Virologists on the coronavirus outbreak | VPRO Documentary (eng subs)

N=Narrator
RF=Ron Fouchier
MK=Marion Koopmans
Int=Interviewer

N: How can we contain the pandemic caused by the coronavirus? Scientists all over the world are trying to answer that question. In the Netherlands too.

RF: Every few years we have an outbreak like this, and everybody goes: 'Why can't we fix this?' If we invest now, we can rid the world of pandemics in 20 years.

N: Ron Fouchier is the main Dutch expert on flu viruses. He wants to understand them and predict their evolution. This is five to ten times

bigger. Marion Koopmans is an expert in virus spread studies. In today's crisis she advises RIVM, the European Union and the WHO.

MK: Globalisation is fine, we all want it, but it comes with certain risks. We should structurally invest in solving that.

N: Both work in the Rotterdam virology laboratory, which is highly regarded internationally. They are always asked to help with research when new virus outbreaks occur. What are viruses? How do they find us again and again? And how can we protect ourselves against viruses, now and in the future? In this special edition of Backlight: Welcome to the lab of the best virus hunters of the Netherlands.

Fouchier and Koopmans were the first to hear about the outbreak in China. They heard alarm bells while most people thought it was a local problem.

Int: Where were you when you first heard about the crisis in China?

RF: We hear these things early on, so it was the first week of December. We were told about an outbreak of an unknown disease in Wuhan.

MK: The start was as unusual as everything that followed: I heard it through social media and a newspaper.

RF: The first few weeks of rumours were identical... ...to the ones in 2003 with the SARS outbreak.

MK: A group of people, 44 I think it was.....came down with pneumonia for an unknown reason. First you try to get hard facts on what's going on.

RF: People getting sick and dying could point to food poisoning...

...or a toxic substance they ingested or inhaled. You don't know immediately if it's an infectious disease.

MK: The first idea was that this group of patients came from a Chinese market. It was thought right away it had something to do with that market.

RF: When it was clear that it was linked to the live animal market in Wuhan...it reminded us of the bird flu in Hong Kong...and of SARS in Guangdong in 2003.

MK: Within a few days they knew it was not SARS. They excluded that pretty fast.

RF: I called some colleagues in China. They soon told me it was probably an infectious disease.

MK: That's when you move up a gear.

RF: After two, three weeks they knew it was a corona-type virus. The Chinese mapped the complete DNA material.

Int: Did the Chinese do a good job?

MK: Yes, I think so. There was criticism at first. But you have to realise: although it started in a city of millions...they singled out a group of pneumonia patients. A very common syndrome. Lots of people have it. But they linked it to that market, and that's remarkable.

RF: The Chinese have come along since 2003, like we have....and can determine the cause of an outbreak very fast.

MK: They found something and could prove the cause.....within a few weeks. That's impressive.

Int: I imagine as a virologist you must have thought: 'Oh, boy. How will this end?'

RF: There's no way to predict what will happen after the first local outbreak. All you know is that people will get sick and die. But what we still don't know, even now, is: How many people will be infected? How many of those will get sick? And how many of those will die? If you knew that, you could predict the impact of this outbreak. But we don't.

RF: We think viruses are the origins of all life. Life on earth once began with viruses: Self-multiplying particles with genetic material. We would not be who we are without viruses.

N: Back in 2016 we also spoke to Fouchier about the danger of viruses. Little did we know that we'd end up in this crisis. But then we also asked:

RF: [Fouchier talking in video shot in 2016] What do we know about viruses? A virus is a small package of genetic material. A ball of fat, really, with protruding proteins... ...that attach themselves to the host. When the virus intrudes, it releases its genetic material... ...and starts multiplying. That's all it is. A virus is about 100 nanometres. If you line up 10,000 of them, you have 1 millimetre. It's fascinating how something so tiny can bring down an elephant.

N: As a virologist, Fouchier is constantly in an arms race with nature. In 2016 he was studying bird flu.

RF: All the flu viruses we see: bird flu, poultry flu, swine flu, human flu... ...all originated in wild birds. Wild birds are the reservoir of flu viruses.

