



State of Missouri regional COVID-19 hospitalized cases model

December 1, 2020

Multiple data points inform Missouri's COVID-19 response

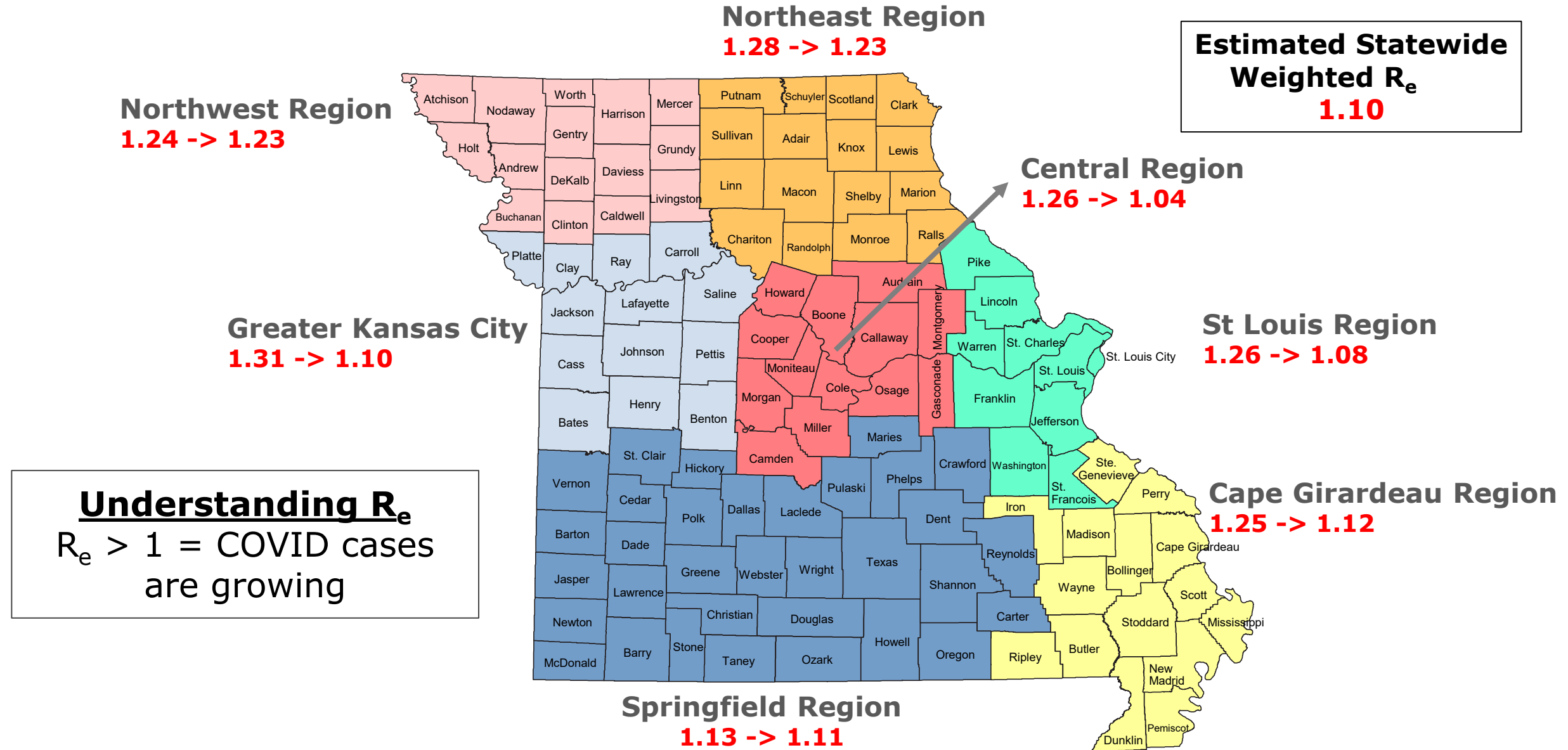
- Syndromic surveillance
- Healthcare system capacity (bed, PPE, and staff availability)
- Testing
- COVID-19 cases and deaths
- Economic and social impact
- Insights from U.S. states, nationally, and other countries
- Evidence from scientific literature
- Mathematical disease modelling

