



State of Missouri regional COVID-19 hospitalized cases model

August 30, 2021

Multiple data points inform Missouri's COVID-19 response

- Syndromic surveillance
- Healthcare system capacity (bed, PPE, and staff availability)
- Testing
- COVID-19 cases and deaths
- Economic and social impact
- Insights from U.S. states, nationally, and other countries
- Evidence from scientific literature
- Mathematical disease modelling

Our model estimates possible outcomes based on currently available information

What does the model tell us	What does it not tell us
Range of plausible outcomes based on our current knowledge of COVID-19 in Missouri	What will happen in the future
Approximate date and magnitude of peak/s based on current understanding of policy interventions and human behavior and assumptions about future interventions	Date and magnitude of peak/s if there are major changes in planned policy interventions and human behavior
Approximate estimate of effective transmission rate across a region	Exact transmission rate in all parts of a region – there may be areas of higher and lower transmission within the region

The ability to forecast depends on the quality and availability of data. For a new disease such as COVID-19, much remains uncertain.

Statewide and Regional weekly changes in transmission rate ("Re")

Northwest Region
0.95 → 0.97

Northeast Region
0.83 → 0.82

Estimated Statewide
Weighted Re

0.92 → 0.90

Greater Kansas City
1.00 → 0.84

Central Region
0.87 → 0.91

St. Louis Region
0.92 → 0.90

Cape Girardeau Region
0.84 → 0.87

Springfield Region
0.85 → 0.68

Understanding Re

Re > 1 = COVID
cases are growing

Central (Region F)

Overview*

Population	502,486
Cumulative Cases	64,218
Cumulative Deaths	734
7-day New Cases	1,780
WoW % Case Change	2.9%

Reproductive Rate (Re)***

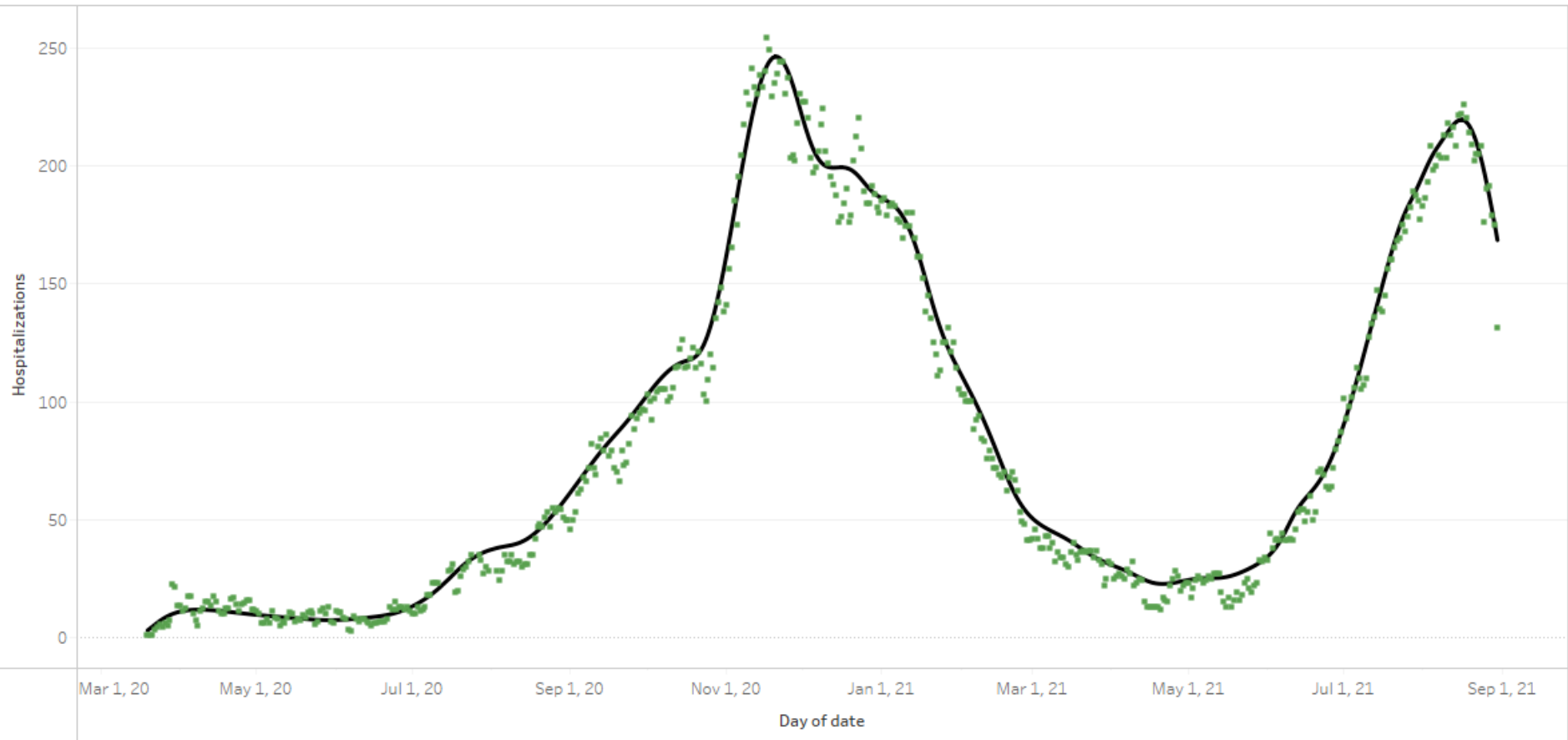
Pre-intervention	2.30
Last Week	0.87
Current Week	0.91
WoW % Re Change	5.2