So we need to understand how they evolve in wild birds. Some can jump across to poultry or to pigs. Others can't.

[Farmer at place RF is visiting]: Excellent. Good to have you here.

RF: Infected wild birds excrete the virus after five days, in their droppings. You have to catch a lot of wild birds to map all the viruses. Wild ducks are the natural host for flu viruses. It doesn't bother them. The virus has evolved with them for millions of years. Most viruses we find in nature are harmless. We all carry viruses that don't bother us at all.

Farmer: Egyptian geese on the far side.

RF: But not all viruses are harmless. When the viruses in wild ducks jump across to poultry... ...they can evolve into more dangerous varieties...that will indeed kill chickens and turkeys.

[8:35] Farmer: We've got one, at least.

RF: We didn't work for nothing.

Both talking: Looks good. - White-breasted, this one. A subspecies. - Let's take a sample. We'll go back to the cabin.

RF: The flu viruses multiply inside the bird's airways, like in humans. But unlike in humans, they also grow in the gastrointestinal tract.

Farmer: That's the cloaca. NOT SURE WHAT'S GOING ON HERE.

RF: Now her throat. She doesn't like that.

Farmer: Done. I'll let her go. See if she'll take off.

RF: Some virus families can cause problems when they jump from animals to humans. Ebola, for example. The mortality rate in infected people...is somewhere between 50 and 90 percent. Luckily Ebola spreads poorly between people. That keeps it from creating global outbreaks. Other viruses spread very fast, like flu viruses. When they cross over to humans and get the chance...to jump from person to person, then you get a pandemic: A global epidemic.

Int: You work with viruses all the time. You must have seen this coming for ages.

RF: Not that this specific virus would hit at this specific moment. But we knew there would be new pandemics. We've been warning about that. Flu pandemics occur once every 25 to 30 years on average when we look back over the past 200 years. We also know that human airway infections like coronaviruses, pneumoviruses and paramyxoviruses all originate from animals. They must have caused a pandemic at some point before they became epidemic in humans.

Int: Is the way we treat animals one reason why the viruses jump to us?

RF: Yes. They can only cross over thanks to close contact with animals. We virologists have predicted this for a number of years: This zoonosis, the transmission from animals to humans, will increase. Because not only the human population grows, almost 8 billion now...but so does the population of kept animals, to feed us all. So the overlap of humans and kept animals gets bigger and bigger. And the viruses will jump across more often than before.

MK: We see the number of this type of outbreak increase. We saw it when SARS happened. We've had a Zika outbreak, we've had Ebola.

These outbreaks are all linked to population density...or, with Zika, a virus introduced in a densely populated area…that had good conditions for mosquitos and caused a new cycle. Which turned into a massive outbreak. Ebola in West Africa had only ever caused small outbreaks...
...in remote areas. But suddenly it reached big cities and spread like crazy. All these examples show that the world's vulnerability...
...to these infections is growing.

N: The closer we live together, the bigger the chance of outbreaks. Fouchier wants to predict the development of viruses...so a universal vaccine can be made.

RF: ~13:30 [Talking in 2016 footage] I'm interested in evolution. The evolution of mankind is too slow to study in one lifetime. But viruses evolve within a few weeks or months. So that's a process I can observe. I copy these bits of genetic material in the lab.....and make mutations in one specific gene. I put it back into the virus and I have a new, mutated virus. And then I learn exactly what the mutation has done. You can't do that this fast with any other organism. Modification of plants takes months or even years. We've all agreed not to do it at all on humans.

Female Voice (Unidentified): Look at these cells. They're different from the H5N1 ones we just saw.

RF (still 2016 footage): These are the viruses that started this whole study. First we looked into changing the way a virus attaches to a cell. Bird flu viruses don't go for cells at the top of the airways. We screened mutations we have from previous pandemics to see if they can change a bird flu virus in such a way that they attach more like a human flu virus. This technology allowed us to discover that one or two mutations that we took from previous pandemics and added to the H5N1 virus made it attach to cells in your nose and throat. Undistinguishable from a pandemic flu virus.

