Sg2 COVID-19 Surge Demand Calculator
Frequently Asked Questions, V2
April 8, 2020

1. **Q: What is the Sg2 COVID-19 calculator meant to do?**

   A: The Sg2 COVID-19 calculator allows health systems to model hospital bed, ICU bed, and ventilator demand during the COVID-19 surge in their market. The calculator uses "known" data inputs such as capacity and population demographics, and allows users to scenario plan around the "unknowns" – speed and magnitude of the infection in a given market, COVID-19 hospitalization rates, and COIVD average length of stay (ALOS). Using SIR methodology and the concept of R0, members can model mild, moderate and aggressive infection scenarios.

   The calculator allows health systems to compare projected demand over existing capacity based on occupancy rates. Outputs include age-adjusted admission rates and average daily census (ADC) for hospital and ICU beds and ventilators. The calculator also allows members to see week-over-week and day-over-day increase patterns in ADC to help gauge which infection scenario their market may be approaching (more aggressive or more moderate) and how many weeks away from peak surge they are.

2. **Q: What organizational/market information is needed as inputs?**

   A: When using the calculator, members will be asked to enter:

   - *Population demographics by age cohort* – what is the impact of the elderly on your surge?

     Pull data from your Sg2 analytics platform or wherever you purchase demographic data (contact your Sg2 account representative for assistance if you are unsure about data access or need assistance).

   - *Population-based hospitalization rate* – what rate do you anticipate in your market?

     Sg2 has studied data out of Italy and are recommending using a hospitalization rate between 1.2-2.0 %, but we have added the ability to input any rate up to 5%. Our recommendations come from what we saw in Lombardi and are seeing now in NYC in terms of surge bed demand.

     A population-based hospitalization rate reflects the portion of the total population that is admitted and differs from what has been commonly report during the COVID-19 crisis which is positive case-based hospitalization rates.

     By comparison, positive case-based hospitalization rates reflect the small percentage of infected patients who tested positive that were hospitalized – so just a small portion of the infected population in a market. Applying this rate to a much larger infected population (e.g., 40%-80% of a market population) will significantly overestimate bed

demand. Organizations are encouraged to run multiple scenarios with the various hospitalization rates included in the calculator to inform planning and as information in their market evolves.

- *Market share* – what portion of COVID-19 patients do you expect to serve?

  Overall IP market share is typically readily available and suitable to use, particularly for an initial set of scenarios and discussions. Organizations may wish to use their IP market share for seasonal pneumonia as a more refined proxy. Regional referral centers, particularly those designated as bioterror hubs may elect to input an alternative IP market share based on regional planning conversations and protocols.

  Organizations may wish to enter 100% as a scenario exercise to get the full picture of market and regional response needed and inform planning discussions with fellow health systems.

- *Bed counts, occupancy rates and length of stay (LOS) for both ICU and non and number of ventilators* – what resources are available?

  Running multiple scenarios provides the most complete picture of need – enter as the hospital normally operates and then rerun based on decanting/flexible space/additional space options that are being considered. Many organizations are aiming to bring occupancy down to 50% as they prepare for a surge – that is one popular scenario to run as a starting point.

3. **Q: In the calculator output, how is "Week 1" defined?** Is it related to the date of the first recorded case or when the calculator was first used?

   A: There are two timelines in the calculator: a weekly output tab and a daily output tab. Both of these have a timeline beginning with week#1/Day #1 that references the start of the first infection in your market and another that references the start of your first hospitalization in your market. These timelines begin the run rates built into the model and not reliant on an actual date – you do not have to input a date of first confirmed case for this calculator.

   Tracking organizational COVID-19 ADC and ADC doubling rates and comparing these to the reference information provided in each scenario timeline on the Output Daily tab is a great way to triangulate current local experience and these scenario model timelines.

