retain new scenarios created.

Erasing An Assumption Set

Assumption sets may be removed by the user. To erase an assumption set, the user can click on the box labeled “Erase An Assumption Set”. A dialogue box will appear asking the user to input the number of the scenario to erase.



When the scenario has been removed, the user will receive the following notification:



5. Outbreak Simulation Model

[Expert]

Some users may want to test how a dynamic modeling approach to how COVID-19 cases can impact future Return Stages and what they might imply for the level of future health care services and costs. Within the model, the **Outbreak Simulation Model** worksheet contains a simple Susceptible, Infected and Removed (SIR) model for projecting an outbreak forward in time. This simulation model does not automatically feed into the health care cost forecast model, but an option allows the user to estimate Return Stage scenarios implied by the SIR model.

An SIR model assumes that immunity is conferred to survivors of an infection. In this assumption, once an individual is infected, they cannot become infected a second time, and they are removed from the simulation. The flow between population categories in an SIR model is in one direction with the simulated population gradually shifting from susceptible to infected, and from infected to removed (deceased or recovered).

The SIR model will simulate over time the percentages of the population that is infected, and in turn derives the number of newly infected persons each month as a percentage of the entire population. These new case counts then can be used to mapped to implied Return Stages over time.

As noted in the model, the following assumptions and overview apply:

- This model assumes that immunity is conveyed to those who survive an infection.

- The starting point for a simulation is data drawn from Johns Hopkins University's COVID-19 database. To provide this outbreak simulation model with the latest data, the JHU data should be refreshed every few days. The SOA is likely to issue updates to the model that will contain refreshed JHU data.

- The model operates by calibrating to the most recent 28 days of JHU data, focusing on the increase in new cases across this period. After calibration, the model moves forward in time in one-day steps. The projection for each day "N" is a function of the projected state of the population on day N-1.

- The model assumes an infectious period of 14 days. This is the period across which an infected person can transmit the virus to another person.

- Social distancing has a strong impact on simulation results. The model provides a variety of parameters by which a user can specify a social distancing approach.

Rating Area

Select Rating Area

New York	Rating area: state
8	Rating area: number

The user can select specific geographic rating areas, which trigger the model to reference actual reported COVID-19 case counts and population levels for the rating area chosen. Choices are for a National Model, or alternatively choosing a state and rating area similar to the input selections on the **Run Forecast** tab.

These selections will then inform the reported cases in the rating area as a proportion of the rating area full population.

Outbreak Simulation Model Variables

The SIR model leverages off six variables that trigger the start of the simulation.

Use the Data Above to Estimate the Susceptible, Infected and Recovered Status of the Population

1.0	Estimated ratio of unreported to reported cases. Sensitivity tests on this parameter are recommended.
94.266%	Susceptible: the % of the population that has not yet been infected
0.172%	Infected: the % of the population that is presently infected
5.562%	Removed: the % of the population that was infected, but has since recovered or died

Estimated level of social activity during final two weeks of data, as % of normal level of social activity

25%	100% represents normal social activity, while 0% represents no social activity whatsoever.

Social Distancing Parameters

2	**Approach for modeling social distancing**
	1 = enter a monthly series of social contact levels
	2 = dynamically adjusted social distancing, as a function of new infections
	3 = endogenize social distancing to hit a target rate of new infections -- this is not a realistic policy, but it can provide useful insights
	4 = hold social distancing at present level
	5 = no social distancing

One variable used is the **estimated ratio of unreported cases to reported cases**.

While the model brings in reported case data from John Hopkins University, these reported cases may only a portion of total cases that would be occurring. This assumption will assist in determining the level of CVOID intensity at the start of the outbreak simulation. Users may want to look at different levels of this variable in order to see the sensitivity of this parameter in the outbreak simulations.

Removed The percentage of the population that has previously been infected but has since recovered or died. This variable defaults to a value of:

(Cumulative reported cases as a percentage of the population, lagged 14 days) x (Estimated ratio of unreported cases to reported cases)

By starting with this as a default level, the model presumes that those removed from the simulation have contracted the disease in the past, but due to the time lag are no longer infected. The user can enter their own value if desired.

Infected The percentage of the population that is infected at the start of the simulation. This variable defaults to a value of:

[(Cumulative reported cases as a percentage of the population, most recent date) - (Cumulative reported cases as a percentage of the population, lagged 14 days)] x (Estimated ratio of unreported cases to reported cases)

By starting with this as a default level, the model presumes that those infected in the simulation have contracted the disease in the past 14 days. The user can enter their own value if desired.

Susceptible The percentage of the total general population that has not been infected but are susceptible. This variable defaults to a value of:

1 – (Infected Population Proportion) - (Removed Population Proportion)

Social Activity Level

An estimated level of social activity during final two weeks of data, as percentage of a full normal level of social activity. If all activity is presumed to be back to full normal, a user would enter 100%. If there are full restrictions implemented for social activity, a user would enter 0%.

Approach for Modeling Social Distancing

Users can select from five specific methods for modeling the level of social distancing to be used in the simulation:

Option 1 allows a user to enter a specific month by month percentage of a full normal level of social activity for the simulation.

Option 1: Enter Social Contact Level as % of Normal Level (100% = normal; 0% = no social contact whatsoever)

	1	2	3	4	5	6	7	8	9	10	11	12
Year 1	25%	35%	45%	55%	65%	75%	85%	90%	90%	90%	90%	90%
Year 2	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
Year 3	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%

Option 2 allows a user to enter in a range of social distancing levels based upon the current infection rate level. As different infection rate levels are hit, social distancing levels will be changed.

Option 2: Dynamically Adjusted Social Distancing

	Infection Rate	Social Level
Level 0	0.000%	100%
Level 1	1.000%	50%
Level 2	2.000%	25%
Level 3	5.000%	10%

Option 3 allows for users to specify a target new infection rate for the population, to which the model will dynamically adjust social distancing rules up or down in order hit the target rate of new infections. While this may not be a realistic social policy, it can provide useful insights to the way simulated Return Stages may emerge.