N: 'Know thy enemy', the old saying goes. Fouchier changed the bird flu virus genetically and made it volatile, to show how easy it is for a virus to adapt and become a serious danger to mankind.

RF (in 2016?): Since 1997 we've all wondered: Can such a virulent virus cause the next pandemic? Which could then be similar to the Spanish flu pandemic? So we developed experiments to test this idea on ferrets. We did an experiment with H5N1 bird flu. We mutated it, genetically changed it, using everything we know about the pandemics of the past 100 years. We gave the virus to ferrets and let it self-multiply. Then we tested if the virus from the airways of an infected ferret could be transmitted to other ferrets by sneezing, coughing or breathing. In 2011 we proved that H5N1, the bird flu virus, can be made airborne. So transmittable via airway droplets and aerosol. No one ever proved this before. It means we have to be careful with that H5N1 virus.
So that's a warning to the WHO and to the Asian countries where these outbreaks occur. And it gives us fundamental knowledge on how viruses become airborne.

N: Dutch scientists have manufactured one of the most dangerous viruses: The bird flu virus. It's a highly contagious variation.

Voiceover from contemporaneous news report: "Researchers working in Wisconsin and the Netherlands working separately have created a form of the deadly bird virus that can easily spread from person to person. There is growing concern..."

Another VO: Government is asking researchers to censor their research on the deadly bird flu virus...

RF (2016): In October 2011, the American authorities told us not to publish our manuscript with the methods and results. And they imposed

a gag order, which the Dutch government accepted. As a result, the press wrote things that suggested we had done something intolerable. So laypeople thought my lab made a biological weapon that could destroy the world.

Voiceover from contemporaneous news report: If terrorists got their hands on this information, they could create a virus that could kill millions of people around the world. The bird flu virus, known as H151…

RF (2016): It seemed as if my work was important in biological warfare to destroy public health. But I had intended to serve public health.

Int (2020): Is that how people still see it now?

RF (2020): In retrospect, everyone says the experiments done in Fouchier's lab gave us real insights into virus transmission between people. Based on those data we can now be alerted to viruses in animals that pose a threat to the human population. For example, based on our work, China decided in 2017 to vaccinate their chickens against a new bird flu strain. Because we all thought this one might cause a new pandemic.

N: It could have been a bird flu, but it's a coronavirus. What is a coronavirus exactly?

