[MUSIC PLAYING]

SPEAKER 1: Thank you for that. Thank you for that introduction. So I have to use this mic because my Mac isn't compatible. So I'll kind of be stepping forward, looking at the slides with you. So my purpose in this talk is to really talk about what's behind this rise of killer viruses. It's something I get asked all the time. You know, what are we going to see next? Why are we seeing this? What's going on here? And I'm going to hopefully try and unpack all of that. And since they're working off my laptop, all my alerts are going to show up on my computer, so you'll see all my personal stuff on the side there.

So there's my disclosures. So the purpose that like, I said, is to really drill down and understand why this is happening. And there's several different causes that are converging, and I'm going to kind of go through them all. I'm going to give you first a snapshot of all the things that I'm thinking about now, and what you should be thinking about, because it is a small world and people travel, and there are things that happen on one side of the globe that impact the other side of the globe very quickly. And really what that drive down to is changes in human-human interactions, changes in human-animal interactions, human-environmental interactions, as well as changes in vectors.

And then I'm going to move on to surveillance and the tools of discovery, what I think are the ways to prevent this from happening. So when you think of what's going on, I'm just to give you a quick list and one word about each of them that you need to think about. So MERS, MERS is spreading in the Middle East. It is a respiratory virus. There have been about a thousand cases all in the Arabian Peninsula, massive, massive outbreak in South Korea with an importation coming from camels and bats. That's something interesting that's going on.

Yellow fever. This is something we thought we were relegated. However, we have a yellow fever vaccine shortage. Just try and get a yellow fever vaccine now in Allegheny County. It can be very difficult. Although the UPMC pharmacy house about 10 left, I think. So that's one way yellow fever appeared in Brazil. It's going on in parts of Africa, and for the first time ever, we had cases in Asia.

Zika. This is something that exploded onto the scene last year, and the first time ever in this hemisphere, was linked with birth defects. I talked about it during I last year's talk. This was something that came out of the blue for most people. But if you're looking at the way the vector was behaving, it wasn't surprising that this happened.

Ebola. Ebola is something that basically had been relegated to central Africa for quite a long time, and then it then basically exploded in West Africa with the largest outbreak ever, caused massive consternation in the globe, including in the United States, when we had an imported case that lead to two nurses getting infected, and basically ground the country to a halt, and made me a standing guest on CNN for about 30 days because it was such a captivating thing. Now politicians take up all that space that Ebola took up.

Powassan. So some of you may have heard of Powassan. This is a tick borne virus that's in the United States. It spreads by the same tick that spreads Lyme disease. And it spreads much quicker. This can cause encephalitis. That's something that's emerging now in the United States.

Severe fever with thrombocytopenia syndrome. In China ticks causing this very severe disease. Some people are having fatal cases. West Nile, never before seen in the United States. Appears in New York around 1999, spreads to almost every state. Spread through mosquito vector. had never ever, really escaped that area of Israel and Africa. It's something that was really surprising. I think one of the first things that got people to think about this.

SARS. This is probably the scariest of all of the outbreak. SARS is something that nobody had really thought about corona-viruses, except for the Graduate School of Public Health dean Don Burke, who had predicted maybe corona-viruses would be a dangerous virus. But SARS came around in 2003, because people were interacting with civet cats. So they were cooking civic cats as a delicacy in parts of China. And this is a bat virus that came from bats into the civic cats, and then went into people, and then basically spread in hospitals very, very dramatically, with over 8,000 cases around the globe with about a 10% mortality, including places like Canada where you saw airports clear out. I was a resident when this was happening and it became something that you'd never really had seen. I'd never seen pictures of airports that were completely empty because people were so nervous about SARS.

Measles. This is something right now that we're having a major outbreak in Minnesota, in the Somali refugee population, because the anti-vaccine movement has gotten its claws into the Somali refugee population, and told them that the vaccine is going to damage them. Measles is something that kills 15,000 people all over the world, but it's something is re-emerging. We had a Disneyland outbreak a couple of years ago.

Monkey-pox. Most of you probably haven't heard of monkey-pox, but if you read the infectious disease little alerts that I get from all over the globe, monkey-pox has been spreading in countries like Nigeria. Monkey-pox is a cousin of smallpox, and because we do not vaccinate for smallpox anymore, there's no protection against monkey-pox, and they are getting longer and longer chains of transmissions in humans. It usually just comes from a rodent to a human, and then it stops. But now these transmission chains are getting a little bit longer, so people are very concerned about it.

