ROBIN: Good evening, everyone. My name is Robin Davies. I'm the head of the Centre for Health Security in the Department of Foreign Affairs and Trade. My role is simply to MC and otherwise be unobtrusive. Thank you all for coming; it's a great turnout. I'm going to hand over immediately to Clare Walsh. She's the Deputy Secretary with responsibility for international development assistance in the Department of Foreign Affairs and Trade. Clare.

CLARE: Thank you, Robin, and good evening everybody. I'm actually here representing Frances Adamson, who is the Secretary of the Department of Foreign Affairs and Trade, and she is very disappointed not to have been here. One, she really did want to be able to open this session tonight, but also, she was absolutely genuinely interested in the lecture that was going to be given. And so, she's also very disappointed to miss the actual substance of the discussion. So, please accept her apologies.

Before I start, could I also acknowledge and pay my respects to the traditional custodians of the land on which we meet this evening, the Ngunnawal people, and pay my respects to their elders, past, present, and emerging.

Can I also acknowledge some very important people we have with us today.

His Excellency, Kuong Koy, who is Ambassador of the Royal Embassy of Cambodia. It's nice to have you here. Could I also welcome and acknowledge Mr. Chatoulong Bouasisavath, Minister Counsellor and Deputy Head of Mission, Embassy of the Lao People's Democratic Republic, Mr. David Langford, the brother of our honouree, Professor Ruth Bishop, and his wife, Margaret, and daughter Sue, who actually works for DFAT. So, there's a very nice synergy in all of that. Could I recognise Professor Brendan Murphy, Australia's Chief Medical Officer, and other distinguished members of the diplomatic corps and leaders from the Australian National University here tonight.

In 2017, the Australian government acknowledged that health security, protecting our region against infectious disease threats, required a greater collaborative effort from all of us, and that Australia is well-placed to play a leadership role in this field. It is a theme that was then subsequently echoed in our foreign policy white paper, which outlines mitigating global health risks as one of our priorities for global cooperation.

I'm talking to the converted, I'm sure, but we all recognise the importance of good health and strong, resilient health systems to support productive societies and economic growth. Just as we recognise health as an enabler for growth, so too can health crises threaten all that we have worked so hard to achieve. A major disease outbreak would have severe health and economic implications for the Indo-Pacific region and for Australia, costing lives, disrupting trade, investment, and the movement of people.

And this is why the government has allocated $300 million over five years to combat these threats and why we've established the Indo-Pacific Centre for Health Security in DFAT, which

Robin leads. The Centre represents a new model for development cooperation, bringing together expertise from multiple policy and scientific agencies across government.

Today, I'm especially pleased to welcome the first cohort of four ASEAN-Australia Health Security Fellows. As many of you will know, they are being supported to undertake a master's degree in field epidemiology at the Australian National University. It's a world-class qualification and the only one of its kind in Australia.

In addition to supporting scholars from ASEAN countries, the program is also supporting capacity building placements in Southeast Asia for selected Australian field epidemiology scholars.

I'm very pleased that I was able to meet with our four scholars a few moments ago, and please forgive me if I get some of the pronunciations wrong: Doctor Vannida Douangboupha from Laos, Mr. Srean Chhim from Cambodia, Ms. Emily Holt (that, I can pronounce), will be placed at the National Centre for Laboratory and Epidemiology in Laos, and Ms. Eleanor Kerr, who will be placed at the Pasteur Institute in Cambodia.

I am confident that this new program will do much to develop people-to-people links and better prepare the health workforce in our region to prevent and respond to infectious disease threats.

I'm also very pleased, in the week following International Women's Day, to launch this new health security address, named in honour of Professor Ruth Bishop, a pioneering Australian virologist, and to introduce one of Australia's leading medical researchers, Professor Sharon Lewin of the Doherty Institute for Infection and Immunity.

While Professor Bishop was unable to be here with us this evening, she is represented by several members of her family, and we're very pleased to have you here. I think I referred to you in the earlier remarks.

Professor Bishop led the team of researchers that discovered rotavirus, ultimately leading to the development of an effective vaccine to protect children against it. For her contribution to health security and the improvement of children's health, Professor Bishop was made an Officer of the Order of Australia in 1996, and in 2013, became the first woman to be awarded the Florey Medal by the Australian Association of Medical Research Institutes.