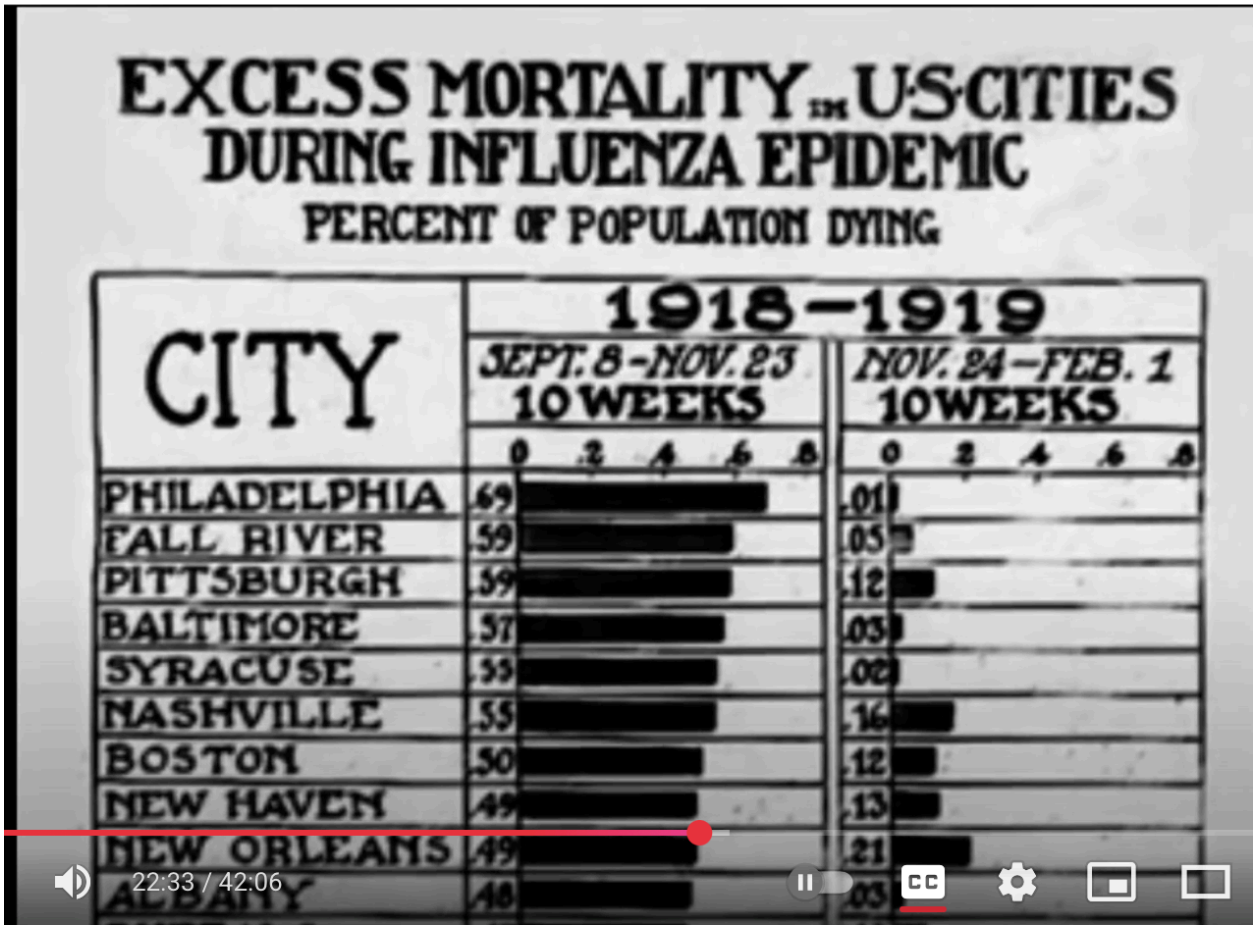
MK: It's similar to the SARS virus, sometimes called SARS-2 coronavirus. But it spreads in a completely different way. It also comes from animals and can cause pneumonia, like SARS did. That became a big outbreak that spread across nations. SARS patients had the virus deep inside their lungs. It didn't show until they were really sick and in bed. They weren't contagious until practically quarantined anyway.

But this current virus is different. It stays in people's noses and multiplies fast, within two days. So it spreads much more easily. That's the big difference.

At first we thought: this is like SARS, let's treat it the same way. The first data from China also suggested it was deep inside the lungs. But when it started to show in travellers in Europe, we realised we had missed the link with all the mild cases. They were spreading the virus without knowing it, until suddenly there was a massive outbreak. That's probably what happened in Italy.

N: Pandemics occurred in the past too. The biggest by far of the 20th century was the Spanish flu. In 1918, as the Great War ended, a flu virus swept the world, killing 50 million people in one pandemic year. So many people died that it caused the war to end. The Spanish flu killed more people than WW1 did. The Spanish flu was the worst pandemic we've known in 100 years. There's plenty of proof that it was indeed caused by a virus. 50 million deaths has been our **worst case scenario** ever since.

22:33



Where is the Spanish flu now? The Spanish flu swept across the globe in that pandemic year, infecting everyone who had not had it before. But after that it became epidemic, returning every winter to infect people again. It did so until 1957. So between 1918 and 1957 we had flu epidemics every year caused by the descendants of the Spanish flu virus.

In 1957 there was a new pandemic caused by a new flu virus. It pushed the old virus out... ...because there was little cross-immunity between the two. The new virus could infect the entire world population because no one was immune. And it pushed out the old virus.

With flu it's always the elderly who are susceptible. As with all infectious diseases. The elderly have poor immune systems to fend off infectious diseases. With flu viruses we see that very young people, aged between 1 and 10, are also more susceptible. The remarkable thing about the Spanish flu was that even healthy adults, aged between 20 and 40, were affected. We think this was due to an overreaction of the immune system. It responded too well.

