State of Missouri COVID-19 analytics update

May 5th, 2020

Developed by the State of Missouri, Washington University in St. Louis, and the Missouri Hospital Association
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
Multiple data points inform Missouri’s COVID-19 response

- **Syndromic surveillance**
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Syndromic surveillance: Total emergency department visits

Daily Total ED visits in Missouri ESSENCE, February 1, 2020 – April 28, 2020

Source: Missouri Department of Health and Senior Services

AS OF 4/28/2020
Syndromic surveillance: ILI as a percentage of Total emergency department visits

Missouri Percentage of Emergency Department (ED) Visits for Influenza-like Illness (ILI in ESSENCE Participating Hospitals 02/01/2020 – 04/28/2020)

Note: Symptom-based query using key words: “fever”, “cough”, or “sore throat”

Source: Missouri Department of Health and Senior Services
Syndromic surveillance: COVID-like illness as a percentage of Total emergency department visits

Missouri Percentage of Emergency Department (ED) Visits for COVID-like Illness in (ESSENCE Participating Hospitals 02/01/2020 – 04/28/2020)

COVID-like illness (% of ED visits)

Note: Symptom-based query using key words: “fever” and “cough” or “shortness of breath” or “difficulty breathing”

Source: Missouri Department of Health and Senior Services
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Healthcare system data is analyzed by region

- Based on Missouri’s Highway Patrol Troop and Healthcare Coalition boundaries, historically used for healthcare preparedness and response planning.
- Regions D, G, and I are combined into one Southwest region to reflect patient referral and EMS patterns, and their engagement with the Southwest Healthcare Coalition.
- While Perry County and Ste. Genevieve County reside in Highway Patrol Troop C, their data is reported through the Southeast Region due to their engagement with the Southeast Healthcare Coalition.
COVID-19 positive and PUI hospitalized cases by region

Note: # of hospitals reporting varies from day-to-day and may alter data on COVID-19 hospitalizations. Greater Kansas City Area does not include the health care facilities on the Kansas side of the Kansas City metro (e.g. Saint Luke’s, University of Kansas).

Source: Missouri Hospital Association, National Healthcare Safety Network, WUSTL analysis
Medical and surgical bed availability by region

Avg. daily beds available / week

Week 1 (3/16-3/22)
- Greater Kansas City area (Region A): 941
- Northeast (Region B): 930
- St. Louis (Region C): 413
- Southeast (Region E): 164
- Southwest (Regions D, G, I): 164
- Central (Region F): 145
- Northwest (Region H): 145

Week 2 (3/23-3/29)
- Greater Kansas City area (Region A): 1,940
- Northeast (Region B): 216
- St. Louis (Region C): 1,495
- Southeast (Region E): 1,495
- Southwest (Regions D, G, I): 1,495
- Central (Region F): 1,495
- Northwest (Region H): 1,495

Week 3 (3/30-4/5)
- Greater Kansas City area (Region A): 3,055
- Northeast (Region B): 379
- St. Louis (Region C): 1,599
- Southeast (Region E): 1,599
- Southwest (Regions D, G, I): 1,599
- Central (Region F): 1,599
- Northwest (Region H): 1,599

Week 4 (4/6-4/12)
- Greater Kansas City area (Region A): 3,366
- Northeast (Region B): 493
- St. Louis (Region C): 1,686
- Southeast (Region E): 1,686
- Southwest (Regions D, G, I): 1,686
- Central (Region F): 1,686
- Northwest (Region H): 1,686

Week 5 (4/13-4/19)
- Greater Kansas City area (Region A): 3,431
- Northeast (Region B): 445
- St. Louis (Region C): 1,267
- Southeast (Region E): 1,267
- Southwest (Regions D, G, I): 1,267
- Central (Region F): 1,267
- Northwest (Region H): 1,267

Week 6 (4/20-4/26)
- Greater Kansas City area (Region A): 2,581
- Northeast (Region B): 289
- St. Louis (Region C): 845
- Southeast (Region E): 845
- Southwest (Regions D, G, I): 845
- Central (Region F): 845
- Northwest (Region H): 845

Week 7 (4/27-5/3)
- Greater Kansas City area (Region A): 2,285
- Northeast (Region B): 280
- St. Louis (Region C): 359
- Southeast (Region E): 359
- Southwest (Regions D, G, I): 359
- Central (Region F): 359
- Northwest (Region H): 359

Note: # of hospitals reporting varies from day-to-day and may alter data on bed availability. Greater Kansas City Area does not include health care facilities on the Kansas side of the Kansas City metro.