Option 3: Adjust Social Distancing to Hit a Precise Infection Rate (this is not a realistic policy, but can provide helpful insight)

1.000%	Target new infection rate (as a % of population) across a 14-day period

Option 4 allows the user to choose to hold social distancing at present level throughout the simulation.

Option 5 allows the user to presume no social distancing, with a full normal level of social activity throughout the simulation.

Running the Outbreak Simulation

After setting the input parameters, the user can run the simulation by clicking on the RUN button at the top of the sheet.

Outbreak Simulation Outputs

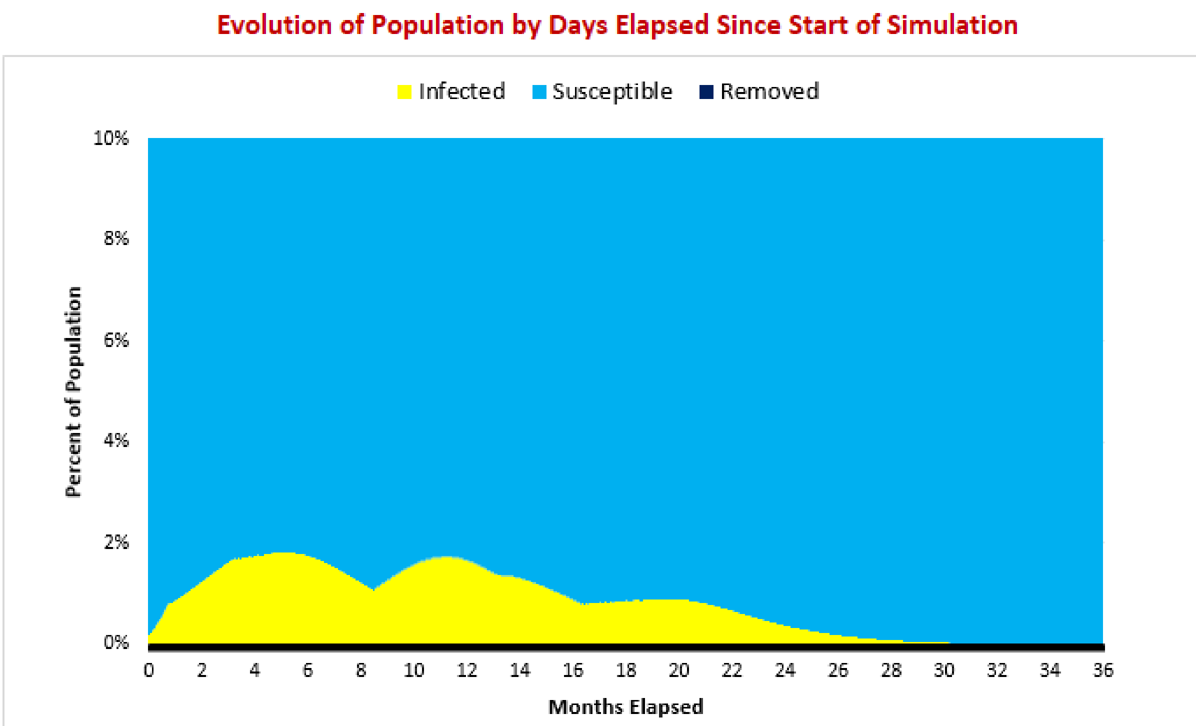
Outputs are displayed in both tabular and graphical form.

A first graph will show the level of Susceptible, Infected and Removed across time in the simulation.

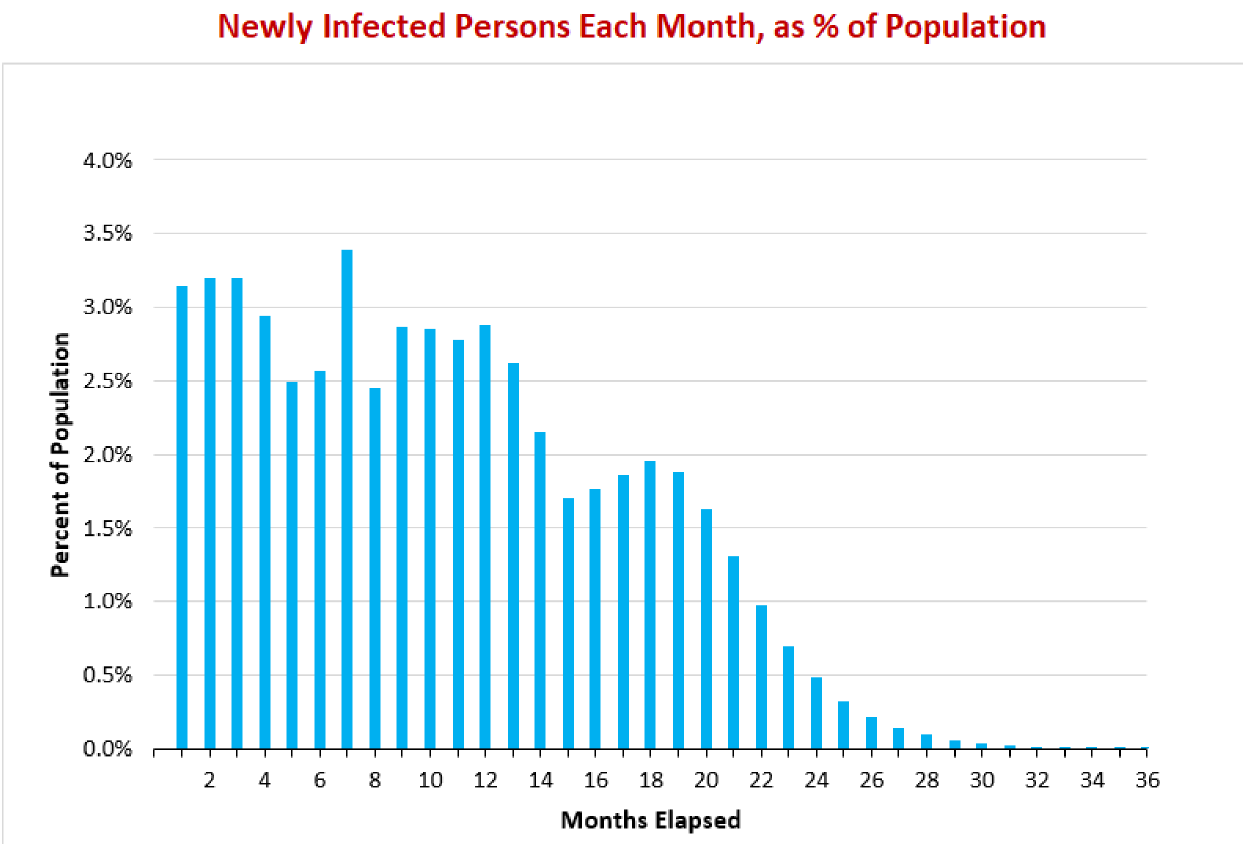
A user can control the focus of this graph by noting how many months they choose to view on the x-axis, and the level to which they prefer the y-axis be graphed.

