

Science AMA Series: I'm Gerardo Chowell. I study the transmission dynamics of infectious diseases. Lately, I've been focused on Middle East respiratory syndrome (MERS). AMA.

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### Abstract

Hi, Reddit, I am Gerardo Chowell, PhD, a professor of mathematical epidemiology at the School of Public Health at Georgia State University. I am currently researching the transmission dynamics of Middle East respiratory syndrome, also known as MERS, and the factors that can make an infectious disease outbreak more likely to spread. As many of you know, South Korea recently suffered an outbreak of MERS that was the largest to occur outside Saudi Arabia. The disease spread through hospitals and killed 36 people, infected more than 180 and led to the government imposing quarantines on nearly 17,000 people to get the outbreak under control. I conducted similar research during the Ebola outbreak in West Africa. \*Thank you so much for your questions. I enjoyed chatting with everybody! \*

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GERARDO\_CHOWELL [R/SCIENCE](#)

## ABSTRACT

Hi, Reddit,

I am [Gerardo Chowell, PhD](#), a professor of mathematical epidemiology at the [School of Public Health](#) at Georgia State University. I am currently researching the [transmission dynamics of Middle East respiratory syndrome](#), also known as MERS, and the factors that can make an infectious disease outbreak more likely to spread. As many of you know, South Korea recently suffered an outbreak of MERS that was the largest to occur outside Saudi Arabia. The disease spread through hospitals and killed 36 people, infected more than 180 and led to the government imposing quarantines on nearly 17,000 people to get the outbreak under control. I conducted similar [research during the Ebola outbreak](#) in West Africa.

*\*Thank you so much for your questions. I enjoyed chatting with everybody! \**

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**How did the mathematical models perform in South Korea recently, given the strange health seeking behaviour of the Koreans?**

**Edit a word.**

[straydog1980](#)

Mathematical models have been useful to quickly assess the transmission potential and the fatality rate of the South Korean outbreak in real-time. However, this outbreak was really fueled by 3 early super-spreading patients that infected the great majority of the total number of cases. Specifically, the first (index) patient infected 30 secondary cases and two patient cases of the second generation infected 80 and 23 secondary cases each. Delays in the detection of these early cases exacerbated the transmission rate. For instance, the index patient of the MERS outbreak in South Korea was diagnosed 9 days after symptoms onset and after visiting 4 different healthcare facilities.

**I recently graduated with an MPH in Epidemiology and I don't have much in the way of job experience. What sorts of jobs/fellowships should I be applying to pursue a career in Epidemiology?**

[Tangus5000](#)

Of course, it really depends on your specific interests, but i would check out the EIS program at the CDC if you are interested in gaining experience on epidemic outbreaks:

<http://www.cdc.gov/eis/about.html>

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**Do you believe in the near future that we will have a world wide outbreak of a disease with a high mortality rate? If so what would be some more likely diseases that could potentially cause a global pandemic?**

[Lifeweaver](#)

Yes! We have had such epidemics in the past. For instance, the Spanish flu killed anywhere between 20 and 100 million people in the world. It would not be surprising to experience a major pandemic in the next decade. There are just too many new infectious pathogens out there awaiting their chance to take off. Influenza is the most likely disease to surprise us probably arising from an avian reservoir.

**Hello Dr. Chowell. First of all, thank you for taking the time to do this AMA. My family mostly resides in South Korea so I would like to ask a couple questions that they have asked me and was not able to answer.**

- 1. How was South Korea prone to such a disease spreading even though the country is relatively sanitary in comparison to other neighboring countries - was this just a bad case of a coincidence?**
- 2. Many movies depict a worst case scenario in which a disease mutates out of control. Is this factor ever considered in your mathematical models or is it too farfetched of an idea in general?**

**Thank you!**

[Grapes](#)

MERS is a relatively new disease, with the first case identified in 2012, and most cases have been confined to the Middle East and a few case importations to other countries. These case importations can be easily misdiagnosed by health professionals because in its early states, symptoms of MERS can be confused with several other respiratory diseases. Without detailed information about travel history of suspected patients presenting with respiratory symptoms, the health care workers would be unlikely to test for MERS. In the context of the South Korean outbreak, the index case did not initially reveal his travel history, which further complicated his timely diagnosis with MERS.

Mathematical models of disease transmission have been used to gain understanding of unfolding and past epidemics, but it is really difficult to predict when an infectious agent will mutate. We are still very busy trying to improve our models to describe and forecast epidemics. We have not tried to factor in mutations that could have dramatic consequences on epidemic outbreaks as it is very difficult to predict when these will occur.

**What caused these outbreaks of MERS and Ebola to be so much larger than past outbreaks in the same/similar areas? Is it possible to anticipate the size of an outbreak or is it up to chance?**

**Thank you for being here today!**

[bitchesaintshirt](#)

A number of factors affect the final size of outbreaks including the specific epidemiology of the disease, the delays in the detection of the initial cases, population density, and the level of the public health infrastructure. In the particular case of the Ebola epidemic in West Africa, an increasing and highly mobile population together with the lack of epidemiological surveillance contributed to the scope of the epidemic. Prior Ebola outbreaks had occurred in relatively isolated areas. All of these should be considered when developing models of disease transmission and control.