4. **Q: What if we are already past Week 1, we have 5 COVID-19 admissions to ICU in our hospital. How can we best use the calculator?**

   A: Once multiple hospitalizations are identified in the market you are no longer at week 0/1 and it's critical to measure rate of change of ADC over time, specifically tracking the doubling time in

ADC. This pattern will start out fast at a doubling rate of 1 to 2 days and then over time gradually slow down as the volume of hospitalizations increases and you approach peak surge. The doubling time will help more accurately identify which scenario to use and time from peak surge. That rate of growth is the most telling signal to your organization whether you are on an initial slow burn or whether you are about to hit the exponential climb; it helps paint the picture of which scenario curve you are following and where you are on that curve.

Keep in mind there is a lag between local infection and local hospitalization - the hospitalizations you see now likely began as infections 7-10 days prior, possibly before social distancing efforts. You will see the lag in your admissions initially but it's that ADC rate change that signals to organizations the surge is coming.

5. **Q: How should we factor in social distancing practices being used in our market when selecting a scenario (early pandemic, mild, moderate)?** For example, if businesses, schools and outdoor trails are closed would that be moderate?

   A: Nobody knows quantitatively what happens to R0 with different social distancing measures. This calculator incorporates the experiences of China and Italy where the R0 did go down following lockdown measures. While complete lockdown like in China is unlikely here in the US, we would offer the following guidance as organizations select and apply scenarios:

   - Mild social distancing efforts includes school closures
   - Moderate social distancing describes stay at home measures where schools are closed, only essential businesses are open and non-essential travel is banned

6. **Q: What is the methodology behind hospitalization rates used in the calculator? Are comorbidities considered?**

   A: The most currently available data on COVID-19 hospitalization rates apply positive COVID-19 test case rates. These rates use the number of COVID-19 admissions as the numerator and the number of *positively tested* COVID-19 cases as the denominator. Because of a lack of COVID-19 testing in the total underlying population, these positive test case rates are the only hospitalization data available early in the COVID-19 pandemic outbreak. These positive case-based rates are an important metric in understanding the impact of COVID-19, but they should NOT be confused with population-based COVID-19 hospitalization rates.

   Population-based COVID-19 hospitalization rates use the number of COVID-19 admissions as the numerator and the number of *total population infections* as the denominator. Because of a lack of testing, the challenge has been in having a reliable denominator that represents the true infected population.

For the Sg2 calculator we needed a population-based hospitalization rate so we created an estimate under different R0 scenarios based on data coming out of China and Italy. Using SIR model curves and cross checking our estimates against actual experience in China and Italy we arrived at the Sg2 recommendation of 1.2%-2%. In the end, the actual hospitalization rate may end up being higher or lower, but we used the best epidemiological methodologies and data available at the time and it allows us to understand order of magnitude to inform preparedness efforts and regional planning. Again, we recommend running multiple scenarios at varying hospitalization rates to best understand the range of impact of impending COVID-19 surge.

Version 2.1 includes added flexibility in hospitalization rate input. The user is able to input any value between 0.5% and 5.0% (v1 included several options in a drop-down menu). We recommend using a value between 1.2% -2.0%, based on the retrospective analysis we did of Lombardi and the new data from New York City,

Relative to comorbidities, that is not a separate factor in the calculator. We felt that effect is already built in by way of hospitalization rates for age cohorts and we were concerned about the inability to avoid double counting if we layered in a separate comorbidity variable.

7. Q: I keep hearing the term "R0" (pronounced 'R-naught')…what exactly is that?

A: R0 is the reproductive number – in essence the doubling time, the epidemiological model which gets you to infection rate for a population. It is quite literally how many people on average 1 person with COVID-19 infects.

The R0 for COVID-19 has routinely been reported out at 2.4 (general flu is 1.3 for comparison) meaning for every person with COVID-19 they spread it to, on average, 2.4 people. It is important to note that the R0 is not a static number – for COVID-19 or for any virus. It will increase or decrease in certain populations. For example, the R0 was higher in Lombardy, Italy compared to China. That's attributed to Lombardy having an older population with high smoking rates and being a more dense, urban area with multi-generational dwellings. Those conditions enabled a higher R0 (spread) in Italy – reported at 2.7-3.2.