Outputs

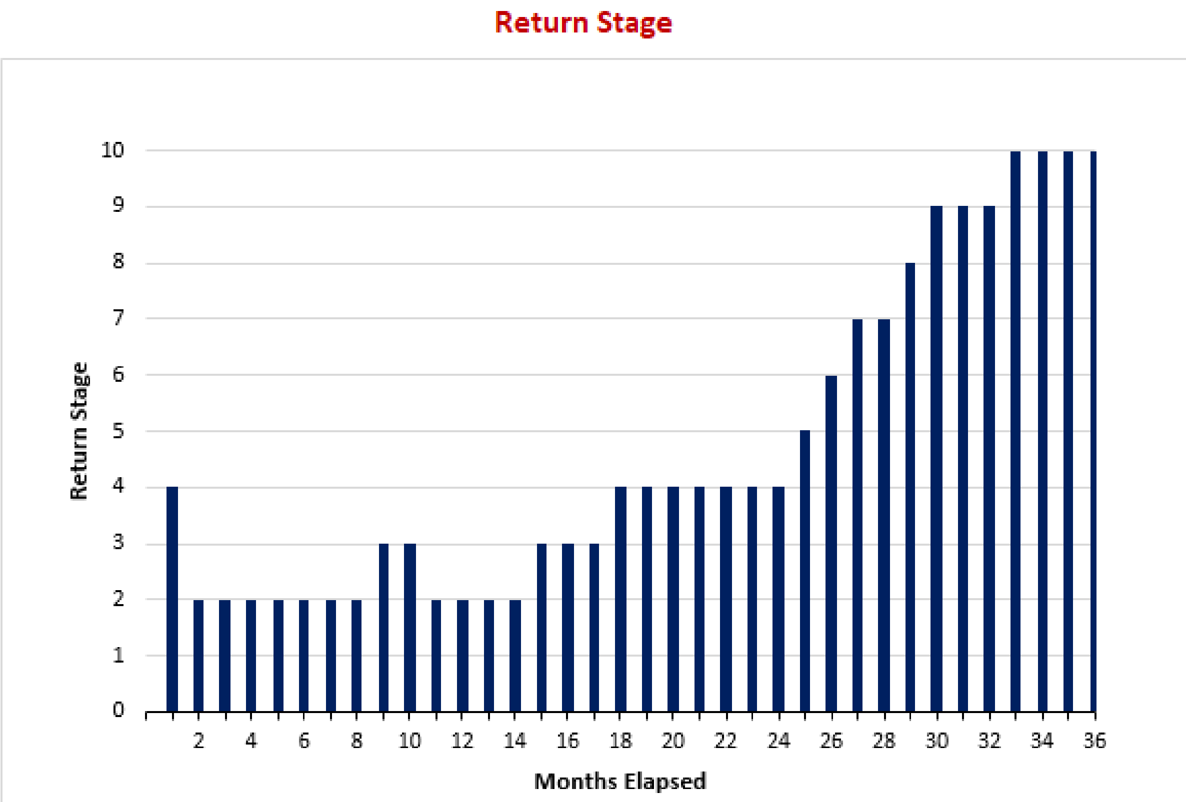
36	Months in simulation (assumes 30 days each month)
100%	On graph: maximum y-axis value to display


Evolution of Population by Days Elapsed Since Start of Simulation
Infected
Susceptible
Removed
10%
8%
6%
4%
2%
0%
Percent of Population
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
Months Elapsed

A second graph will indicate the level of newly infected cases each month as a percentage of the entire population.



A third graph will enable the user to map new infection rates to implied Return Stages.



The model allows a user to adjust the mapping to Return Stages if desired, with a default mapping included within the model.

Specify Monthly Return Stage as a Function of 14-Day Rate of New Infections

Return Stage	Infection Rate	
1	4.000%	
2	3.600%	
3	3.200%	
4	2.800%	
5	2.400%	
6	2.000%	
7	1.600%	
8	1.200%	
9	0.800%	*If the rate is below this threshold but above the level 10 threshold, then the return stage is 9.*
10	0.400%	*If the rate is below this threshold, then the return stage is 10.*

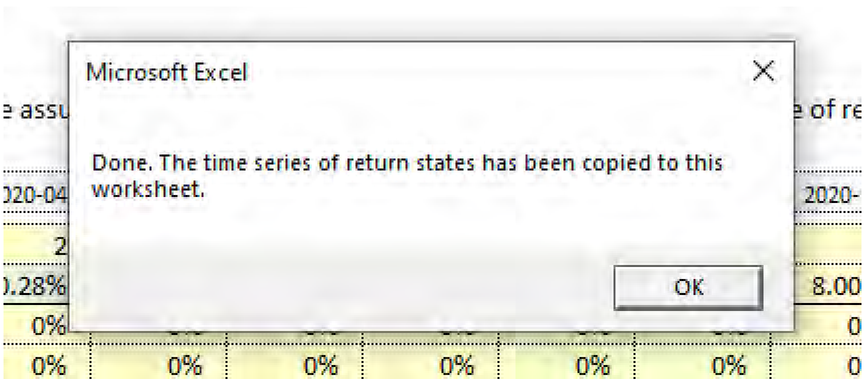
Through this outbreak simulation process, the model can suggest Return Stage paths that may be followed, and in turn influence the levels of health care costs, deferral of services and recoupment of deferred services.