Bed / Ventilator Availability**

% ICU Beds Occupied	64%
% ICU Beds Occupied C19	18%
% ICU Beds Free	36%
% Ventilators in use	40%
% Ventilators free	60%

Base Case Central Region

Model Scenario: Base Case, Data from: 3/19/2020 to 8/30/2021



■ Hospitalized COVID-19 Patients
■ LEMMA Hospital Estimation

[* Source: USA Facts via HHS Protect, data is as of 8/30/2021]
[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
[*** Reproductive Rate data and the Region Projection chart are as of 8/30/2021]

Greater Kansas City Area (Region A)

Overview*

Population	1,395,314
Cumulative Cases	158,272
Cumulative Deaths	1,941
7-day New Cases	5,366
WoW % Case Change	3.5%

Reproductive Rate (Re)***

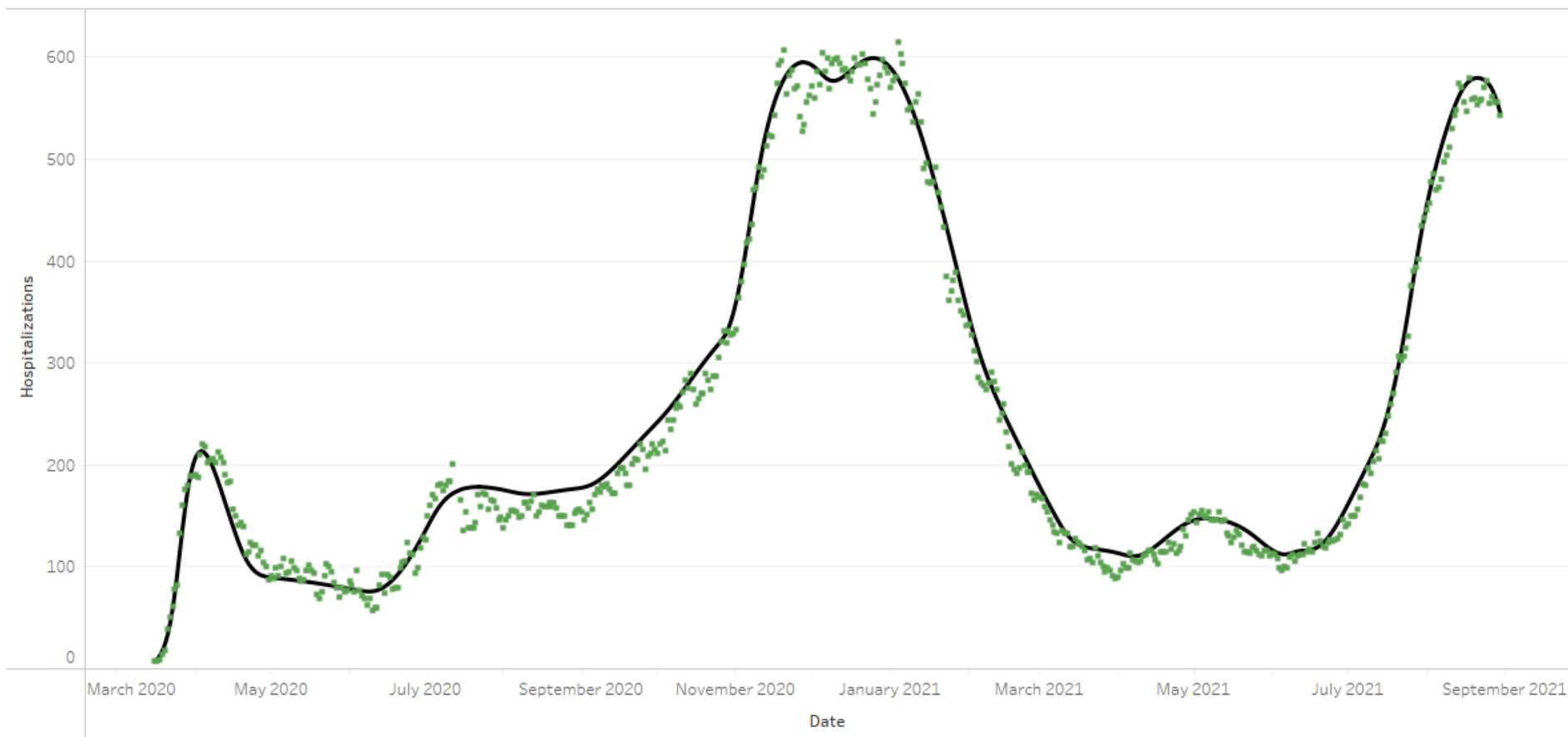
Pre-intervention	2.80
Last Week	1.00
Current Week	0.84
WoW % Re Change	-16.1

