



State of Missouri regional COVID-19 hospitalized cases model

January 12, 2021

Multiple data points inform Missouri's COVID-19 response

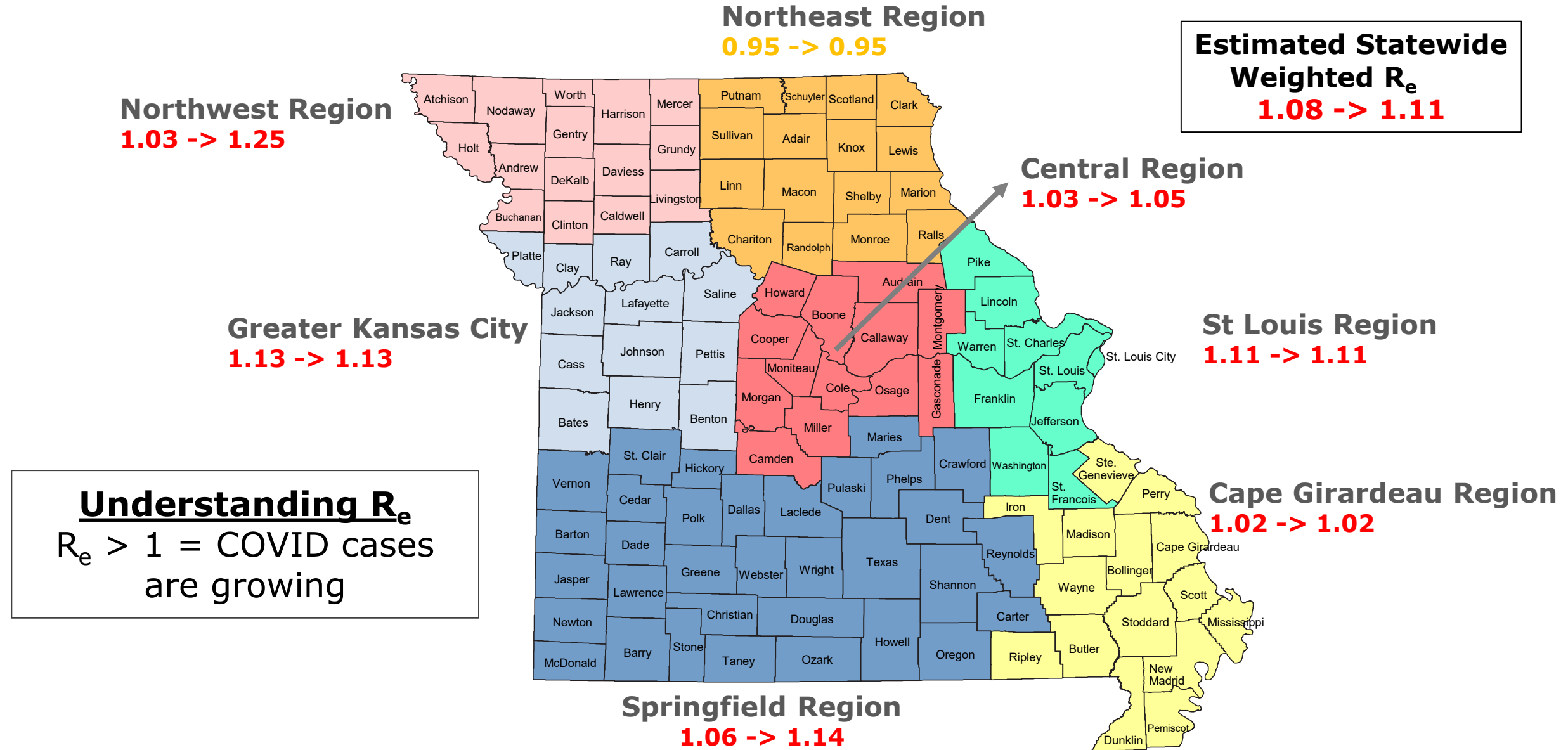
- Syndromic surveillance
- Healthcare system capacity (bed, PPE, and staff availability)
- Testing
- COVID-19 cases and deaths
- Economic and social impact
- Insights from U.S. states, nationally, and other countries
- Evidence from scientific literature
- Mathematical disease modelling

