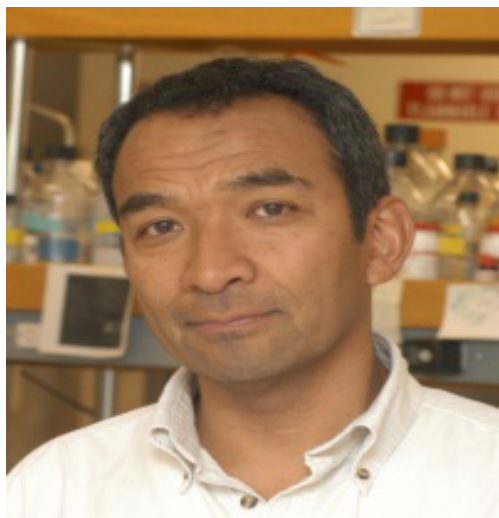


# INTERVIEW WITH LEE RILEY

Mike Moses, Alex Gagnon, Jennifer Cherone, John Domingo, Felicia Linn, Hannes Prescher, Pryanka Murali

Dr. Lee Riley, M.D., is a UC Berkeley professor of Epidemiology and Infectious Diseases. Dr. Riley earned his B.A. in philosophy at Stanford University, and completed medical school at the University of California, San Francisco. After medical school he obtained an internship and residency at Columbia Presbyterian Medical Center in internal medicine. Riley then joined the Epidemic Intelligence Service of the Enteric Diseases Branch of the Centers for Disease Control and Prevention (CDC), where he spent three years. He also served as Laboratory Project Manager with the India Biomedical Support Project, organized by the World Health Organization, after which he joined the Cornell University Medical College as a professor of medicine in 1990. He became a tenured professor of medicine in 1994, and in 1996 came to the University of California, Berkeley to be professor of epidemiology and infectious disease. He also serves as Chair of the UC Berkeley School of Public Health Division of Infectious Diseases and Vaccinology. Berkeley Scientific Journal had the opportunity to meet with Dr. Lee Riley and talk about his work in Brazil and India.



Dr. Lee Riley, M.D. teaches Epidemiology and Infectious Diseases at UC Berkeley.

**BSJ:** Can you begin by telling us how you became interested in slum settlements and diseases in slums?

**Riley:** Sure. I've been working abroad for many years, since the early 90's when I was a faculty member at Cornell. When I joined the faculty at Cornell, at the school of medicine, I was then sent on to Brazil to look

at some possible projects we could do. Cornell has been involved in Brazil for about 45 years now, so I joined the faculty as an assistant professor and they wanted me to do a project there as well, so I started on a diarrheal disease project, focusing on kids with diarrhea. It turns out most of the kids with severe diarrhea were kids from slums, and of course I sort of knew that already but didn't pay much attention. We were interested in looking at different kinds of infectious agents that cause diarrhea. As we were doing the project, nobody seemed to really care about what happens to kids because for one, kids don't really contribute economically to these communities, so it was kind of frustrating even though it was intellectually satisfying. So we started working on another disease, called leptospirosis. Leptospirosis is a type of bacterial infection that is transmitted by rat urine, and we were seeing all of these severe cases of leptospirosis. The clinical manifestation of leptospirosis is initial flu-like symptoms, followed by liver failure, and kidney failure. And the people die because of kidney failure, the kidneys just shut down. About 15% of them die, so it's a pretty bad disease, and what was interesting was it predominantly affected young adult males. This is something that the government really paid attention to.

**BSJ:** Because they are the most productive members of the economy.

**Riley:** Exactly. Young adult males are the main income earners, and they are the ones that contribute to the economy. And it turns out that more than 95% of these cases came from the slums. This was all done in Salvador, Brazil. Salvador is the third largest city in Brazil. So the first study we did was to look at risk factors for death; why some people die from this disease and others don't. When we reported our finding in *The Lancet*, the government really paid attention. It's a major international journal, and I think the Brazilian government was embarrassed that they had this problem. Brazil is one of the richest countries in the world, economically it's a very rich country, and yet they had this disease in their backyard, something you see in some of the poorest countries of the world. So they were embarrassed, but instead of kicking us out they became interested and asked us to set up similar surveillance in other cities, and the local government actually came into the city we were working in to try to implement some sanitation measures and other things.

