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Spillover: Animal Infections and the Next Human Pandemic

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David Quammen

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With evolution to provide the fuel and chance to provide the spark, infections can burst through barriers, ravaging habitats like wildfire. When we cannot control the variables, our own habitat could be the next microbial target. Reporting from the epicenters of microbial infection in his new book, *Spillover: Animal Infections and the Next Human Pandemic*, award-winning writer David Quammen examines one of nature's grim promises: disease will jump from animal to human.

Spillover includes adventure, action, and mystery. Mr. Quammen journeys across the globe to track down the origins of human epidemics and pandemics. He consistently demonstrates that Ebola, SARS, and HIV/AIDS, among others, are the results of microbes jumping from animals to humans, zoonotic spillovers of sorts. Mr. Quammen questions the causes of these spillover events, ultimately concluding that we humans may be the very ones providing the sparks, and then turning around and crying fire.

Mr. Quammen's journey is for everyone to take. Though a man of literature by training (Yale '70, Oxford '73), he displays qualities that make for an incisive scientist. Mr. Quammen is eagerly observant and relentlessly inquisitive. His language is accessible and inviting and builds a bridge between stuffy science and the public at large. Mr. Quammen makes the writing appropriate for anyone who may be curious about science. Your mother-in-law will learn something, as will your physician.

However, after reading *Spillover*, one cannot help but question Mr. Quammen's concerns. Even if we suffer the next zoonotic pandemic, how can we compare that to concerns like cancer and cardiovascular disease? While an exotic monkey virus, though intriguing, might kill 1,500 in a secluded village, the daily toll of cancer in the United States is the same. Moreover, a reader looking for the fast facts might find the storytelling to be laborious. It can be hard to appreciate every last detail Mr. Quammen has fit into this sizeable package of adventure and science. To highlight the medical aspect of his book and address these concerns, Mr. Quammen agreed to an interview with me. The following is a transcription of that conversation.

Abdul-Kareem Ahmed: What prompted you to tackle the subject of zoonotic diseases? Was it always a fancy, or did something trigger this 6-year adventure?

David Quammen: It's been 12 years since I started thinking about it. I had read a bit about Ebola and was fascinated by it, just for its gruesomeness and its drama, as a lot of people were.

I was sitting at a campfire in Central Africa in the middle of a forest with a couple of local guys. This was back in July of 2000. I was part of a cross-Congo trek, and these guys were part of the forest crew.

They started telling me the story about when Ebola had struck their village and was killing their friends and loved ones. The people didn't know at the time that it was a virus. One of these fellows mentioned to me that at the same time, nearby in the forest, he and his friend had seen a pile of 13 dead gorillas. He didn't put that into context, he just mentioned it. But I knew about his village from the medical literature. I knew that the (Ebola) outbreak had been brought there in the carcass of a chimpanzee that had been found dead in the forest. I knew that gorillas as well as chimps and humans are susceptible to Ebola.

So when he mentioned from firsthand experience he had witnessed 13 dead gorillas nearby in the forest, it connected these different parts for me. It connected humans with other apes and with this virus.

That was when I decided that I wanted to write a book about this. I generally have written about ecology and evolutionary biology. I have no training and little experience in writing about molecular biology or microbiology or cell biology. It was new terrain for me. The part that I felt comfortable with, and that I felt most interested in, was the ecology and evolutionary biology of infectious diseases, in particular, of emerging viruses.

AA: Throughout the book you give a firsthand account of these diseases. You actually go to these sites on the ground. Weren't you concerned for your safety?

DQ: The more I learned about this subject and about these diseases, the more my irrational fears turned into rational concerns. I was generally going in with very experienced scientists whom I trusted a great deal. These experts were from EcoHealth Alliance, the Wildlife Conservation Society, and from various universities.

I trusted them, and I knew that they weren't inclined to foolishly take unnecessary risks. So I did whatever they did. If they wore respirator masks and goggles and two layers of rubber gloves and rubber boots, then I wore the same. I stood four feet behind them. I stayed out of the way of needles and blood samples and hoped that they weren't going to hand me a large scratching and clawing fruit bat that might be carrying some lethal virus.

AA: As a writer, how did you feel being among a select few people who were actually looking at these diseases? Did you feel that you were in the way, or did you feel that you were facilitating their efforts?

