Miami-Dade County COVID-19 Hospital Impact Model for Epidemics (CHIME)

The following epidemiological model was created for Miami-Dade County Fire Rescue by researchers at Florida International University. The model was created using the CHIME model created at the University of Pennsylvania (1). The report details three separate scenarios for social distancing, 20%, 40% and 60 % social distancing and resultant expectation estimates.

Model Assumptions

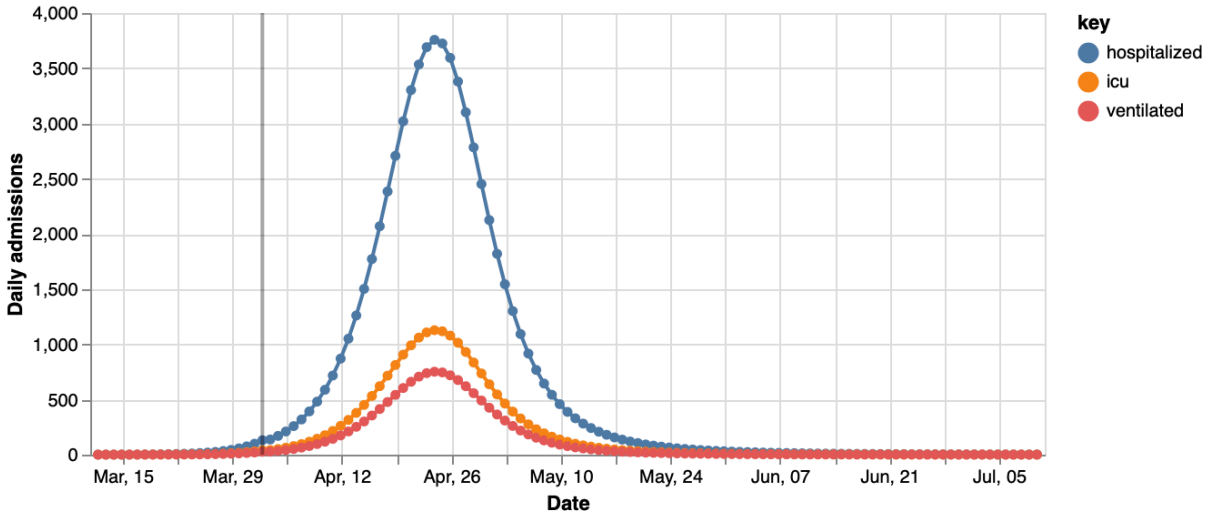
As of **April 2nd, 2020** the estimated number of currently infected individuals is **17701**. This is based on current inputs for Hospitalizations (**1058**), Hospitalization rate (**2%**), Region size (**2752000**), and Hospital market share (**100%**). An initial doubling time of **2.5** days and a recovery time of **14** days. Low social distancing corresponds to **20%** reduction in social contact, moderate social distancing corresponds to a **40%** reduction in social contact, and high social distancing corresponds to a **60%** reduction in social contact.

Miami-Dade County COVID Hospital Expectation Estimates

	20 % Social Distancing	40% Social Distancing	60% Social Distancing
Hospital Admit Peak Date	3,757	2,415	1,104
Hospital Admit Peak Amount	Apr 24th, 2020	May 03rd, 2020	May 24th, 2020
Total Hospital Admits by July 11th	68,050	65,976	55,250
ICU Admit Peak Date	Apr 24th, 2020	May 03rd, 2020	May 24th, 2020
ICU Admit Peak Amount Per Day	1,128	725	332
Total ICU Admit by July 11th	20,415	19,792	16,575
Ventilated Admit Peak Date	Apr 24th, 2020	May 03rd, 2020	May 24th, 2020
Ventilated Admit Peak Amount Per Day	752	483	221
Total Ventilated by July 11th	13,610	13,195	11,050

Scenario 1: Low Social Distancing (20%)

