Sg2 COVID-19 Surge Demand Calculator: How Accurate Has It Been?

Summary of Validation Document (v1.0). In May 2020, Sg2 released a Validation Document (v1.0) reviewing the accuracy of the Sg2 COVID-19 Surge Demand Calculator v3.2 hospitalization projections for Albany, GA; Chicago, IL; New York City, NY; San Antonio, TX; and San Francisco, CA. The analysis demonstrated that the Sg2 model was able to satisfactorily match actual data from these 5 regions.

A comparison of the Sg2 Surge Demand Calculator against other models frequently cited by the White House and the state of New York overestimated census and bed need projections. These models used projected hospitalization rates that applied cited case-positive hospitalization rates from the international literature to the projected total infected population rate estimates. Case-positive rates are known to be much lower than the total infection rates due to limited testing and the number of asymptomatic COVID-19 infections. Sg2 derived its lower hospitalization rate using actual COVID-19 hospitalization data from Lombardy, Italy, and New York City and comparing the data to the active infected population under the SIR curve for specific dates in the early phase of the pandemic. In addition, Sg2's model enabled more rigorous modeling of the impact and timing of social distancing measures that resulted in projections mirroring actual surges in markets across the US. For a given market, the time between first community-acquired COVID-19 hospitalization and the initial enactment of social distancing measures was found to be the most sensitive input in correctly projecting whether a market would experience a surge in inpatient demand above capacity. Other factors that contributed to the accuracy in projections were the application of market-specific, age-adjusted COVID-19 hospital rates (see Appendix, Table 1) and custom inputs for average length of stay that captured differences in case mix and local practice patterns.

Improving the Model. Hospital leaders and strategic planners value the Sg2 model due to its ability to accurately predict surge(s) to inform planning and resource allocation efforts in response to COVID-19. Based on feedback from model users, Sg2 has continued to further refine the model to better help health care organizations with planning efforts in their combat against COVID-19. Sg2 recently released the Sg2 COVID-19 Surge Demand Calculator v5.1 with new features that allow users to utilize multiple social distancing steps and customize 3 different scenarios to anticipate changes based on local market behavior.

Prominent Updates

- More detailed ability to quantify the impact of social distancing impact on COVID-19, including an effect that phased in changes in the transmission rate over time, reflecting the real-life gradual changes to the reproductive rate over time
- Multiple new inputs for scenario modeling of COVID-19 resurgence based on changes in social distancing measures
- Improved output visualizations that no longer include outputs reflecting ADC without social distancing. Since social distancing practices have been widely adopted, the outputs for the potential surge without social distancing measures were removed from the output tabs as they are no longer relevant for modeling purposes
- Opportunity to model up to 3 different scenarios for future reproductive rates to understand best- and worst-case scenarios for ADC demand

ADC = average daily census; SIR = susceptible, infectious, recovered.

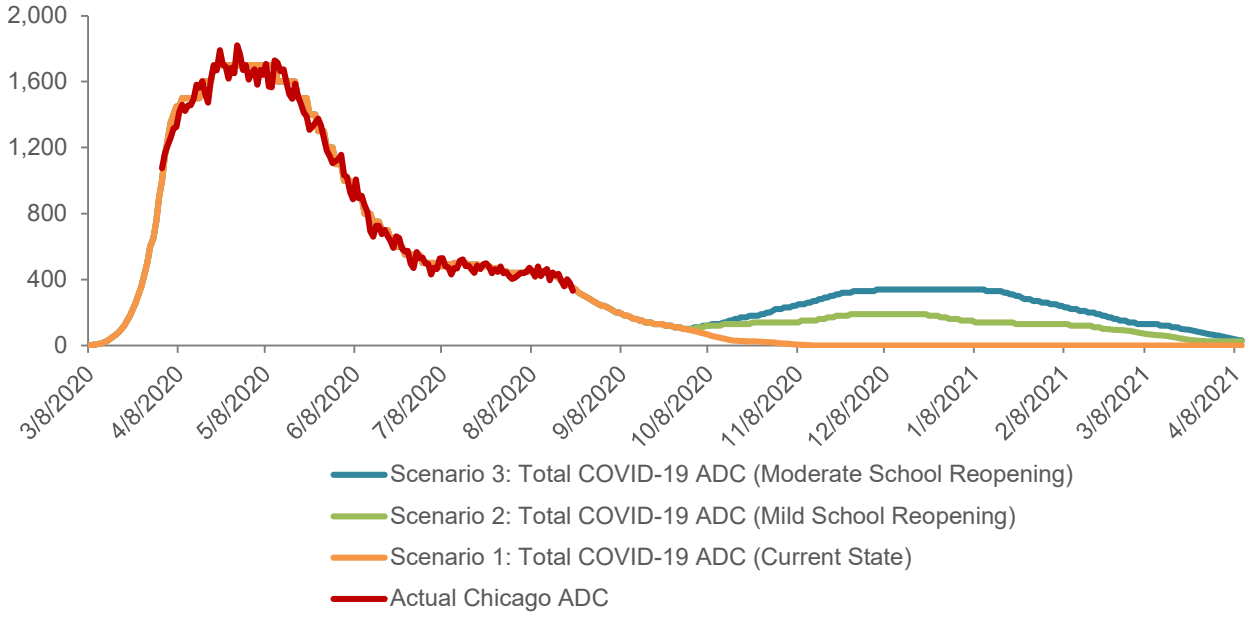
Purpose of Validation Document (v2.0).