DQ: I felt very privileged and thrilled to be there with these scientists doing this work. I knew that it was very important for me not to be hindering them because their work is very serious and demanding and also somewhat dangerous. I didn't feel like I could be of much help to them, although they sometimes humored me: "Here's a task for you, you swab the mouth of the bat ... and then screw the tops on the bottles." I was happy to be allowed to feel like I was participating.

AA: We have an idea of what you did to write *Spillover*, but then there's the question of why. You pose this question in the book. Isn't it misguided to summon concern over a few scientifically intriguing diseases, some of them new but of relatively small impact, while boring old diseases continue to punish humanity?

DQ: It is an important question. Someone who wrote a recent book review was gently taking me to task for having focused on these, you might even call them “boutique,” diseases that haven’t affected or killed very many people.

First of all, it’s very important to understand zoonotic diseases and the principles of zoonotic diseases, because in addition to these “boutique” outbreaks that only cause misery or death to a few dozen or a few hundred people, we have other zoonoses that kill in the millions. AIDS and influenzas are zoonotic diseases that result from spillover. These diseases can’t be well understood until the principles of zoonotic spillover are understood.

Secondly, a large part of my book is devoted to these big epidemics, such as HIV, which has killed 30 million people. If someone says, “Well, why pay attention to something like SARS that only killed 800 people,” one of the answers is: The principles we learn from it are very important. Additionally, it could have been the next AIDS. We’re looking for the next AIDS, and the next AIDS is going to begin as a small zoonotic spillover. So we should look at every zoonotic spillover because we want to identify the next AIDS before 15 million people have become infected and are doomed.

AA: This raises an important question. Is humanity a hopeless target of the Next Big One, the next zoonotic pandemic? In all of the interactions we have between each other and animals and, of course, microbes, do we survive each day simply because of fool’s luck, or is there a method we can assign to this madness?

DQ: Humanity will inevitably become victim to more of these spillovers. We live at such high densities and we cause so much disruption in diverse ecosystems that we will continue coming in contact with new viruses. There are so many viruses out there that it is inevitable that some small fraction of them will be capable of spilling into humans, replicating, and causing severe disease that may be transmissible between humans. What we can affect is how bad the results are of those inevitabilities. Whether those spillovers turn into epidemics and pandemics are contingent facts that we can influence.

Usually my books are not very hopeful. This book is a little bit more hopeful than people expect, because there are expert voices who are saying to me, “Well, it depends.” Is it possible for the intelligence and the adaptability of humans to mitigate the severity of the Next Big One? I think of it as sort of a race between two factors. On the one hand, there is the inevitability of further zoonotic spillovers, many of which could be extremely murderous. On the other side, there are the scientific advances that we are making in public health and the advances in vigilance and response. It’s a race between those two factors, as to how bad the Next Big One will be.

AA: One of the responses you brought up concerned Singapore’s ability to contain its SARS outbreak. Notably, it was the strong hand of government and medical authorities that allowed them to stamp out the sickness. They implemented heavy measures, like jail time and fines for quarantine breakers, to achieve this. As Americans, we might regard such measures as encroaching on our liberty. What are your thoughts on the role of authority in such emergency situations? How much influence should white-coats and suits have when an outbreak occurs?

DQ: The question of civil liberties coming into conflict with disease response measures is a very serious and complicated question that we need to start thinking about. I’m not going to say, “Here is the answer.” I would like to see the conversation begin, to see people start thinking about this, to see people become familiar with what happened in the case of SARS and what the pros and cons are.

Singapore did contain its SARS outbreak, as did Beijing, Toronto, and Hong Kong, three other cities that have strong command-and-control and very good public health systems. If SARS had come out of the Congo and gotten into Kinshasa, the results might have been very different. I don’t want to be condescending to the Democratic Republic of the Congo. It’s a country

that I feel great, great sympathy for. But you don't have anything there like the situation that you have in Singapore in terms of the capacity to control a viral outbreak.

Before 12 years ago, anybody could get on a plane anywhere in the world carrying a pocket knife. Now it's unthinkable that you would get on a plane carrying a pocket knife. But you can still get on a plane carrying a virus. I've seen some cases during bad influenza outbreaks when I was flying. We were walking through infrared screeners and cameras that were telling the authorities whether any of us were running a temperature. I've been told by other people that it's not all that difficult to screen people for fever or for a particular virus. In the time that it takes us to go through airport security, they could add an additional step. They could take a swab from the inside of our cheek and run it very quickly into a sensor. By the time you go through, take off your shoes, and walk through the scanner, they could also test for a particular virus. If you're carrying it, they might not let you get on the plane. They might not let you get off the plane.

