State of Missouri regional COVID-19 hospitalized cases model

June 24th, 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

<table>
<thead>
<tr>
<th>What does the model tell us</th>
<th>What does it not tell us</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of plausible outcomes based on our current knowledge of COVID-19 in Missouri</td>
<td>What will happen in the future</td>
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<tr>
<td>Approximate date and magnitude of peak/s based on current understanding of policy interventions and human behavior and assumptions about future interventions</td>
<td>Date and magnitude of peak/s if there are major changes in planned policy interventions and human behavior</td>
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<tr>
<td>Approximate estimate of effective transmission rate across a region</td>
<td>Exact transmission rate in all parts of a region – there may be areas of higher and lower transmission within the region</td>
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<tr>
<td>Projected hospitalizations for regions in MO with sufficient data, i.e. Kansas City Area, Central, St. Louis Area, Southeast and Southwest</td>
<td>Projected hospitalizations in regions where daily COVID-19 hospitalizations are fewer than 15 because insufficient cases</td>
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</tbody>
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The ability to forecast depends on the quality and availability of data. For a new disease such as COVID-19, much remains uncertain.
Overview
Population: 1,395,314
Cumulative cases: 4,174
Cumulative deaths: 85
7-day new cases: 474
Week-over-week % case increase: 13%

Reproductive rate
Pre-intervention: $2.80 \pm 0.15$
Today: $1.16 \pm 0.09$
Change from last week: $\uparrow 0.09$

Source: State of MO, MHA, WUSTL analysis; USA Facts; US Census Bureau
Greater St. Louis area (Region C)

Overview
Population: 2,229,518
Cumulative cases: 9,538
Cumulative deaths: 807
7-day new cases: 478
Week-over-week % case increase: 5%

Reproductive rate
Pre-intervention: $3.39 \pm 0.14$
Today: $1.12 \pm 0.11$
Change from last week: ↑0.07

Projected COVID-19 hospitalizations

Source: State of MO, MHA, WUSTL analysis; USA Facts; US Census Bureau
Southwest / Springfield (Regions D,G, I)

Overview
Population: 1,221,847
Cumulative cases: 1,552
Cumulative deaths: 14
7-day new cases: 723
Week-over-week % case increase: 87%

Reproductive rate
Pre-intervention: 2.36 ± 0.16
Today: 1.15 ± 0.05
Change from last week: ↑ 0.01

Projected COVID-19 hospitalizations

Note: Due to low levels of hospitalized COVID-19 cases, modelling projections are highly sensitive to slight shifts in observed data and must be interpreted with extra caution.

Source: State of MO, MHA, WUSTL analysis; USA Facts; US Census Bureau
**Southeast / Cape Girardeau (Region E)**

**Overview**
- Population: 363,478
- Cumulative cases: 920
- Cumulative deaths: 33
- 7-day new cases: 105
- Week-over-week % case increase: 13%

**Reproductive rate**
- Pre-intervention: 2.61 ± 0.15
- Today: 1.35 ± 0.07
- Change from last week: ↓0.05

**Projected COVID-19 hospitalizations**

Note: Due to low levels of hospitalized COVID-19 cases, modelling projections are highly sensitive to slight shifts in observed data and must be interpreted with extra caution.

Source: State of MO, MHA, WUSTL analysis; USA Facts; US Census Bureau
Central (Region F)

Overview
Population: 736,847
Cumulative cases: 665
Cumulative deaths: 7
7-day new cases: 96
Week-over-week % case increase: 17%

Reproductive rate
Pre-intervention: 2.30 ± 0.08
Today: 1.11 ± 0.13
Change from last week: ↑0.02

Projected COVID-19 hospitalizations

Note: Due to low levels of hospitalized COVID-19 cases, modelling projections are highly sensitive to slight shifts in observed data and must be interpreted with extra caution.
Source: State of MO, MHA, WUSTL analysis
DISEASE MODEL

See FAQs for additional details

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)**

```
Susceptible  →  Exposed  →  Infectious  →  Removed
           |             |     Hospitalized
           |     Floor  |     ICU  |     Vent
```
Projections are made for each Emergency Response region with sufficient data

- **Low levels of daily COVID-19 hospitalizations in the Northeast and Northwest regions** limit the ability to generate projections for these regions
  - Northeast: Average of 4 daily confirmed or suspected COVID hospitalizations from 3/26 to 6/1
  - Northwest: Average of 17 daily confirmed or suspected COVID hospitalizations from 3/26 to 6/1

- **Projections are available for all other regions**