Bed / Ventilator Availability**

% ICU Beds Occupied	84%
% ICU Beds Occupied C19	21%
% ICU Beds Free	16%
% Ventilators in use	30%
% Ventilators free	70%

Base Case Kansas City Region

Model Scenario: Base Case, Data from: 3/16/2020 to 8/30/2021



■ Hospitalized COVID-19 Patients
■ LEMMA Hospital Estimation

[* Source: USA Facts via HHS Protect, data is as of 8/30/2021]
[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
[*** Reproductive Rate data and the Region Projection chart are as of 8/30/2021]

Northeast (Region B)

Overview*

Population	179,448
Cumulative Cases	22,971
Cumulative Deaths	257
7-day New Cases	748
WoW % Case Change	3.4%

Reproductive Rate (Re)***

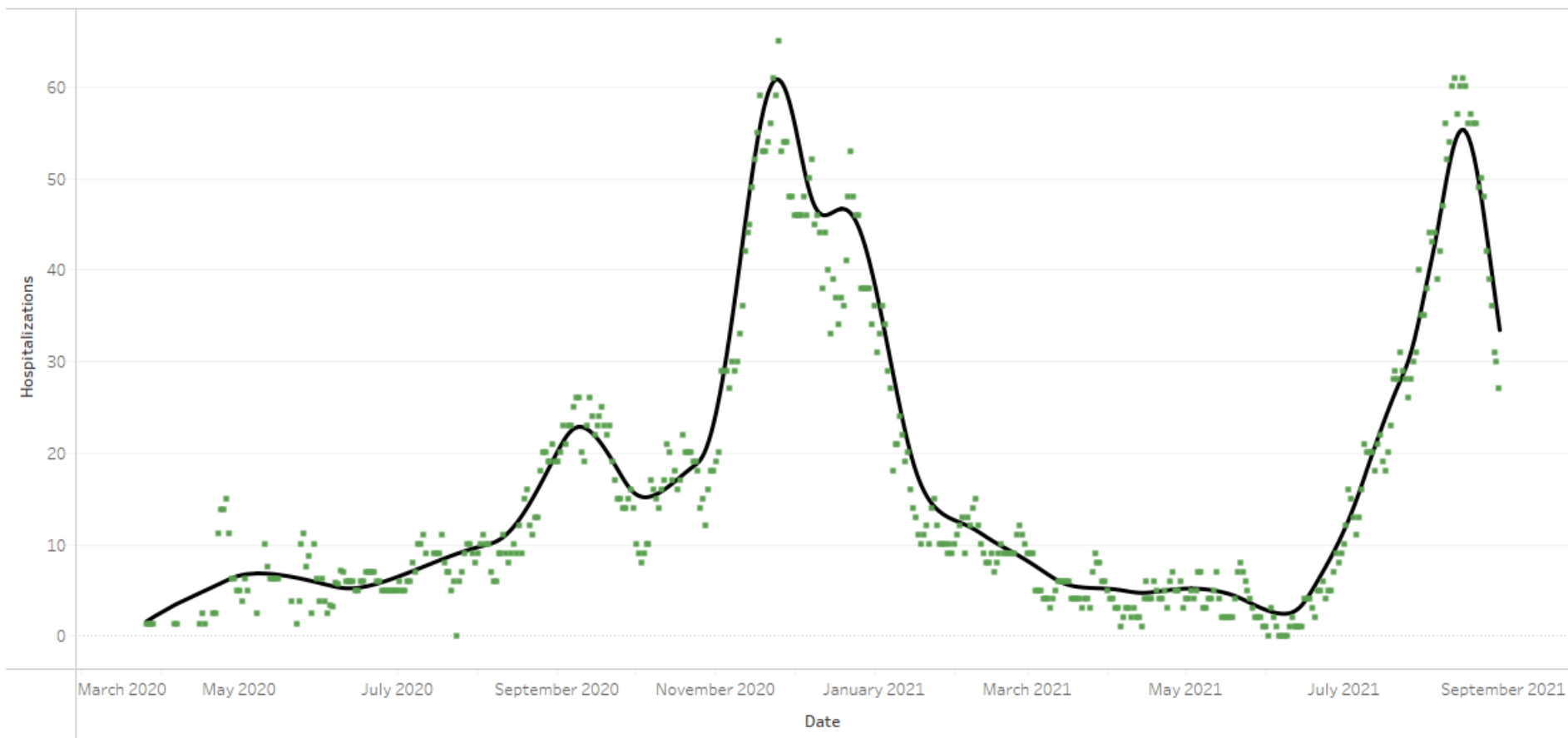
Pre-intervention	2.15
Last Week	0.83
Current Week	0.82
WoW % Re Change	-1.3