**BSJ:** So they really cared.

**Riley:** Yes, they really cared, so we were lucky. And the

reason I think they cared is because Brazil could afford to do that. If we did a similar study in poor cities in India or Africa, nothing would have happened because they can't afford to do anything and there are no resources to intervene. So that's one satisfying aspect of working in places like Brazil. Our collaborators in Brazil continued to study leptospirosis, and initial study was based on hospitalized people. Then we started asking ourselves, "where do these people come from?" Of course we knew they were coming from the slums, but which slums in the city contributed most to these severe cases. We found one neighborhood near the airport which consistently had these cases coming up, so our collaborators began a community-based study trying to look at risk factors not just for death, but also for severe disease. So obviously in these communities everyone is getting exposed, right?

**BSJ:** Right.

**Riley:** So what happens in these communities, in this particular place, it's built into a valley, so in the rainy season everything is flooded down in the lower part of the valley and people have to walk through these floodwaters. And so what happens is the leptospirosis, the bacteria that causes the disease, is excreted from the rat urine and contaminates the flood water people have to walk through. The virus actually bores through the skin and enters the bloodstream and disseminate all over the body and you die. And these people have no choice, they have to walk through this water to go to work, school, etc. So we knew the structural issues that contributed to this disease, but we also wanted to know, since everybody is getting infected, why do only a subset of them develop the severe disease while others don't develop any disease. That was our next

symptoms.

**BSJ:** Just the adult men?

**Riley:** Well we see symptoms in little kids but not to the degree that we see them in adult men. We still don't know why this is the case. It's not exposure, it's not epidemiological, the reason is more of a biological reason and we are still working on that. Anyways,

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*"Government, foundations, etc. can keep on giving money and buying drugs, but nothing is going to happen, nothing is going to change until you deal with the structural issues of these communities that engender these types of diseases."*

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going door to door in these communities, we were also seeing a lot of other diseases that we hadn't expected. Not just infectious diseases, but chronic diseases like hypertension, diabetes, mental illnesses, and even gunshot wounds and injuries because most of the time people don't seek medical care for these things so they end up with deformities and chronic infections, all kinds of things. We were seeing all of these things, so I said what we really need to pay attention to is not specific diseases, but the structural issues that contribute to the manifestation of all these different types of illnesses. That's when we became interested in developing the concept of slum health. Of course, we're doing this sort of research project, we're usually funded to do one project, so what do you do? We don't have any money to do any of these other things. There are these people that die in front of us because of all these diseases, but what do you do, just ignore it? If somebody gets hit by a car, what are you going to do? Just walk away (because you have no funding for that)? We're faced with this sort of ethical dilemma. So, I had to bring attention to this whole issue and we started looking at this in a more concrete manner.

**BSJ:** So, you took a step backwards in the causal chain and looked at what's causing all these things.

**Riley:** Right. So, it's not in my area of expertise—I'm an infectious diseases doctor and I do basic biology research, but we're all kind of sociologists, anthropologists, and economists so there are also all these kinds

of ways of looking at things. We're still struggling; it's kind of a new science that needs to be created to do this kind of work. We call these "social cluster" diseases. It's a new science that we need to develop just to study this problem.

**BSJ:** Have you had any success getting grants particular to this new form of science?

**Riley:** No, we've had small amounts of money here and there, but again, the problem is that the formal health

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*"We actually did a case control study and found that people who lived in houses closest to the sewage were much more likely to have severe disease than those who weren't even if they were living in the same community."*

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question. To answer that we had to go door to door and interview these people, draw blood, and look for evidence of infection. The evidence for the infection is if you have an antibody against the bacteria, that means they were infected even though they might not manifest the infection clinically. And we found some really interesting discrepancies. For example we don't see severe disease in kids, and the antibody against infection you see. So kids are getting exposed but they don't develop severe symptoms. And women also, they are exposed but they don't develop severe

sector really hasn't recognized it as a real problem. If you focus on a specific disease, yes, you can get things published. Even governments in most countries, including the U.S., I don't think they really recognize this as a health problem—it's more of a social problem. So if you try to write a research grant and submit it to NIH or other such organizations, they ask "what is this?" That is why we write these opinion articles: to publicize this whole issue. We have governments and foundations spending billions of dollars giving drugs to treat AIDS and TB, but when you actually look at these populations that develop TB and AIDS, more than 80% come from the slums of the urban centers. Government, foundations, etc. can keep on giving money and buying drugs, but nothing is going to happen, nothing is going to change until you deal with the structural issues of these communities that engender these types of diseases. So, I'm trying to step backwards and asking "what are these social structures that contribute to these diseases?" Otherwise, nothing is going to change, we will continue to have these problems.