Chikungunya. I spoke about that I think two years ago. Another mosquito borne illness. Had really not been in this hemisphere that much, and it had an explosive outbreak centered in Saint Martin, which then spread everywhere with local transmission and places even as close as Florida, and Texas.

Same thing with Dengue. Local mosquito borne illness, local transmission in Florida, Texas, Hawaii. This is something that's come back.

And then Avian Flu, which I'm going to spend a little more time talking about, because I think this is the highest priority threat agent that we think about. It's the thing that's most likely to cause a global pandemic with major societal impact. So this is kind of just a snapshot of what I'm trying to talk about, and Swine Influenza you can't really do anything without thinking about Swine Flu, after what happened in 1976, and we're starting to see increasing cases of variant flu.

Hepatitis A. I just came back from San Diego where the national infectious disease meeting was. For those of you who don't know there is a massive Hepatitis A outbreak with deaths in the homeless population in San Diego. Also homeless population of Los Angeles, and some other counties, kind of spreading through homeless population. This is something we thought had been gone. We had a vaccine since 1995. We were at an all time low. Well, we have a resurgence in those unvaccinated populations, which is kind of scary, because if you look, you can see people sandblasting the sidewalks there, power washing the sidewalks, trying to get people to sanitation because Hepatitis A comes back when your guard is down.

So this is a slide that the director of NIAID always uses, and I kind of feel odd using it, but it's his slide that he puts in all these presentations he gives, but this is what I'm trying to say, is that there are so many things going on all over the globe. And more things get added every year, and it's not something you can avoid. This is something, everybody here has been to one of those countries, or has a patient from one of those countries. So you have to really have high situational awareness.

So when you look at the trend of infectious disease, in the first quadrant you can see this is the number of outbreaks that have been reported every year. It's going up and the disease richness, how many different things you're seeing is going up as well. And then also when you look at that human specific, going up. Viral diseases going up, which is the topic here that we're talking about as well. And most of these are non-vector borne, but you're also seeing an increase in vector borne. So the thing is what's going on since 1980 to 2010? And I'm trying to kind of unpack all of those factors.

So when you think about why this is happening, and why it wasn't happening in 1800, I think it takes a little bit of mathematical reasoning. So you think about something called the incubation period. So that's when someone gets exposed to a disease, and how long it takes before they start showing symptoms. And then and then you have this period of contagiousness, which may begin before during the incubation period, for example like an influenza, or after the invasion period when you have symptoms like Ebola for example. And then travel time. And a simple equate you could think about. If your travel time is less than the incubation period, or the period of contagiousness, you will start seeing importation of disease.

So if in 1800, if you are on a boat going from London to New York you likely became symptomatic on the ocean, and you either got sick and got better, or you got sick and died and were thrown overboard. So you weren't going to import anything anywhere. But when you have flight times from New York to London and seven hours or so something, and then from London to Kinshasa, you have a 12 hour time difference there. So you can probably get anything anywhere during your incubation period, just like what happened in Dallas with Ebola, just like what happened with the two importations of MERS cases we had in Indiana and Florida. So this is why we see importation, because travel times have shrunk, and it is a very global world.

This is a cartoon of the Yellow Jack, which the Yellow Jack was something that ships would fly when they had Yellow Fever on board. It was before they knew it was mosquito borne, and that was probably one of the first travel related diseases that people thought about. The Yellow Fever could come from one part to another part, because mosquitoes were stowing away basically. People didn't know that it was mosquitoes until Walter Reed figured that out, but this is what got people thinking about travel related diseases. And it was one of the major factors for the International Health Regulations, and remember, Yellow Fever in the Americas, in South America, it's something that came from West Africa. It was on slave ships. So this was one of the first importations of disease that we saw.

This is a picture of a global flight map, where you can see how many flights are going everywhere to everywhere. And this is something that I think is new. This wasn't something that would have been possible even 100 years ago. So that's why these diseases are coming about, because the things that were segregated in one part of the world are now finding access to other parts of the world, and this is the biggest factor. Globalization and having a truly global world where you can be a citizen of the world, and you know, it's a small world. It's kind of a cliche, but it's very true, that the world is flat, and it's small, and people can get anywhere to anywhere. You can even go to Iceland from Pittsburgh now, which is kind of interesting.

But this is what we talk about in 2017. This is very evident, but if you go back to 1492, this is where the origins really start. So this is something called the Colombian Exchange. So when Christopher Columbus and all of the European explorers came to North America, they got all these great things, tobacco pineapple, beans, vanilla, tomatoes, but the Europeans brought Smallpox, Influenza, Typhus, Measles, Malaria, which was almost a virgin population. The Native Americans at that time had never seen any of these diseases. So this is the first example, really of a global exchange where you're starting to see this happen. So it's been going on since 1492, but it still took a long time to do it.

