



# State of Missouri regional COVID-19 hospitalized cases model

December 8, 2020

# Multiple data points inform Missouri's COVID-19 response

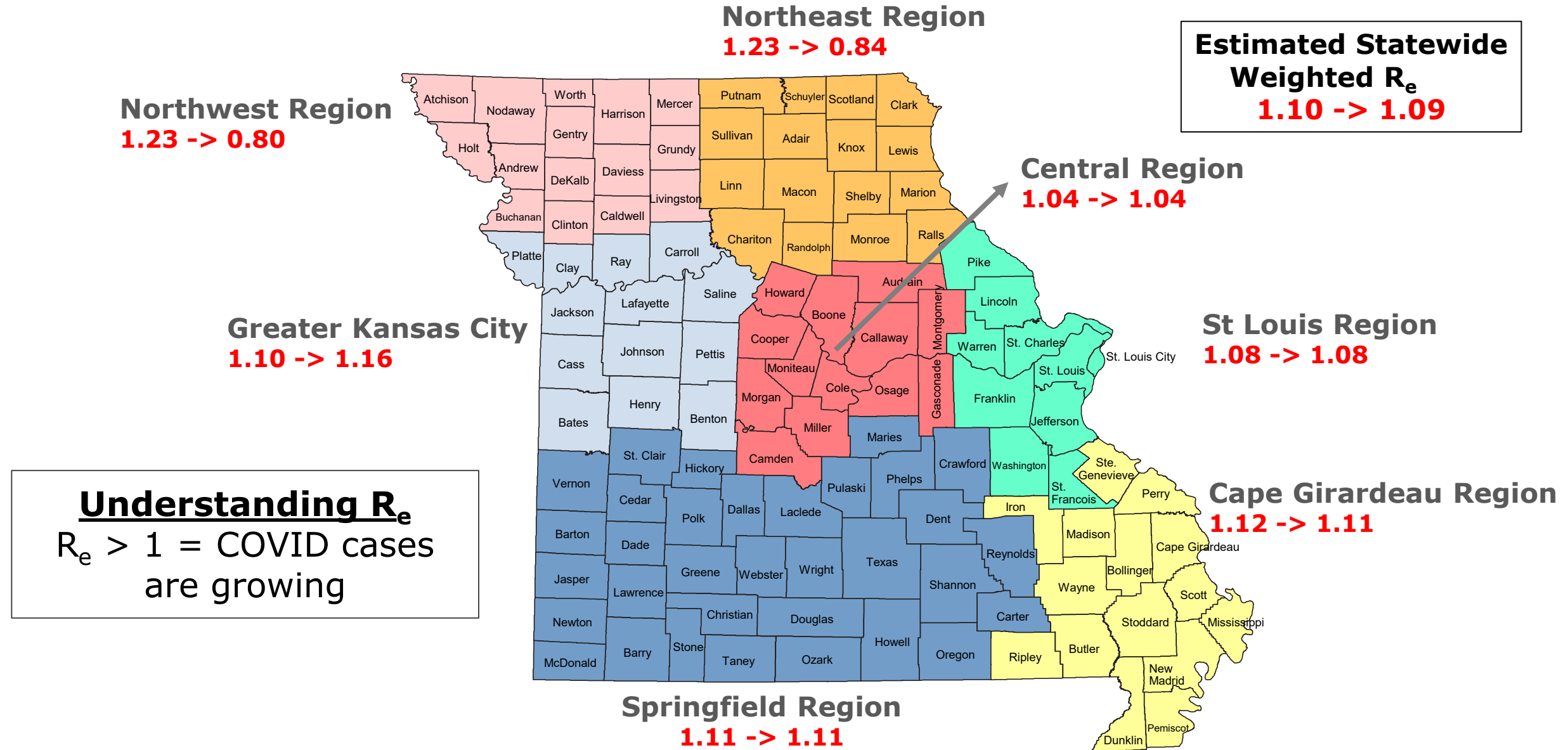
- Syndromic surveillance
- Healthcare system capacity (bed, PPE, and staff availability)
- Testing
- COVID-19 cases and deaths
- Economic and social impact
- Insights from U.S. states, nationally, and other countries
- Evidence from scientific literature
- Mathematical disease modelling