I would like to acknowledge Professor Bishop's achievements and express my appreciation to her and her family for allowing us to name this lecture in her honour.

Now it is my great pleasure to introduce our speaker for this evening, Professor Sharon Lewin. Sharon was appointed the Inaugural Director of the Peter Doherty Institute for Infection and Immunity, a joint venture between the University of Melbourne and the Royal Melbourne Hospital in 2014.

Sharon's vision, and that of the Doherty Institute, is to improve health globally through discovery research and the prevention, treatment, and cure of infectious diseases. Sharon has been particularly lauded for her role in HIV and AIDS research and has attracted way too many honours for me to list this evening.

Most recently, on Australia Day, just a few weeks ago, really, she was appointed an Officer of the Order of Australia, just as Ruth Bishop was 23 years ago. Congratulations for that. That's a fantastic recognition of the work that you do.

The title of her address this evening is "*From HIV to Zika – building on lessons learnt to be fully prepared for what might be next*." Thank you, Sharon, and please come to the podium.

SHARON: Thank you very much for that very kind introduction. And I too would like to start by acknowledging the traditional owners of the land on which we're meeting, the Ngunnawal people, and paying my respects to their elders, past and present. And welcome, any indigenous people here today.

What a great honour this is to give this lecture, the first lecture, and I want to thank Robin Davies particularly, and DFAT, for organising it.

And as I look out in the room, I can see many distinguished guests, and friends and colleagues, and I hope, interested members of the public that care about health security and care about what Australia can do, particularly in this region, with respect to health security, because I think we can do a lot.

And so, what I want to do today is take you on a bit of a journey through the sorts of emerging diseases that we've dealt with in the last three decades using a few key examples, and some of the ways they're informing how we're thinking about a response going forward.

But before I start, I do want to talk a little bit about Ruth Bishop, and you heard earlier from the Deputy Secretary that Ruth Bishop's famous for having discovered a new virus. The new virus was rotavirus. It's called rotavirus because it's shaped a bit like a wheel, that you can see up in the image there from 1973.

And it's every virologist's dream to discover a new virus. Not many of us get that opportunity, and not many of us get that opportunity to discover something like a new virus, characterise what that means and how you develop immunity to it, develop a vaccine, and then see it implemented in just one career, which is quite extraordinary, and I see that Ruth Bishop did all of that. So, something that many of us aspire to.

So, Rush Bishop's great observation was working out that babies actually developed immunity to this virus, and therefore, if they developed immunity, you could potentially generate that

through a vaccine. And the development of a vaccine for rotavirus has literally saved millions and millions of lives.

And I heard a very interesting story from Helen Evans, who's here this evening, who told me that Bill and Melinda Gates were most captivated about doing something for global health after they visited Africa and saw that so many babies died of diarrhoea, from rotavirus-related diarrhoea, and that a vaccine was available, the vaccine was so expensive, it wasn't able to be delivered in the countries where children are dying of the disease.

And that led to significant investment from the Gates Foundation, in a whole range of vaccines and issues and global health. Vaccines are now available in more than 50 low-income countries and save many, many lives.

And the journey that Ruth took from that discovery in 1973 of rotavirus, particularly actually the strain RV3BB, was just tested in a placebo-controlled trial and published in the *New England Journal Of Medicine* last year, one of the most highly-credible medical journals, showing its efficacy, a significant advance on what vaccines we currently have for rotavirus, because this is given actually at birth, which means that the uptake will be much more significant.

And I was delighted to see that, actually, Ruth is a co-author on this paper. So, from 1973 to 2018, publishing the best work.

To me, on a very personal level, her story's remarkable. Most importantly, she is a woman and a mother, and achieved such extraordinary success while raising a family in the 1970s. Pretty, pretty rare. Women still battle in science, being successful in science, in 2018, and she managed to do it then, in the 1970s.

Second, as a virologist, and I explained before, the ultimate dream of every virologist is discovering a new virus, but the careful observations that she made in order to take her discovery to the next step. And that is probably the most inspiring thing to me, was that she didn't stop there with the discovery of an interesting scientific finding, she actually took the next step of transforming that discovery to developing a solution that saved lives, and I think that is really what drives many of us in science, in clinical medicine, in clinical research, and global health.