You can see some of these diseases were something that could spread on a ship. So one person might have smallpox on a ship and it would kind have an outbreak and go along, and then bring it here, or influenza where it could spread on the ship, and continue to remain viable, but that's where you started seeing this introduction of disease. And so it's not something that's super new, but it's become much more magnified because the travel time has decreased exponentially. This is something from Geosentinel Network. This is a network that the CDC runs, where they look at return travelers. I just want to just draw your attention. It's too hard to project but this is an analysis of Internal Medicine, each different area has different diseases. So for example, sub-Saharan Africa, Malaria, Latin American, Caribbean, Dengue. If you look down to Europe it's influenza, is one of the most common travel related diseases. So it's important to ask travel history. I can't get that across enough to people, because lots of things come out in travel history that you may not think about. Not just Ebola, but things like flu. Remember the hemisphere has an opposite flu season. So it's summertime, you can have flu. But maybe they just came back from Australia. So you have to think about what's common in those areas.

And this is a slide of SARS, and this is just to reinforce what a disease can do in the right circumstances. You see multiple importations. We even out about 10 cases in the United States. Basically tied to a super spreader in a hotel in Hong Kong, where he was a doctor. He was at a medical conference, just like this, and everybody went to go visit him, because he was sick in his room, and then they all went back to their own cities, and seeded the world with SARS. And this caused billions of dollars of loss. We still don't have a SARS vaccine. 14 years later, we have no sorry anti-viral. It's kind of disappeared from the scene because people have gotten better at not eating civet cats, basically, because that was what was the tip off there.

And the thing that really made SARS worse were the human factors. This was spreading in Chinese hospitals, but they were hospitalizing these individuals in military hospitals, and the Chinese Communist government kept it very silent, and these are some of the cartoons at that time because they were saying there's nothing going on, nothing going on, nothing going on, until somebody leaked it on an email bulletin board, a listserv called PubMed, which is a really great one, which I recommend. And on that listserv people started saying, we've got these respiratory illnesses, and then people started going in there trying to figure out what was going on in China. And then it came out. And then you actually could bring the force of the world to actually figure out what was going on, because they had no idea what was causing it at that point.

MERS is the cousin of SARS. It's in the same family. And what we've seen there is an alarming number of cases in the Arabian Peninsula. MERS is a little bit different, and there's no civet cat here, but it's camel borne likely, it's probably bats, to camels, to humans. And you have to remember that in the Middle East, humans interact with camels the way people do with horses here. They ride them, they use them for transplantation. They have them as pets. So this is something that was a spillover event from camels, and has now spread to several different countries, and you just draw your attention as the Republic of Korea, or South Korea where there was a massive outbreak there, where somebody doctor shopped and went to multiple different hospitals, because he wasn't diagnosed, he got I guess, I think to the third hospital, so it took three to figure out what was going on. Although he had a positive travel screen from the beginning, and he infected a lot of people, and South Korea went into a major crisis over MERS.

So I think that when you think about the human race, and I think this is more of a philosophical type of slide. We went through three major transitions. You have to remember that humans for the vast, vast majority of their existence have been nomads. And about 10,000 years ago they started to do agriculture. And when agriculture happened, we started to see this what we call the age of pestilence and famine, where you have diseases that were never occurring before, because nomadic tribes, and I'll talk about that in a second are much less likely to sustain an infectious disease outbreak, becoming more common now with agriculture. And then from there, we have massive advances with the Industrial Revolution, where sanitation becomes normal, eventually we get to antibiotic treatment vaccine, and then you have this age of receding epidemics, and it's during this-- in the age of receding epidemics when before, any doctor that's all they dealt with was infectious disease. The real need for infectious disease specialist came around in this age of receding epidemics because less people had seen things.

So for example, right now all of you would console me if you had a Malaria case, but the equivalent of you in Africa would say, oh, that's nothing. You know, we don't need infectious disease for a Malaria case. So you have to remember, it's what's common to people. And that's what happened was this age of receiving epidemic. And then with globalization, urbanization aging, we went to the age of degenerative and man-made diseases. And that's where we're seeing some types of cancer, heart disease, diabetes, and less of these infectious disease, and some of the prior speaker was talking about, some of those diet induced diseases, I think are part of that, the man-made diseases. And what we see as the birth rate and death rate were pretty much equivalent, and now we've seen dramatic declines in the death rate and birth rate, and the total population going up because we've controlled a lot of these epidemic. But globalization and urbanization are two factors that will push more infectious disease forward.