Using Outbreak Simulation Model Output in the Forecast Model

A user can efficiently copy the projected Return Stages to the health care portion of the model. The user enters the most recent month for which the simulation reported case data is from in cell T47. Then by clicking the "Copy the Return Stages to the Run Forecast Tab" the implied Return Stages are loaded in **Row 26 of the** Run Forecast Tab.

Copy the Return Stages to the Run Forecast Tab

After this process is completed, the user will be given the following model message:



If new Return Stages have been imported into the **Run** Forecast worksheet, The user may want to utomatically update implied infection rates given the new set of Return Stages. The user can click on the "Calculate Infection Rates" button to populate infection rates.

Calculate Infection Rates

Additional numerical examples of the Outbreak Simulation Model can be found in the Example Calculations section of this User Guide.

6. Running the Model

To run the model, the user moves to **Run Forecast** worksheet, and ensures that the desired set of inputs are showing in throughout this worksheet. In particular the information in the data in the Social Distancing Scenario and the Infection Rate Scenario should be checked.

When the user is ready to run the forecast, they can click the RUN button on the worksheet.

Run

Results will be populated on the **Forecast** worksheets.

7. Reviewing Model Outputs

Once the model is run, the user will have several ways to review the output that is generated, and across different time periods, time steps and numerically and graphically. This section describes the different types of output produced by the model.

Forecast – Summary Worksheet

The "Forecast – Summary" worksheet provides an aggregated view of model detail month by month. Three major breakdowns of how costs are calculated are the following:

- A breakdown of total cost between traditional non-COVID health care services and COVID-related services
- A breakdown of total cost by the four major service categories of Inpatient, Outpatient, Physician and Pharmaceutical
- An overview of how traditional non-COVID health care services are deferred, eliminated and recouped in the model.

The user has the choice of viewing these cost summaries at a Monthly level, an Annual Level or both Monthly and Annual level using the selector on the worksheet.

Forecast Summary

This tab provides an aggregated set of costs. Results are expressed in dollars. Greater detail is available on the "Forecast - Detailed" tab.

Output Display

Annual

	2020	2021	2022
Return Stage	2	10	10
Cumulative Infection Rate	16.01%	18.09%	18.09%
Cost Calculation Subtotals			
Baseline, No Trend	6,276.32	6,638.54	7,022.24
Baseline, With Trend	6,276.32	6,638.54	7,022.24
Baseline, Adjusted for Defer and Recoup	4,418.09	7,146.98	7,022.24
COVID: Treatment	158.76	21.13	0.00
COVID: Mental Health	89.43	33.78	0.00
COVID: Diagnostic Testing	0.00	0.00	0.00
COVID: Antibody Testing	0.00	0.00	0.00
COVID: Vaccine	0.00	0.00	0.00
Total Cost	4,666.28	7,201.89	7,022.24
Provider Category			
Inpatient	939.57	1,366.49	1,315.04
Outpatient	1,094.85	2,096.60	2,005.59
Professional	1,375.56	2,401.91	2,289.18
Pharmacy	1,256.30	1,336.90	1,412.43
Total Cost	4,666.28	7,201.89	7,022.24
Deferrals and Recoupments			
Baseline, With Trend	6,276.32	6,638.54	7,022.24
Eliminated	1,117.80	232.00	0.00
Deferred	1,091.06	333.91	0.00
Recouped	350.63	1,074.34	0.00
Deferred, but Not Yet Recouped	740.43	0.00	0.00
Net Current Cost, Excluding COVID costs	4,418.09	7,146.98	7,022.24

Forecast – % of Baseline Worksheet

The Forecast - % of Baseline worksheet provides a view of model detail month by month, all relative to a situation where the baseline is projected costs in the absence of COVID. Similar breakdowns are provided to the Forecast – Summary worksheet. The user has the choice of viewing these cost summaries at a Monthly level, an Annual Level or both Monthly and Annual level using the selector on the worksheet.

Forecasted Costs as a Percent of Costs in the Absense of COVID-19

Each cost item is divided by the projected cost in the absence of COVID-19

Output Display

Annual

Return Stage	2	10	10
Cumulative Infection Rate	16.01%	18.09%	18.09%
	2020	**2021**	**2022**
Cost Calculation Subtotals			
Baseline, No Trend	100.00%	100.00%	100.00%
Baseline, With Trend	100.00%	100.00%	100.00%
Baseline, Adjusted for Defer and Recoup	70.39%	107.66%	100.00%
COVID: Treatment	2.53%	0.32%	0.00%
COVID: Mental Health	1.42%	0.51%	0.00%
COVID: Diagnostic Testing	0.00%	0.00%	0.00%
COVID: Antibody Testing	0.00%	0.00%	0.00%
COVID: Vaccine	0.00%	0.00%	0.00%
Total Cost	74.35%	108.49%	100.00%
Provider Category			
Inpatient	78.77%	109.11%	100.00%
Outpatient	61.34%	110.81%	100.00%
Professional	66.25%	110.17%	100.00%
Pharmacy	102.79%	101.75%	100.00%
Total Cost	74.35%	108.49%	100.00%
Deferrals and Recoupments			
Baseline, With Trend	100.00%	100.00%	100.00%
Eliminated	17.81%	3.49%	0.00%
Deferred	17.38%	5.03%	0.00%
Recouped	5.59%	16.18%	0.00%
Deferred, but Not Yet Recouped	137.99%	0.00%	0.00%
Net Current Cost, Excluding COVID costs	70.39%	107.66%	100.00%

Forecast - Annual % Increase

The Forecast – Annual % Increase worksheet makes year over year comparisons of annual costs and can help identify how the combination of COVID costs and deferral of services interact in the scenario in the future compared to the forecast in 2020. Depending on the severity of the scenario and Return Stages, timing of costs may also effect the magnitude of increases or decreases in 2021, 2022 and 2023.

Annual Increase of Forecasted Costs

Year over year cost increases

	2021	2022	2023
Inpatient	45.44%	-3.77%	5.00%
Outpatient	91.50%	-4.34%	6.00%
Professional	74.61%	-4.69%	5.00%
Pharmacy	6.42%	5.65%	7.50%
Total Cost	54.34%	-2.49%	5.79%

Forecast - Detailed

The Forecast – Detailed worksheet provides a deeper, more detailed look for key model variables for the user.