New Admissions per day

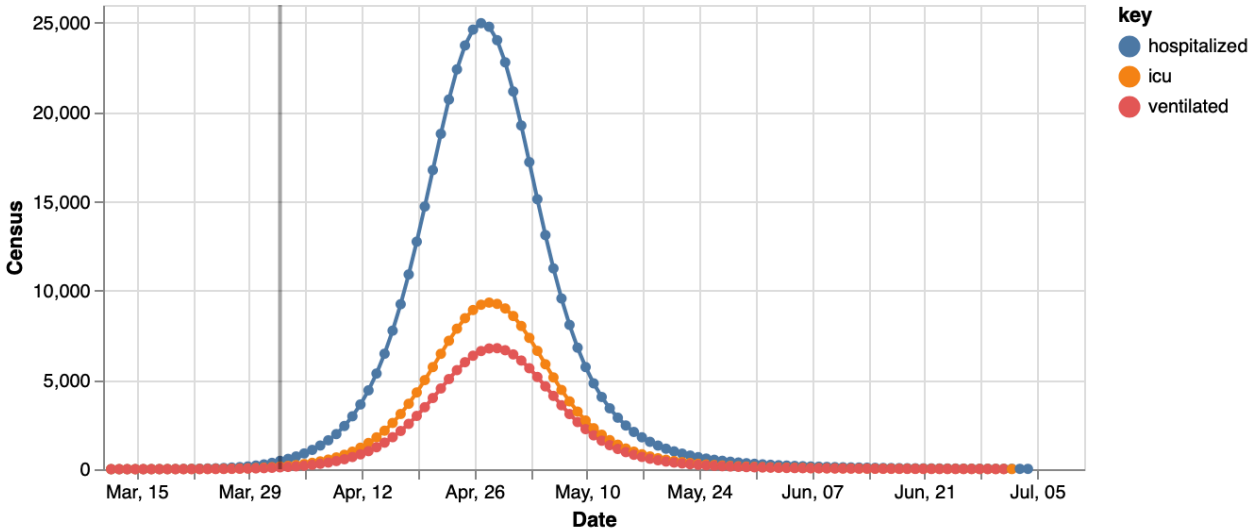


Hospitalized Admissions peaks at **3,757** on Apr 24

ICU Admissions peaks at **1,128** on Apr 24

Ventilated Admissions peaks at **752** on Apr 24

Census (Total Burden per date)



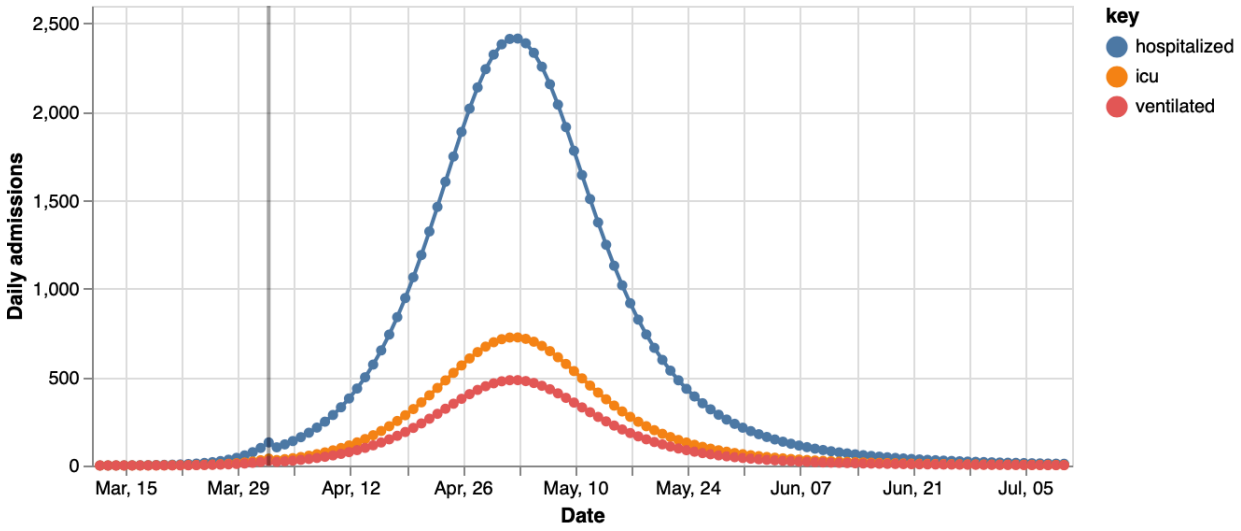
Hospitalized Census peaks at **24,980** on Apr 27