**These might sound like very basic questions, but what symptoms make MERS unique when compared to other viruses? How can one protect themselves if they were to visit South Korea or the Middle East? Lastly, how do you think the Hajj, the Muslim yearly pilgrimage, will affect the spread of the disease? Thank you very much.**

[redditsaywhat](#)

It the early stages, symptoms may include fever, cough, and shortness of breath (see more here: <http://www.cdc.gov/coronavirus/mers/about/symptoms.html>). However, that is similar to many other ailments. As a result, it is difficult to diagnose MERS without laboratory testing. I would advise to see your physician in the presence of any respiratory symptoms specially if you have traveled to a MERS endemic country or have visited healthcare facilities or been in close proximity to camels or camel-derived products.

Large mass gatherings could facilitate the transmission of MERS and other diseases. In particular, the Hajj pilgrimage brings together large groups of people originating from a number of countries. Hence, this increases the potential for MERS importations to multiple countries when pilgrims return home. At the time of writing there is an ongoing MERS outbreak in Riyadh with cases linked to healthcare facilities (more info here: <http://www.cidrap.umn.edu/news-perspective/2015/08/more-hospital-links-merge-riyadh-mers-surge>)

**Hello Dr. Chowell thank you for doing this AMA. I'm currently studying medicine and I find epidemiology & public health really interesting. Do you have advice for those seeking to join this field? What do you think health professionals should be doing to become more effective at infectious control?**

[Balmoria](#)

Perhaps you want to consider gaining more formal training through an MPH or PhD in Epidemiology.

**Greetings Dr. Chowell!**

**Thank you for doing this ama. How well do travel bans inhibit the spread of infectious disease?**

[chargedcapacitor](#)

The effect of travel bans on reducing the risk of outbreaks depend on the epidemiology of the disease in question. The problem is that some travelers may be infected but not yet showing signs of the illness at the time that they pass through border control. Research using mathematical modeling has shown that travel bans do little to prevent the introduction of infectious diseases. For instance, for the case of influenza, travel bans may delay a bit the start of epidemics but are unlikely to prevent local transmission.

**Have you had any interest in transmission modeling of ILI in congregate populations? Maybe we can talk offline via e-mail on a project we are working on in a US military population.**

[1nVu](#)

That sounds interesting. You can reach me at [gchowell@gsu.edu](mailto:gchowell@gsu.edu)

**Thank you for taking the time to do this AMA, I imagine things are quite hectic with the state of the world in terms of infections diseases. I only had two questions. 1.) How infectious is MERS compare to other viruses such as influenza virus from an epidemiological perspective, and how likely are we to see more MERS infections in the future? 2.) I recently graduated with a BS in Microbiology and am exploring the possibility of getting an MPH degree. Any advice for students who are in my position or wanting to focus on studying infectious diseases?**

### **SarcasticProvocateur**

MERS is definitely less transmissible than the flu due to their different transmission modes. In particular, influenza can be transmitted by close contact and small particles that spread through a room when a person coughs or sneezes (aerosols). In contrast, MERS is transmitted through close contact with infectious individuals. This explains why large-scale community outbreaks have not taken place.

MERS is endemic in the Middle East where frequent introductions into the human population from a natural reservoir (likely dromedary camels) continue to occur. At the time of writing, an outbreak is ongoing in Riyadh, Saudi Arabia (more info here: <http://www.cidrap.umn.edu/news-perspective/2015/08/more-hospital-links-emerge-riyadh-mers-surge>).

As for your question about career advice, I would suggest that you seek formal training in infectious diseases and epidemiology through an MPH in Epidemiology or a related field. If you are interested, here is some information about our program at Georgia State U: <http://publichealth.gsu.edu/academic/divisions/epidemiology-biostatistics/>

**During the Ebola scare in the United States last year, Dr. Frieden (Director of CDC) repeatedly said that any hospital in the US would be capable of properly handling an Ebola patient without fear of transmission. Obviously that was not the case and the initial safety measures were insufficient to protect several caregivers from contracting the disease. For diseases like Ebola and MERS, what is the most difficult aspect of preventing hospital-acquired infections? Does it simply boil down to human error?**

### **shiruken**

There is always a non-negligible risk of infection for healthcare workers treating patients with highly infectious diseases like Ebola. The precise implementation of strict infection control protocols entails many processes including, for example, the appropriate management of patients in the emergency room and the correct donning and removal of personal protective equipment are key to prevent transmission in healthcare settings.