Bed / Ventilator Availability**

% ICU Beds Occupied	85%
% ICU Beds Occupied C19	35%
% ICU Beds Free	15%
% Ventilators in use	13%
% Ventilators free	88%

Base Case Northeast Region

Model Scenario: Base Case, Data from: 3/26/2020 to 8/30/2021



■ Hospitalized COVID-19 Patients
■ LEMMA Hospital Estimation

[* Source: USA Facts via HHS Protect, data is as of 8/30/2021]
[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
[*** Reproductive Rate data and the Region Projection chart are as of 8/30/2021]

Northwest (Region H)

Overview*

Population	234,361
Cumulative Cases	29,872
Cumulative Deaths	489
7-day New Cases	879
WoW % Case Change	3.0%

Reproductive Rate (Re)***

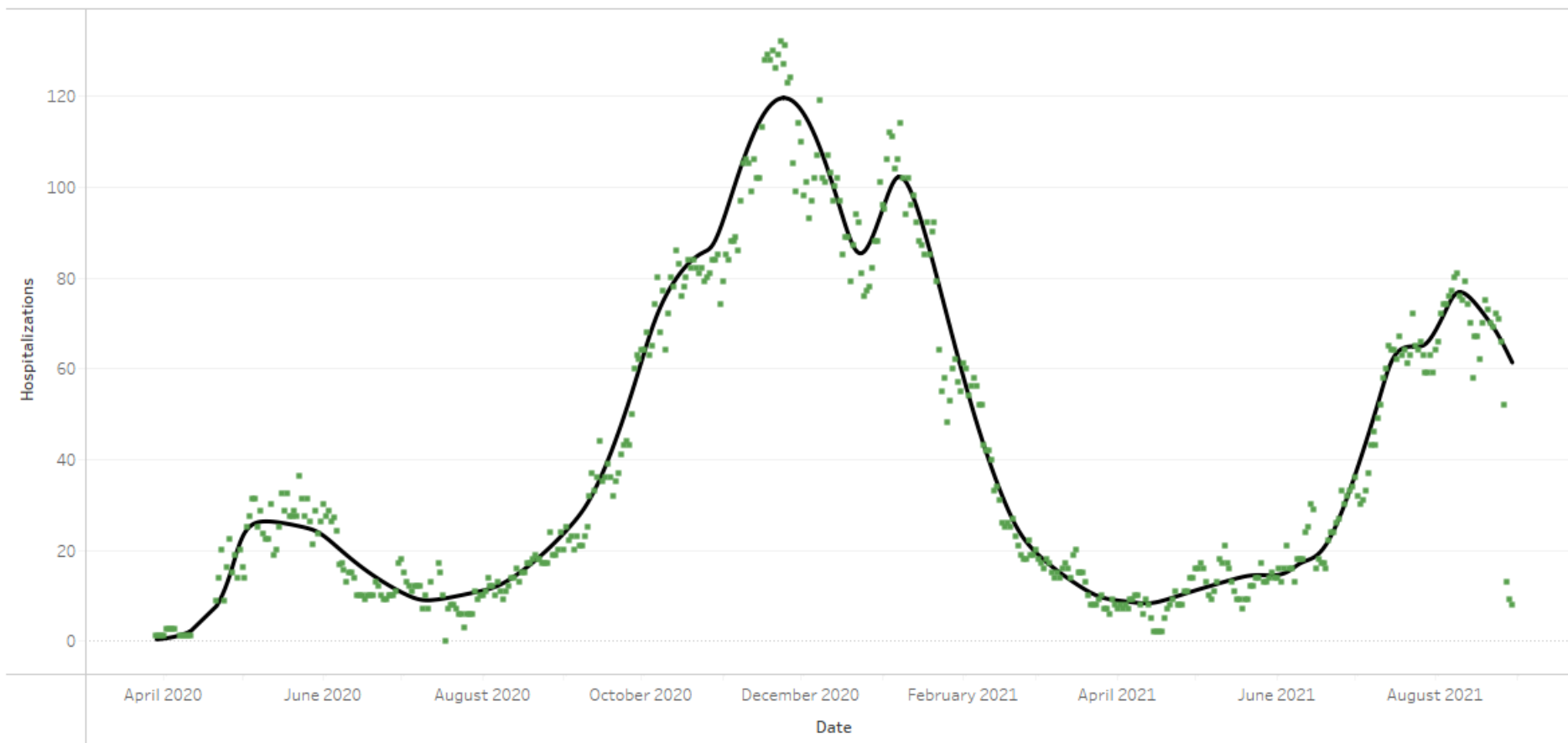
Pre-intervention	1.24
Last Week	0.95
Current Week	0.97
WoW % Re Change	2.2