AA: That adds an interesting angle to transportation security. I remember you mention in the book that the outcome of SARS could have been quite different if it entered the subway system, an instance of a human-dense area.

DQ: That's right. We need to start imagining those possibilities and discussing them, and deciding whether [any measures] would be acceptable to us or not.

When you begin discussing scary viruses, like Ebola, people say we need to be concerned about bioterrorism. Well, yes, and money is being spent on that. But I like the comment I heard from one of my expert sources. People talk about how they're going to weaponize this virus or that virus. Well, think about avian flu. We don't need to worry about some cult weaponizing it, because the birds are already weaponizing it. The world of nature and things we humans are doing — disrupting ecosystems and then traveling — those factors are going to be by far the largest measure of our risk. I think that conscious bioterrorism, the possibility that these things might be weaponized and released, is a marginal concern, relative to the natural possibilities of release.

AA: As people concerned for our own health and well-being, we often consider viruses and pathogens as these extremely obscure things that are for some reason bothering us. As someone with an ecology focus and respect for all forms of life, would you say, "Of course they're trying to colonize us. That's just their nature. You have to look at it without human bias."

DQ: Yes, absolutely. Viruses are not evil organisms. Viruses are no more evil organisms than lions or butterflies or frogs are. They're just trying to survive and replicate, according to Darwinian principles, the way all other living organisms do (if you consider viruses as living). They obey Darwinian evolution; their activities are defined by Darwinian natural selection. What they're trying to do is pass on their genomes. There's nothing sinister about that.

As I say in the book, parasitism and infection are natural processes, every bit as much as competition, predation, and photosynthesis are natural processes. The infection of an organism by a virus is no more unnatural than what a lion does to a wildebeest or a zebra. These things come to our attention when a new virus spills over into humans. That's parallel to what happens when a lion occasionally kills a cow and an occasional cow-herder because it's been deprived of its natural prey and all that's around are cows and cow-herders.

AA: You make a strong case that it is our disruption and disintegration of the ecosystem that often allows otherwise isolated microbes to gain an edge and possibly cause outbreaks. Traditionally, the practice of medical professionals is to respond to the aftermath of such events. Should such professionals have influence in or be involved with preventing these outbreaks from ever occurring?

DQ: Yes. Medical doctors and public health professionals should be very much involved, and not just back in the hospitals. You're seeing that more and more. Some of the people that I write about in the book have medical degrees, and quite a few have public health degrees.

There's this new professional I mention in the book who has this synergy of skills and training. They maybe start with a degree in veterinary medicine and then add a doctorate in ecology or perhaps a master's in public health. That's somebody who can be out there, in the forest, in the villages, observing and helping to influence what is done to reduce the risk of spillovers and to contain spillovers when they occur.

Add to those human physicians and virologists. I think it would be great if more people with both medical degrees and degrees in virology move into field work on zoonotic spillovers. That kind of training is essential to this field. I do know a few of these kinds of professionals. For instance, there is Karl Johnson, M.D. He's probably the granddad of Ebola work. He's a friend of mine, and he probably wouldn't want me to call him that, maybe "the father of Ebola work." He was trained as a medical doctor and considers himself a viral ecologist. We need more Karl Johnsons; we need more people with that kind of training, with a medical degree and an understanding of the ecology of viruses, and how something can come out of a rodent in the rural landscape of Bolivia and cause a hemorrhagic fever in people.

AA: Some patients, children, adults, and the immunocompromised own exotic pets. A study in the journal *Emerging Infectious Diseases* (Grant and Olsen, 1999) demonstrated that physicians don't feel comfortable discussing the roles of animals in the transmission of zoonotic diseases with patients, and yet people don't look to their veterinarians for education on human health. What do you think of this fundamental divide?