And so, she managed to transverse that entire scientific spectrum, from discovery to translation to implementation, areas that I think Australia can play a very major role in.

She's actually recognised globally as one of the world's vaccine heroes. This is a beautiful slide given to me by Julie Bines, who now leads the Rotavirus Program at the Murdoch Children's Research Institute, who worked with Ruth Bishop. And the photograph was taken by Annie Leibovitz, some of you may know Annie Liebowitz, a fabulous photographer, and was commissioned by Bill and Melinda Gates Foundation.

And actually, the photograph, I won't go through who each of the people are, but in front of you are the inventors, all their relatives, of probably every significant vaccine, vaccines for polio, rubella, meningitis, and pneumococcus.

And of course, you can see Ruth Bishop here. It's a shame it's in black and white, because I understand she was wearing a bright red jacket that she used to like to wear. So, wouldn't it look great, just black and white, with the red jacket? So, she's clearly prominent here as the discoverer of the rotavirus vaccine.

But this woman, down in the left, is Doctor Xiao-Yi Sun, and Doctor Xiao's late husband, Doctor Jian Zhou, is the co-finder of the human papilloma virus vaccine, which he co-discovered with Ian Frazer, another Australian. So, I think it's pretty incredible, when looking at the photograph of our century's vaccine heroes, and we have two Australians represented.

So, vaccines are an important way that we can deal with infectious diseases. We have lots of effective vaccines. They're listed in front of you. And many, many of these vaccines work really, really well. But actually, out of all of this list of vaccines for infectious diseases, eradication or elimination of infectious diseases is extremely rare, and we've only eliminated one, which is smallpox.

And on this list of vaccines, we still have many gaps. We don't have a vaccine, an effective vaccine for malaria, we don't have an effective vaccine for HIV. And every time we see a new infectious disease emerge, there's a scramble to develop vaccines, whether it's MERS or Nipah or other viruses.

And even though we have this armamentarium of vaccines that work, we still see people, particularly young children, dying of vaccine-related diseases. So, there's a lot of work to do, not just in developing new vaccines, but implementing vaccines that we know already work.

And if you look at the top five causes of death globally, you can see in 2007, that three of the five top causes of death globally were related to infectious diseases, lower respiratory tract infections, diarrhoea diseases, and HIV. There has been some progress, when we look at the top causes of death in 2017, with HIV/AIDS slipping down that list to number 15, and I'll talk a little bit about why, but diarrhoea disease and lower respiratory infections still rank there in the top five causes of death, which is quite extraordinary and gives an indication about why our work there remains so important.

15 percent of deaths worldwide are from infectious diseases, and although many of us are worried about the increasing burden of non-communicable diseases globally, infectious diseases, in addition to effects on our mortality, have a very significant effect on mobility, and can also paralyse health systems in the setting of different outbreaks.

So, why is all this important for health security? Infectious diseases, established infectious diseases that have been around for many, many years, emerging and re-emerging infectious diseases, all have a potential to cause significant economic harms on a regional or global scale.

And I'm going to give you three examples here.

Ebola, the outbreak of Ebola in 2014-2015 killed about 11,000 people and caused about a US$3 billion loss in economic terms in West Africa.

Tuberculosis, what I'd classify as an established infectious disease, for which we have curative treatments, six months of drugs, potentially even less now, and yet, we still battle the global burden of tuberculosis with an estimated cost of US$1 trillion dollars in the next 15 years if we're unable to tackle this. It could reach the GDP of the Netherlands.

And finally, malaria, also what I'll term as an established infectious disease. WHO estimates that US$4 trillion dollars in economic gains will be generated by eliminating malaria by 2030. And there have been some very good success stories from malaria, with declining numbers of deaths from malaria. Many people think that this could be an achievable target. Many people sitting in this room are working hard towards the elimination of malaria.

But I think the other important issue is that this is not just about economics. I'm sure everyone in this room also believes that health security is really very much a human right, that often health security challenges communities that are the most powerless and invisible, and health security's inextricably linked to building stronger local communities. And if we do that in our world and in our region, in turn, that's good for everyone, including Australians.

But probably what people worry about most with emerging infectious diseases is that, and I know I'm probably stating the obvious for this room, is that microbes do not know national borders. An infectious disease threat anywhere is a threat everywhere. Making our world safer from epidemics means strengthening the capacity of countries to prevent, detect, and respond effectively to current and emerging health threats.