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
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 ") in several regions remain above 1



Central (Region F)



Overview

Population	502,486	
Cumulative Cases	41633	
Cumulative Deaths	436	
7-day New Cases	1771	
WoW % Case Change	4.4%	

Reproductive Rate

Pre-intervention	2.3	
Last Week	1.031	
Current Week	1.049	+/- 0.05
WoW % Change	1.7%	

Bed / Ventilator Availability

% ICU Beds Occupied	61%	
% ICU Beds Occupied C19	17%	
% ICU Beds Free	39%	
% Ventilators in use	38%	
% Ventilators available	62%	

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: 1/23/21 1:00 AM, Model Percentiles: median, p25, p75, p5, p95, Hospital Beds: none

Hospitalizations



Greater Kansas City Area (Region A)



Overview		
Population	1,395,314	
Cumulative Cases	91514	
Cumulative Deaths	1082	
7-day New Cases	5045	
WoW % Case Change	5.8%	

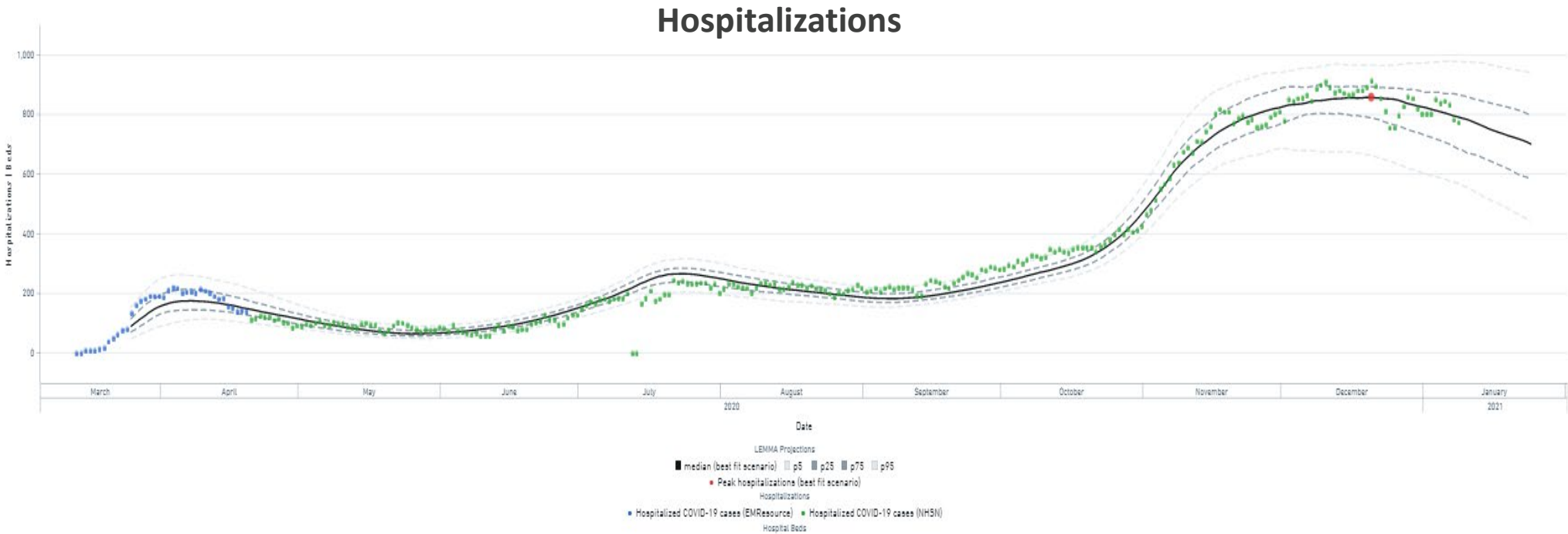
Reproductive Rate		
Pre-intervention	2.8	
Last Week	1.13	
Current Week	1.131	+/- 0.05
WoW % Change	0.1%	

Bed / Ventilator Availability		
% ICU Beds Occupied	80%	
% ICU Beds Occupied C19	21%	
% ICU Beds Free	20%	
% Ventilators in use	28%	
% Ventilators available	72%	