Output Display	
All	Cost components
Monthly	Aggregation across time
No	Delete (rather than hide) unselected cost components

Users can use the selector to choose to look at all cost variables, or additionally focus in on one variable within the model. The user has the choice of viewing these cost summaries at a Monthly level, an Annual Level or both Monthly and Annual level using the selector on the worksheet. Additionally, the user can choose to delete data from the forecast if desired, rather than more simply hiding the rows that contain the data.

This view can be very helpful to seeing the inner workings of the model variables and is a helpful cross-checking resource when used in combination with the calculation routines provided in the Model Documentation Guide.

Detailed Forecast

This tab provides outputs for each cost item. Results are expressed in dollars per member. A compact forecast summary is presented on the '

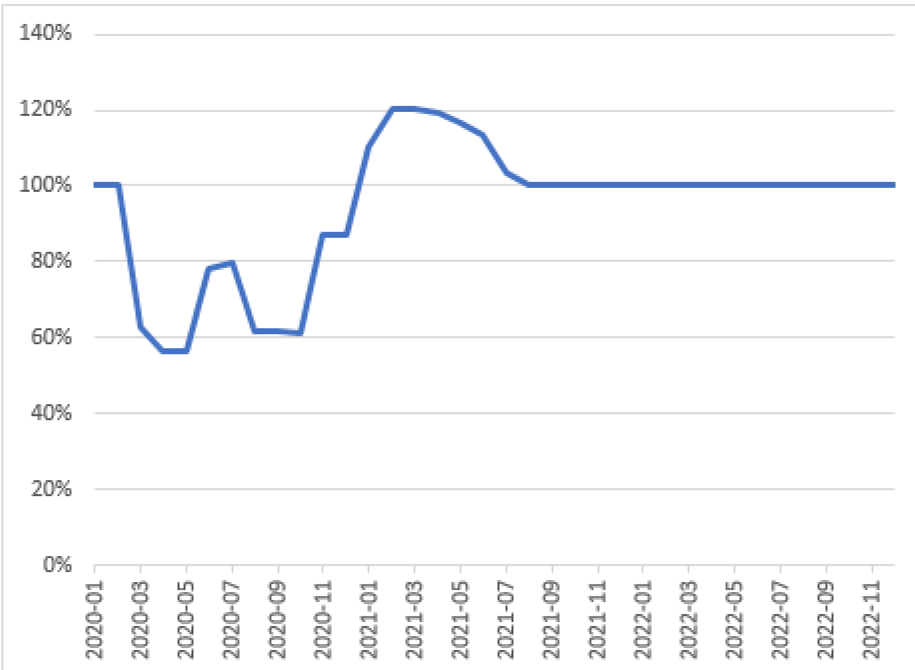
Output Display	
All	Cost components
Annual	Aggregation across time
No	Delete (rather than hide) unselected cost components

Service Category	Service Subcategory	Cost Component	2020	2021	2022	2023
			2	10	10	10
			16.01%	18.09%	18.09%	18.09%
Inpatient	Hospice	Baseline without Trend	1.73	1.82	1.91	2.00
Inpatient	Hospice	Baseline with Trend	1.73	1.82	1.91	2.00
Inpatient	Hospice	Eliminated	0.74	0.00	0.00	0.00
Inpatient	Hospice	Deferred	0.29	0.00	0.00	0.00
Inpatient	Hospice	Recouped	0.33	0.00	0.00	0.00
Inpatient	Hospice	Not Yet Recouped	0.18	0.00	0.00	0.00
Inpatient	Hospice	COVID Treatment	0.00	0.00	0.00	0.00
Inpatient	Hospice	COVID Social Dist	0.00	0.00	0.00	0.00
Inpatient	Hospice	COVID Diag Testing	0.00	0.00	0.00	0.00
Inpatient	Hospice	COVID Antibody Testing	0.00	0.00	0.00	0.00
Inpatient	Hospice	COVID Vaccine	0.00	0.00	0.00	0.00
Inpatient	Hospice	Net Current Cost	1.03	1.82	1.91	2.00
Inpatient	Labor/Delivery/ Newborns	Baseline without Trend	208.77	219.21	230.17	241.68
Inpatient	Labor/Delivery/ Newborns	Baseline with Trend	208.77	219.21	230.17	241.68
Inpatient	Labor/Delivery/ Newborns	Eliminated	3.55	0.00	0.00	0.00
Inpatient	Labor/Delivery/ Newborns	Deferred	0.00	0.00	0.00	0.00

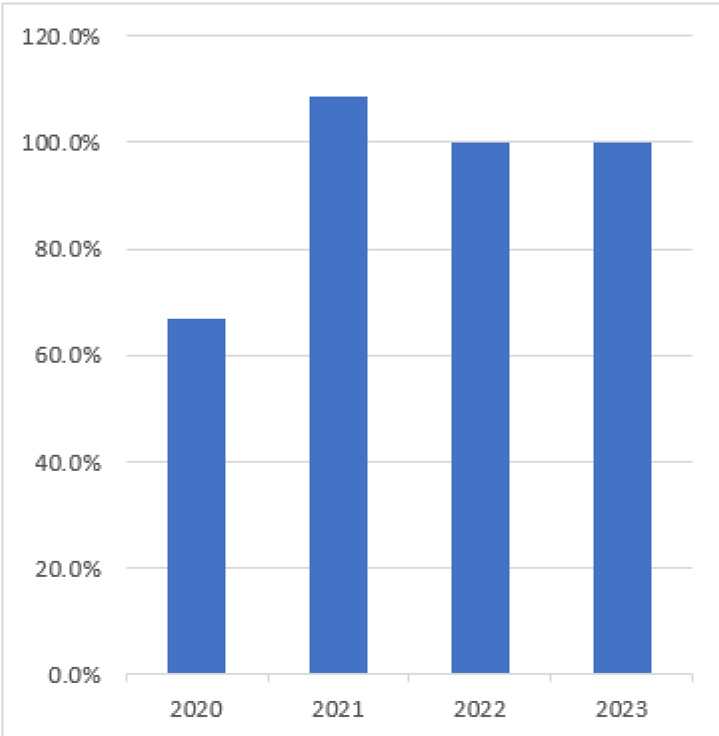
Forecast – Graphs

In order to visually see the forecast results, a set of graphs have been included. The following graphs pull in information from the forecast:

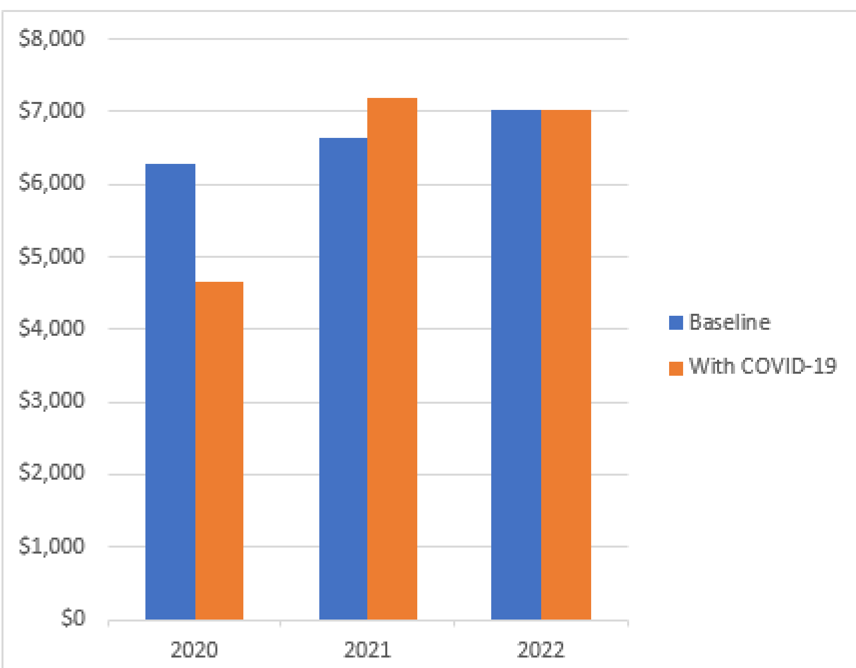
Monthly Costs as a % of Baseline Monthly Costs



Annual Costs as a % of Baseline Annual Costs



Annual Costs in Dollars



8. Example Calculation Worksheets

The model also has several additional worksheets that may be helpful to demonstrate some prominent calculations. Full details of the calculations can be seen in examining the spreadsheet cells, as well as through the Visual Basic loops that are contained in the accompanying Model Documentation Guide.

The following worksheets are available for review and understanding by the user:

Example Calc - Defer & Recoup

This calculation demonstrates the mechanics of the model for the way certain health care costs are eliminated, deferred and potentially recouped through the model.

An Illustration of the Model's Process for Projecting the Impact of Deferrals and Recoupments on

	Deferrals and Recoupment Rates as a Function of Return Stage									
Return Stage	1	2	3	4	5	6	7	8	9	10
Deferral Rate Relative to Max Deferral Rate	100%	85%	75%	65%	50%	30%	10%	0%	0%	0%
Recoupment Rate Relative to Max Recoupment Rate	0%	15%	30%	45%	60%	80%	100%	100%	100%	100%

$50	Baseline PMPM cost, in Jan 2020, of some particular non-urgent service
5.00%	Expected annual rate of cost increase in the absence of the outbreak
25%	For return stage 1, enter the % of the baseline volume of services that will be permanently "foregone" -- these ar
35%	For return stage 1, enter the % of the baseline volume of services that will be deferred to a future date, after soc
40%	For return stage 1, this is the % of baseline services that are unaffected by the outbreak
25%	For return stage 10, enter the maximum additional volume of services, relative to the baseline level, that provide
100%	The maximum accumulated level of deferred services that have not yet been recouped, expressed as a % of the
	If deferred-but-not-yet-recouped services accumulate to a level above that shown in cell F16, then the backlog

BOM = beginning of month
EOM = end of month

	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07	2020-08	2020-09	2020-10	2020-11	20
Return Stage	10	10	1	1	1	2	3	4	5	7	9	
Deferral Rate	0%	0%	100%	100%	100%	85%	75%	65%	50%	10%	0%	
Recoupment Rate	100%	100%	0%	0%	0%	15%	30%	45%	60%	100%	100%	
Baseline Costs	$50.00	$50.20	$50.41	$50.61	$50.82	$51.03	$51.23	$51.44	$51.65	$51.86	$52.07	
Ceiling for Accumulated Deferrals	$50.00	$50.20	$50.41	$50.61	$50.82	$51.03	$51.23	$51.44	$51.65	$51.86	$52.07	
Max Provider Capacity	$62.50	$62.75	$63.01	$63.27	$63.52	$63.78	$64.04	$64.30	$64.57	$64.83	$65.09	
Backlog of Deferred Services, BOM	$0.00	$0.00	$0.00	$17.64	$35.36	$51.03	$51.23	$49.31	$38.83	$24.57	$10.31	

Example Calc - Treatment Costs

This calculation demonstrates the mechanics of the model for how COVID-19 treatment costs are determined in the model.

An Illustration of the Model's Process for Projecting the Cost of COVID-19 Treatment

For the sake of simplicity, this example assumes that all costs fall into a single service category. In fact, costs are distributed across many categories, and the calculations b

Annual Cost Trend (rows 32 to 35 of run Forecast)

2020	2021	2022	2023
5.0%	5.0%	5.0%	5.0%

$1,649	Initial baseline cost, per symptomatic infection
1.0	Number of unreported cases per each reported case (cell P16 from Run Forecast)
50%	Reported cases as a % of total cases