ICU Census peaks at **9,330** on Apr 28

Ventilated Census peaks at **6,777** on Apr 29

Scenario 2: Moderate Social Distancing (40%)

New Admissions per day

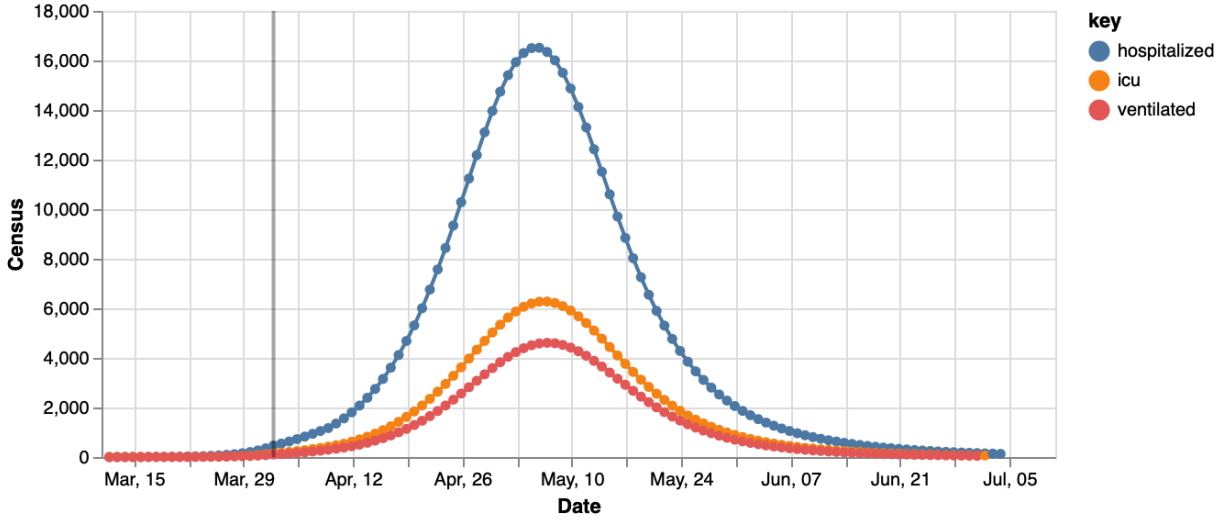


Hospitalized Admissions peaks at **2,415** on May 03

ICU Admissions peaks at **725** on May 03

Ventilated Admissions peaks at **483** on May 03

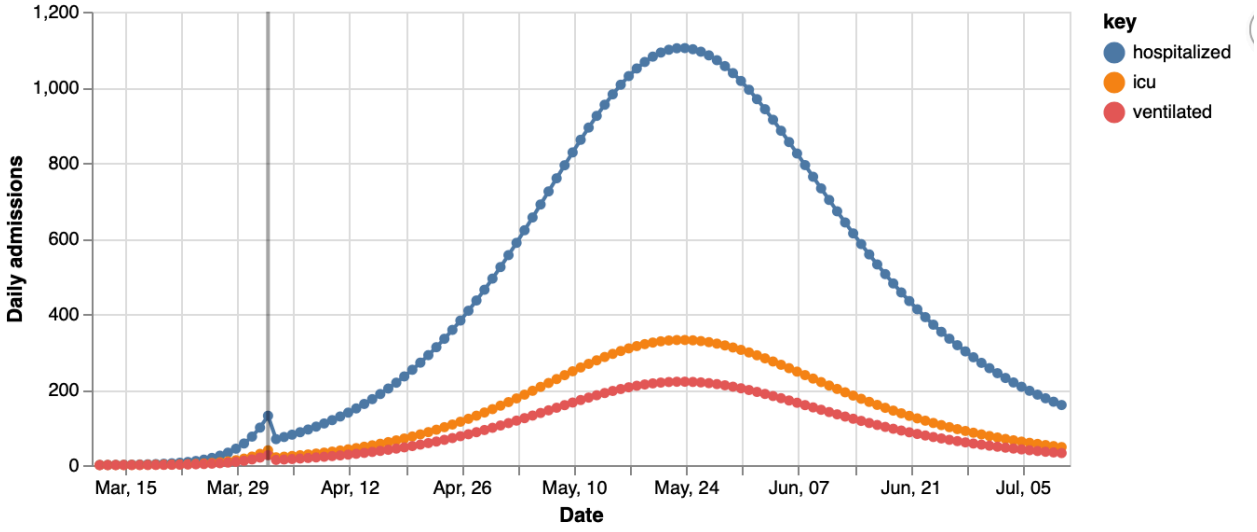
Census (Total Burden per date)