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	30471	
Cumulative Deaths	254	
7-day New Cases	2069	
WoW % Case Change	7.4%	

Reproductive Rate

Pre-intervention	2.3	
Last Week	1.253	
Current Week	1.043	+/- 0.05
WoW % Change	-16.8%	

Bed / Ventilator Availability

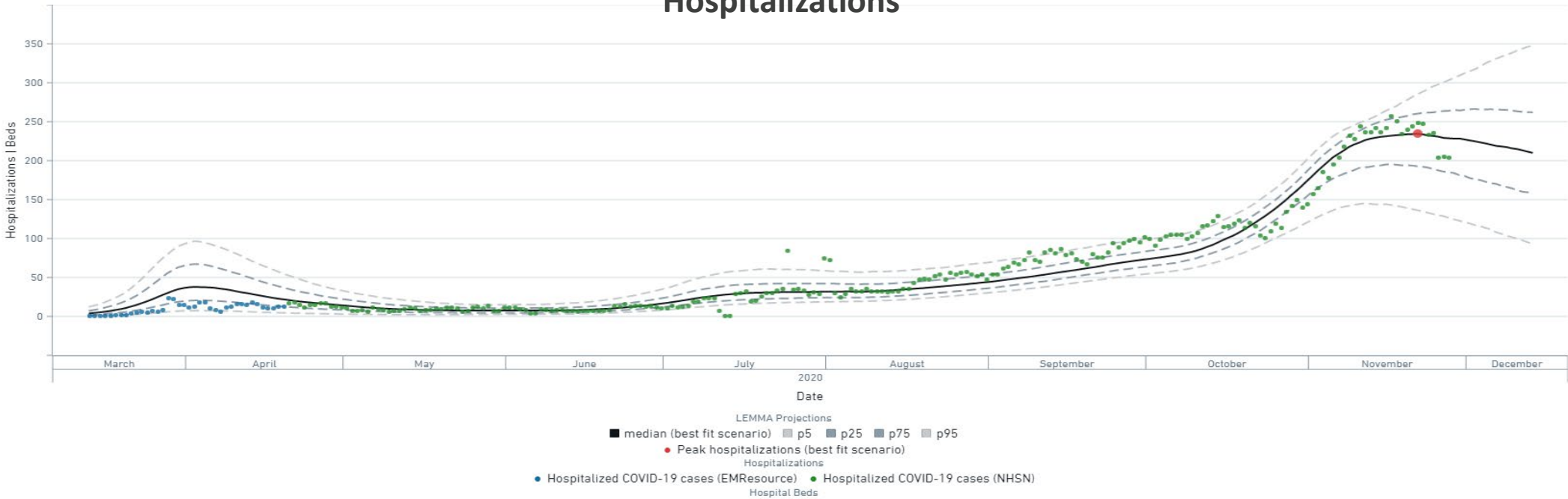
% ICU Beds Occupied	64%	
% ICU Beds Occupied C19	18%	
% ICU Beds Free	36%	
% Ventilators in use	49%	
% Ventilators available	51%	

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	63719	
Cumulative Deaths	736	
7-day New Cases	5162	
WoW % Case Change	8.9%	

Reproductive Rate		
Pre-intervention	2.8	
Last Week	1.308	
Current Week	1.109	+/- 0.05
WoW % Change	-15.2%	

Bed / Ventilator Availability		
% ICU Beds Occupied	85%	
% ICU Beds Occupied C19	21%	
% ICU Beds Free	15%	
% Ventilators in use	30%	
% Ventilators available	70%	

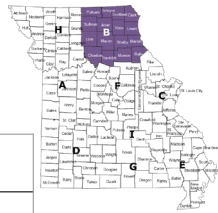
Base Case Kansas City Region

* % 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



Northeast (Region B)



Overview		
Population	179,448	
Cumulative Cases	8428	
Cumulative Deaths	65	
7-day New Cases	678	
WoW % Case Change	8.9%	

Reproductive Rate		
Pre-intervention	N/A	
Last Week	1.274	
Current Week	1.23	+/- 0.06
WoW % Change	-3.5%	

Bed / Ventilator Availability		
% ICU Beds Occupied	84%	
% ICU Beds Occupied C19	69%	
% ICU Beds Free	16%	
% Ventilators in use	18%	
% Ventilators available	83%	

