

## How does an epidemic end?

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Please note that this is a second part in a series of posts made to help explain the current COVID-19 outbreak and the epidemiology behind the outbreak in Darke County, Ohio. As such it is recommended to view the first part of this series, entitled “Really, how bad is COVID-19?” as it will supply context to some of the things talked about in this post.

Now that we know the severity of COVID-19 and how contagious it is, we must now ask what the future of this virus in Darke County may look like. Specifically, how does the COVID-19 outbreak in Darke County end? Right now, there are currently three ways in which the COVID-19 outbreak in Darke County could end. The first is through stopping the community spread of COVID-19 in Darke County and preventing the import of COVID-19 into the county. The second way COVID-19 could end in Darke County is by achieving something called herd immunity. The final way that COVID-19 could end in Darke County is through vaccinations against COVID-19.

As mentioned, the first way to stop the current outbreak is to stop the transmission of the virus in our community. How can we do this? Well, we are already working to slow down and stop the spread of COVID-19. This is through the policies such as social distancing, wearing masks, and quarantining of those who are suspected or confirmed to have COVID-19. I must preface that what we know right now is still preliminary, and that as more information becomes available some conclusions may change. But right now, research available provides evidence that shows social distancing and wearing masks is an effective way of lowering the transmission of COVID-19 (1,2). Thus, unless more research-based evidence becomes available that goes against

social distancing and mask wearing, it is highly recommended by the Ohio Department of Health (ODH), Centers for Disease Control (CDC), and World Health Organization (WHO) to social distance and/or wear face masks to slow down the transmission of COVID-19 (3,4,5). Through these policies, it is possible to reduce the  $R_0$  of COVID-19 and bring a stop to the current outbreak in Darke County. Unfortunately, though, this would only provide a temporary relief from COVID-19 as it is highly likely that individuals from outside the county would bring COVID-19 with them and reignite the outbreak in Darke County.

Knowing this, let's look at the second way of ending the COVID-19 outbreak with herd immunity. First, though, let's define what herd immunity is. Herd immunity is the process in which enough of the community is immune to a disease so that it is statistically improbable that someone who is not immune would come in contact with someone infected with COVID-19 (6). Herd immunity can be generally be found through the equation:  $1 - (1/R_0)$ . Thus, we can use the two previously established  $R_0$  from "Really, how bad is COVID-19?" of 2.5 and 5.7. If the  $R_0$  of COVID-19 is 2.5, this would mean that 60% of the population of Darke County would have to become immune in order to achieve herd immunity. If the  $R_0$  of COVID-19 is 5.7, this would mean that 82.46% of the population of Darke County would have to become immune in order to achieve herd immunity. It was found that in 2018 Darke County had a population of 51,734 (7). So, we know that from our population of 51,734, that 60% or 82.46% of that population must become immune to achieve herd immunity. Thus, 31,041 (60%) or 42,660 (82.46%) of our population has to become immune. Now, it is believed that 35% of all individuals who get COVID-19 will be asymptomatic. Thus, of the 31,041 that is needed to reach 60% immunity 10,865 would be asymptomatic and of the 42,660 needed to reach 82.46% immunity 14,931 would be asymptomatic. Thus 20,176 of the 60% immunity and 27,729 of the 82.46% immunity

would have mild to severe COVID-19 symptoms. We should define, though, the difference between asymptomatic and pre-symptomatic. Asymptomatic individuals will never have symptoms, thus there would be absolutely no way for that individual to know they have COVID-19 outside of laboratory testing. Pre-symptomatic individuals may at first seem to be asymptomatic and may only be identified through laboratory testing. Yet, pre-symptomatic individuals will eventually develop mild to severe COVID-19 symptoms (8). Finally, some individuals may only have very mild symptoms of COVID-19, such as diarrhea, muscle aches, and fatigue (9). While it is known that pre-symptomatic and mildly symptomatic individuals can and do spread COVID-19, there is some debate as to whether asymptomatic individuals can spread COVID-19. Data is currently inconclusive, with research showing both a high risk of spread by asymptomatic individuals as well as low to no risk of asymptomatic spread (10,11,12). Thus, while more research needs to be performed to determine a definite answer to asymptomatic spread, it is the stance of both the Ohio Department of Health and CDC that asymptomatic individuals are to be considered contagious. It is also unknown how long antibodies within those who recovered from COVID-19 may last, though preliminary studies do suggest that those who recover may have antibodies for only 2-3 months after infection (13). Thus, even if we do achieve herd immunity through COVID-19 infection, the effects of herd immunity may only last a few months.

Finally, it is possible that we could reach herd immunity and stop the transmission of COVID-19 without becoming sick with COVID-19. This can be done through vaccinations. Vaccines using dead or weakened target virus or non-infectious parts of the target virus to help the body make antibodies that provide immunity towards the target virus (14). Yet, while there are many vaccines in development at this time, there is currently no FDA approved vaccine

available for the COVID-19 virus. It is also not known how soon a vaccine may be made, as any potential COVID-19 vaccine has to be put through rigorous testing to ensure it is safe and would not cause potential short-term or long-term harm to those vaccinated. Furthermore, 60% to 82.46% of the population would have to be vaccinated in order to create herd immunity and stop the transmission of COVID-19. This will be difficult at the beginning, though, as getting the manpower and supplies to have 60% to 82.46% of the population of Darke County will unfortunately take time. Thus, we cannot currently rely only on the COVID-19 vaccine, as getting a vaccine through health and safety testing and getting supplies to provide enough testing to produce herd immunity in Darke County is most likely not going to be possible in the very near future. Thus, we must take steps to slow down the transmission of COVID-19 in Darke County to buy time and prevent injuries and deaths from COVID-19 as much as possible. We can do this through social distancing, wearing masks, and avoiding any unnecessary social gatherings as much as possible.

#### Sources

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