## 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
Projected hospitalizations for regions in MO with sufficient data, i.e. Kansas City Area, Central, St. Louis Area, Southeast and Southwest	Projected hospitalizations in regions where daily COVID-19 hospitalizations are fewer than 15 because insufficient cases

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

► Transmission rates (" $R_e$ ") remain critically high statewide



# Central (Region F)



## Overview

Population	502,486	
Cumulative Cases	32941	
Cumulative Deaths	278	
7-day New Cases	2470	
WoW % Case Change	8.1%	

## Reproductive Rate

Pre-intervention	2.3	
Last Week	1.043	
Current Week	1.041	+/- 0.05
WoW % Change	-0.2%	

## Bed / Ventilator Availability

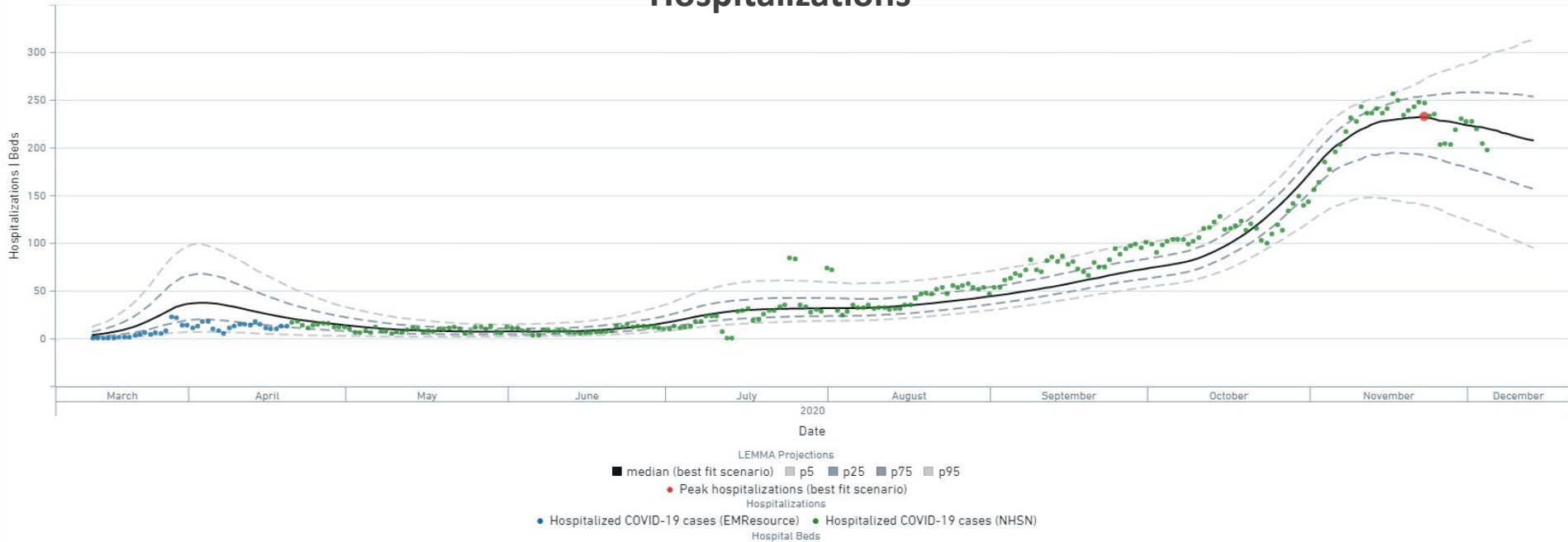
% ICU Beds Occupied	68%	
% ICU Beds Occupied C19	17%	
% ICU Beds Free	32%	
% Ventilators in use	45%	
% Ventilators available	55%	

### Base Case Central Region

\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more

## Hospitalizations



# Greater Kansas City Area (Region A)



## Overview

Population	1,395,314	
Cumulative Cases	69439	
Cumulative Deaths	794	
7-day New Cases	5720	
WoW % Case Change	9.0%	

## Reproductive Rate

Pre-intervention	2.8	
Last Week	1.109	
Current Week	1.16	+/- 0.05
WoW % Change	4.6%	