**A couple of somewhat unrelated questions:**

**Is it possible for the Guinea/Liberia/Sierra Leone region to eradicate Ebola from their ecosystem, especially since there had been few, if any, cases reported in the region prior to last year's outbreak? Or is the area just doomed to have it be endemic within their reservoirs with sporadic new infections?**

**Can modelling identify any disease primarily in the animal environment with a high likelihood crossing into humans like MERS and Ebola? What kinds of interventions are prescribed for these situations?**

### **stymied03**

Actually, the natural reservoir of the Ebola virus is still unknown. Bats are the most likely source, but other species could be implicated in the virus dynamics in nature. This obviously hampers any interventions aimed at eradicating the virus from its natural source.

**What do your models suggest would be the most cost efficient ways of reducing the risk of outbreaks?**

### **StephenHolzman**

The specific interventions to mitigate the risk of epidemics will depend on the epidemiology of the disease and the local population characteristics. More generally, disease models show that strong public health infrastructure is key for timely detection of cases of a newly emerging disease, rapidly

isolate infectious individuals, maintain high infection control measures in health care settings, and quickly trace and monitor potential secondary cases during the early stage of a potential epidemic.

**Hello doctor Chowell, what literature do you suggest as a must read for someone who want to transform raw data into useful information about a disease spread and are not very familiar with the topic? I'm a biologist but i'm doind a computer science couser right now, i'm starting to work with Bovine Tuberculosis. I'm been reading about SIR model, some spatial statistics, mostly using R language to implement things. I'm not very bright on math, but i have no problem reading it too. So what's the basic literature would you recommend?**

[squiercg](#)

I would suggest to start with these useful resources:

<http://anintroductiontoinfectiousdiseasemodelling.com/>

<http://www.springer.com/us/book/9781461416852>

<http://modelinginfectiousdiseases.org/>

<http://www.springer.com/us/book/9789048123124>

**I'm a teacher in South Korea and several schools in my area were closed for a week during the MERS scare. Do you think closing schools actually did anything to stop the spread of the virus?**

[jamez548](#)

The closure of schools during the South Korean outbreak likely played a very minor role in the transmission of MERS because this outbreak stemmed from healthcare settings in its entirety. At the time of this outbreak, the data about the epidemiology of MERS coming from MERS endemic countries was not very clear, and this could have prompted public health authorities in South Korea to take extreme measures to mitigate the outbreak. The evidence that healthcare settings contribute in a major way to the transmission of MERS has been mounting in the last few months.

**What did you learn about the best ways to control an outbreak? Does your research help develop interventions?**

[lolalala1](#)

Yes, carefully calibrated mathematical models tailored for specific diseases and settings can be very helpful in designing effective control interventions. For instance, it is important to quantify how different routes of transmission contribute to the overall transmissibility of an infectious disease. In the context of MERS, healthcare settings have been found to play a major role in transmission whereas unsafe burials and weak healthcare infrastructure contributed significantly to the spread of Ebola in West Africa.

**Saludos, Gerardo.**

**Epidemiology, I believe, can be boiled down into data collection, model building and generation of recommendations. Do you feel there is any weak link or underdeveloped area along this pipeline?**

**As I am at an early phase in my career I would like knowing where to direct it in order to maximize the chances of getting something named after me. Teehee.**

**(Really I enjoy anything other than direct field work so I am having a hard time choosing what to do after my Masters)**

[joevector](#)

Sure, the field of mathematical epidemiology is still growing. There are a number of research questions in which you could have an impact on furthering our understanding of disease transmission and forecasting epidemics using quantitative tools. Developing better mathematical tools to improve our ability to generate short-term epidemic predictions would be a great addition to our toolkit. You may consider going after a PhD in Epidemiology or a related field.

**I'm an MPH in epi, fresh grad working for a state health dept. I don't know what my next steps will be. I wanted to gain exposure to public health practice but am also a big fan of academic research.**

- **Could you talk a little bit about your career path?**

**Also:**

- **What strikes you most about MERS or the transmission mechanism?**
- **Do you foresee the virus being a large issue in many other countries?**

- **And what's your favorite pathogen?**

**Thanks for doing this AMA!**

[lolwuut](#)

I became interested in the field of infectious disease dynamics after taking part in a summer research school of the Mathematical and Theoretical Biology Institute at Cornell. After this, I decided to pursue a PhD in Biomathematics in order to get formal training and carry out original research on the dynamics and control of infectious diseases. After getting my PhD, I carried out research at Los Alamos National Laboratory as a postdoctoral fellow. More info here: <http://biome.biomedcentral.com/bringing-ebola-under-control-how-modelling-transmission-can-help/>

Regarding the MERS mechanism, we have underscored the large contribution of hospital-based transmission using mathematical modeling. We found that "the relative contribution of hospital-based transmission is over four times higher than that of community transmission, indicating that disease control should be focused on hospitalized patients." (more info here: <http://www.ncbi.nlm.nih.gov/pubmed/25480133>)

My favorite pathogen is probably influenza. This is a pathogen that mutates rapidly and has generated 4 pandemics in the last century.