Hospitalized Census peaks at **16,512** on May 06
ICU Census peaks at **6,273** on May 07
Ventilated Census peaks at **4,610** on May 07

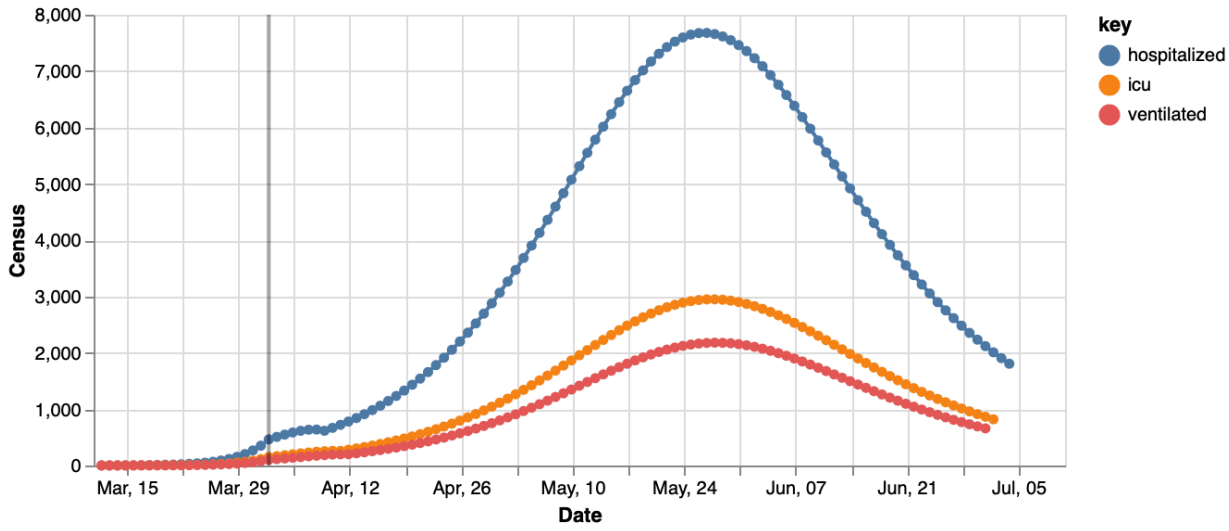
Scenario 3: Large Social Distancing (60%)

New Admissions per day



Hospitalized Admissions peaks at **1,104** on May 24
ICU Admissions peaks at **332** on May 24
Ventilated Admissions peaks at **221** on May 24

Census (Total Burden per date)



Hospitalized Census peaks at **7,677** on May 27
ICU Census peaks at **2,949** on May 28
Ventilated Census peaks at **2,180** on May 28