## Bed / Ventilator Availability

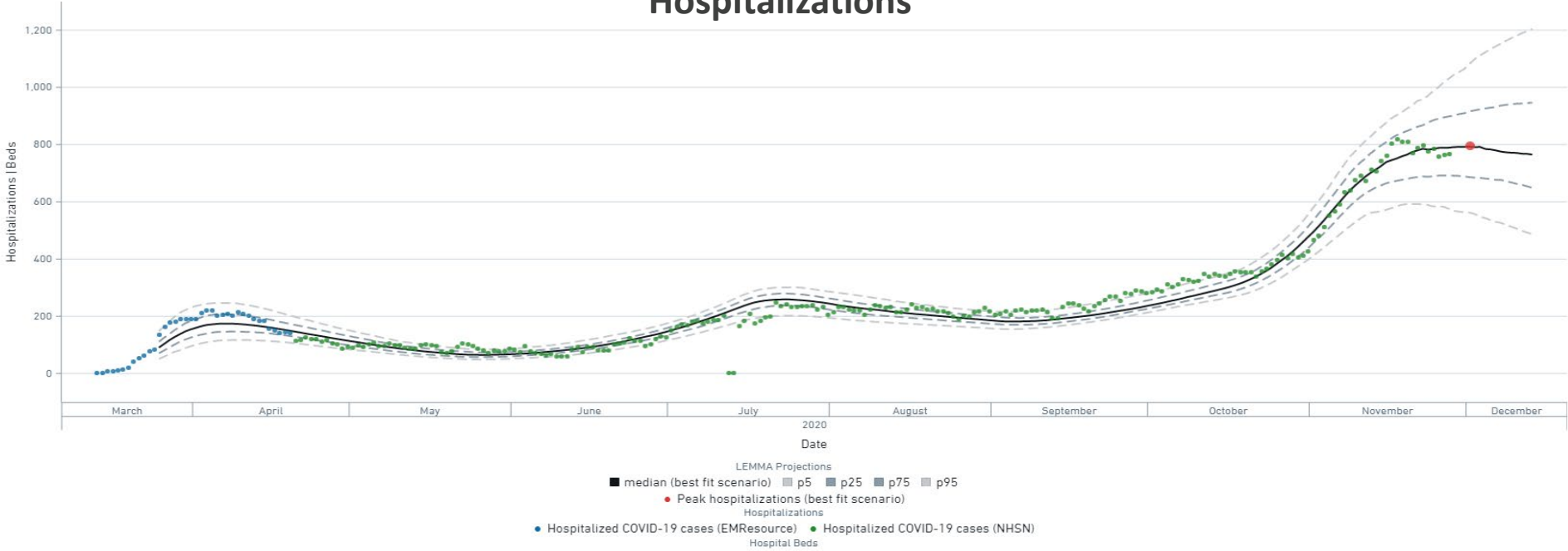
% ICU Beds Occupied	81%	
% ICU Beds Occupied C19	20%	
% ICU Beds Free	19%	
% Ventilators in use	29%	
% Ventilators available	71%	

Base Case Kansas City Region

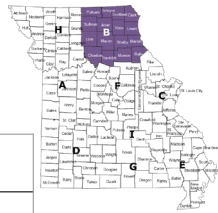
\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more

## Hospitalizations



# Northeast (Region B)



Overview		
Population	179,448	
Cumulative Cases	9155	
Cumulative Deaths	72	
7-day New Cases	727	
WoW % Case Change	8.6%	

Reproductive Rate		
Pre-intervention	N/A	
Last Week	1.23	
Current Week	0.84	+/- 0.06
WoW % Change	-31.7%	

Bed / Ventilator Availability		
% ICU Beds Occupied	97%	
% ICU Beds Occupied C19	64%	
% ICU Beds Free	3%	
% Ventilators in use	38%	
% Ventilators available	63%	

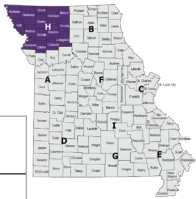
Base Case Northeast Region

\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more



# Northwest (Region H)



## Overview

Population	234,361	
Cumulative Cases	13452	
Cumulative Deaths	228	
7-day New Cases	1172	
WoW % Case Change	9.5%	

## Reproductive Rate

Pre-intervention	1.24	
Last Week	1.232	
Current Week	0.799	+/- 0.07
WoW % Change	-35.1%	

## Bed / Ventilator Availability

% ICU Beds Occupied	91%	
% ICU Beds Occupied C19	28%	
% ICU Beds Free	9%	
% Ventilators in use	23%	
% Ventilators available	77%	