R0 can also decrease in populations that enact social distancing measures as we saw in China and other parts of Asia and can be lower with environmental factors like natural population separation seen in rural markets.

So R0 helps us figure out the contagiousness and speed of spread which underpins infectious disease modeling – we need to understand rates and timing. This is what helps create those SIR model curves regularly seen and is what is driving our efforts to "flatten the curve." For our purposes the R0 helps inform scenarios offered in the Sg2 calculator and influences the calculations behind the scenes that produce the curves you see as output.

8. **Q: What are the confidence intervals (statistical range of values with 95% certainty) for your model?**

   A: The Surge Demand Calculator is a scenario planning model and not a predictive model. There are several variables that drive the calculator, and even among publications and reported data, there is a wide range for those variables. Based on our internal data analyses, those variables differ substantially within the US based on geography, practice patterns, age distribution, testing availability and others. The goal in building the calculator was to provide recommendations on variable inputs based on what users are seeing at a national and international level, while giving users a model that allows for the flexibility to localize inputs to their market. For these reasons, the outputs of the calculator should not be considered predictions.

9. **Q: Should we consider a different R0/scenario if population density exists in our market?**

   A: Yes, population density as well as degree and timing of social distancing are two critical factors that influence your choice of scenario. New York City, obviously a very population dense city, relies on public transportation and has concentrated housing and we've seen large case counts there compared to Seattle. In addition to less dense population concentration and lower use of public transportation, lower R0 in Seattle may also be due to presence of large tech companies who proactively initiated social distancing measures ahead of government thus slowing the spread.

   Other environmental factors such as humidity and social practices (hand hygiene, tactile nature of the culture) may also influence disease spread although as with considerations above there is no hard data on just how much each of these factors influences the outcome. As a result, running scenarios and monitoring uptick in your market is key.

   Note Sg2 recommends organizations run the Early Pandemic scenario even if it seems market factors are unlikely to produce that result. It is helpful to understand a worst-case scenario for planning purposes, but prioritize current activity based on the most likely scenario.

10. **Q: Do we have a sense of/recommendations for curves to use for rural or low-contact communities versus urban or high-contact communities?**

    A: In general, the R0 will be lower in rural communities because the frequency of close contact will be lower. In these markets, or in those with strong policies in place to lower person-to-person contact, a lower R0 scenario may be more appropriate than the Early Pandemic (R0=2.4) scenario. It is unlikely that the R0 in those communities will fall below 1, and markets should still anticipate disease spread.

It is very important to note that rural markets may have limited resources to respond even to a lower R0 scenario; for example, the number of ICU beds in the market is likely lower in rural areas. In these instances, even a smaller surge of patients could outpace available resources, and it will be very important for hospitals to plan accordingly. We recommend that you look at multiple scenarios to provide you with a full picture.

When selecting the most realistic model for your organization, there are 2 main factors to consider:

Factor 1. What is the population density of your market?

The higher the population density, the more rapid the spread of infection (higher R0). Think of densely populated urban markets that are heavily reliant on public transportation. Rural markets will have lower R0 given lower population density and the fact that people typically travel by car.

Factor 2. Implementation of Social Distancing: What was done and when it was done?

We are finding that closing schools and limiting large gatherings have had a modest impact on disease spread. That said, early data suggest that "Stay at Home" measures (eg, closures of restaurants, bars and nonessential businesses) are starting to make a difference. Note that it takes time to see this impact in your hospitalization figures (typically, 1 to 2 weeks after implementation).

11. **Q: How would Sg2 guide us in selecting a scenario for our market situation as follows:** We are relatively low population density, have a relatively healthy population/low smoking rates but fairly high numbers of elderly. We have just started to see infections and instituted modest social distancing (aka school closures) 5 days ago.