	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06
New infection rate, reported + unreported, as % of uninfected members	0.00%	0.00%	1.00%	2.00%	2.00%	2.00%
New infection rate: reported (i.e. clinical cases), as % of uninfected members	0.00%	0.00%	0.50%	1.00%	1.00%	1.00%
Cumulative reported + unreported infections, as % of total members	0.00%	0.00%	1.00%	2.98%	4.92%	6.82%
Cumulative reported infections (i.e. clinical cases), as % of total members	0.00%	0.00%	0.50%	1.49%	2.46%	3.41%
age-sex factor in column in column O of "Data Costs"	100%	100%	100%	100%	100%	100%
risk factor in column in column P of "Data Costs"	100%	100%	100%	100%	100%	100%
Membership Volume Adjustment in row 65 of "Run Forecast"	100%	100%	100%	100%	100%	100%
Membership Morbidity Adjustment in row 66 of "Run Forecast"	100%	100%	100%	100%	100%	100%
Seasonality Factor in row 67 of "Run Forecast"	100%	100%	100%	100%	100%	100%
projected cost per symtomatic infection	$1,655.81	$1,662.55	$1,669.33	$1,676.13	$1,682.96	$1,689.81
cost for this service = cost per symptomatic infection * rate of new symptomatic infections	$0.00	$0.00	$8.35	$16.59	$16.33	$16.07
adjusted cost reflecting various adjustment factors	$0.00	$0.00	$8.35	$16.59	$16.33	$16.07

Example Calc - Vaccine Costs

This calculation demonstrates the mechanics of the model for how potential vaccine costs are determined in the model.

An Illustration of the Model's Process for Projection the Cost of COVID-19 Vaccinations

While the example below is focused on vaccines, it also serves as an example for the computation of the cost of COVID-19 testing, which follows an identical cal

Annual Cost Trend (rows 32 to 35 of run Forecast)

2020	2021	2022	2023
5.0%	5.0%	5.0%	5.0%

$135.00	Cost per vaccination (column AD of "Data - Costs")
50.0%	% of vaccination costs borne by insuer (cell B21 of "Run Foreca

	2020-01	2020-02	2020-03	2020-04	2020-05	2020-06	2020-07
Vaccinations This Month, as % of Members	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Cumulative Vaccinations	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
age-sex factor in column in column AE of "Data Costs"	100%	100%	100%	100%	100%	100%	100%
risk factor in column in column AF of "Data Costs"	100%	100%	100%	100%	100%	100%	100%
Membership Volume Adjustment in row 65 of "Run Forecast"	100%	100%	100%	100%	100%	100%	100%
Membership Morbidity Adjustment in row 66 of "Run Forecast"	100%	100%	100%	100%	100%	100%	100%
Seasonality Factor in row 67 of "Run Forecast"	100%	100%	100%	100%	100%	100%	100%
projected cost per vaccination	$135.55	$136.10	$136.66	$137.21	$137.77	$138.33	$138.90
projected cost per vaccination * % of members receiving vaccinations	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
adjusted cost reflecting various adjustment factors	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
vaccination costs borne by insurer	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Example Calc - SIR Model

This calculation demonstrates the mechanics of calculations used in the Outbreak Simulation Model. By entering variables such as the percentage of the population that is susceptible, infected and recovered, the user can create a scenario of how an outbreak would progress. Inputting an R-effective transmission rate is also part of the example.

An Illustration of the Calculations Used in the Outbreak Simulation Model

The output break simulation model is a "stylized" model, meaning that it is simpler than "real" outbreak models, and is intended primar
A SIR model divides the population into susceptible, infected and removed categories, and, for each time step, estimates shifts betwee
The SIR model included in this tool assumes that individuals can be infected only one time, after which they are "removed" and are no l
The model assumes that infections last 14 days on average, and that an individual is capable of infecting others across this entire 14-day
The rate of new infections is equal to the product of the susceptible population, the infected population, and the daily transmission rate
the virus from somebody who is already infected. If each infected person tranmitsthe virus to fewer than 1 person (on average) across t
In this model, "R-effective" is equal to the daily tranmission rate multiplied by 14 days; or, conversely, the daily transmission rate is equ
infection to gradually (or rapidly, if R-effective is large) to spread through the population. An R-effective of less than 1 will lead to the e
R-effective is related both to the underlying contagiousness of the virus, and the level of social distancing. For sake of simplicity, howev
directly on R-effective. But for sake of completeness, columns N and O show the assumed relationship between level of social behavior
with a mixture of art and science, with art playing the dominant role. The basic idea is simply that the level the rate of social contact, the

95.0%	Susceptible:	the % of the population that has not yet been infected
1.0%	Infected:	the % of the population that is presently infected
4.0%	Removed:	the % of the population that was infected, but has since recovered or died

Day	R Effective	Daily Transmit Rate	Infected	Susceptible	Removed	New Removals	New Infections
0	1.50	0.11	1.00%	95.00%	4.00%	0.07%	0.09%
1	1.50	0.11	1.02%	94.91%	4.07%	0.07%	0.10%
2	1.50	0.11	1.05%	94.81%	4.14%	0.07%	0.10%
3	1.50	0.11	1.07%	94.71%	4.22%	0.08%	0.10%
4	1.50	0.11	1.09%	94.61%	4.30%	0.08%	0.10%
5	1.50	0.11	1.12%	94.51%	4.37%	0.08%	0.11%
6	1.50	0.11	1.15%	94.40%	4.45%	0.08%	0.11%
7	1.50	0.11	1.17%	94.29%	4.54%	0.08%	0.11%
8	1.50	0.11	1.20%	94.18%	4.62%	0.09%	0.11%
9	1.50	0.11	1.22%	94.07%	4.70%	0.09%	0.11%

9. Additional User Information

This User Guide has been developed to give an overview of the inputs and outputs of the model. Other references for users to review are the following:

- A recorded video that walks through screen by screen use of the model, produced by the SOA. This video can be seen on the SOA website at: https://www.soa.org/resources/research-reports/2020/covid-19-cost-model/

- A Model Documentation Guide, which highlights the mechanics of the model and provides insights into the data sets that were studied to form base costs and COVID-related costs that are used in the model. This Model Documentation Guide can be viewed at: https://www.soa.org/resources/research-reports/2020/covid-19-cost-model/

- Follow up questions can be sent via e-mail to the SOA at research@soa.org

10. Model Limitations

It is important to note to users that this model aims to create examples of potential health care costs across scenarios, with a main goal of being able to be used by both insurance company actuaries and regulatory actuaries to discuss and assess the variety of ranges of estimates of 2021 health care costs. With this tool and report as a common reference point, the rating approval processes can continue with objective information and prompt a more informed discussion about health care costs and premium levels for the variety of insurance markets across states in 2021.