So when you look at-- this as the human lifespan. Most of our time has been nomadic foraging, 99 point something percent. So you have to know that our genes are evolved for a nomadic lifestyle. So as population density increases, human to human interaction increases. You have these waste management deals that you would never have to deal with when you were a nomadic tribe, because you're just gone. Whatever waste you had there was there. Having agriculture, interactions with animals, massive lifestyle changes. You become much more sedentary. To reflect back on what the last speaker said, your diet becomes much more homogeneous, because you're now growing crops that are probably very, less variety, less color, like his slide said. And then also you have to remember that evolution has a very, very strong force, and because our genes are adapted to nomadic, or evolved for nomadic lifestyle, it's going to be very different when you're in a different situation. And that's basically what we're seeing here with this.

So the biggest thing about agriculture to remember is, you have lots of different animals that you're interacting with. And when you have agricultural exposure, you have something called Zoonosis, and Zoonosis are really an interesting phenomenon, and the word just means animal disease. And when you talk about a Zoonosis, we have we have a couple other related concepts. So the reservoir, where is this normally? So rabies reservoir is bats. And when it spills into humans, it goes from bat, maybe to dog, to human, or bat to human. That's what the zoonotic event is when we talk about it, it's a spillover event.

And sometimes you can have a vector or an insect. For example, if you think about West Nile. West Nile, it lives in certain birds. It comes from birds, by a mosquito, into a human. And overall, and those of you who are in clinic yesterday, or at the hospital. It's a relative. You're not going to see that many Zoonosis in your hospital. But if you go back forever, most infectious diseases were Zoonosis at one time. Measles from dogs, HIV from chimpanzees. All of these things usually come from animal species.

And you have many, many different ways that you can get a Zoonotic disease, and I won't go too much over that circle over there. But one of the things you have to think about is on this side. So lots of people are getting exposed to animal viruses, but very, very few can make that jump. Maybe it has to do with receptors, maybe it has to do with genetics, but once they make that jump, only a small portion will get an infection. So a level two is what, from this paper that I'm citing here, a level is just an infection, and maybe that's just a one off and you're done. Maybe that's rabies, because you get rabies from a bat, and then you die, and you don't transmit it to anybody else.

However, there are some that have the ability to transmit. So one person gets, another person, and then they can transmit it to another person. And that's kind of the first step that you need to get to a level three, that it can transmit a little bit. But really, it has to be able to spread in a sustained fashion from people to cause an epidemic. So this is a high barrier that a virus that's not adapted to humans has to do. And that's why it's sort of rare, but it's what we're really looking at, is trying to understand where a long step any emerging virus may fall.

So what are some of the factors that are coming out that these Zoonotic infections that we're hearing about. We've got much better diagnostic testing. I can't say enough that diagnostic testing is one of the biggest advantages we have over even two generations ago. We can figure out, we can sequence everything, we can find things. We get we can find diseases that don't necessarily-- that we never even heard of. There's lots of things going on in the microbiology lab. So I think that's really great.

Recreational travel to rural areas. How many people go to Yosemite? People go to the Grand Canyon. People ever go to Cook's Forrest, and come back with Babesiosis. So there's lots of things that you can do. People travel to these areas. International travel's become the norm. It's become very easy to move from one part of the world to the other. We talked about that a lot.

Population displacement due to warfare. Any time there are refugee movements, and there's massive numbers of refugees, there is a lot of factors that can cause people to come into interaction with animals and get zoonotic infections and spread. Homelessness, that's another one because people are then exposed to things like for example, rat urine and mice urine. There's lots of diseases that happen in rat and mice urine.

Interactions with animals. People have odd pets. There was a Monkey-pox outbreak in Indiana because people were importing Gambian rats, and they were using Gambian rats as pets that had Monkey-pox on them. So there was about a dozen cases or so because of people's interactions with animals.

High population of reservoir host. There can be a big rain fall in Arizona. During an El Nino year the population rises and then you have Hantavirus predictably. You could have different weather patterns different events, you can have newly emerged unrecognized organisms. There's lots of different things. That's the point. There's lots of things that affect it, but they're all kind of converging. This is just a headline from 2012 when there was a Yosemite Hantavirus outbreak that killed three people because people were having these kind of cabins where there were mice in them, and Hantavirus, as you know, is something that you get from aerosolized mice urine.