**BSJ:** So, you focus more on prevention than curing the end result.

**Riley:** Well prevention, but also trying to understand the kind of biology behind it. Of course, it's the economics and social construct, but I think there's a scientific way to answer and address these questions. There's a very simple example, as I've mentioned earlier, people get affected because they're exposed to contaminated water, so what do you do? Well, just put a sewage system; cover up these open sewers—that's it. A very simple intervention, but nobody would know that until somebody went in there and did a detailed risk factor study. We actually did a case control study and found that people who lived in houses closest to the sewage were much more likely to have severe disease than those who weren't even if they were living in the same community. There are lots of other slums in the city where there are no leptospirosis cases because they don't have this type of valley condition. If you go to other places that do have it [the valley situation], they have a similar set of problems. They have places where people are exposed to sewage in high density. But nobody [in terms of researchers and/or other external organizations] goes to these slums, it's dangerous. So we don't get the



A typical slum in Brazil. Of the populations that develop TB and HIV/AIDS, roughly 80% originate from the slums.

right kinds of information. We have to go in there and do surveillance, generate the data, analyze the data, and then publish them. In this sense, publication has become the voice of the people who live in these slums because the local news reporters are not going to write about these problems even though they exist.

**BSJ:** They just seem to ignore it.

**Riley:** It's not a matter of consciously ignoring, it's that they don't even know what's going on.

**BSJ:** So, this kind of research should be standard protocol for the formal health sector. When there's a problem with a particular disease, then they should retrace the problem to the initial source.

**Riley:** Exactly, it's important to determine the risk factor, and if you can identify a risk factor for which you can convene against, do it. You can't wait for poverty to be fixed, it has been going on for thousands of years. We already know that poverty leads to a poor health outcome, that's not the issue, we already know that. However, there are things that we can do, right now, given the conditions. To do so, we need to do science and epidemiology. This is what

we're trying to rush.

**BSJ:** When you mentioned that there exists a relationship between the particular disease and the location of the resident in the valley, did this relationship reflect the frequency of exposure or with severity of symptoms?

**Riley:** We didn't really measure a frequency of exposure, it was more of an ecological study.

**BSJ:** So, the symptoms were of interest?

**Riley:** Right. The way we did that particular study was that we identified the people who got hospitalized and didn't die. Then we traced back to where the person came from, and interviewed this individual's

neighbors. There were two types of controls: one was within five houses of this person, the other was further distanced from this person's household. That's how we determined the people who were hospitalized where those who were more likely to be living closer to these open sewers. Another crucial criterion considered included also having seen rats in the previous five days before the person got sick. Initially when we started the project, we figured everyone's exposed to the same sort of environment so we wouldn't see any differences. We were surprised that we observed really significant differences, even in the same type of nature. And you know in these slums, that people consider you know, sort of think of these slums, you know, just areas full of just nothing but poor people, but it's not you know. There is a huge spectrum of people of different socioeconomic status. Sometimes, you know, like in Rio, Rio de Janeiro you have millionaires living in these places, because they're making money off of selling things to the residents. It's a huge community right of people, there's a real incentive for people, even banks to move into these places to go and make money, profit.

You even have these video rental places that people set up and you can make a lot of money because there are lots of people in these places. So, you have these same people who would develop these diseases. They just happened to be exposed in the right environment.

**BSJ:** Did you do any analysis into like the income level of people?

**Riley:** Yes we have those.

**BSJ:** So is it across the spectrum or is it weighted in any way?

**Riley:** Yes, it's essentially across spectrum, at least for leptospirosis. I think for the other diseases, we're also beginning to look at other diseases now and, you know, the income doesn't seem to really matter that much. It's just where you are. So it's a new project that we started is a disease called rheumatic heart disease. So rheumatic heart disease is a disease of the heart valve that results from the repeated exposure to a very common bacterial throat infection, that we've all had here.