Bed / Ventilator Availability**

% ICU Beds Occupied	75%
% ICU Beds Occupied C19	34%
% ICU Beds Free	25%
% Ventilators in use	16%
% Ventilators free	84%

Base Case Northwest Region

Model Scenario: Base Case, Data from: 3/29/2020 to 8/30/2021



■ Hospitalized COVID-19 Patients
■ LEMMA Hospital Estimation

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[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
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Southeast / Cape Girardeau (Region E)

Overview*

Population	363,478
Cumulative Cases	43,852
Cumulative Deaths	622
7-day New Cases	1,358
WoW % Case Change	3.2%

Reproductive Rate (Re)***

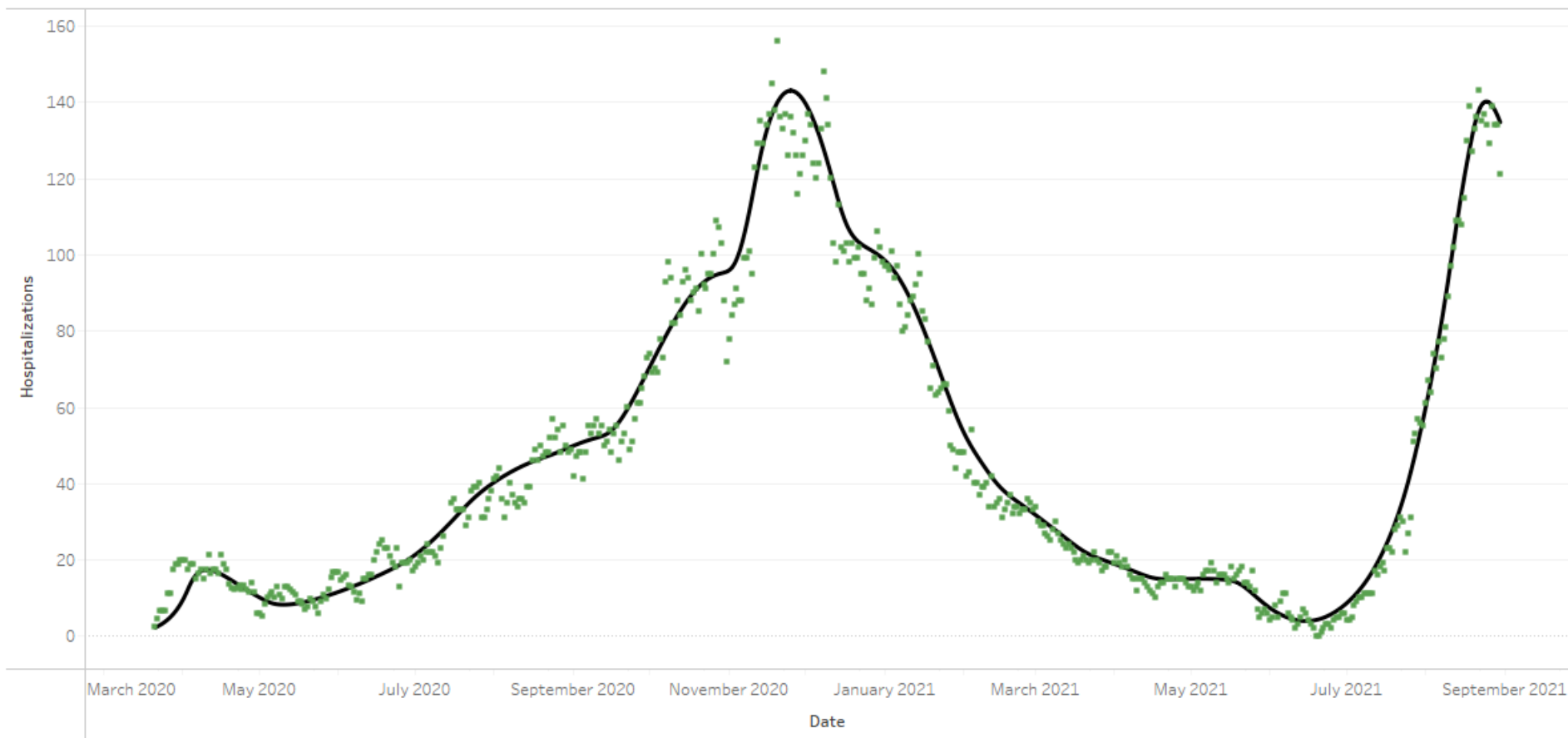
Pre-intervention	2.61
Last Week	0.84
Current Week	0.87
WoW % Re Change	3.2