There have been cases in Pennsylvania of Hantavirus, and basically what ends up happening is you aerosolize this you're in from the mice, and it spills into humans, and humans are a dead end host. They don't spread it anywhere but it is very, very dangerous because this causes you know, the classic thing is a young person with Pulmonary Edema, and it's a very severe infection, and people die from it from refractory hypoxia. And that's something that can happen because of interactions animals. I'm not saying everybody needs to wear a gas mask when they sleep in a cabin, but that's something that they may think about doing when they've been somewhere where there's clearly mice droppings.

Does anybody know what the significance of that is, that picture? I wrote Ebola there but anybody know what that is? It's a hollowed out tree, but the first case of Ebola in the West African outbreak was in Guinea, and it was in a two-year-old kid, and that was his favorite play place, was that tree. I think the tree's been cut down now for obvious reasons, but the little two-year-old, the one in the index case, played in that tree, which probably had bat droppings in it. And that's likely how that case happened.

And then you have this happening in Guinea, which had never seen an Ebola case. They have poor diagnostics, which is a theme I'm going to keep referring to. They thought it was cholera for three months, case is festering in Guinea, and then by that time the cat was out of the bag it was too hard to actually catch up.

So Ebola is something that is on everybody's mind, as a very dramatic example of what I'm talking about. Ebola has this reservoir, likely in bats. And then moose, and non-human primates, and deer, would then go into humans through direct contact, and then humans spread them in hospital settings like we saw in Dallas, and like what happens in village health centers, as well as with burial practices in Africa where people wash the body with their bare hands. Ebola has a lot of different bat reservoirs that are suspected, but it's not something that it's been completely proven yet. We haven't had direct transmission prove between a bat and a human, but these are some of the ugly looking bats that Ebola may reside in.

But it's interesting because bats are this major reservoir for many different viruses things like Rabies, NIPA virus, Hendra virus, Marburg, SARS, MERS, why is it so? I think it's surprising to most people to realize that bats are the most populous mammalian species on the planet, and they're everywhere! There's no place you can't find a bat. From, I grew up in Butler. They were always flying around your house in Butler, but you can also find them in Bangladesh. And they can travel long distances because that's what they're able to do. So they have a lot of viruses there. They've got all kinds of interesting diseases in bats, even weird fungal diseases that are kind of cool as well, but this is one of our high value targets if you're looking for new viruses to spill into humans.

The picture here, just about flu, and I think that this is something that you have to keep in mind. We're about to enter our flu season. Hopefully you all have your flu shots. But this is not your seasonal flu that I'm talking about, or not your father's seasonal flu, I guess from the old oatmeal commercial, but basically what you've got here are pictures of live poultry markets in China where avian influenza thrives. And you can see how they house these chickens, and how people will then butcher them in a live market where they put themselves at risk. And then this is a picture of a person petting a pig at a farm event, an agricultural event, at an agricultural fair. They have lots of these fairs from Butler like I said, and at the farm show and the fair, everybody does this with pigs there. And you can get swine viruses that way as well.

So these are things that are kind of making the jump into humans, and I'll talk a little bit about flu, because this is the paradigm of a scary virus that can do interesting things. So when you look at flu, it's an RNA virus. RNA viruses tend to take much more than DNA. It's less stable. Their genome, their chromosomes are eight little segments. And what ends up happening is these things can shuffle. They can shuffle in and they can mutate. That's why we need a new vaccine every year. But what happens sometimes is there's a major shuffling and you get hybrid viruses, that maybe have been in a bird, in a pig, and then in a human, and then you can get something almost kind of chimeric pandemic virus comes out. And that's what happened multiple times.

We've had three major pandemics. 1918, where we had a virus that's circled the globe right after World War I. Killed probably 20 million people. We're coming up on the anniversary of it, and that virus was completely of avian origin. Probably didn't start in Spain like they called the Spanish flu, probably started in the United States and Kansas is what the most data shows. And then just use the troop movements to travel the small world to spread across the world.

But then what happened in '57 was this old, a 1918 virus became the normal seasonal virus after a while, and it recombine with an H2N2 avian virus, and we had this H2N2 outbreak in 1957, which was pretty severe, which had some of those genes, which were now human adapted, as well as new avians. The same thing happened in 1968 where we had an H3 avian virus combined with the current H2N2 virus, and we had a new. So we don't know what the next pandemic virus will be. Will it be all avian, will it be a combination? And when you look at flu. This is something that is not easy to contain, because it has respiratory transmission. Public health interventions don't work so well. And the other thing about flu that makes it really powerful is that it transmits during its incubation period. So the day before you are you have symptoms. You may be contagious, and remember, 25% of flu cases don't have any symptoms at all. And you're still contagious. This makes flu basically the paradigm of something that can really cause a lot of damage, and get out of hand before we actually know about it.