Base Case Northwest Region

\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more

## Hospitalizations





# Southeast / Cape Girardeau (Region E)



## Overview

Population	363,478	
Cumulative Cases	24176	
Cumulative Deaths	260	
7-day New Cases	1683	
WoW % Case Change	7.5%	

## Reproductive Rate

Pre-intervention	2.61	
Last Week	1.118	
Current Week	1.113	+/- 0.05
WoW % Change	-0.4%	

## Bed / Ventilator Availability

% ICU Beds Occupied	74%	
% ICU Beds Occupied C19	36%	
% ICU Beds Free	26%	
% Ventilators in use	38%	
% Ventilators available	62%	

Base Case Southeast Region

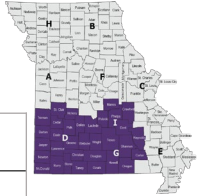
\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more

## Hospitalizations



# Southwest / Springfield (Regions D,G, I)



## Overview

Population	1,221,847	
Cumulative Cases	62331	
Cumulative Deaths	887	
7-day New Cases	4641	
WoW % Case Change	8.0%	

## Reproductive Rate

Pre-intervention	2.36	
Last Week	1.112	
Current Week	1.111	+/- 0.06
WoW % Change	-0.1%	

## Bed / Ventilator Availability

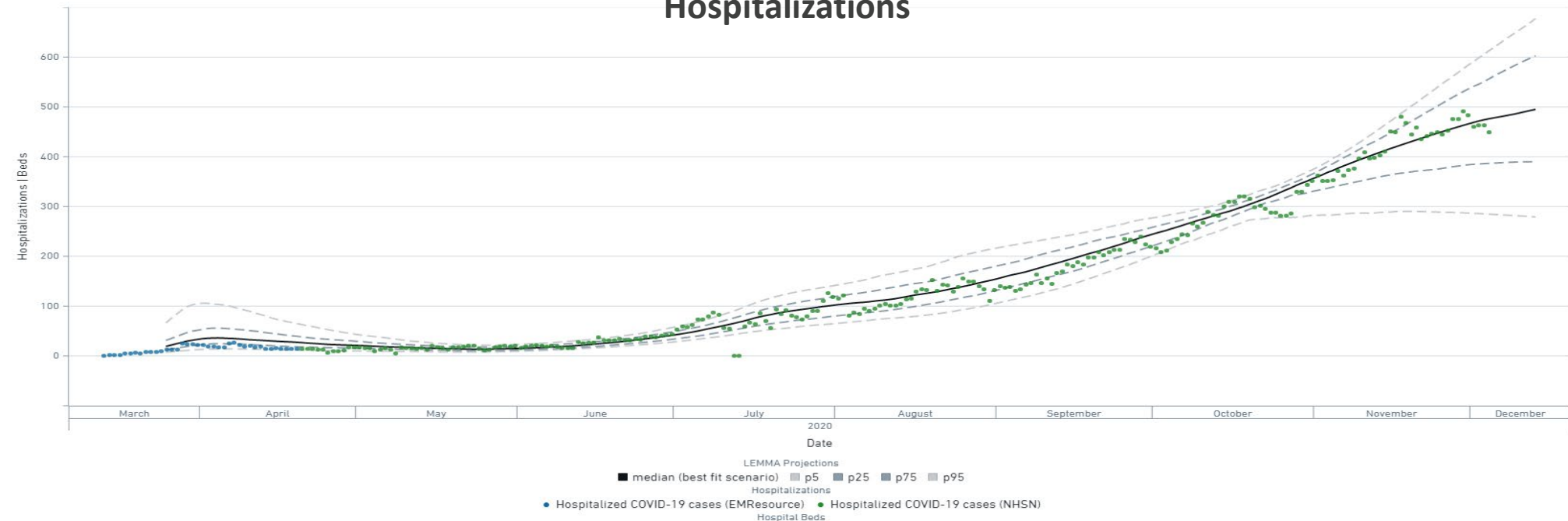
% ICU Beds Occupied	94%	
% ICU Beds Occupied C19	40%	
% ICU Beds Free	6%	
% Ventilators in use	32%	
% Ventilators available	68%	

Base Case Southwest Region

\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more

## Hospitalizations



# Greater St Louis Area (Region C)



## Overview

Population	2,229,518	
Cumulative Cases	116712	
Cumulative Deaths	1836	
7-day New Cases	9103	
WoW % Case Change	8.5%	