DQ: That's why EcoHealth Alliance is in business, to fill that gap in between there, in terms of doing research, but also in terms of educating the public. It's only one organization, but it's an organization with some very good people in it. It's going to become more and more important. There are also people like Nathan Wolfe. He directs Global Viral, what was formerly known as the Global Viral Forecasting Initiative. He has developed a method where blood samples taken simply on filter paper and carried home dry can then be used to screen for certain viruses using PCR. He is collecting samples in Central Africa and Southeast Asia and elsewhere from people involved in bushmeat. He is getting them to take blood samples of the bushmeat, and he is getting blood samples from them, too. He is out there doing this joint diagnosis. Are there new viruses — or are there known but dangerous viruses — that are being carried in wild animals killed for bushmeat, and are those viruses getting into the hunters, the first-line consumers? That is just one situations in which there is this integration of veterinary and human medicine.

AA: I would imagine exotic pets are a concern as well in this integrative field.

DQ: Yes, definitely. Lassa fever got into the United States by way of the exotic pet trade. It is possible for others as well, viruses that can be transmitted by exotic pets and domestic pets, to a certain extent. For example, there are a number of diseases that can be passed even from dogs and cats into humans.

AA: Do you think that some sort of early communication between the two professions of veterinary and medical education would help future doctors appreciate the emergency of infectious diseases?

DQ: Absolutely. I think that to teach infectious disease without teaching about zoonotic disease is illogical. I think it would be very helpful. It's almost like trying to teach somebody calculus without having taught them algebra and geometry.

AA: Considering the range of subjects we've talked about, is there anything you would like to add?

DQ: I think what we've been talking about is very important. The reason I've written this book is to try and make the connection not just between veterinary science and human science, but between the scientific and medical professionals and the general public. I think it's really important for people to understand better some of the science, some of these dynamics and principles.

What I say to you is, don't try to apply your knowledge until you have some. What I mean by that is, invest a little time and mental energy in reading my book or reading some other book and actually understanding the principles of this phenomenon and getting a little bit deeper into it. I'm not going to hand you a card that says, "Here are two or three things you can do to save the world from zoonotic diseases." It's very complicated, and that's why my book is more than 500 pages long.

I'm a science writer. This is a very important ecological niche, the niche that we are in: the translation of complicated and urgent medical science into forms that are consumable and absorbable by the general public without being oversimplified, without being sensationalized, without being rendered inaccurate. I would like to mention this as a reminder to medical professionals, in order to encourage them to have some time and patience for the next science writer who knocks on their door.

AA: That was my next question. Physicians and scientists usually have precious little free time for pleasure reading, let alone keeping up with scientific literature. How could they benefit from reading *Spillover*? Some concerns I heard were that there are too many details here that you and I would consider texture in a story. Professionals might want to get to the bottom line, fast.

DQ: What I've tried to do in *Spillover* is to encompass a lot of very important and very complicated scientific information in a package that reads like a guilty pleasure. Sugar coating it is a little bit too cynical a way to put it. I've tried to create a book that is interesting to people who love books and who love reading. But also it delivers a whole lot of education to people on a very important subject.

Why should a busy medical professional read this book to learn about zoonotic diseases when he or she perhaps could read a 100-page review article and get much of the same information? My answer this: They should read it because this is a book that can be an important tool to them. He or she might discover that this a book that they would like to give to his or her brother-in-law, sister, nephew, niece who's considering going to veterinary school, and mother who is saying, "What is it that you do again?" I hope that I've created a very valuable tool to bring this information to a lot of people who ordinarily would not be patient enough or interested enough to consume this information.

I would say the scientific professionals could benefit from reading this book because then they know what's out there, that it can be a tool for them to try and explain this subject to other members of the general public.

AA: What you are really getting at there is a motivation for writers to write about science.

DQ: Yes. We're always working for two audiences. We're working for an audience that is in front of us and an audience that we can see when we glance back over our shoulder. The audience in front of us is the general public, and the scientists who are our sources are the audience behind our shoulder. We're mostly addressing the general public, but we have to look over our shoulder every once in a while and see whether those scientists, those experts, those people who've served as sources are nodding or shaking their heads. We need to make sure that we've got them on board, that we satisfy their standards of what good scientific explanation is.

I'm sure that there are mistakes in my book, and there are some things that I could have done better. But I've taken a lot of trouble to write readable and enjoyable books that also are very accurate and substantive scientifically.

If you sell a million books, but the scientists say, "Oh, it's bull----, it's hype, it's sensationalism," then that's a problem.

AA: David, I want to thank you for this opportunity.

DQ: You're very welcome, Abdul. I've enjoyed talking with you, and I appreciate your interest in the book.

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