The update to the Validation Document (v1.0) is intended to demonstrate how the Sg2 COVID-19 Surge Demand Calculator v5.1 continues to match actual data reported from Chicago, IL; Dallas, TX; Milwaukee, WI; New York City, NY; San Antonio, TX; and San Francisco, CA. In addition, the document offers insights into how new features in the model can be leveraged for scenario planning as the nation begins to consider the impacts of school reopening policies and Labor Day activities. Based on local news reports, projections were made regarding the potential timing and impact of school reopening, demonstrated in the regional models below. Lastly, this document reviews important lessons learned regarding hospitalization and infection rates.

CHICAGO, IL (V5.1)

The Sg2 model was able to accurately model the actual ADC peak magnitude and timing that Chicago experienced, as well as the ongoing trajectory of virus within the region.

ADC Surge Scenario Impact for COVID-19



Source: City of Chicago. COVID-19 hospital capacity metrics. Chicago Data Portal. Accessed August 2020.

Starting R_0: 2.2 (See Appendix, Table 2, for guidance regarding starting reproductive rates.)

Accuracy of the model:

- Peak timing and magnitude were predicted with accuracy.
- Average of 4% variance between actual Chicago ADC and Sg2 projected total COVID-19 ADC

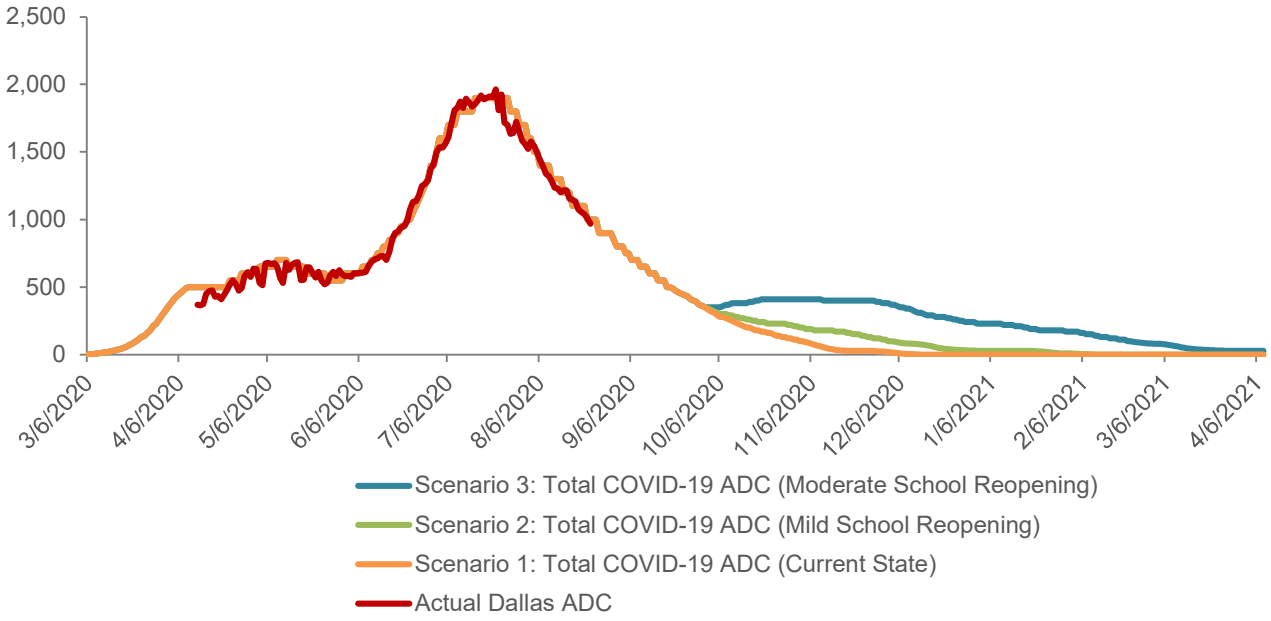
Scenario planning for school reopening:

- Mild school reopening scenario is defined by the region returning to 80% of the initial R_0 (resulting R_0: 1.8). This scenario will result in a sustained number of hospitalizations throughout fall before gradually declining during the winter.
- Moderate school reopening scenario is defined by the region returning to 90% of the initial R_0 (resulting R_0: 2.0). Chicago may experience a slight surge late fall if the region increases to an R_0 of 2.0.

DALLAS, TX (V5.1)

The Sg2 model accurately modelled both the initial ADC peak magnitude and timing that Dallas experienced as well as the resurgence that occurred with reopening the economy.

ADC Surge Scenario Impact for COVID-19



Note: Actual Dallas ADC from 7/23 to 7/28 may be incomplete due to transition in the reporting process.
Source: Texas Health and Human Services. COVID-19 hospitalizations by trauma service area. Accessed August 2020.

Starting R_0: 1.8

Accuracy of the model:

- Peak timing and magnitude were predicted with accuracy.
- Average of 6% variance between actual Dallas ADC and Sg2 projected total COVID-19 ADC

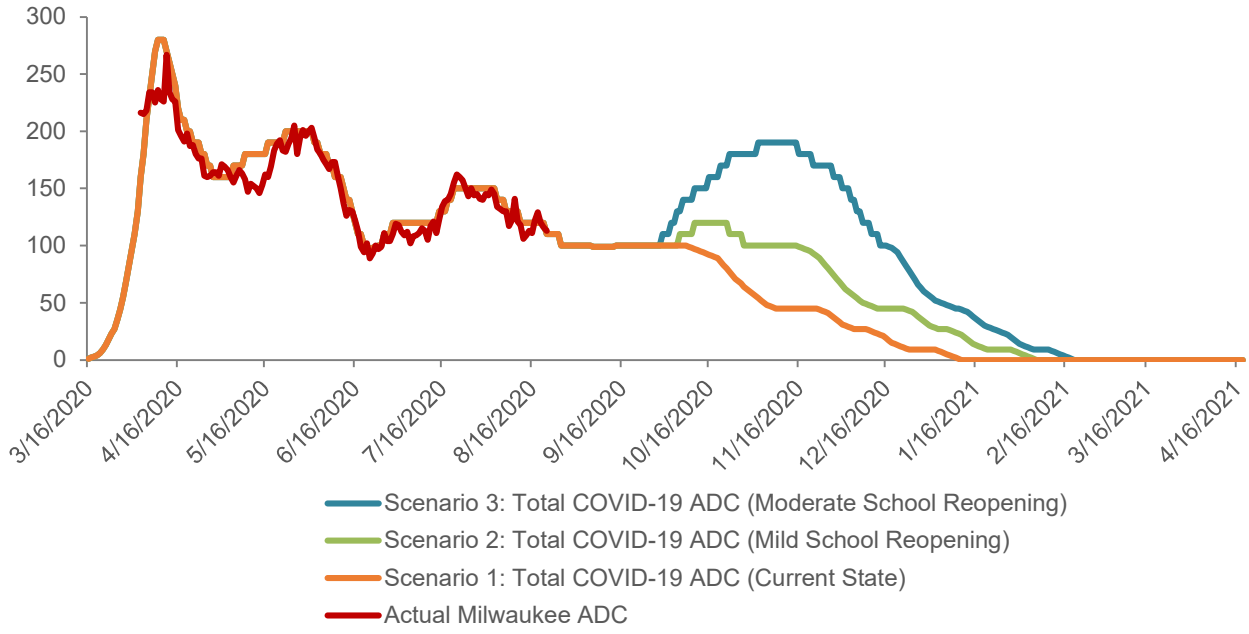
Scenario planning for school reopening:

- Mild school reopening scenario is defined by the region returning to 80% of the initial R_0 (resulting R_0: 1.4). This scenario will slightly prolong the ongoing surge.
- Moderate school reopening scenario is defined by the region returning to 90% of the initial R_0 (resulting R_0: 1.6). In this scenario, Dallas may experience a slight increase in cases during the fall before gradually declining in December and onward.

MILWAUKEE, WI (V5.1)

The Sg2 model outputs matched the multiple mini-surges Milwaukee experienced since the onset of the pandemic.

ADC Surge Scenario Impact for COVID-19



Source: Milwaukee County COVID-19 Dashboard. Accessed August 2020.

Starting R_0: 1.9

Accuracy of the model:

- Peak timing and trajectory of virus spread were predicted with accuracy.
- Average of 6% variance between actual Milwaukee ADC and Sg2 projected total COVID-19 ADC

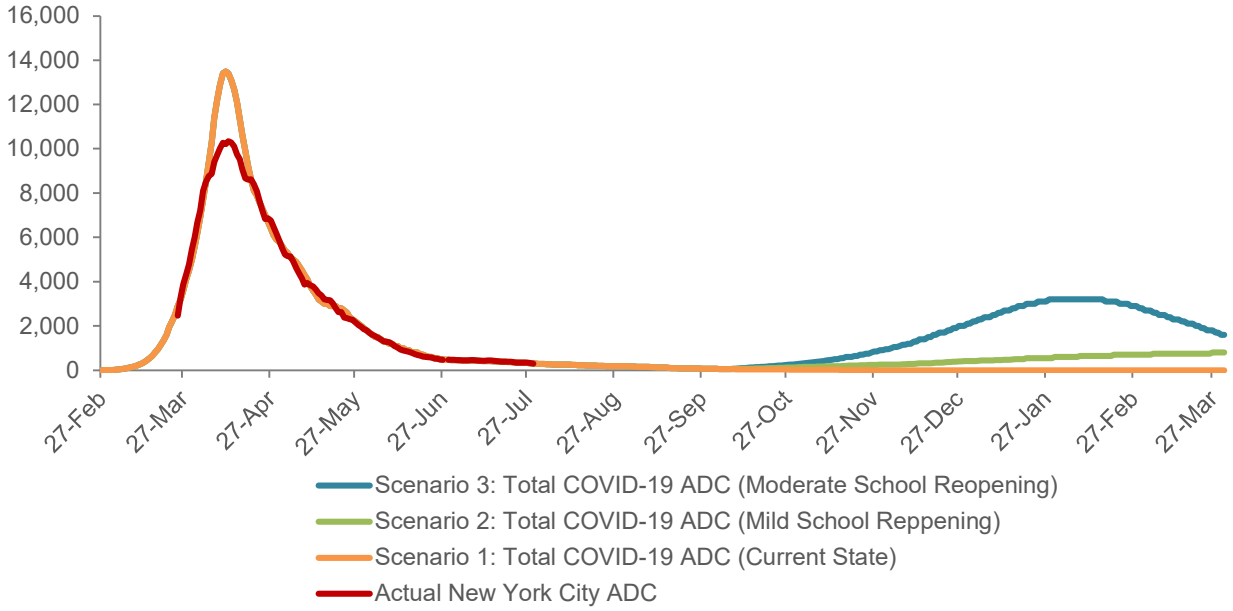
Scenario planning for school reopening:

- Mild school reopening scenario is defined by the region returning to 80% of the initial R_0 (resulting R_0: 1.5), which will lead to a slightly prolonged continuation of the current surge before gradually declining in early 2021.
- Moderate school reopening scenario is defined by the region returning to 85% of the initial R_0 (resulting R_0: 1.6). Milwaukee may experience another surge late 2020 if the R_0 increases to 1.6.