    A: Based on the information provided above Sg2 would recommend the **Mild** Social Distancing Scenario (R0 2.0) as a most likely scenario. While low density and a generally healthy population are helpful, the recent modest social distancing effort is a driving factor (aging population is already factored into the hospitalization rates applied).

    Again, we also recommend running the early pandemic scenario for comparison as a worst-case range.

12. **Q: Is the hospitalization rate default setting 1.2% for all hospitalizations or just ICU?** And what is the denominator – all patients or those diagnosed COVID-19+?

    A: 1.2% is our estimate of a population-based hospitalization rate based on international experience. That rate reflects all COVID-19 hospitalizations, not just ICU. Note that our assumptions in the calculator assume 25% of all COVID-19 hospitalizations will be to the ICU. That's a conservative estimate based on various numbers reported from the CDC (30%), Italy

(16%) and NY to date (21%). Members can select a different hospitalization rate for scenario planning (any range between 5% and 0.5% is accepted by the calculator). Also, members can adjust the rate of COVID-19 hospitalization that require ICU care, inputting any ratio desired for modeling purposes. Guidance on input value selection is embedded within the calculator input tab.

13. Q: If working with multiple hospitals/multiple markets how should we group/review our analysis?

A: Sg2 recommends running a calculator for each unique market where there are differences in population, social distancing, etc. Organizations may wish to run all scenarios for all markets and aggregate to provide a system-wide look at need and proactively look at overall need, potential for some markets to support others, etc.

Users will want to download the calculator from Sg2.com and save calculator outputs by market to their desktop; the tool currently does not allow entry and aggregation of multiple market outputs.

14. Q: What guidance do we have for organizations that care for adults only? What should they input for those pediatric age cohorts?

A: Figures to date show just 1% of all COVID-19 admissions are to a Children's Hospital – quite low. Acute care-only organizations could enter zero in the 0-9 and 10-19 demographic fields of the calculator if they don't plan to receive pediatric patients.

Acute care hospitals will want to coordinate with Children's Hospital(s) in the market as part of a regional planning effort. Many Children's hospitals are preparing to take Non-COVID-19 ICU young adults up to age 25 to help with capacity issues at peer acute care facilities during a surge. Such approaches were successful in Italy.

15. Q: What assumptions on ALOS have been made?

A: The calculator includes drop down menu to select ALOS for both ICU and non-ICU beds. The range of figures offered encompass numbers seen in the literature to date (international, no figures available from US at the time this calculator was published) and allows for local variation. For reference, ALOS data from Italy:

- Total ALOS for COVID-19 patients = 10 days (both ICU and non-ICU cases); this data was consistent in China and Italy and early reports suggest US may be similar
    - Non-ICU patient = 8 days ALOS
    - ICU patient = 16 days ALOS (6 on floor and 10 in ICU)

16. Q: How are you defining "symptomatic cases" in the age-adjusted hospitalization table?

A: Symptomatic cases are individuals who tested positive for COVID-19. This definition and the data featured in Table 3 of the methodology paper were published in a recent article from Imperial College (London, UK): Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand.

17. Q: Why did you use data from Lombardy vs "the rest of" Italy?

A: Data from Lombardy was leveraged since it was the epicenter of the infection, and regional hospitalization data (non-ICU, ICU, ventilator) was also collected and published. Although we had access to national-level data, we wanted to take a more conservative approach. When we analyzed data from Italy as a whole, we found that utilization rates were diluted since spread of the disease, along with the availability and accuracy of the data, was not uniform across the country.

18. Q: How can you apply the Surge Demand Calculator projections to PPE utilization projections?

A: The Surge Demand Calculator allows you to anticipate the average daily census (ADC) of COVID-19 positive patients. If you know the daily rate of PPE use per inpatient bed (for example, by leveraging the PPE Burn Rate Calculator from the CDC), you can calculate your PPE demand by multiplying your PPE burn rate per person by the projected ADC from the Calculator. If you can differentiate between ICU and non-ICU PPE burn rates, we would encourage using the ICU and non-ICU ADC outputs to best estimate PPE utilization.