**BSJ:** Strep?

**Riley:** It's a group A strep throat infection, and you know this disease used to be relatively common in the U.S. in the 1930's and 40's before the antibiotics came. But, this is a huge problem in the slums of all urban centers of the world, the slums of the world. You know, I think the reason is because when kids develop sore throat, they don't necessarily seek help, or even if they seek help, they may not necessarily get treated

with antibiotics and because of sort of the crowding in these communities, there is a repeated exposure to these strains of group A strep, and so after many years, they develop the heart disease. So what happens your immune response mounts both a cell mediated and antibody mediated immune response against this protein that the bacteria makes. Well, it turns out this protein shares epitopes that are similar to the proteins found in the valve, so the host immunity mount to respond against the self-proteins. So after many repeated episodes of infection, your heart valve starts getting damaged. So these people end up getting their valves replaced maybe in their late 20's, or early 20's and because they're young, when they start getting into their 40's they might have to get it replaced again. It's a huge cost to the government to do this, and in Brazil they do this free of charge for the people. So,

Brazil could be spending more than \$50 million a year just to do this, when for less than one million dollars you could prevent all these things from happening. Just by antibiotics, cheap antibiotics. So, again this happens because these people live in the slums. So what we're trying to do is to develop a sort

of new of laboratory test that can stage the illness so when your valves start getting damaged, and initially you might be totally asymptomatic, and then when it gets a little more damaged, then you might start feeling shortness of breath, when you exercise and you run or you walk, and then the disease progresses further and you might be getting shortness of breath even at rest. But in order to assess these conditions you have to be evaluated by a cardiologist, or you have to undergo an echocardiogram and both of these procedures require expertise, and the people who live in the slums are not going to go and see these specialists. And they are not going to do that until they develop a stroke, or they just can't breathe, then they get what's called congested heart failure. That's when they end up in the formal health sector but by that time it's too late and by that time the formal health sector has to spend lots of money taking care of these people. So that's the problem. So we're going to develop a test that can stage the disease, early in the phase of the illness, so that we can start the treatment earlier and so we can avoid this, and that's what we're trying to do right now. So that's kind of thing we do in the lab here to develop a test and then take to the field to apply.

**BSJ:** What is the nature of the test?

**Riley:** So it's just a blood test. You take the blood and do an ELISA [Enzyme-linked Immunosorbent Assay] test, it's just a very simple assay, and there is you can measure a certain type of biomarker, that is indicative of the stage of the illness, that correlates with the conventional staging method. Then we can just replace the conventional method that requires an expert who can set up in a local clinic to do this.

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**BSJ:** Is it very cheap and easy to input this test into the formal sector?

**Riley:** Anybody can interpret it. You just see this pattern that needs some other kind of monitoring method. Well of course this is really preliminary. We have a PhD student now trying to set this up in Brazil, so that's one of the projects.

**BSJ:** So you have people in Brazil all the time and people here all the time working in concert?

**Riley:** The PhD students come to my lab and they like to go abroad so I send them down to Brazil. They stay either short term or long term.

**BSJ:** And how often do you go back down?

**Riley:** About three or four times a year, for a short period of time, one to two weeks at a time.

**BSJ:** And you've been going there since the mid-90's?

**Riley:** Early 90's, so I've been there for almost twenty years.

**BSJ:** And so the evolution of your research in Brazil has it been pretty continuous for the last twenty-five years or so?

**Riley:** Yes.

**BSJ:** So all that we've talked about so far has been an evolving process.

**Riley:** Right, right, so you know as I said we started, we focused on a very specific kind of infectious disease, but you know when you get older you can do many things.

**BSJ:** A Jack of all trades.

**Riley:** So yes, we've become more focused on these things, but the theme is slum help and since I'm an infectious disease person, I'm still focused mostly on infectious disease problems with the slums. You know, I wish I could do all the things, but I just don't have time to do the research.

**BSJ:** It takes a long time even to work on one thing, and you've been working on this for a long time.

**Riley:** Right. But, I think having good PhD students to work on these really helps.

**BSJ:** How many PhD students are you working with right now?

**Riley:** Well, here I have about five.

**BSJ:** And do you work in concert with any other labs or organizations?

**Riley:** Yes, I work with all the different research extensions of myself. Here, I work with chemistry

department. We have some people at Cornell and much of the leptospirosis work was done by my fellow that they sent down to Brazil. His name is Albert Ko.