## Reproductive Rate

Pre-intervention	3.39	
Last Week	1.077	
Current Week	1.083	+/- 0.03
WoW % Change	0.6%	

## Bed / Ventilator Availability

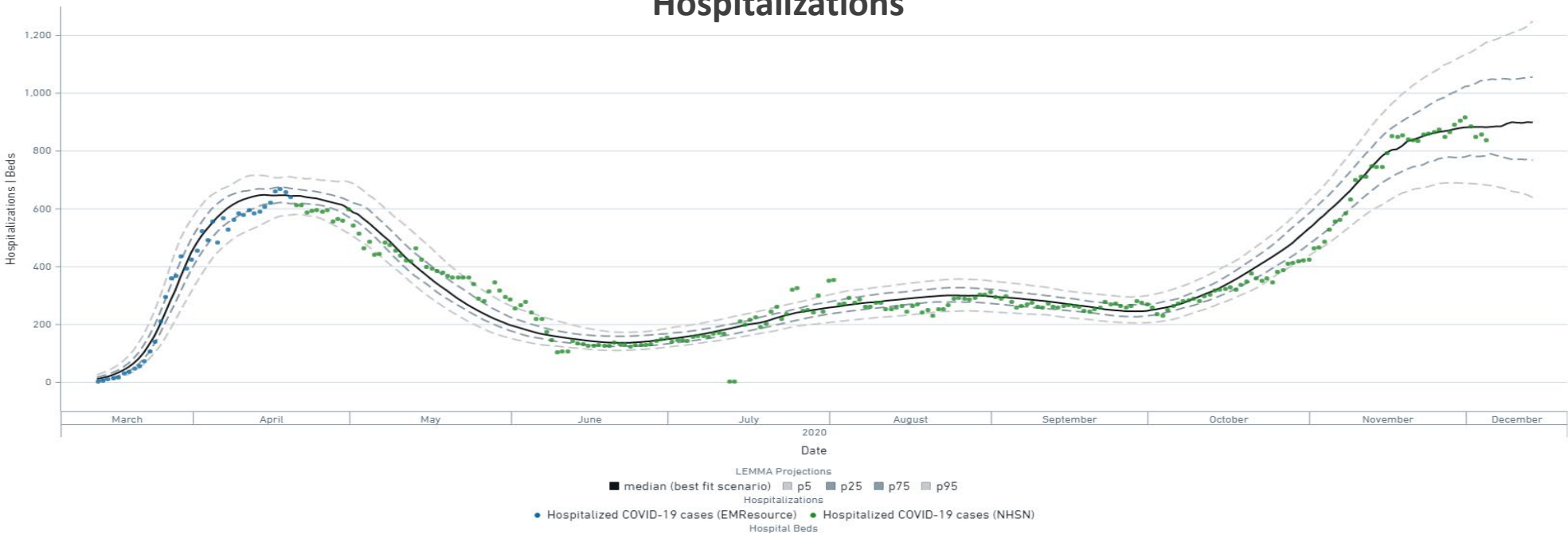
% ICU Beds Occupied	81%	
% ICU Beds Occupied C19	21%	
% ICU Beds Free	19%	
% Ventilators in use	42%	
% Ventilators available	58%	

Base Case St. Louis Region

\* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 12/14/20 1:00 AM, + 2 more

## Hospitalizations



Version 1.0, As of June 3, 2020

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 WU/STL. 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 --> Removed
    Hospitalized --> Floor
    Hospitalized --> ICU
    Hospitalized --> Vent
  
```

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 much uncertainty about how best to control the epidemic. Decision makers must make the best possible decisions with the available information at hand.

Mathematical models are commonly used to make projections of 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., Imperial College, Harvard, [UW-M](#)). However, these generally do not incorporate key local or regional inputs, such as variations in local population demographics, healthcare system

wledge of COVID-19 in each region effective transmission rates across projected into the future based upon ture.

ospitals serve patients across

hway Patrol Troop and Healthcare and response planning. There are

t patient referral and EMS patterns,

rol Troop C (i.e., the Greater St. due to their engagement with the

City

Northeast MO)?

Low levels of daily COVID-19 hospitalizations in the Northeast and Northwest regions limit the ability to generate projections for these regions. In particular, the numbers of hospitalized cases have been so low that

## 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
- **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)