Int: A lot of people died within 24 hours.

RF: Yes, mainly the ones who fought in the war. A big proportion of soldiers aged between 20 and 40 died as a result of the Spanish flu.

N: Viruses can hang around for years in new forms. What does that mean for our future?

Int: How do you see the future of this pandemic? What will happen?

MK: When you see how widespread the virus is now, I think it will not be eradicated for the foreseeable future. It will keep on circulating as one of the new winter viruses. We'll go through a period of serious impact first because immunity levels are low. In this phase we must put up with the measures currently taken.

Int: So that will take a while.

MK: Yes, it will. We're also doing this to play for time for vaccines to be developed. Treatments may develop faster. That process is in full swing. But it will take a long time.

Int: Can we say it's a risk we take in a society where everyone travels everywhere and is totally interconnected?

RF: Definitely. People in our society travel a lot. The population is dense, especially in big cities. People go on wildlife vacations and keep pets. Our lifestyle makes us extremely sensitive to virus outbreaks. Our population density reminds me of rabbits with myxomatosis. You know that phenomenon? When there's too many of them, in a small area, a virus comes along and makes them all sick. And a large part of their population dies. The concentration of rabbits allows the virus to spread easily. We're in the same situation: 20 million people huddled together in places like Wuhan or New York.

N: Trading live animals in Asian markets still goes on. This is the prime place for viruses to jump from animals to people.

RF: Live animal markets in Asia have 'problem' written all over them. We used to have livestock markets all over the world. You'd go buy a chicken, slaughter it right there, and take it home to eat. But that's outdated now. 7 or 8 billion people needing so many kept animals to feed them means you can't buy them alive and kill them yourself anymore. We've seen it going wrong with the bird flu. There were several outbreaks in Asia.

And of course we saw it again with SARS: Again it was kept animals, civets in this case who had a virus that jumped to humans and caused an outbreak. It should stop. Trading live animals, putting 20 species together, killing them on the spot, releasing all kinds of crap into that market. That's how humans get infected.

Int: So that should be banned, would you say?

RF: Well, China is a bit behind in that development. In the West, in Europe and North America, let's not forget, we also had live animal markets until pretty recently. Sixty years ago it was completely normal to buy a live chicken. But I think China will have to adapt too. It's better to

use slaughterhouses and sterile meat packaging .and sell meat at the supermarkets. Or stop eating meat altogether.

MK: Globalisation is fine, we all want it, but it comes with certain risks.

RF: Virologists are more aware than anyone, of all the natural viruses and the diseases they can cause. There are new virus outbreaks every year. Ebola, Zika, Mexican flu. And now this coronavirus. Every few years we have an outbreak like this, and everybody goes: 'Why can't we fix this?' Virologists always give the same answer: You could have fixed this, by investing in research.

Int: The search for a vaccine is on. Can we pump in billions and have a vaccine tomorrow?

RF: You can't just develop a vaccine. You can't spend a billion now and have a vaccine in the morning. First you have to design a concept. Then you develop that, test it, first on animals, and only on humans when it's safe to do so. We test on animals first because we know that some coronavirus vaccines offer no protection but make the infection worse instead.

Int: The current vaccine tests are slow. How long will it take?

MK: With this current one they're aiming to deliver fast. It's subsidized and they promise a vaccine will be available in 16 weeks. Most experts snigger at that, but that's the ambition. In any case, it's a platform that should be able to upscale very fast. But the question is, will this vaccine work, and is it safe? That takes time. There's a whole range of other vaccine candidates, but they have the more classical production period. Even if you condense the process it will be 12 to 18 months at least. So you're talking more than a year.

Int: You might expect it to slow down in summer, but winter will follow.

MK: Exactly.

RF: Ideally we'd have a universal flu vaccine to outwit all future pandemics. Including bird flu and horse flu and swine flu. We'd be protected against all kinds. But that will take 10, 20 years. If we invest now, we can rid the world of pandemics in 20 years.