NEW YORK CITY, NY (V5.1)

The Sg2 model accurately modelled the timing of the peak ADC in New York City, and the magnitude of the peak was slightly lower than what the model projected.

ADC Surge Scenario Impact for COVID-19



Source: NYC Health. COVID-19: Data; New York State. Pressroom: Official News From the Office of the Governor. All websites accessed July 2020.

Starting R_0: 2.5

Accuracy of the model:

- Peak timing and trajectory of the virus spread were predicted with accuracy.
- Average of 6% variance between actual New York City ADC and Sg2 projected total COVID-19 ADC

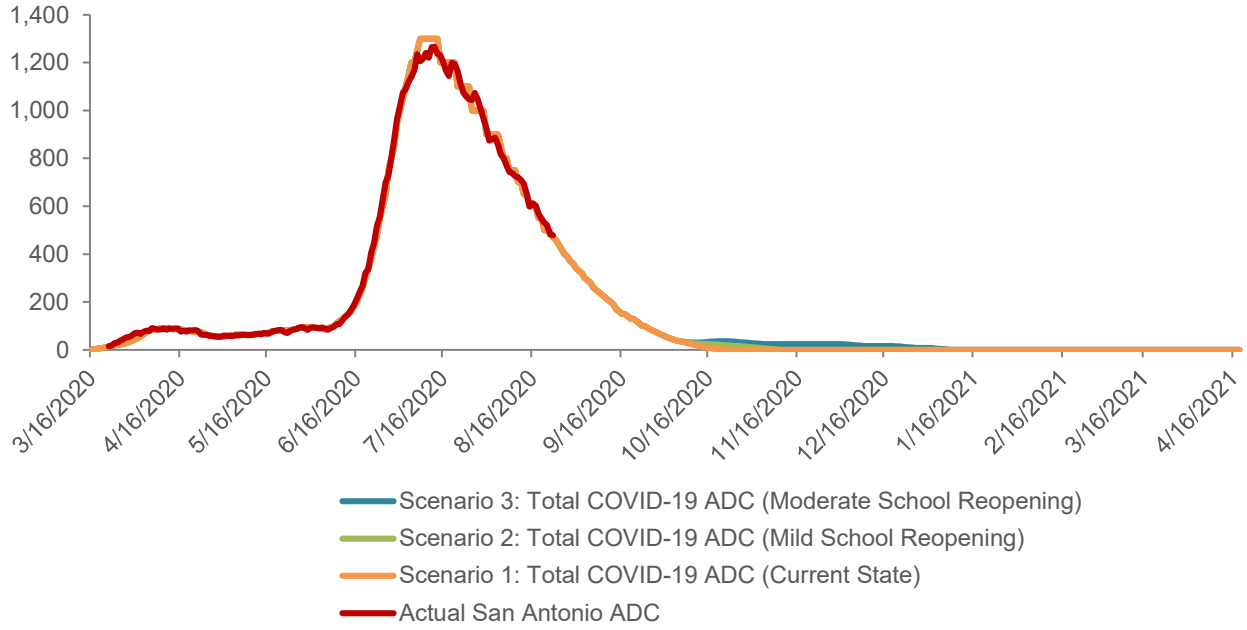
Scenario planning for school reopening:

- Mild school reopening scenario is defined by the region returning to 70% of the initial (and highest) R_0 (resulting R_0: 1.7), which will lead to a slight and gradual increase in the census in early 2021.
- Moderate school reopening scenario is defined by the region returning to 80% of the initial R_0 (resulting R_0: 2.0). New York City may experience a moderate surge in February 2021 if the local R_0 increases to 2.0.

SAN ANTONIO, TX (V5.1)

The Sg2 model accurately fits the actual surge trajectory for San Antonio.

ADC Surge Scenario Impact for COVID-19



Source: City of San Antonio. COVID-19 trends. Accessed August 2020.