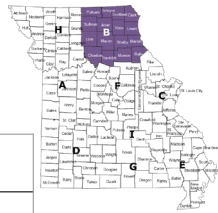
Base Case Kansas City Region

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

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 1/20/21 1:00 AM, Model Percentiles: median, p25, p75, p95, Hospital Beds: none



Northeast (Region B)



Overview		
Population	179,448	
Cumulative Cases	11838	
Cumulative Deaths	120	
7-day New Cases	562	
WoW % Case Change	5.0%	

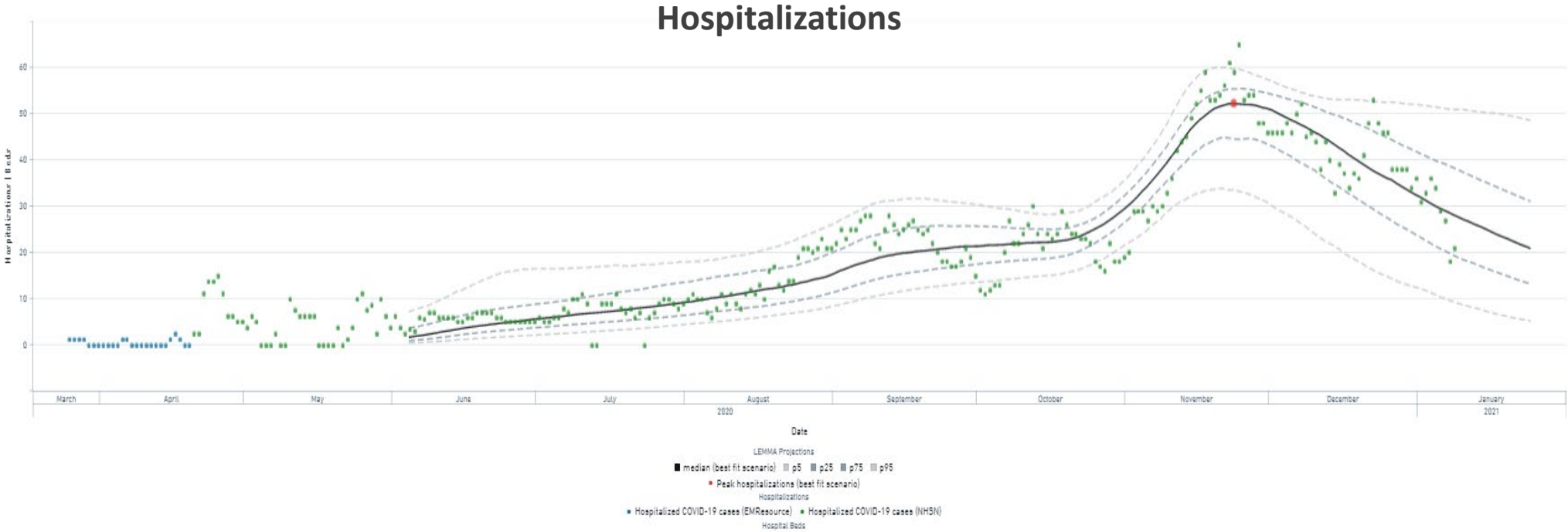
Reproductive Rate		
Pre-intervention	N/A	
Last Week	0.953	
Current Week	0.951	+/- 0.06
WoW % Change	-0.2%	

Bed / Ventilator Availability		
% ICU Beds Occupied	86%	
% ICU Beds Occupied C19	54%	
% ICU Beds Free	14%	
% Ventilators in use	10%	
% Ventilators available	90%	

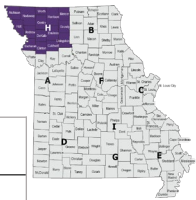
Base Case Northeast Region

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

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 1/25/21 1:00 AM, Model Percentiles: median, p25, p75, p8, p95, Hospital Beds: none



Northwest (Region H)



Overview

Population	234,361	
Cumulative Cases	16931	
Cumulative Deaths	324	
7-day New Cases	748	
WoW % Case Change	4.6%	

Reproductive Rate

Pre-intervention	1.24	
Last Week	1.028	
Current Week	1.254	+/- 0.07
WoW % Change	22.0%	