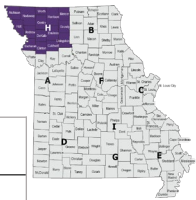
Base Case Northeast Region

* % 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	12280	
Cumulative Deaths	208	
7-day New Cases	960	
WoW % Case Change	8.6%	

Reproductive Rate

Pre-intervention	1.24	
Last Week	1.234	
Current Week	1.232	+/- 0.07
WoW % Change	-0.2%	

Bed / Ventilator Availability

% ICU Beds Occupied	72%	
% ICU Beds Occupied C19	22%	
% ICU Beds Free	28%	
% Ventilators in use	17%	
% Ventilators available	83%	

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	22493	
Cumulative Deaths	240	
7-day New Cases	1807	
WoW % Case Change	8.9%	

Reproductive Rate

Pre-intervention	2.61	
Last Week	1.241	
Current Week	1.118	+/- 0.05
WoW % Change	-9.9%	

Bed / Ventilator Availability

% ICU Beds Occupied	72%	
% ICU Beds Occupied C19	32%	
% ICU Beds Free	28%	
% Ventilators in use	39%	
% Ventilators available	61%	

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



[Data updated 12/01/20]

Southwest / Springfield (Regions D,G, I)



Overview

Population	1,221,847	
Cumulative Cases	57691	
Cumulative Deaths	789	
7-day New Cases	3796	
WoW % Case Change	7.1%	

Reproductive Rate

Pre-intervention	2.36	
Last Week	1.132	
Current Week	1.112	+/- 0.06
WoW % Change	-1.8%	

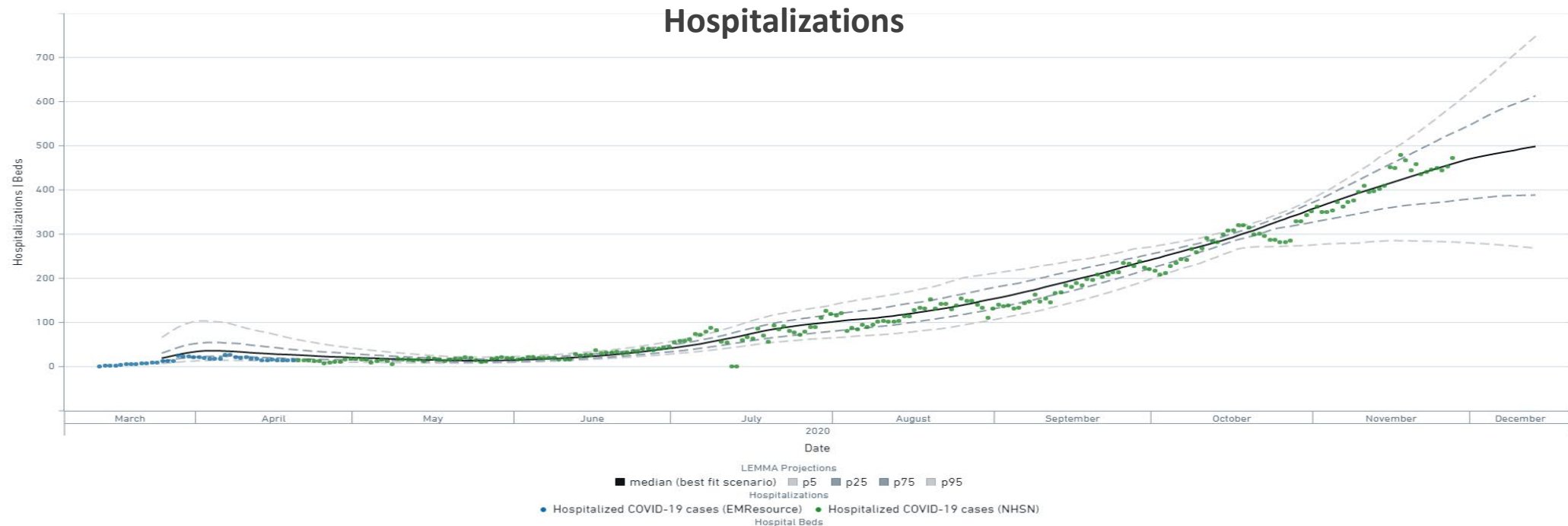
Bed / Ventilator Availability

% ICU Beds Occupied	85%	
% ICU Beds Occupied C19	39%	
% ICU Beds Free	15%	
% Ventilators in use	31%	
% Ventilators available	69%	

