As Missourians seek to understand the spread of COVID-19 and how it may be controlled, this document can be used by policymakers, key stakeholders, and interested citizens as a resource and tool. The amount of data and information circulating about the number of cases and spread of COVID-19 can make it difficult to assess the current status and plan policy responses. We have developed this document as a resource to explain key terms and concepts frequently used to describe the rapidly evolving situation.

Understanding How Quickly the Virus is Spreading

A fundamental equation from epidemiology explains the transmission of all infectious diseases and calculates the rate of new infections in a given area, the R₀ (often pronounced “R naught”). The R₀ is the result of a combination of factors that contribute to how quickly the virus is able to spread through communities. The R₀ can be calculated by multiplying the raw infectiousness of the disease (F₁) by the amount of interaction among people within a community (F₂) and by the length of time that a typical person is contagious (F₃) (Figure 1).

**Figure 1. Calculating the R₀ of Disease Spread**

![Diagram showing the R₀ formula]

F₁: raw infectiousness of this disease from an infected person to someone else they contact  
F₂: number of daily contacts people in a community typically have with each other or surfaces touched  
F₃: number of days each infected person is contagious and in contact with others

The first term (F₁) is the infectiousness of the virus itself. This number is specific to COVID-19, based upon how it travels (through the air, from others’ coughs), and by its ability to survive outside a human body for several hours. The scientific community generally agrees on the infectiousness of the disease and has determined that it spread more readily than the seasonal flu. Stay-at-home policies and social distancing practices do not have an impact on this number.

The second term (F₂) is the measure of the number of daily contacts people have with each other. This number is specific to communities and cultures and our habitual behaviors. In general, the less contact individuals have with others the lesser the spread of the virus will be in their community. It is the most modifiable by policies and has been the primary area of focus as policymakers look for ways to control the spread of the virus. Some of the policies that have been used in states across the US to reduce this number include:

- mandatory stay-at-home orders
- requiring businesses to implement social distancing measures including capacity limits
- requiring businesses to clean all surfaces with increased frequency
- requiring or recommending that everyone in enclosed public spaces wear a facial covering

The third term (F₃) is the number of days that each infected person is contagious and in contact with others. This number is in part dictated by the viral properties of COVID-19, which has a median infectious period of about 7 days. For those who develop symptoms, scientists estimate that 2 days elapse during which a person may be infectious without symptoms. Some people may be infectious without ever developing significant symptoms. However, policies may be able to significantly reduce the time period in which infected persons are in contact with others by:

- daily monitoring of symptoms for personnel in public-facing and high-risk settings
- frequent testing of personnel in public-facing and high-risk settings
- contact tracing of people who have tested positive
- requiring quarantine of all individuals identified as COVID-positive for 10-14 days
Federal guidance on resuming state functions and gradually normalizing suggests that it is necessary for us to choose a combination of policies and individual actions that keep the rate of new infections (R₀) below 1. An R₀ of 1 or lower would indicate that our overall infection rate is holding steady or going down, while an R₀ over 1 would indicate that the overall rate of infections is rising and the spread of the virus is not under control (Figure 2). The only mechanisms currently available to government leaders and public health officials to control the spread of COVID-19 are policies that impact our interactions with others, and these policies are essential in keeping R₀ at 1 or lower and controlling the spread of the COVID-19 virus.

Even after Governor Mike Parson’s stay-at-home order was implemented in Missouri, the absolute number of cases has continued to grow, as it is simply a cumulative total of cases in the state. Analysts instead look at the rate of change in COVID-19 cases. Comparing today’s cases to a prior date can be misleading, as this percentage also inevitably increases over time. A better measure of the virus’ current spread, which is a good short-run approximation of R₀, is to compare the most recent 7-day case growth to the case growth over the previous 7 days. By this method, the statewide R₀ has been approximately 1.05 over each of the last two weeks (Figure 2). If this rate continues, the weekly number of new infections will continue to grow. Any lessening of social distancing measures in Missouri (including the policies and behaviors detailed in F2 and F3 above) will likely cause R₀ to increase due to the increased number of interactions that people will have, therefore increasing the opportunity for the virus to spread.

The county-level statistics on the spread of COVID-19 vary across the state. In areas that are currently at a lower local R₀, and which have been able to control the spread within their communities, it is still expected that they would see an increase in spread and R₀ as the communities open businesses and public places. However, if the reopening of these communities is slow and strategic, and they are able to scale back if needed, there remains the opportunity to keep R₀ under 1 and the spread of the virus controlled.

Missouri Currently and Going Forward

Beginning March 23rd, many cities and counties throughout the state enacted stay-at-home orders; the governor declared a statewide order effective April 6th. In the past several weeks, significant numbers of other measures listed in the above bullets have been put into place. Efforts are ongoing to ensure that testing capability is commensurate with this demand. The strategy going forward is to gradually – and with constant monitoring of the data – attempt to shift the focus from the most restrictive policy to a combination of less restrictive policies.

Stay-at-home orders in combination with many other actions have resulted in a lowering of the statewide R₀, the rate of new infections, from about 2.5-3.5 new infections for each initial infection (the raw rate, without any intervention) to about 0.9 for the week ending on April 26th, but R₀ is now hovering at about 1.05 for the last two weeks. This explains Missouri’s relative success in managing the disease so far. But Missouri’s continued containment of the spread relies upon using a combination of other policies to keep the rate at or below 1. The State will rely upon several policies, as previously mentioned, but their efficacy will depend in large part on adherence by businesses and individual members of the public. As the State begins to allow businesses that were closed to reopen, and as people resume moving around and interacting more with others, it will be imperative that decision makers continue to monitor the spread of the COVID-19 virus and adjust policies accordingly when needed.