The model is not attempting to create any singular answer for how health care costs in any line of business or in any rating area will specifically emerge, be a specific rating tool for use by any insurer or promote situations that would form the basis of antitrust for health care insurance markets.

11. Disclaimers

The SOA makes no warranty, guarantee or representation, either expressed or implied, regarding the SOA 2021 Health Care Cost Model ("Model"), including its quality, accuracy, reliability , or suitability and hereby disclaims any warranty regarding the Model's merchantability or fitness for any particular purpose.

SOA makes no warranty that the Model is free from errors, defects, worms, viruses or other elements or codes that manifest contaminating or destructive properties.

In no event shall SOA be liable for damages (including any lost profits, lost savings, or direct, indirect, incidental, consequential or other damages) in connection with or resulting from the use, misuse, reliance on, or performance of any aspect of the Model.

The user assumes all responsibility for the use of the Model.

12. Appendix

Descriptions of SOA Return Stages

SOCIETY OF ACTUARIES RESEARCH BRIEF RETURN STAGES

Return Stage Number	Description	COVID-19 Case Count Trends	Health Care System	Social Distancing and Public Activities	Business Activity
1	Full Local Pandemic	New case count rate growing	COVID hospitals at capacity or strained; Non-COVID hospitals closed or only accepting emergent cases; Medical and surgical centers closed; No elective or non-essential services; Lack of in-person treatment or service would result in patient harm.	No public interaction; No public activities; Face covering required; No public travel; Schools closed	Essential business activity only; Retail and recreation mobility down 70% or more from baseline normal
2	Wide Spread	New case count rate growing	COVID hospitals at capacity or strained; Non-COVID hospitals with minimal activity and accepting emergent cases; Medical and surgical centers with minimal activity; Minimal elective or non-essential services; Lack of in-person treatment or service would result in patient harm.	No public interaction; No public activities; Face covering required; No public travel; Schools closed	Essential business activity only; Retail and recreation mobility down 60% from baseline normal
3	Early Flattening	New case count rate slowing	COVID hospitals at capacity but not strained; Small non-COVID hospitals, medical center and physician office activity; Lack of in-person treatment or service would result in patient harm.	Individual and family socially distanced activities; Face covering as standard norm; Restrictions in travel; Schools closed	Non-essential business activity through pick-up and delivery; Remote work for office buildings; Retail and recreation mobility down 50% from baseline normal
4	Continue Flattening	New case count rate slowing	COVID hospitals at capacity but not strained; Small non-COVID hospitals, medical center and physician office activity; Lack of in-person treatment or service would result in patient harm.	Individual and family socially distanced activities; Face covering as standard norm; Restrictions in travel; Schools closed	Non-essential business activity through pick-up and delivery; Remote work for office buildings; Retail and recreation mobility down 40% from baseline normal
5	Recovery	Minimal new cases	All hospitals with capacity; Medical center and physician office activity through safety precautions; Intermediate acuity treatment or service; Not providing the service has the potential for increasing morbidity or mortality	Gatherings of 10 or fewer people; Face covering as standard norm; Restrictions in travel; Schools closed	Manufacturing, office buildings, retail, personal services activity through safety precautions; Retail and recreation mobility down 30% from baseline normal

SOCIETY OF ACTUARIES RETURN STAGES (Continued)

Return Stage Number	Description	COVID-19 Case Count Trends	Health Care System	Social Distancing and Public Activities	Business Activity
6	Recovery	Minimal new cases	All hospitals with capacity; Medical center and physician office activity through safety precautions; Intermediate acuity treatment or service; Follow-up visits for management of existing medical or mental/behavioral health condition; Evaluation of new symptoms in an established patient	Gatherings of 10 or fewer people; Face covering as standard norm; Restrictions in travel; Schools closed	Manufacturing, office buildings, retail, personal services activity through safety precautions; Retail and recreation mobility down 25% from baseline normal
7	Revitalization	Minimal new cases	All hospitals with capacity; Medical center and physician office activity through safety precautions; Provisions for low acuity treatments or services; Routine primary or specialty care	Gatherings of 50 or fewer people; Face covering encouraged; Travel permitted; Schools open	All business activity available through safety precautions; Retail and recreation mobility down 20% from baseline normal
8	Stabilization	Minimal new cases	All hospitals with capacity; Medical center and physician office activity through safety precautions; Routine primary or specialty care; Preventive care visits and screenings	Gatherings of 50 or fewer people; Face covering encouraged; Travel permitted; Schools open	All business activity available through safety precautions; Retail and recreation mobility down 15% from baseline normal
9	Restoration	No new cases	All hospitals with capacity; Normal medical center and physician office activity	No restrictions—Conventions, concerts, festivals, large events allowed; No face covering; Travel permitted; Schools Open	Fully open; Retail and recreation mobility down 10% from baseline normal
10	Fully Restored	No new cases	All hospitals with capacity; Normal medical center and physician office activity	No restrictions—Conventions, concerts, festivals, large events allowed; No face covering; Travel permitted; Schools Open	Fully open; No change in retail and recreation mobility from baseline normal

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With roots dating back to 1889, the Society of Actuaries (SOA) is the world's largest actuarial professional organizations with more than 31,000 members. Through research and education, the SOA's mission is to advance actuarial knowledge and to enhance the ability of actuaries to provide expert advice and relevant solutions for financial, business and societal challenges. The SOA's vision is for actuaries to be the leading professionals in the measurement and management of risk.

The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

Quality: The SOA aspires to the highest ethical and quality standards in all of its research and analysis. Our research process is overseen by experienced actuaries and nonactuaries from a range of industry sectors and organizations. A rigorous peer-review process ensures the quality and integrity of our work.

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Quantification: The SOA leverages the diverse skill sets of actuaries to provide research and findings that are driven by the best available data and methods. Actuaries use detailed modeling to analyze financial risk and provide distinct insight and quantification. Further, actuarial standards require transparency and the disclosure of the assumptions and analytic approach underlying the work.

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