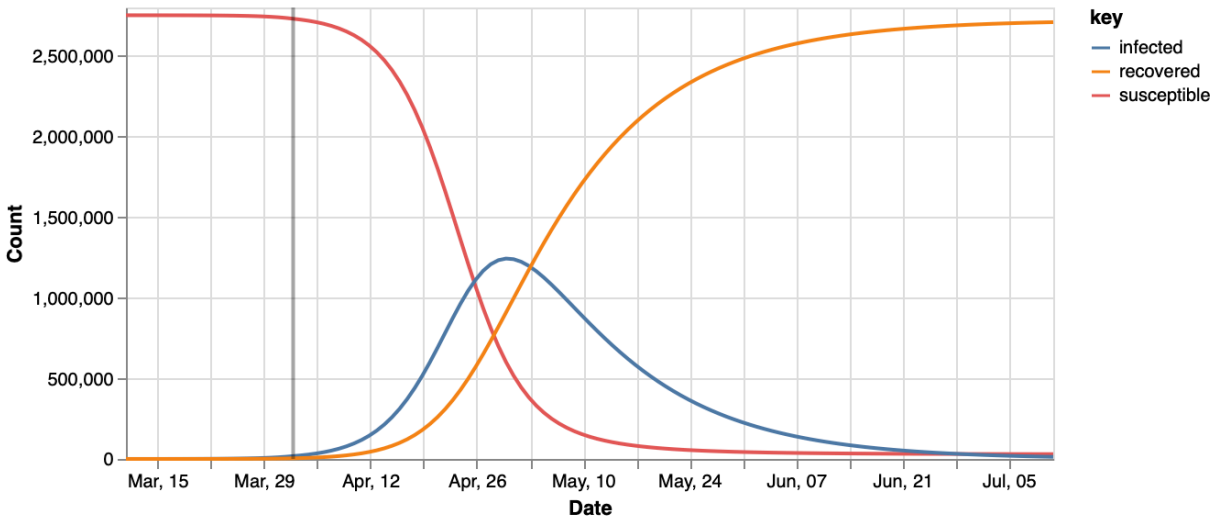
Executive Summary

To this author's knowledge, this is the first CHIME model applied to Miami-Dade County. Based on the magnitude of social distancing, the expected total number of hospitalizations predicted by **July 11th, 2020** ranges from **55,250** to **68,050**. The peak of the epidemic in terms of daily hospitalizations, daily ICU cases, and daily ventilations varies by the amount of social distancing and ranges from **April 24th, 2020** to **May 24th 2020.** The average and baseline assumption appears to be **May 3rd** if 40% social distancing occurs. Strikingly, May 3rd corresponds exactly to the predicted peak resource usage for the State of Florida found using the Institute of Health Metrics and Evaluation's Covid model (2). Peak Burden (census), i.e., the amount of hospitalizations occurring during the same time period ranges from **24,980 to 7,677.** Increasing social distancing from 20% social contact reduction to 60% social contract reduction reduces hospitalizations by approximately **70%**, and flattens the epidemic curve by approximately one month. For the ICU census peak, this value ranges from **9,330** to **2,949.** At 60% social contract reduction compared with 20%, this results in a **68.4%** reduction in ICU burden. Census peak for ventilation ranges from **6,777** to **2,180.** Similarly to hospitalization and ICU burden, through social distancing, peak ventilation census can be delayed by a month from April 29th to May 28th. For ventilation census, this can be reduced by **67.83%**. The reduction in peak epidemic burden is similar to the 69% reduction via social distancing found by Imperial College and the 65% census reduction found by the University of Pennsylvania (3). The next step for predicting Covid hospital impact in Miami-Dade County will be quantifying the resource availability, resource need, and total mortality for Covid-19 in Miami-Dade County, and South Florida as a whole.

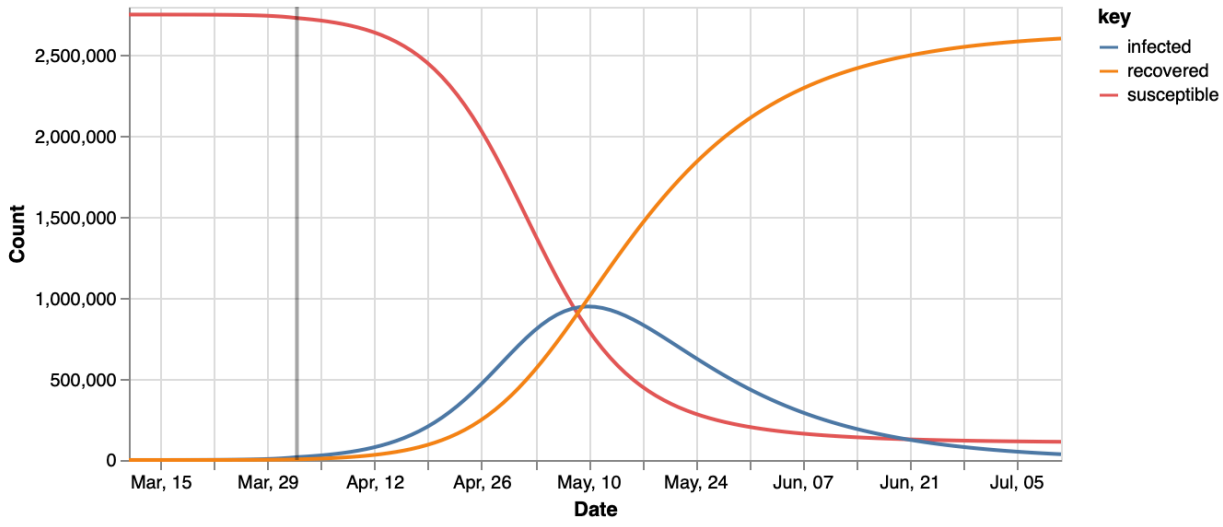
Susceptible, Infected, and Recovered (SIR) Models