Int: As a scientist you say it's possible?

RF: Yes, I'm certain of it. Science has achieved other major victories too: Travelling to the moon and developing a cure for AIDS. So I think we can manage a flu vaccine too. This could be an issue worth investing in. The Netherlands do it too little, one of the reasons being that governments always have a limited duration. Our government is elected for a four-year term. Problems arising after that, like the next pandemic are not on the agenda. Governments usually focus on balancing the budget for a four-year term. They don't look beyond that. So for this kind of long-term investment in fundamental knowledge about infectious diseases and preparing for a pandemic you need a much longer period. So we should all agree to change that and arrange things for longer than four years at a time.

MK: We invest hugely in keeping our dikes safe. So we can prevent flooding, which happens once every 1250 years. Keep the dikes from bursting. But that's how we should see this issue. Invest big. This one outbreak will cause economic damage like you wouldn't believe. Preventing even one outbreak would give you the funds for many years of research.

Int: Have we learned our lesson?

MK: We scientists had learned it already, so don't ask us. But it's...We'll have to wait and see.

Int: Do you have faith in it?

MK: I'm an optimist by nature, but the economic impact of this will be huge. Most likely, when things are more or less under control again the focus will shift to other things. And then we must all be super alert that we won't go back to what we had.

RF: Industry will never cough up 100 million for a vaccine they may have to use in 30 years. Or for a drug they may be allowed to use in ten years. The industry wants to invest today and make money tomorrow.
Not invest today and maybe make money 30 years from now. It's society that should invest in that.

Int: Are there no businesses eager to jump into the gap right now?

RF: The Spanish flu in 1918 had no such effect. The Asian flu in 1957, 2 million dead, had no such effect. The Hong Kong flu in 1968, 1 million dead, nothing. After SARS in 2003, with dozens of billions in economic damage, no investors were eager to prevent the next outbreak with a few million. So in that sense I'm not optimistic. Even if Netherlands need 10 or 20 billion to fix the economic crisis, they won't put a few million into virus research. Why not? That's not clear to me at all. A new pandemic is definitely coming. We'll definitely see more victims, half a million or a million. Maybe as many lives as the Spanish flu took. I really don't know why we're not preparing for it.

N: Apart from more research money there are other solutions to prevent pandemics. Both Fouchier and Koopmans see a ray of hope.

RF: The first thing we could do is limit the zoonosis. The transmission of viruses from animals to humans. We can eat less meat. We can study the animals and their viruses, so we can exterminate the viruses in the animal population. We can vaccinate some animal populations and control the viruses. A combination of these measures could result in less zoonosis, less virus transmission from animals to humans. In addition you can do something for the few cases we'll still see, by creating vaccines for people to protect them, and by developing generic medication.

All the viruses we've seen in the past decade: Bird flu, SARS, the MERS coronavirus and the current one are all airway viruses. You get them in your nose, throat and lungs. That's where they wreak havoc. It would be good to develop drugs to repair that damage faster.

There's a lot of stem cell research going on and studies on regenerating tissues for human use. If that research can speed up the repair of epithelium in airways, we may be able to make a generic series of drugs that limit the impact of airway viruses.

We exterminated smallpox. We vaccinated the whole world against smallpox and now it's gone. No human will ever get it again. We're working on exterminating measles and polio through vaccination.

So we do achieve an awful lot in fighting viral infections. They can be prevented and conquered. No doubt about it. But it demands huge commitment. Exterminating smallpox, measles and polio has cost the world billions. But as a result many more billions can be saved.

MK: Looking back on many of those outbreaks, you see that there's a combination of factors that allowed us to see this coming. Can that information be mined in advance in a smart way? It's about looking into big data approaches. Can't we put all the information available from all

over the world into some kind of smart system that can warn us when one animal species shows explosive birth or death rates? When something changes in such a way that the viruses in that species are also likely to change?

This is a new research project. It had its virtual kick-off last week. The aim is to develop these kind of methods that will allow us to say: Something is happening there, let's zoom in on that with our technology for tracing unknown infections. Because we see a risk appearing there.