And we have some very significant challenges. So, this map of the world shows you the major emerging disease that was of highest significance in the 1980s, and still remains a disease of high significance, but that was the major challenge in the 1980s. This work actually comes from Anthony Fauci, who's spoken and published a lot, the Head of the (US) National Institutes of Allergy and Infectious Diseases.

And he created this map for what we're dealing with now, and you can see here, the emerging, re-emerging, and deliberately emerging, that just covers anthrax, infections that we are relatively worried about in 2019. So, we can see, there is an enormous challenge.

And first, it's key to think: why are we seeing this emergence of so many new infectious diseases, and particularly over the last three decades? And there are lots of different explanations for why we're seeing this change. Many of the diseases on that list are zoonoses, they come from animals. Many of them are carried and transmitted by vectors such as bats and mosquitoes.

But breakdowns in public health programs, in the setting of economic or civil unrest, increased urbanisation, and certainly climate change, are playing a major role in driving emerging and re-emerging infectious diseases. In fact, the WHO estimates that by 2030, rising temperatures will lead to 60,000 more deaths from malaria, and 48,000 additional deaths due to diarrhoea each year.

So, these are very, very major significant problems that are driving changes in our ecosystem.

And of course, the issue of travel. This diagram just shows you movement across the world over a 24-hour period. I'm just going to show you a fraction of the video. It just shows you plane travel across the world and why an infectious disease can occur in one part of the world and rapidly move within a 24-hour period.

So, before I start to talk to you a bit about some of these emerging diseases, I want to go to a core argument that I'd like to make in this lecture, that strengthening—we do need to worry about emerging and re-emerging diseases—but strengthening global health security really has to start from protecting people from diseases they face today.

And those big three are HIV, TB, and malaria. They account for three million deaths alone, back in 2016.

And I'm going to talk a little bit more about HIV. It's where I've spent pretty much my entire career working. I started medicine in the early 80s when HIV had not yet been discovered. I spent my early clinical years at the time of the Grim Reaper, which many people in the audience will know, but I find that the more I give this talk, an increasing number of—certainly medical students—don't know what the Grim Reaper was, but it was an alarming campaign to tell people about HIV. It very much captured what people felt about HIV at that time, highly stigmatised and a death sentence.

And over the course of my career, as in common with many people in the room, we're seeing this dramatic change in the outlook for HIV. And, although controversial, people talking about whether we might even see the end of AIDS.

I'm going to talk a little bit about what led to that transformation, and why HIV was able to evolve or change our outlook was so dramatic over the last 30 years, and perhaps, take some lessons into how we might approach new infectious diseases, and then I'll talk a little bit more about emerging infectious diseases.

So, one of the first lessons from HIV for me is that investment in science has paid off. So, this is an image of a man with what HIV used to look like in the absence of antiretroviral treatment, a universal death sentence, and then, on the right, is the same individual after taking the antiretroviral therapy.

But the development of antiretroviral therapy didn't happen on its own. It needed billions of dollars of investment in the science, understanding the virus, understanding how it replicates, working with the private sector to develop new medications, and then more recently, especially over the last 10-15 years, working to make sure that those drugs are cheap and accessible globally.

And that investment has indeed paid off. Numbers of AIDS-related deaths continue to decline globally, although I should add this: one million people a year die of HIV. And on the right is what HIV treatment looks like now, literally a single tablet a day, at a cost of around $50-100 a year in low and middle-income countries, and about half the world's population living with HIV now can access treatment. That's the good news story.

You could also think, "Well, half has still not had access to antiretroviral treatment," and anyone that does have access needs lifelong care.

There've been incredible advances in HIV prevention. On the left, many of them will be familiar to you, condoms and screening the blood supply, but on the right is probably the most dramatic advance we've had in HIV prevention in the entire history of HIV—PrEP, and that's pre-exposure prophylaxis, or taking an antiviral medication to prevent you becoming infected with HIV. It has about 95-99 per cent efficacy.

It's almost as good, or probably just as good, as taking the pill to prevent pregnancy, and yet very, very few countries have been able to implement widespread access to PrEP. A whole lot of reasons why that's the case, but funding certainly is one underlying cause of that.