**BSJ:** So you mentioned other regions like India, Africa. Have you done any work in particular slums in those regions or has it essentially been Brazil?

**Riley:** The slum work has been consistently in Brazil, but we started a project, or actually we are helping a project in Mysore India. It was started by a former PhD student here on the infectious disease complications of reproductive health, especially women who live in rural slums. So, she has been following these women who become pregnant and then get all kind of infectious disease complications. And she is not a lab person; she asked us to sort of set up a lab in Mysore to help with that analysis of different bacterial organisms women might be exposed to. So I visited there in February, and again one of my major interests is in Tuberculosis (TB). So, there is lots of TB there and we are trying to set up a TB project there. And TB is also one of the major diseases of slums so it fits in with our interests. So, we may start some projects in India as well. We've already sent some students there.

**BSJ:** So you are really broadening your scope.

**Riley:** Our projects are not just limited to developing countries. We also have a strong collaboration with Japan.

**BSJ:** And you were just in Japan, correct?

**Riley:** Yes, I just came back. This is looking at the globalization of drug resistance genes. Because of the globalization of food trade we are seeing the spread of all these drug resistance genes through contaminated food. Japan is a major food importing country, and so they have major problems with all these drug resistant infections. And we have the same interest. We have a domestic project as well looking at urinary tract infection here on campus. In women, we are finding all these drug resistant E. coli and we propose that UTI [Urinary Tract Infection] may actually be a food born disease. We have some good evidence for that.

**BSJ:** UTI, food born disease. That is interesting. Has anyone suggested that before?

**Riley:** No. We have lots of crazy ideas, but we have an article in the New England Journal a few years ago, so I think a lot of people are beginning to accept that idea.

**BSJ:** It seems like each area of the world has its own little issues.

**Riley:** That's why infectious disease is interesting. It's totally unpredictable. It's always changing and we are always finding things. It's what keeps us employed.

**BSJ:** So you mention a lot about the economic effect these informal settlements and their health problems have on the formal economy. Do you see any other

spillovers, like any health effects that are affecting the rest of the populations outside of the slums?

**Riley:** In terms of a direct effect, I don't know really a specific example. Many people live in the slums and have TB and they get employment as servants in people's homes. There is some concern that the people who hire these people might get exposed to TB. Like the influenza epidemic, the epidemic enters these slums and can be a magnifier for the spread to the rest of the population. But I don't know any specific examples like that.

**BSJ:** It's hard to quantify that?

**Riley:** Yes, it's really hard to quantify which way the

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transmission occurs. So, much of the impact is more economic.

**BSJ:** So, you don't have any specific plans to quantify that effect?

**Riley:** No, it's hard. It's much easier to work with the slum populations than the non-slum populations. For instance, in Brazil, we know that TB happens in rich people but it is much harder to get access to the records. Because they go to private clinics to get their medications and private physicians are not going to release the records. But we know that happens. It's just like here, it is much harder to study rich people than poor people.

**BSJ:** What about the special challenges of working with people in the slums? Are there educational barriers, communicative barriers?

**Riley:** Yes, there are a lot of barriers. Probably the major barriers are just safety going into these communities. We've been lucky in Salvador. So, one of the things we do in the research team, and Albert Ko's group has done this, is to include people who live in the slums as part of the research team. So in the process, these people learn certain skills and get paid. And because they live in these farm villa slums, they are accepted. So, when the team goes in and they see that the members of their own community are in the team, the team is accepted. So, we do things like that to make it a little easier to work in these communities.

I don't think we can do this kind of thing that we're doing now in Rio. It's just too dangerous. It's not that we'd be directly attacked but there always gang fights going on all over the slums, and between the collateral damage and policing the gangs, it would just be too difficult. So that's why Salvador is not as bad although it's been getting a little worse over the past few years because the drug trade is coming in.

**BSJ:** Have you seen any major changes in the particular favelas you've worked with over the past 25 years because a lot of them have been displaced and they're gone?

**Riley:** Well in India they always displace these slums because slums tend to get built up in somewhat desirable plots of land. Especially in Bombay, because it's just a really tiny space where they can build things, so people get constantly [displaced]. The same thing happened in Shanghai and Beijing and all these big, central cities. But in Brazil, it doesn't seem to happen as much; it just gets bigger. 60 percent of the city of Salvador is considered to be slum, and I've been working there for over 20 years so I can see the evolution. Every time I go, there are new settlements created in these open lands,

open hills, and places that are not that desirable. If you actually interviewed these people, you would find that they've been there for years and years. They're totally informal; they don't own the place. I don't know how their tenant-ship works but it's very complicated.

