

PLOS Science Wednesday: Hi reddit, we're Erin, Jameison, and Chris. We published a study in PLOS NTDS that identifies numerous factors propelling the Zika virus outbreak in the Americas – Ask Us Anything!

PLOSScienceWednesday¹ and r/Science AMAs¹

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Abstract

Hi Reddit, My name is Erin Mordecai and I am an Assistant Professor of Biology at Stanford University. My research focuses on the complex ways in which global change (including climate, land use, species invasions, etc.) influences infectious disease. I am joined by coauthors Jamieson O'Marr and Chris LeBoa. Jameison is a junior undergraduate majoring in biology at Stanford University, whose research interests involve using ecological methods to study and predict the spread of infectious disease. Chris is an undergraduate human biology major at Stanford University concentrating in disease ecology. His research focuses on using preventative strategies to reduce infectious disease risk. We recently published a review paper titled “Environmental and Social Change Drive the Explosive Emergence of Zika Virus in the Americas” in PLOS Neglected Tropical Diseases. This study was unusual in that it was written as a class project in my Stanford undergraduate seminar course, Bio 2N: Global Change and the Ecology and Evolution of Infectious Disease. We set out to explore all the ways in which global change may have fueled the emergence and spread of Zika virus in the Americas in the last two years. We found evidence for many factors at play, including poor housing and infrastructure, suitable climate, abundant mosquitoes that are well adapted to live and breed near humans, lapsed mosquito control, and global travel. For example, we found that Zika cases shot up in a province in Ecuador following a massive earthquake that destroyed housing and infrastructure. We also found that deforestation and low GDP both correlated with the number of Zika-linked microcephaly cases in Brazil. Because of the high suitability for mosquito transmission throughout much of the Americas (including parts of the southern US), we need to be much more vigilant about vector control and rapid public health responses to new emerging diseases. We will be answering your questions at 1pm ET – Ask Us Anything! Don't forget to follow Erin on Twitter @morde.

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PLOSSCIENCEWEDNESDAY [R/SCIENCE](#)

Hi Reddit,

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Wednesday: Hi reddit, we're

Thanks for coming and doing this AMA! What an interesting approach to writing a review! Can you tell us more about the design of this project? What was the writing process like? How much of the course was devoted to producing this manuscript? Were there unexpected challenges?

[p1percub](#)

Erin here. It was a total experiment! Since the Zika epidemic was so new, there wasn't much scientific literature on it at the time. I thought that it might be possible for undergraduates to read most of what had been done on Zika relatively quickly. That made them relative experts in just a few weeks. We brainstormed together to come up with hypotheses for drivers and consequences of the epidemic, grouping them into three categories: environmental drivers, social drivers, and social consequences. The students then researched by reading papers on their own and wrote individual papers on topics of choice. They then wrote three group papers on the three major categories of hypotheses. Then our first

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author, Sofia, combined the group papers into a single collaborative paper. Over the course of the summer after the course, she whittled the big class paper down into a publishable review, which we submitted to PLoS NTD.

Looking at your paper, it seems that structural inequalities lead to differences in health outcomes (what anthropologists often call structural violence) but importantly for epidemiology this vulnerability can spark a large scale outbreak that extends beyond those marginalized groups. Does this suggest that to reduce risk of outbreak we need to address structural issues related to poverty?

[firedrops](#)

Jamieson

There is most definitely a correlation between socioeconomic status and vulnerability to disease. Those who live in poverty are often surrounded by more risk factors for diseases, such as crowded living conditions, poor sanitation, and the lack of a reliable sewage system. For mosquito borne diseases such as zika, these conditions are often optimal for their growth and reproduction. This does suggest that one way to combat vector borne disease would be to combat the structural issues related to poverty, therefore eliminating the conditions that are allowing the mosquitoes to breed and spread disease.

It is really cool that you gave your undergraduates authorship on the paper. Not all professors would have done that.

Do you plan to do a similar class project turned publication in the future? What benefits are there to getting a class to work on a project like this? What drawbacks are there? And is it something you'd recommend other professors try out in their own courses?

[Upvotes4theAncestors](#)

Erin: It was a great experiment for me. The students in my class were incredibly smart and insightful when it came to formulating hypotheses. They were able to quickly learn to read scientific articles and get the main points. It was a great experience co-authoring a paper with them, in part because they were good writers and generated lots of interesting discussion and ideas that I didn't have on my own. I am definitely planning to do student projects with the goal of publications again in the future. This year's class will explore temperature-dependence of vector-borne disease by collecting data from the scientific literature, as a way of understanding what may happen to disease under climate change. I would recommend trying this approach with a group of high-level, very motivated students (this was a class that students had to apply and write a short essay to get into, and was not a required class). Break your project down into small, manageable tasks with weekly milestones to help them succeed. Another helpful approach was to have the class read papers at home and do a short online quiz that asked them to summarize main points, then during class I knew which concepts people were grasping and which we needed to go over together. Finally, normalizing the activity by letting the students know that this exercise was challenging for everyone was important for making sure students felt confident to explore literature that they didn't understand 100% right off the bat.

Why is Chile the only country not touched by the virus in South America? At least that's the info i got when i went to the travel clinic a month ago.