This correspond with number of susceptible, infected, and recovered individuals in the hospital catchment region at any given moment

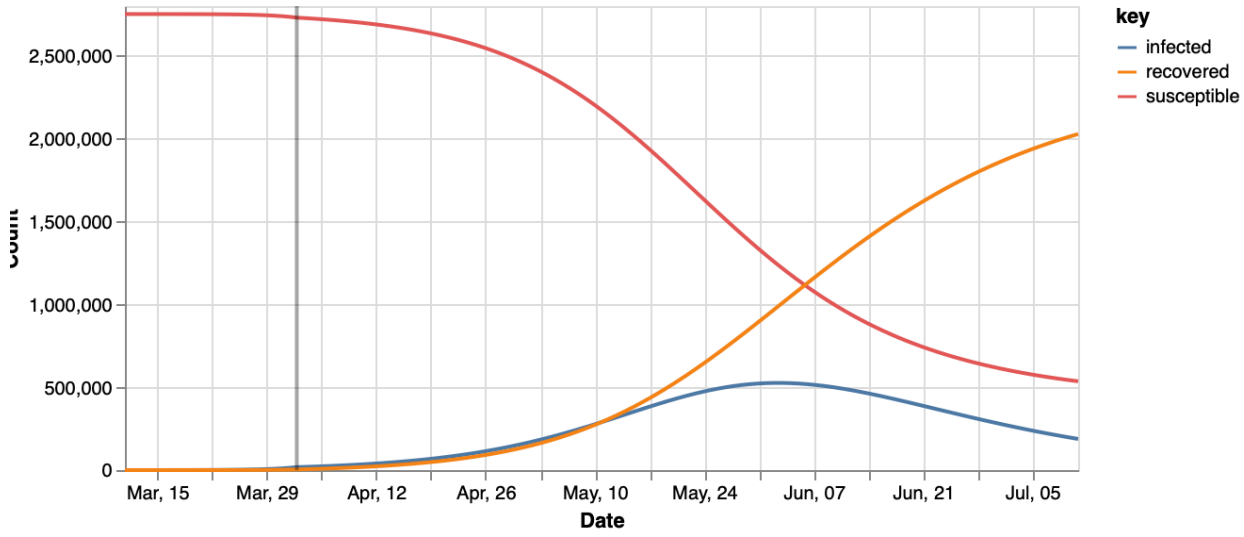
Scenario 1: Low Social Distancing (20%)



Scenario 2: Moderate Social Distancing (40%)



Scenario 3: Large Social Distancing (60%)



References

(1) University of Pennsylvania Covid Model. (2020, March 15). Retrieved April 2, 2020, from https://code-for-philly.gitbook.io/chime/#quick-resources

(2) IHME COVID-19 health service utilization forecasting team. Forecasting COVID-19 impact on hospital bed-days, ICU-days, ventilator days and deaths by US state in the next 4 months. MedRxiv. 26 March 2020. doi:10.1101/2020.03.27.20043752.

(3) Draugelis, M., & Hanish, A. (2020, March 18). CHIME comparison with Imperial College COVID-19 Publication. Retrieved April 2, 2020, from http://predictivehealthcare.pennmedicine.org/2020/03/18/compare-chime.html

Appendix

Model Parameters

Current date (Default is today)

2020/04/02

Hospital Parameters

Regional Population

2752000

Hospital Market Share (%)

100

Currently Hospitalized COVID-19 Patients

1058

Spread and Contact Parameters

I know the date of the first hospitalized case.

Date of first hospitalized case - Enter this date to have chime estimate the initial doubling time

2020/03/11

Severity Parameters

Hospitalization %(total infections)

2.5

ICU %(total infections)

0.75

Ventilated %(total infections)

0.5

Infectious Days

14

Average Hospital Length of Stay (days)

7

Average Days in ICU

9

Average Days on Ventilator

10

Display Parameters

Number of days to project

100