**BSJ:** Have you seen a lot of evolution in the environment there? I noticed in one of your papers that you built up a lot social services and infrastructure.

**Riley:** Yes, they do have those and they do it on their own. And the Brazilian government also accepted these communities as semi-permanent entities so they also provide services. For some favelas, especially the large slums, the government puts small clinics nearby. Private pharmacies move into these places and it just becomes a community in itself. So I think Brazil is a bit better off. You know when you look at the building structures and show these scenes of slums to people from India, they'll wonder why these are slums. So there is all this relative perception of what slums are depending on where you are from.

**Mike:** In a lot of your work, you seem to want to influence policy in some ways. How effective has that been, in general, for you?

**Riley:** I don't directly go out and talk to politicians or anybody. We just do research and hope that people read [what we publish] and do something. Our last paper definitely had an impact temporarily in Brazil. We're trying to push this idea that the globalization of

the food trade and the use of antibiotics and growth hormones in animal reservoirs has contributed to the spread of drug resistance. People are picking up on this and I don't know where this will go. Traditional drug resistance infections have been associated with things like salmonella, shigella, e. coli, and other known food poison diseases. But if we start saying that not just diarrheal diseases but UTI and other infections in hospitals may ultimately be coming from food, then people may start paying attention, especially the consumers. There're always some obstacles with trying to legislate or regulate the private industry practices in the US and they don't often work. The thing that really brings attention to the private industry, the food industry, the pharmaceutical industry, is what the consumers do. If the consumers start to say they're going to boycott meat from animals that have been injected with antibiotics, then they'll start paying attention. And they are paying attention in the market. McDonald's is actually beginning to use meat from animals that don't receive antibiotics. If they start doing that, this is going to have an impact so that's the way to do it. The kind of things we publish, we hope, could be used as a basis for consumers to understand.

**Mike:** So in many ways, the bottom-up approach is the way to go.

**Riley:** What I need to do is write a book or a textbook about how antibiotics in animal feed is a bad thing. And there's been discussion about it for a long time but what I'm trying to do is not just limit it to diarrheal diseases but all kinds of drug resistance infections and where they're coming from. So I don't have time to the politics but hopefully what we publish will serve as a basis, kind of like doing it in a quiet way.

*"A lot of places these people don't exist. They aren't even registered, their birth or even death are not even registered, so officially these places don't exist."*

**Mike:** Do you know of any other labs doing the same work as you?

**Riley:** There are many groups like international organizations working with slums. There's no lab, but Jason Corburn in the Department of City and Regional Planning is a new faculty member who's been working with slums in Africa. He does small lab work with epidemia in Africa. He does his own lab-work, he does epidemiology in a traditional approach. But he and I were trying to collaborate.

**BSJ:** And do something in Africa?

**Riley:** So he'll do something in Brazil, and I'll help him with some of the laboratory aspects in Africa. We kind of complement each others' sites. So he'll help us with

some of the structural issues with some of the slums in Brazil and look at those. I guess I would provide in Africa some help with infectious disease laboratory procedures. In terms of laboratory people, there are probably not that many people doing this kind of work.

**BSJ:** It's so multidisciplinary, and that's why it's so important for you to collaborate with people.

**Riley:** Exactly.

**BSJ:** It really seems to be a three-pronged research project. There's policy, sociology, and the scientific aspects of your work.

*"We're trying to push this idea that the globalization of the food trade and the use of antibiotics and growth hormones in animal reservoirs has contributed to the spread of drug resistance."*

**Riley:** And I can only do the scientific part.

**BSJ:** So what you were saying as far as the slums were concerned, you want to see some integration of an inquiry protocol into where these diseases are coming from so that you can identify the causal factor. As far as the heart valve situation, maybe some sort of cheap and effective on-going treatment strategy. I wanted to ask you your opinion on formalizing these informal settlements. Is it possible? Is it way too idealistic? Can we add hospitals to these places?