And H5N1 was one people were very, very scared about it because it emerged in China, and basically spread in some of those related countries. And it has a 60% mortality rate, H5N1. Does anybody know what the mortality rate of 1918 was that killed 20 million people? Somebody scream something, yell something.

AUDIENCE: 30%?

SPEAKER 1: 2%. So 60% to 65% mortality. So 2009 H1N1, the pandemic that was less severe and deaths, but did cause a lot of disruption, and did kill a lot of people. This is exactly the point we make. This is in the bottom corner there, the H1N1 2009 strain was a triple reassortment that resorted with the Eurasian Swine Strain. So just imagine what an odd combination that was. That's what was so scary about it, because we saw this virus that no one had seen before. Nobody was looking at swine herds, and you had this triple reassortment with another reassortment. So it was a quadruple reassortment. I think that was what was really scary about H1N1. And by the time we saw the first cases in San Diego in April of 2009, it was already everywhere.

And then the vaccine came after the peak of illness. So it was a really good trial run, but we didn't do the best that we could, because the vaccine was delivered way too late. And there was initial overestimation of the severity of the disease based on anecdotes from Mexico. And then people really didn't have a good idea of how bad it really was, but it did kill people in the prime of their life. So if you take the people that die during the normal seasonal flu, it's very young, very old, during H1N1, it was people and 25 to 40. You take that and multiply by their expected lifespan, and then you compare that to other pandemics, it is pretty severe because of the age of the people it killed.

Right now we're starting into the flu season. This is the latest flu view from the CDC, and we don't have very many-- we're at kind of the tail end of the graft there, and we're going to expect to go back up. But I draw your attention to the blue shade. Those are swine viruses that they're finding, that are jumping into people, mostly at agricultural fairs. So this is something that we're tracking to see how many of these occur, and if they do anything kind of worrisome.

So this is why a lot of people get mad at me for always ordering flu tests, but I want to know what it is, and I like to know what type it is, because I kind of keep that in mind, what's going on. And I think that there are surveillance lights that the CDC pulls from it but I think it's important in any of your settings to know that someone has flu, or when they don't know when flu is circulating in your community.

I think the scariest form of flu is H7N9 and most people probably haven't heard much about it because it hasn't really been breaking the headlines too much here. This is another bird flu in China and we're in the third wave right now of it. And the third wave has had a massive increase, and there's been changes in the virus, and the virus is now showing more human tropism where you're starting to see this virus have the ability to bind to human receptors, where before could mostly just bind to chicken receptor, or bird receptors. We're seeing anti-viral resistance in it, and when it came out a couple of years ago, we made a vaccine and put it in a stockpile. That strain's now changed. The vaccine that's in the stock pile or H7N9 is not likely to be a match anymore.

So this is becoming very, very scary. It's now killing chickens. Before it wasn't killing chickens. Now there's a high pathogenicity variant, and because my little stuff is showing up on there, this is a graph called the i-rap, which is the influenza rapid assessment that the CDC uses, and you can't see the top corner H7N9 has been listed by the CDC as the highest priority flu pathogen, most likely to cause a pandemic right now, which is scary. There were a lot of meetings about this at the IDSA meeting two weeks ago in October.

So there's a couple different steps in it that a flu virus has to do. So the avian adapt strength has to become widespread while the domestic swine or another reservoir species, and then one or more humans have to get this infection. And then it has to cause enough disease that there's infectious secretions in a person, and then transmit to more humans, and not be accidentally stopped because somebody gets hit by a train, and it doesn't go anywhere. It has to get into someone and then move along.

And that's where we are. So we're around number four for H7N9 and then it can go it can move globally. So around four we're seeing small chains of human transmission, usually in people that are closely blood relatives, so there may be some genetic component there, but this is where H7N9 is, at the fourth step, which is pretty scary, which leads me to this concept.