Starting R_0: 1.5

Accuracy of the model:

- Peak timing, magnitude and trajectory of COVID-19 census were predicted with accuracy.
- Average of 7% variance between actual San Antonio ADC and Sg2 projected total COVID-19 ADC

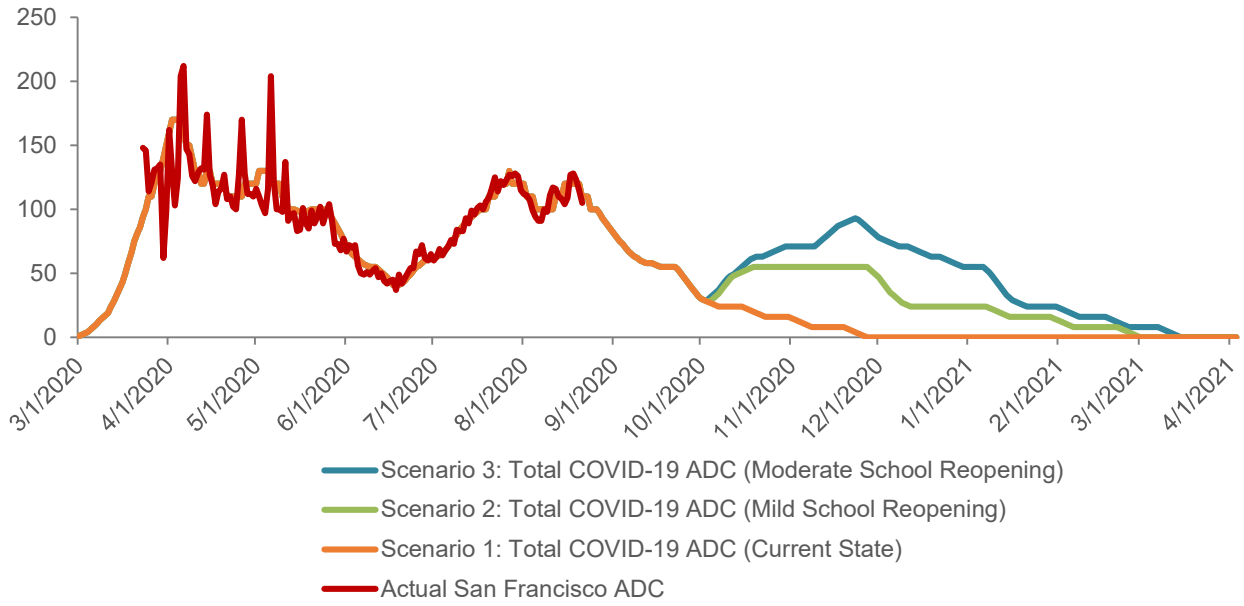
Scenario planning for school reopening:

- Mild school reopening scenario is defined by the region returning to 80% of the highest R_0 (resulting R_0: 1.6), which will follow the trajectory of the current state.
- Moderate school reopening scenario is defined by the region returning to 90% of the highest R_0 (resulting R_0: 1.8). The ongoing surge will be sustained slightly longer if the R_0 increases to 1.8.

SAN FRANCISCO, CA (V5.1)

Since early May, the Sg2 model has been able to model the COVID-19 ADC with accuracy.

ADC Surge Scenario Impact for COVID-19 and PUI Cases



PUI = patient under investigation. **Source:** DataSF. COVID-19 Data and Reports. Accessed August 2020.

Starting R_0: 1.8

Accuracy of the model:

- At the onset of the pandemic, San Francisco experienced fluctuations in COVID-19 ADC. However, the Sg2 model continued to predict the ADC trajectory with sufficient accuracy.
- Average of 10% variance between actual San Francisco ADC and Sg2 projected total COVID-19 ADC