**Riley:** That's a good question, and I think it would vary, depending on the country, the region, and the city. A lot of it would depend on how much the formal

health sector recognizes these communities as real social entities. A lot of places these people don't exist. They aren't even registered, their birth or even death are not even registered, so officially these places don't exist. And other places, they do recognize these communities. So a lot of it is dependent on what the formal health sector does. In Brazil it seems like these are semi-permanent institutions and they could probably formalize but I don't know, its a good question, how you formalize these places. In India too they have made attempts to formalize. What they do is they have a policy where if people leave these slum communities then the government will build--they incentivize private industry to build these residences. They might give tax-free status or tax incentives as they build these

malls and these complexes if they also build residences for these slum-dwellers. The problem is when they build these structures, especially for people who have been in these slums for a long time. They actually had a lot of space. When they move to these new buildings they are actually forced into these much smaller tiny spaces, and they don't want to move. Even though they are completely new and nicely furnished, they don't want to move.

**BSJ:** I would imagine that they are rooted in the community too, and it disrupts that.

**Riley:** Exactly. There's a whole social and economic structure in these communities. So its really disruptive, even though these buildings physically look very nice and clean. You saw Slumdog Millionaire, right?

**BSJ:** Yes.

**Riley:** So it's sort of like that. So even these attempts, which may be well-meaning, may not necessarily be the best thing for the people who live in these communities.

**BSJ:** Right. So this is one of the major problems were going to see continuing into the future?

**Riley:** Yes, and its just going to get worse. You know one billion people live in places like that right now in the world, and in 2030, it is estimated that its going to be two billion, its going to double. You know we're talking about global warming—there's a lot more attention paid to global warming right now, with Obama publicity and everything like that. So with global warming the estimate is that in 50 years, two billion people will be displaced, because the water level will rise and people living in the coastal areas will have to move up. Two billion in 50 years. Well, they're saying two billion in the next 20 years, without global warming. This is going to happen no matter what. Even if we start doing something now, this is going to happen. We already have to deal with a two billion refugee population. And we don't even use the word refugees in this

a lot worse. All of these countries—the BRIC countries: Brazil, Russia, India, and China— they are going to be dealing with this, and its going to be a huge economic drain to these countries. What AIDS did to Africa in the last 20 years, these slums are going to do to these BRIC countries in the next 20 years.

**BSJ:** And those are the countries with have large populations and huge levels of growth.

**Riley:** Exactly. They are doing very well economically

*“What AIDS did to Africa in the last 20 years, these slums are going to do to these BRIC countries in the next 20 years.”*

right now, but it could all collapse because of these populations.

**BSJ:** Unless they take a word of advice from Dr. Riley  
\*laughter\*

**Riley:** I've already said those things in our papers, so we'll see. But you guys are young and you've heard what I've said. Mark my words.

**BSJ:** I'm going to start by buying some meat that's antibiotic-free and then I'll work from there.

\*laughter\*

**Riley:** The reason were working with UTI is that UTI is the most common infectious disease in women, and women are the main consumers in our society. So if we can get the women to rise up in arms to say “we've got to stop using antibiotics” then the industry will start paying attention.

**BSJ:** Women have the power here as the consumers.

**Riley:** Right.

population. If you use the word refugee that gives a certain connotation and a certain status to this population. You have refugees from a war, refugees from a natural disaster. They get some status, they get attention, we will all get together and buy food, and send things on and feel happy and everybody relieves their guilt. But slums—if you look at these pictures of a slum, they look no different from refugees. Yet they're not considered refugees, but these are refugees. and that's what is going to happen in 20 more years. It's going to be just

**BSJ:** So we talked about social clustering, and you mentioned that there were special factors that contribute to these diseases. Are there any other aspects of the special distribution of people in slums that contribute to the transmission patterns? Can you talk about some of the other effects of slums, such as what makes them unique?

**Riley:** Sure. In one of the papers I wrote, I used the U.N. definition of slums. I used each definition and I would say, “If you have this definition, what kind of

*“You know one billion people live in places like that right now in the world, and in 2030, it is estimated that its going to be two billion; its going to double.”*

disease do you see in the slums." So for instance, one of the definitions was "Lack of Safe Drinking Water," so you can imagine all kinds of diseases associated with lack of safe drinking water. It isn't just the usual things like diarrhea, hepatitis, things along those lines that you could get from water, but just the lack of water to clean yourself contributes to things like scabies, which are skin lesions. And when you have skin rashes and lesions, they get super-infected with certain kinds of strep bacteria, and when you get infected with strep a bacterium that also induces another type of autoimmune disease called glomerulonephritis, which is a disease of the kidneys. And that's because of a lack of water, now can you imagine getting kidney disease because you don't have safe water? Again, if you don't look at these communities in these ways, you don't know that. So that is just one example.