Bed / Ventilator Availability**

% ICU Beds Occupied	73%
% ICU Beds Occupied C19	34%
% ICU Beds Free	27%
% Ventilators in use	37%
% Ventilators free	63%

Base Case Southeast Region

Model Scenario: Base Case, Data from: 3/21/2020 to 8/30/2021



■ Hospitalized COVID-19 Patients
■ LEMMA Hospital Estimation

[* Source: USA Facts via HHS Protect, data is as of 8/30/2021]
[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
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Southwest / Springfield (Region D,G,I)

Overview*

Population	1,221,847
Cumulative Cases	155,636
Cumulative Deaths	2,313
7-day New Cases	3,749
WoW % Case Change	2.5%

Reproductive Rate (Re)***

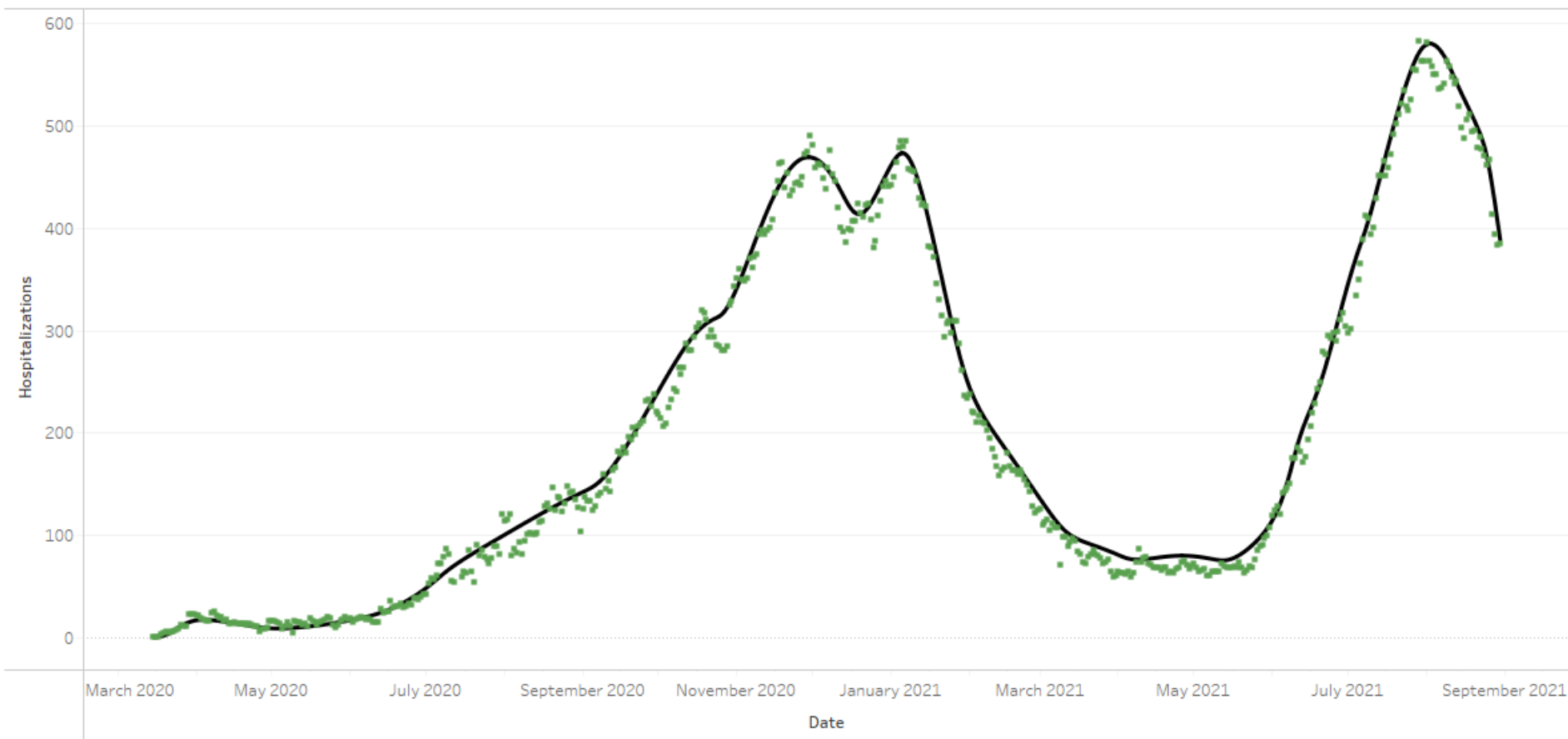
Pre-intervention	2.36
Last Week	0.85
Current Week	0.68
WoW % Re Change	-20.0