So one health is something that we talk a lot about in the circles at our think tank. One health is an integrated human animal view of health. And I can just know here that there's probably zero veterinarians here. How many of you doctor speak to your veterinarians about what's going on in the animals that they're seeing? Remember, all these diseases come from animals. Eventually at some point, and there's very, very, very poor integration between veterinary medicine and human medicine. So one health is trying to switch that where you have the AVMA, and the AMA trying to come up with joint meetings, and trying to really integrate what's going on in the veterinary world with the medical. And when I go to meetings there's probably equal, or maybe 30% veterinarians, 70% medical doctors, which is pretty high, where you have veterinarians that are actually talking about what's going on in the reservoir species, what's going on in domestic animals. But I think maybe in the old days, the old family medicine doctor would know the veterinarian walking around, they know whose cows were sick, and who was tending to those cows. But that's kind of gone away. And I think it needs to come back to become more resilient that defending against these infectious disease.

We're going to talk a little bit about vector borne diseases. These have really struck back I think in the last couple of years, mostly because there's been massive urbanization, and we have human adapted mosquitoes that love the urban environment. And there's a lot of complacency. Once a vector borne disease goes down, you don't have any West Nile cases. Nobody wants to deal with the mosquitoes anymore. It becomes a budget item, and that gets kind of overlooked. This can roar back.

When you look, this is what we thought Aedea Albopictus, and Aedes Aegypti, these are human adapted mosquitoes that spread Yellow Fever, Dengue Chikungunya Zika. When you look here, this is where we thought they were. So Alberich just kind of in the South East, and Aegypti in the very south, but when they actually measure, they're basically everywhere that you could see. Almost half the US population is at risk for IED spread diseases, including Pittsburgh, where we've seen Aedes albopictus been isolated.

So this is not surprising when you think about how mosquito budgets kind of have gone down, and then you and then you see Dengue, Chikungunya, and Zika having local transmission in the US, it shouldn't surprise you because all it takes is the right person being bitten by the right mosquito. And that happens all the time, when people come back from Florida, or from Key West, or from Puerto Rico, or the US Virgin Islands. And especially now in the hurricane, think about how much standing water there is in those places for those mosquitoes to breed in. It will be interesting to see what happens with these diseases.

And it's important to remember, Yellow Fever isn't a tropical disease. It's only a tropical disease because we beat it out of the United States. If you look at this map, there were Yellow Fever outbreaks all across the eastern seaboard, as far north as Boston. On the left side of the screen is a monument in Memphis to people who died during a Yellow Fever outbreak. And during George Washington's administration the government basically ground to a halt in Philadelphia because Yellow Fever outbreak was so bad. So don't think that these things can't come to temperate climates. They were in temperate climate in the start of this country. Remember, Washington DC was a swamp. It's a swamp. So that literally was about draining the swamp back then to make it actually habitable.

And the last thing I want to talk about, I call it the return of the primitive, the anti-vaccine movement. I can't talk enough about these people because they really get on my nerves. When you look at our measles cases in the United States. And it just dropped 70% of the cases of measles that have occurred have been in unvaccinated individuals. This is it this is not a hard inference to make. You don't need to drill into the data. It's very clear that if that measles vaccination is very essential to keeping measles at bay. And I think it's sick what they did in Minnesota with the Somali refugee population and try to convince them not to get vaccinations. Now we have a major outbreak in Minnesota. I think that this is something that they're really trying to pull us back to the prehistoric ages, and you have to remember that measles kills 15,000 kids a year. One in 20 people during the measles outbreak in Disneyland were hospitalized. One in 1,000 people die from measles, and the anti-vaccine movement has very flashy celebrities, and a lot of power behind them including RFK Jr, and it's very hard to counter that, because they think--

I don't know if anybody here could even name a pro-vaccine celebrity. Can someone name one? There's a couple. I just want to see who people name just from my own benefit.

AUDIENCE: Penn and Teller.

SPEAKER 1: Penn and Teller. Yeah, that's one. Yeah. Penn and Teller are good. They're pro-vaccine. Penn and Teller, Amanda Peet, Tim Daly, what?

AUDIENCE: The author, Roald Dahl, who wrote *James and the Giant Peach.*

SPEAKER 1: Yeah. Yeah. Yeah. They're involved with Partners in Health. They funded all that stuff in Haiti. His daughter is really close with Paul Farmer, the Harvard infectious disease doctor. So there's very few. That's the point. We don't have that. Kristen Bell is another good one to talk about as well. I'd like to give them a little bit of a plug because there are so few of them. And I think it's important to recognize them, because Jim Carey, Jenny McCarthy, Mayim Bialik, all of these other ones are kind of there pushing this everywhere.