Another definition is "Lack of Sanitation," referring to garbage pickup and so on, and this encourages increased rat density, which leads to leptospirosis, and of course all kinds of other diseases. In the Philippines they have these city dumps with huge stacks of garbage, and people actually live in these communities to scavenge so they can find things that they might be able to sell or even eat. Now this garbage is stacked up several stories high and actually undergoes spontaneous combustion, so it is always smoldering and there's lots of heat, and things sometime fall or collapse on top of these houses in the dumps and the people are just roasted alive. And when they eat things from the garbage dumps, pregnant women who eat leftover food, their fetuses develop complications and are born with hydrocephalus and all kinds of congenital diseases. Again, all of these problems are because of unsanitary conditions.

The third definition is "Lack of Tenure," which refers to entitled land. So what happens is people have no power over issues that surround their environment, such as where industry or the government decides to dump their waste, toxic waste. A good example is what happened in Port Paul, India (LOOK UP), where they had a release of cyanide. Have you heard about this? This is the biggest industrial disaster in the history of mankind. Isocyanide is used as a component of pesticide. There was an accidental release, and 20,000 people immediately died. This happened in the 1980's. It contaminated the groundwater, and to this day the groundwater is still contaminated. They built this plant right next to one of these slums.

**BSJ:** Because the slums "don't exist" according to the government, right?

**Riley:** Right they "don't exist," and plus it's cheap land so they built this plant there. So that's an example. And these people have no say in what goes on. Can you imagine this company coming to Beverly Hills and saying they want to build this plant? That would never happen, because the people who live there would say something about it. That happens in the U.S. too, what happened with hurricane Katrina? Who were the people most affected by that disaster? The poor people of the city.

Another part of the definition is "Poor Structural Housing." A good example of that is what happened

in Iran in these slums, there was an earthquake that killed about 32,000 people. A few days before this earthquake happened in Iran, an earthquake of the same magnitude happened in California. In California, only one person died. The difference was because of the sound structural housing in California. So if you look at all these definitions from the U.N., you can come up with all sorts of different mechanisms for disease manifestations.

**BSJ:** That includes disease, injury, everything.

**Riley:** Right. In Brazil, I don't know if you have ever seen these housing structures, they are brick houses built in a kind of vertical fashion. The houses are built along a cliff, and there isn't much open space between these places. So because they built these houses in a vertical fashion, the only place where they have open spaces are on top of the houses, on the roof. So what happens is kids go up to the top of these buildings to fly kites, and they fall and get injured. Also, the adults don't have anywhere to hang out, so they go up to the roof, get drunk, and they fall. So the structures contribute to these injury issues in the slums.

In the lowest part of the valleys, during the rainy season, the entire areas get flooded, many houses are flooded and that's how they get diseases. And this is where they walk, the people who live down in the valleys have no choice but to walk through the floodwaters.

**BSJ:** Did the population know these were the reasons they were contracting these diseases before you went in and informed them.

**Riley:** No. Now they know, so they are a little more careful about how they go into the water, they wear boots and things like that.

**BSJ:** But before, they didn't take any precaution.

**Riley:** Right. Before they would just walk through with bare feet.

**BSJ:** When you went door to door to interview people in these slums, how cooperative were they?

**Riley:** I would say 75-80% were cooperative, they let us interview them and take blood samples.

**BSJ:** That is a very high percentage.

**Riley:** Yes, we have a team that has been there a very long time.

**BSJ:** So do you enjoy going down there to Rio?

**Riley:** Yes, it is a great place to work.

**BSJ:** Well thank you so much for speaking with us, this has been very interesting and educational.

**Riley:** No problem. These are important issues and students should be aware of what is going on in these parts of the world, and hopefully students will get

involved with these issues as they choose their future career paths.

#### IMAGE SOURCES

<http://news.fletcher.tufts.edu/reflections/wp-content/uploads/2010/10/favelas2.jpg>  
<http://www.news.cornell.edu/stories/Oct07/WCMC.leptospirosis.html>