[CapitaineMomo](#)

Erin: I believe there are some small local areas of transmission in Chile, but because of the country's climate it is not well suited for the mosquito that transmits Zika.

One section of your paper discusses the impact of "perceived risk of disease." It notes the influence of Zika's propensity for asymptomatic infections. I have noticed that at least in public forum discussions, a sizable population of people in the US appear to reject the idea that Zika poses a significant threat, choosing to believe that the proposed link between Zika and microcephaly is unfounded.

Do you think it would have been easier to convince the general public and policy-makers to respond to Zika if it caused symptoms in a greater percentage of people infected, even if the symptoms were typically mild? Is there anything we can learn from the management of other health risks that may seem insignificant to the individual in the short term but pose a public threat (e.g. nicotine products) that can help organizations like the WHO to develop better messaging strategies to bring disease perception into alignment with disease reality?

[neurobeegirl](#)

In terms of spreading public awareness regarding the spread of disease it is disappointing that people would find the links between Zika and microcephaly unfounded. The CDC and other scientific agencies are very careful and conservative when they make a claim of causation between a disease and effect like they did with zika. <https://www.cdc.gov/media/releases/2016/s0413-zika-microcephaly.html> However I think that this is not just a problem with this topic alone but of current public distrust of science as a whole whether it be about climate change, vaccines, or birth defects related to zika. The connection of zika as a teratogen is why much more of the United States knows what Zika is compared to Chickungunya or many other emerging infectious diseases. If there were more mild cases of the disease ie fever, joint pain, rash most people and doctors would probably be unable to distinguish the disease from chickungunya or dengue. From the zika outbreak we learned how necessary it is to have funding for emerging diseases as in the funding needed to quickly do the research and develop vaccines for zika was debated in congress and then never passed While zika as an emerging disease is not that deadly, we should be ready and have funding available to research possibly more deadly emerging diseases in the future.

Do you plan on studying how the attitudes among the impoverished towards previous dengue infections may have contributed to those not seeking care hence their propensity towards getting infection

[jemdadoo](#)

Chris: Great question jemdadoo. There is a great amount of overlap between dengue and zika, as they are transmitted by the same type of mosquito. Many of the people in the country have been exposed to dengue in the past and I have not seen any study asking residents about their perception of healthcare after zika infection.

This is more likely a problem of poverty and access to healthcare than the perception of healthcare. People of lower SES most often have poorer healthcare coverage and so if someone gets a low grade fever like what zika causes they would be less likely to go receive proper medical care for it.

Sort of a tangential question to the paper itself: do you think that the increased funding for Zika research is going to end up trickling into funding for microcephaly treatments such as preventative screening and gene therapy?

Also, as someone who also works on Zika, it's good to see the virus is actually getting some attention. It isn't likely to be a global threat, but it poses a lot of risks in the developing world and to military personnel abroad. The last thing the world needs are more tragic cases of microcephaly.

[iquiz1852](#)

Erin: I hope some of the funding ends up going to treatment of microcephaly and other birth anomalies associated with Zika. It is such a tragic outcome for a cohort of children born before we knew much about the effect of the virus in utero. It's not just a problem abroad! We've had local Zika transmission in the US in parts of Florida, Texas, and possibly Hawaii.

Hello! Thanks for doing this AMA. Is Zika the only mosquito virus whose spread is dependant on societal and infrastructure issues? Are there other such viruses that may also be transmitted more effectively after earthquakes, or could this research also be applied to less well-studied viruses besides Zika?

[rseasmith](#)

Erin: Great question! There are several other viruses transmitted by the same mosquito (*Aedes aegypti*) and I would expect those to respond in a similar way to Zika. These include dengue and chikungunya viruses, among others. Right now in Brazil there is a sylvatic (transmitted by forest mosquitoes) outbreak of yellow fever going on. If this ends up spilling into the urban *Aedes aegypti* mosquitoes we will have a huge problem on our hands.

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Erin: Great, thanks!

Have you identified any factors which are specific to Zika, or more prominent factors in Zika than in other arboviruses? Chikungunya, for instance, shares its two primary vector species with Zika. Would all of the factors you found apply to Chikungunya as well?

[rslake](#)

Jamieson:

The factors discussed in our paper were targeted towards zikas two primary vectors, *A aegypti* and *A albopictus*. As you mentioned these two mosquitoes are also the primary vector species for other viruses such as Chikungunya, so the factors described in our paper could very well apply to the spread of Chikungunya.

Given current projections for global climate change, can you make projections of when Zika could threaten higher latitudes (38-42) in the US?

[ThomasMarkov](#)

Erin: Right now we have high densities of *Aedes aegypti* and *Aedes albopictus* (the two main vectors of Zika) in much of the Southeast US, as well as parts of California and going up the East Coast. Climate change could make the mosquito season longer and potentially allow the mosquitoes to spread further north. Warmer winters could allow the mosquito eggs to survive at higher rates. However, our risk in the US is to some degree mitigated by the generally decent housing conditions (air conditioning, window screens) and vector control services we have. That being said, there were a lot of Zika cases in south Florida when that local epidemic started, so I wouldn't rule out local transmission in the US.