Source: Missouri Hospital Association
ICU bed availability by region

Avg. daily ICU beds available / week

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<tbody>
<tr>
<td>Greater Kansas City area (Region A)</td>
<td>St. Louis (Region C)</td>
<td>Southwest (Regions D, G, I)</td>
<td>Southeast (Region E)</td>
<td>Northwest (Region H)</td>
<td>Northeast (Region B)</td>
<td>Central (Region F)</td>
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</tbody>
</table>

Note: # of hospitals reporting varies from day-to-day and may alter data on bed availability. Greater Kansas City Area does not include health care facilities on the Kansas side of the Kansas City metro. Data includes all types of ICU beds (adult, pediatric, NICU, negative airflow)

Source: Missouri Hospital Association
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- **Testing**
  - COVID-19 cases and deaths
  - Economic and social impact
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COVID-19 testing: Overview

Source: Missouri Department of Health and Senior Services
COVID-19 testing: Positivity rate

Average 7-day testing results (% negative, % positive, % indeterminate)

Source: Missouri Department of Health and Senior Services
COVID-19 testing: Volume and positivity rate by county

Tests conducted / 100k population: 1,469

Positive tests (% of total): 9%

Highest # of tests conducted / 100k population in Saline (7,657), Mississippi (3,404), and Buchanan (3,177)

Highest % positivity in Lewis (30%), Pemiscot (23%), and Moniteau (20%)

Note: County of provider or county of lab is used for tests where the county of patient is not available, as per CDC recommendations.

Source: Missouri Department of Health and Senior Services
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- **COVID-19 cases and deaths**
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COVID-19 cases: Overview

Source: USA Facts database
COVID-19 cases: Missouri compared to other states (cases / 100k population)

Note: X-axis denotes days since 20th confirmed case in each State, so each State line may vary in length
Source: USA Facts database

AS OF 5/2/2020
COVID-19 cases: Cumulative by county

Total cases: 8,353

- 98 counties have more than 1 case of COVID-19
- Total cases concentrated in St. Louis and Kansas City area
- Highest case count / 100k in Saline county (869), followed by St. Louis City (410) and County (334)

Cases / 100k population: 141

Source: USA Facts, State of Missouri analysis
COVID-19 cases: New case growth

7-day % increase in case count: 19%

New cases over current 7-day period compared to prior 7-day period: 3%

Fastest case growth in Andrew (+400%), Buchanan (+302%), and Benton (+100%)

Case growth is accelerating in Buchanan (+661%), Benton (+300%), and Pike (+300%). Case growth is decelerating in Newton (-100%), Warren (-100%), and Camden (-100%).

Source: USA Facts, State of Missouri analysis
COVID-19 deaths: Overview

Source: USA Facts database
COVID-19 deaths: Missouri compared to other states (deaths / 100k population)

Note: X-axis denotes days since 10th confirmed COVID-19 death in each State, so each State line may vary in length
Source: USA Facts database
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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>
</tr>
<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>
</tr>
</tbody>
</table>

The ability to forecast depends on the quality and availability of data. For a new disease such as COVID-19, much remains uncertain.
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)
Projections were 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 daily hospitalizations of 5
  - Northwest: Average daily hospitalizations of 13

- Projections were made for all other regions
Greater Kansas City area (Region A)

Overview
Population: 1,395,314
# of COVID-19 cases: 1,500
# of COVID-19 deaths: 39
ICU Bed Availability*: 59
Medical / Surgical Bed Availability*: 280

Reproductive rate
Pre-intervention: 2.7
Today: 0.68

(* Daily average during week of 4/27 – 5/3
Source: State of MO, MHA, WUSTL analysis
Greater St. Louis area (Region C)

Overview
Population: 2,229,518
# of COVID-19 cases: 5,678
# of COVID-19 deaths: 287
ICU Bed Availability*: 129
Medical / Surgical Bed Availability*: 845

Reproductive rate
Pre-intervention: 3.4
Today: 0.99

(*) Daily average during week of 4/27 – 5/3
Source: State of MO, MHA, WUSTL analysis
Southwest / Springfield (Regions D,G, I)

Overview
Population: 1,221,847
# of COVID-19 cases: 267
# of COVID-19 deaths: 12
ICU Bed Availability*: 82
Medical / Surgical Bed Availability**: 359

Reproductive rate
Pre-intervention: 2.2
Today: 0.55

(*) Daily average during week of 4/27 – 5/3
Source: State of MO, MHA, WUSTL analysis
Southeast / Cape Girardeau (Region E)

Overview
Population: 363,478
# of COVID-19 cases: 298
# of COVID-19 deaths: 7
ICU Bed Availability*: 40
Medical / Surgical Bed Availability*: 176

Reproductive rate
Pre-intervention: 2.4
Today: 0.61

Projected COVID-19 hospitalizations

(*) Daily average during week of 4/27 – 5/3
Source: State of MO, MHA, WUSTL analysis
Central (Region F)

Overview
Population: 736,847
# of COVID-19 cases: 560
# of COVID-19 deaths: 5
ICU Bed Availability*: 85
Medical / Surgical Bed Availability*: 397

Reproductive rate
Pre-intervention: 2.2
Today: 0.55

(*) Daily average during week of 4/27 – 5/3
Source: State of MO, MHA, WUSTL analysis