Base Case Southwest Region

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

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



Greater St Louis Area (Region C)



Overview

Population	2,229,518	
Cumulative Cases	107609	
Cumulative Deaths	1714	
7-day New Cases	9560	
WoW % Case Change	9.9%	

Reproductive Rate

Pre-intervention	3.39	
Last Week	1.265	
Current Week	1.077	+/- 0.03
WoW % Change	-14.9%	

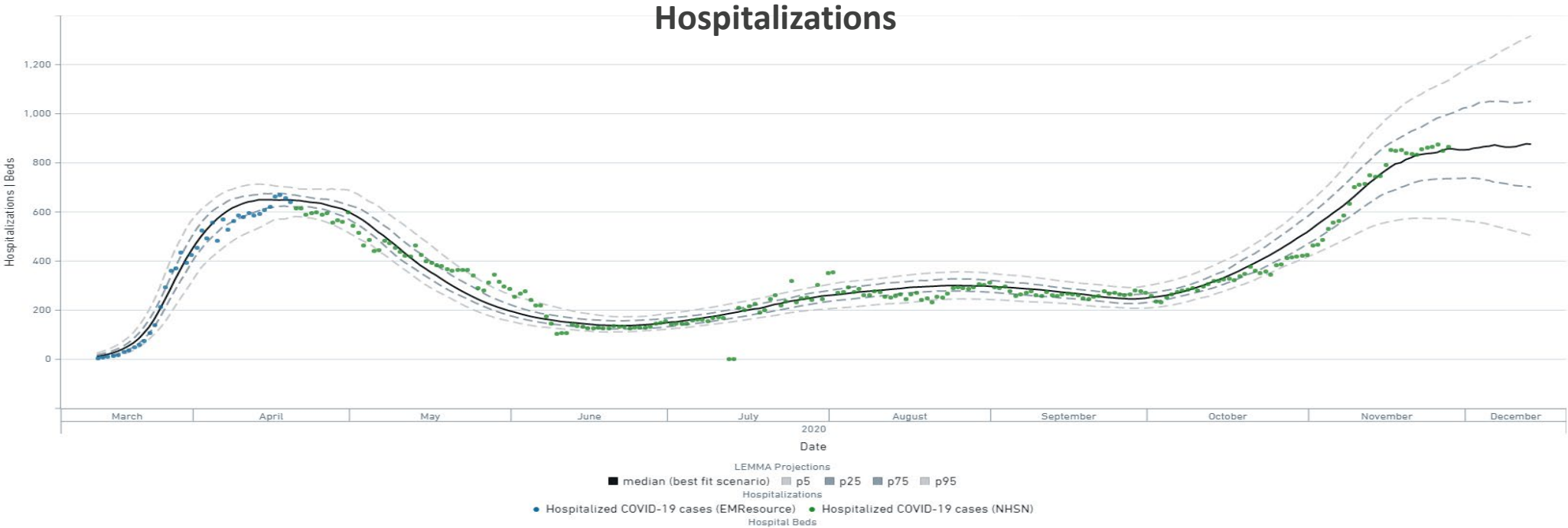
Bed / Ventilator Availability

% ICU Beds Occupied	80%	
% ICU Beds Occupied C19	21%	
% ICU Beds Free	20%	
% Ventilators in use	44%	
% Ventilators available	56%	

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



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 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 --> 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, [JHU](#)). However, these generally do not incorporate key local or regional inputs, such as variations in local population demographics, healthcare system

knowledge of COVID-19 in each region, effective transmission rates across regions, and are projected into the future based upon current data.

Hospitals serve patients across the state.

Highway Patrol Troop and Healthcare workers are involved in response planning. There are many factors that influence response planning.

Emergency patient referral and EMS patterns, which vary by region, are critical to response planning.

Highway Patrol Troop C (i.e., the Greater St. Louis area) is due to their engagement with the healthcare system.

St. Louis 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)