Bed / Ventilator Availability**

% ICU Beds Occupied	87%
% ICU Beds Occupied C19	39%
% ICU Beds Free	13%
% Ventilators in use	27%
% Ventilators free	73%

Base Case Southwest Region

Model Scenario: Base Case, Data from: 3/15/2020 to 8/30/2021



■ Hospitalized COVID-19 Patients
■ LEMMA Hospital Estimation

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[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
[*** Reproductive Rate data and the Region Projection chart are as of 8/30/2021]

Greater St. Louis Area (Region C)

Overview*

Population	2,229,518
Cumulative Cases	247,578
Cumulative Deaths	3,672
7-day New Cases	5,595
WoW % Case Change	2.3%

Reproductive Rate (Re)***

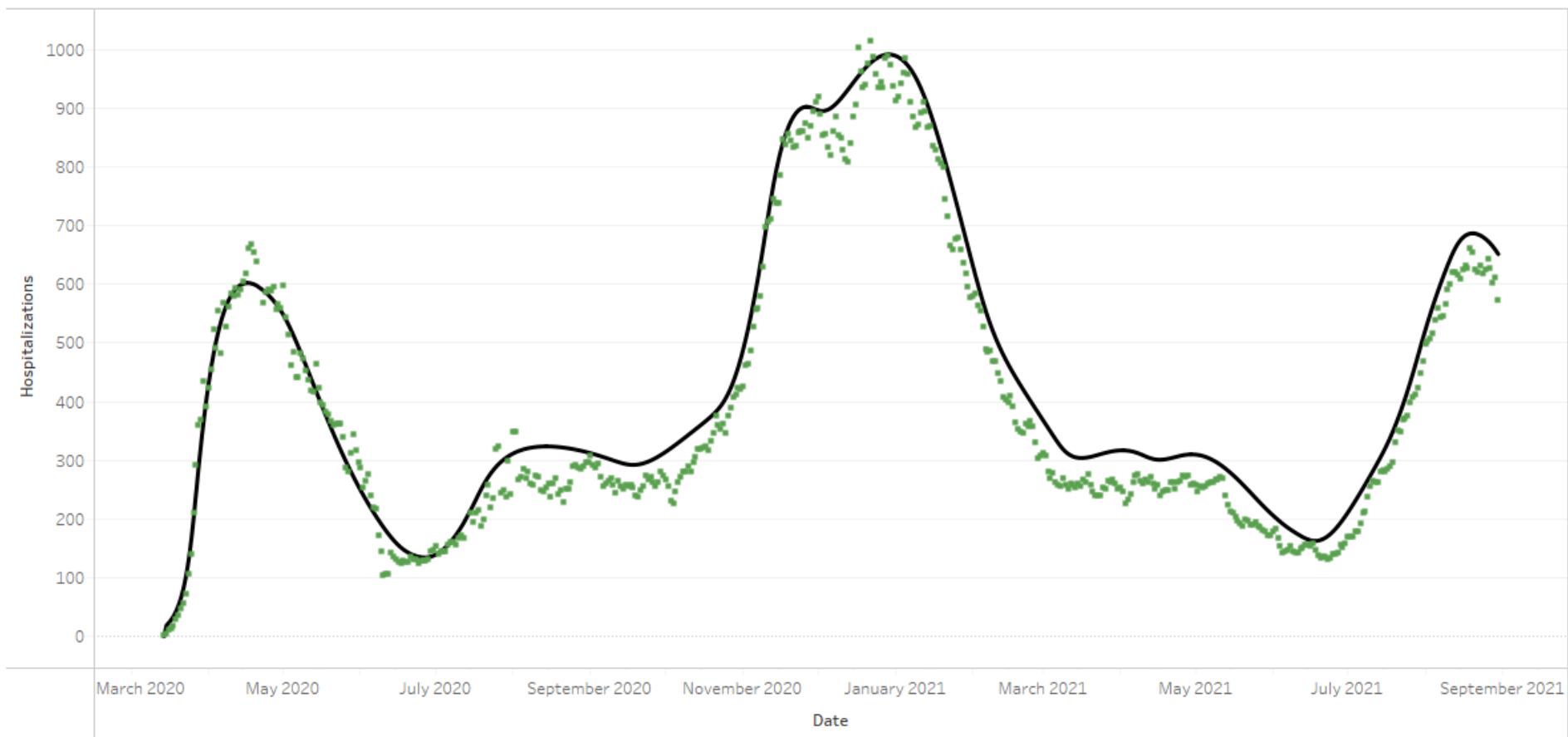
Pre-intervention	3.39
Last Week	0.92
Current Week	0.90
WoW % Re Change	-2.6