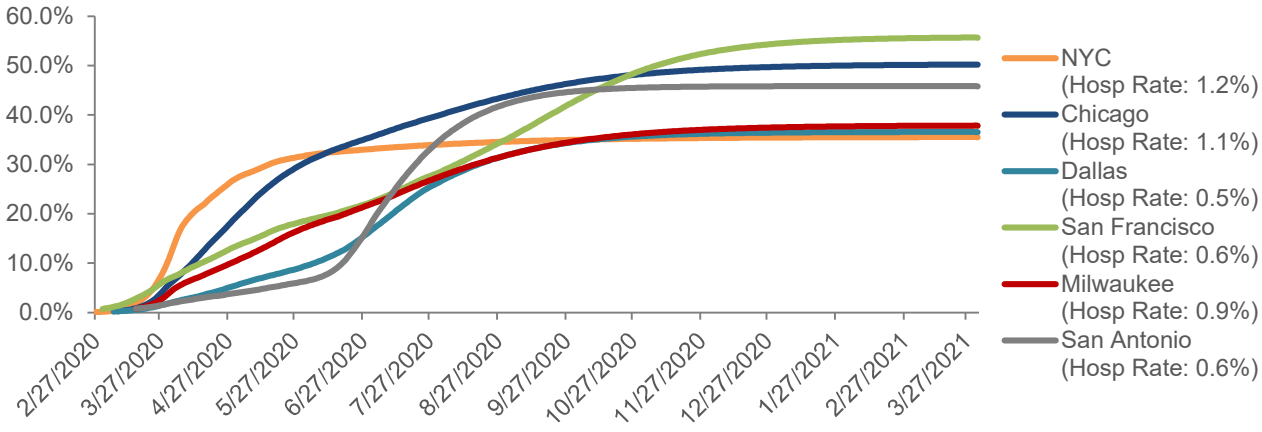
Scenario planning for school reopening:

- Mild school reopening scenario is defined by the region returning to 85% of the initial R_0 (resulting R_0: 1.5), which will prolong the surge slightly longer.
- Moderate school reopening scenario is defined by the region returning to 90% of the initial R_0 (resulting R_0: 1.6). San Francisco may experience a moderate surge late fall if the R_0 increases to 1.6.

LESSONS LEARNED FROM HOSPITALIZATION AND INFECTION RATES

- Regional infection rates across the nation demonstrate different trajectories based on local market conditions. The graph below visualizes the infection rates for the six regions discussed in this paper.

Infection Rate by Region



- Major cities that experienced a distinct surge (ie, Chicago, Dallas, New York City, and San Antonio) observed infection rates between 20% and 25% during the peak surge.
- A recent seroprevalence study published in the *Journal of American Medical Association (JAMA): Internal Medicine* reviews seroprevalence data from 10 markets across the nation. The study found that the ratio of case positives to infected population ranged from 1:6 to 1:24, with most hovering around 10- to 12-fold higher.
  - Specifically, the New York City metro area found that the ratio of reported cases to estimated infections was 1:12. A preliminary analysis using the Sg2 model found that the ratio of positive cases to infected population in New York City remained close to 1:13 since early April, consistent with the findings from the study.
  - In Chicago, the Sg2 model suggests that this ratio was between 1:16–17 since mid-May, also consistent with findings from the *JAMA: Internal Medicine* study.
- A closer look at data from Chicago, New York City and San Antonio revealed that the percentage of case positives shifted toward younger age cohorts over time.
  - For example, the percentage of case positives in San Antonio in the 0 to 29 population increased by nearly 3-fold from early April (15%) to late June (43%).
- Hospitalizations were less likely to depict changes across age cohorts.
  - In San Antonio, hospitalizations remained consistent across the different age cohorts over time.
  - In contrast, hospitalizations in Chicago and New York City slightly increased in the younger age cohorts over time.

Sg2 COVID-19 SURGE DEMAND CALCULATOR VALIDATION—APPENDIX

Table 1: Population-Based Non-ICU and ICU Hospitalization Rates

Age Group (Years)	Symptomatic Cases Requiring Hospitalization	Hospitalized Cases Requiring Critical Care
0 to 9	0.1%	5.0%
10 to 19	0.3%	5.0%
20 to 29	1.2%	5.0%
30 to 39	3.2%	5.0%
40 to 49	4.9%	6.3%
50 to 59	10.2%	12.2%
60 to 69	16.6%	27.4%
70 to 79	24.3%	43.2%
80+	27.3%	70.9%

Table 2: Sg2 COVID-19 Surge Demand Calculator Starting Infection Rate (Reproductive Rate, R_0) for Local Community Viral Spread—Reproductive Rates and Suggested Uses

R_0	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7
Total Infection Rate (%)	91%	90%	89%	87%	85%	83%	80%	77%	73%	70%
Relative Population Density	High urban density			Moderate urban density (urban/suburban mix)				Low urban density (rural)		
Relative Use of Public Transportation	High reliance on public transportation			Increased reliance on automobile transportation				No real public transportation use		

Note: R = reproduction number, a mathematical term that indicates how contagious an infectious disease is (R_0 or R naught).