Bed / Ventilator Availability

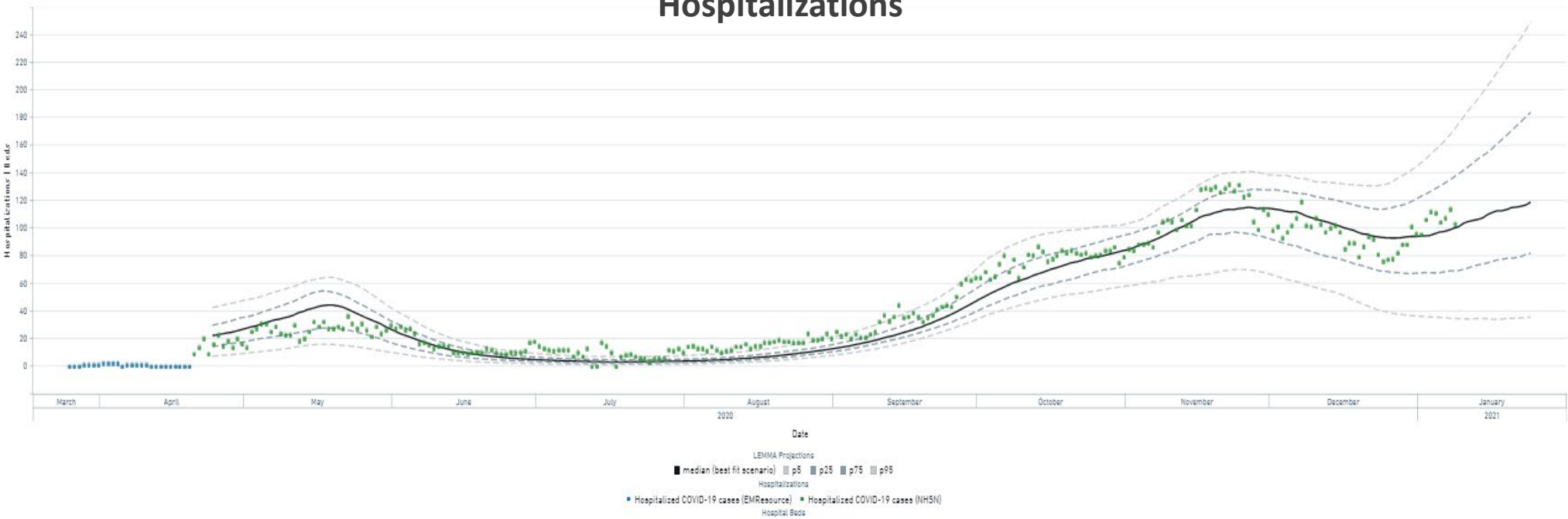
% ICU Beds Occupied	81%	
% ICU Beds Occupied C19	44%	
% ICU Beds Free	19%	
% Ventilators in use	18%	
% Ventilators available	82%	

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: 1/23/21 1:00 AM, Model Percentiles: median, p25, p75, p5, p95, Hospital Beds: none

Hospitalizations



Southeast / Cape Girardeau (Region E)



Overview

Population	363,478	
Cumulative Cases	29399	
Cumulative Deaths	385	
7-day New Cases	1074	
WoW % Case Change	3.8%	

Reproductive Rate

Pre-intervention	2.61	
Last Week	1.016	
Current Week	1.018	+/- 0.05
WoW % Change	0.2%	

Bed / Ventilator Availability

% ICU Beds Occupied	61%	
% ICU Beds Occupied C19	10%	
% ICU Beds Free	39%	
% Ventilators in use	27%	
% Ventilators available	73%	

Base Case Southeast Region

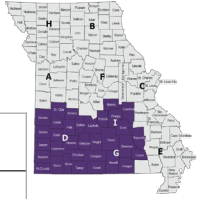
* % of occupied ICU beds taken by COVID-19 PUI/Confirmed patients

Model Scenario: Base Case, From Date: Mar 1, 2020, To Date: 1/25/21 1:00 AM, Model Percentiles: median, p25, p75, p5, p95, Hospital Beds: none

Hospitalizations



Southwest / Springfield (Regions D,G, I)