So I think this is something else that will be a factor in the emergence of killer diseases. The anti-vaccine movement, and what inroads it makes. And it happens all over. We have problems with the anti-vaccine movement in Allegheny County. I sit on the HPV-- I was on the HPV advisory council and there's a lot of stuff that you don't know that's going on in the anti-vaccine movement. So I think it's important to remember that chance favors the prepared mind, and just by priming you with all this information, at least you'll think about it, maybe enough to send me an email that maybe this is weird, I got one last night about a possible MERS case in Erie, which I don't think was, but so people do send people-- You know, it's easy to talk people through these and figure that out if you're thinking about it. But the first thing you have to do is think about it, like Louis Pasteur says, "I think if you're thinking about it in your prime, you're more likely to pick things up."

A couple last slides I want to talk about, is the tip of the spear. So this is a picture of Bushmeat. You can see a gorilla head, and there's lots of hotspots. So we're trying now to understand where this is happening, looking for what's called viral chatter, which is a term coined by Don Burke, the dean of the School of Public Health here. It's looking for the first forays of a virus, so sampling blood, trying to figure out what's going on in Bushmeat hunters, what's going on in abattoir workers, people who are doing things that most other people don't do. And also looking at hotspots, where these viruses emerge, where the reservoir species all converged with humans.

So this is where the current thinking is, and what I think we need to get to is not just doing that in Africa and Asia where there's scary stuff, you have to remember that 40% of septic shock patients have no etiology. They got better. We don't know what it was, or how many people go to like a medic express, and they're like, you had some virus. Maybe you'll get better. You've got better, so don't worry about it. Hopefully you don't get antibiotics for it, but how many times do people know what they actually have? So I think that we want to get to this tricorder culture. That's a picture of Captain Kirk holding that tricorder that bones used to do to scan someone and say oh, you've got this, you've got that. And I think we're moving there with PCR technology, with now there's cleowave PC, molecular tests for flu and RSV. You can do all this stuff in an ER in an office setting, and I do think that we need to pursue these unknowns wherever they are. If they're in the ICU at a tertiary care center, or an ICU in a small place, or I think it's important to know what people have, because you will never figure out what these new viruses are unless you're actually looking for them.

And one of the slides I want to show is there was a doctor named Bill Ocapita. He was a chief of Internal Medicine in Zaire during the beginnings of the HIV epidemic. In the 1960s and 1970s he started seeing cases of Kaposi's Sarcoma, opportunistic infections, and writing them in a notebook, saying Kaposi's Sarcoma, cryptical meningitis, and he never diagnosed them, but imagine what a head start you would have had an HIV, in blood screening the hemophilia population, if you would have known about HIV then! He's writing this all down in a notebook, and what if it was a Microsoft Surface tablet that was linked to the cloud, and people were saying wow, there's all these weird opportunistic infections in this clinic in Zaire?

That's what we're trying to get to! Is being able to actually do that. And you have to think, in many places of the world they don't have any rudimentary diagnostic tests. It's just oh, you've got typhoid, you've got malaria, here's a shot of chloramphenicol, here's some charmiesonline. They don't think about what the diagnosis is. The same thing happens at an urgent care clinics. Oh, you've got a cold, here's a Z pack. Here's this, here's that. They don't actually figure out what's going on. We have that technology. And it's hard sometimes to make the economic case that you need to test these people for all of these viruses, but I do think it's the essential way of actually getting intelligence of what's going on. There's lots of biological dark matter out there that nobody really delves into. And every one of your patients has probably had a viral infection that they got better from, and you know what it was. So I urge you to think about that.

That's all, and that's what the Global Health Security Agenda that the Obama administration releases about, is trying to build that capacity in countries so that they can do laboratory testing. So we aren't surprised by SARS, or MERS, or Zika. So just to give an homage to one of my mentors, that's DA Henderson, and that's George W Bush's face that's covered up by my alerts there. DA Henderson died two years ago. He was the founder of our center, the Center for Health security, and he was the leader of the smallpox eradication campaign. And it's the first and only eradication of a human disease. And this is something Jennor predicted when he invented the vaccine for smallpox, and he died. He was a mentor to me and got me really to think about that stuff. And I think it's always this immortalizor that I can put my name Pub Med with his name, and we have coauthored papers there, which I think is really awesome.

But I think that what DA's vision was, was to control these infectious diseases by using human ingenuity. That's what I'm trying to get across, that this is possible. That I scare you with all these diseases, but the future isn't completely oblique. We did it with smallpox in 1980 with poor technology. We can do this now, as long as people are alert to it and preparing for it. So thank you for that and I'm happy to take questions in the remaining time. Feel free to email me, read my blog, follow me on Twitter. Thanks again. And sorry for the pop ups on my screen.