Bed / Ventilator Availability**

% ICU Beds Occupied	87%
% ICU Beds Occupied C19	17%
% ICU Beds Free	13%
% Ventilators in use	39%
% Ventilators free	61%

Base Case St. Louis Region

Model Scenario: Base Case, Data from: 3/14/2020 to 8/30/2021



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■ LEMMA Hospital Estimation

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[** Source: Teletracking via HHS Protect, data is as of 8/30/2021]
[*** Reproductive Rate data and the Region Projection chart are as of 8/30/2021]

See FAQs for additional details

Link here: <https://health.mo.gov/living/healthcondiseases/communicable/novel-coronavirus/pdf/modeling-faqs.pdf>

Version 2.0, As of March 30, 2021

Missouri's Regional COVID-19 Hospitalized Cases Model: Overview and Frequently Asked Questions

Model Overview

One of the many data analyses that inform Missouri's COVID-19 response is a regional model of hospitalized COVID-19 cases that the State of Missouri developed in partnership with the Washington University in St. Louis and Missouri Hospital Association.

Missouri's model uses a standard SEIR (susceptible, exposed, infectious, recovered) compartmental structure that is based upon a tool called LEMMA (Local Epidemiological Modeling for Management & Action), which was developed by experts from UMass Amherst, UC Berkeley, UCSF, and WUSTL. The model focuses on COVID-19 hospitalized cases to directly address the question of hospital capacity and provide a more accurate picture of COVID-19's impact on the healthcare system.

```

graph LR
    Susceptible --> Exposed
    Exposed --> Infectious
    Infectious --> Removed
    Infectious --> Hospitalized
    Hospitalized --> Floor
    Hospitalized --> ICU
    Hospitalized --> Ward
    EffectivelyVaccinated[Effectively Vaccinated] --> Susceptible
    EffectivelyVaccinated --> Removed
  
```

To help inform decisions at the regional and local level, each region is modeled separately using the latest local data, including COVID-19 confirmed and suspected hospitalizations, population, policy interventions, and average hospital length of stay.

General FAQs

Why are regional models of COVID-19 important?

When new diseases such as COVID-19 emerge, there is uncertainty about how best to control the epidemic. Decision makers must make their decisions with the best available information at hand.

Mathematical models are commonly used tools to help us understand how infectious diseases might impact key outcomes such as hospitalized cases or deaths. Today, there are many sophisticated models of COVID-19 that make global or national projections (e.g., see the Centers for Disease Control and Prevention's latest compilation

Regional COVID-19 transmission models help inform local policy, public health, and business decisions

- Mathematical models are commonly used to make projections of infectious disease epidemics (e.g., tuberculosis, HIV)
- Many sophisticated models on COVID-19 make global or national projections (e.g., Imperial College, Harvard, IHME)
- However, these generally do not incorporate critical local or regional inputs, such as:
 - Variations in local population size and age structure
 - Date and nature of social distancing and other policies
- Regional projections are important because:
 - Regional epidemics may differ markedly from the national average
 - Policy response occurs at state, county, and municipal levels

State of MO, WUSTL, and MHA have developed a regional model of hospitalized COVID-19 cases

- **Standard SEIR model that combines universal characteristics of COVID-19 infection (e.g., transmission parameters) with local inputs to support regional decision making**
 - Mathematical model developed by experts from UMass Amherst, UC Berkeley, UCSF, and WUSTL
 - Uses a statistical approach that adjusts underlying parameters as new data are observed
- **Customized using the latest local data from Missouri's emergency response regions, including:**
 - COVID-19 positives and PUIs
 - Population and age structure
 - Policy interventions
 - Avg. hospital length of stay
 - Vaccination rate by age and vaccine efficacy
- **Projects COVID-19 hospitalized cases** to directly address the question of hospital capacity and provide a more accurate picture on COVID-19's impact on the healthcare system

Model Structure (SEIR)