Overview

Population	1,221,847	
Cumulative Cases	81438	
Cumulative Deaths	1281	
7-day New Cases	4454	
WoW % Case Change	5.8%	

Reproductive Rate

Pre-intervention	2.36	
Last Week	1.062	
Current Week	1.141	+/- 0.06
WoW % Change	7.4%	

Bed / Ventilator Availability

% ICU Beds Occupied	77%	
% ICU Beds Occupied C19	31%	
% ICU Beds Free	23%	
% Ventilators in use	26%	
% Ventilators available	74%	

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: 1/29/21 1:00 AM, Model Percentiles: median, p25, p5, p95, Hospital Beds: none

Hospitalizations



Greater St Louis Area (Region C)



Overview

Population	2,229,518	
Cumulative Cases	150574	
Cumulative Deaths	2320	
7-day New Cases	7912	
WoW % Case Change	5.5%	

Reproductive Rate

Pre-intervention	3.39	
Last Week	1.106	
Current Week	1.109	+/- 0.03
WoW % Change	0.3%	

Bed / Ventilator Availability

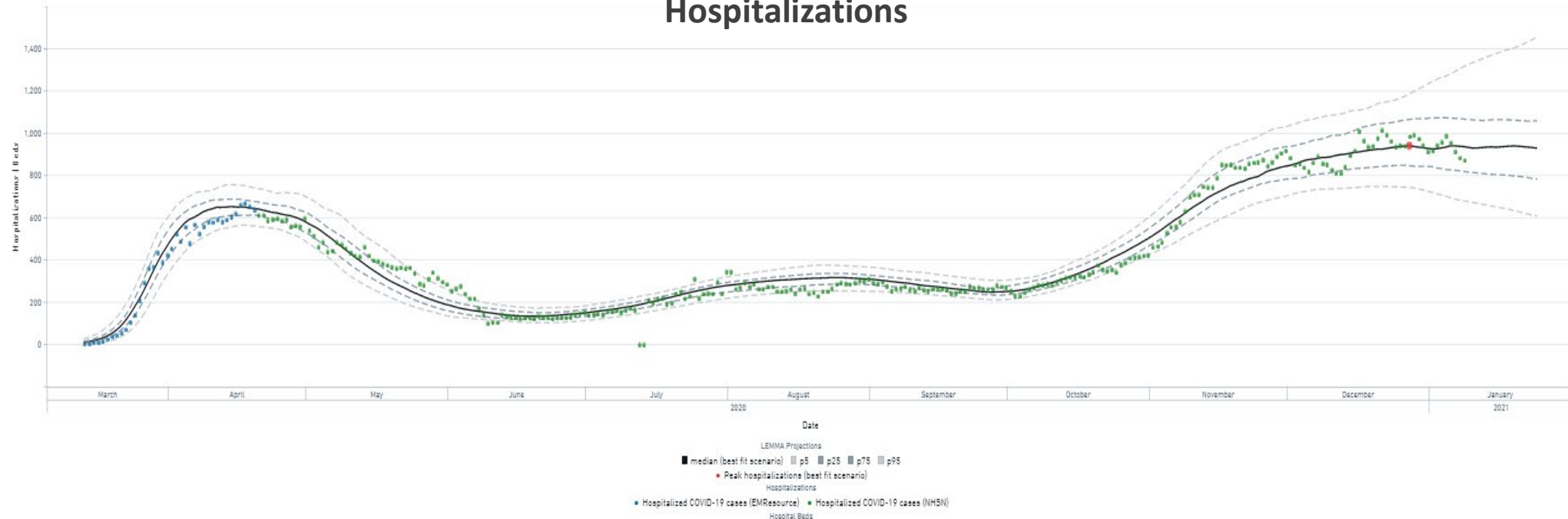
% ICU Beds Occupied	81%	
% ICU Beds Occupied C19	19%	
% ICU Beds Free	19%	
% Ventilators in use	38%	
% Ventilators available	62%	

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: 1/25/21 1:00 AM, Model Percentiles: median, p25, p75, p5, p95, Hospital Beds: none

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 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 --> 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, [UMM](#)). 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 projected into the future based upon future.


hospitals serve patients across

Highway Patrol Troop and Healthcare and response planning. There are

patient referral and EMS patterns,

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

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)