A second major lesson from HIV is the efficacy and impact of working in partnership with civil society. It's been the story of HIV from the beginning. Initially, of course, largely with gay men in high-income countries, but now those partnerships have extended across the world in low-income settings and have been a major driver for why rapid access to treatment has been so effective.

And this is a really important issue, and it's a very challenging issue in the setting of an emerging infectious disease, because there's no time to create those deep partnerships, which don't just come very quickly. They need a long period of building trust and capacity-building, and understanding the science.

We saw how difficult that was, for example, in Ebola, when a key component of stopping the Ebola outbreak in West Africa was around practices related to burials. But the relationship with the community took a long time to really establish, to stop the key practice that was leading to transmission. But that has definitely been one of the real drivers of the great successes in HIV. And that partnership continues to be incredibly important, as does the advocacy from civil society.

A third key lesson from HIV has been the significant mobilisation of funding globally, and this just gives you a timeline on, and an estimate of, the sort of money that's been invested in the HIV response.

Starting back in the early days, in 1986, with a tiny amount of money invested, increasing to, in 2013, close to 19 billion dollars a year going towards supporting HIV.

There are a number of key drivers for that. Certainly philanthropy, the Bill and Melinda Gates Foundation, the US government, through their program called PEPFAR that I'll speak later about, UN agencies that drove both funding through the Global Fund and advocacy through UNAIDS.

But what's of concern with the HIV response is that treatment is lifelong, so once people are on treatment, there's no prospect of them stopping treatment unless we one day find a cure. So, we're locked into a bind of requiring this level of investment and funding indefinitely at the moment.

And what we're seeing is that global funding for HIV is actually decreasing. So, from 2013 to 2016, about a 20 percent decline in HIV funding. And I think it's important to realise that much of the funding for HIV is heavily-dependent on US contributions, and I think that has some inherent vulnerabilities.

So, that seven billion dollars, if you look at current funding, most of it from bilateral initiatives, but also, a significant amount through the Global Fund and another organisation, Unitaid, and about 67 percent of it, about 2/3, comes from the United States. So, that's very vulnerable, particularly in the current economic climate.

And I finally wanted to end with HIV, that it's not all rosy. There are major challenges still in managing HIV, particularly in our region, in the Asia-Pacific. And it's an example of the fact that we may have the tools to end HIV, or to stop transmission, or to stop people dying of AIDS, but it's the implementation that's absolutely key.

So, just in our region, we still are seeing high rates of HIV drug resistance in Papua New Guinea. We are seeing no drug resistance in a country like Australia. It's driven by adherence to medication. Indonesia has one of the highest rates of mother-to-child transmission of HIV, while many, many countries, including lower and middle-income countries, are reporting elimination of

mother-to-child transmission of HIV. And in the Philippines, a rapid increase in new HIV diagnoses, largely due to criminalisation of drugs and a lack of public health programs for men having sex with men.

So, although the advances have been extraordinary in HIV—we have the tools that I think really could end the epidemic—we're still struggling, we still have an ongoing struggle on implementation.

I want to switch tack a bit now and talk about what happens when a sudden, new disease appears, and what that can do. And the best example of that is with SARS. So, SARS appeared in 2003 from a series of cases that were based in Hong Kong, and within days, managed to spread across the world throughout Asia, into Europe, and into the US.

And I remember this very, very clearly. I actually had just started my first job as Head of Infectious Diseases at the Alfred Hospital. It was about a month later that SARS appeared.

And although we never had any cases of SARS, and I'm sure many people in the room will remember this, the effort and time required just to be prepared for what might happen when that first case would be diagnosed, or to make sure that staff were safe, to reduce hysteria about the idea that SARS was going to come, or could potentially be in one of the hospitals, was very, very significant. And that was at a very local level, but I know at a global level similar experiences were shared.

So, SARS appeared and disappeared over nine months. There was about 8,000 cases, about 774 deaths, and I did get this slide from Tony Fauci. He has got Australia highlighted, but there were no cases of SARS in Australia.

And so, it came and went suddenly. It had the capacity to spread very quickly and was highly infectious, and that's often not a good thing for an infectious disease to be sustained. And people obviously got very sick with a high mortality rate. It came and went so quickly that we still, 15 years later, don't have an antiviral for SARS, nor do we have an effective vaccine.

But what SARS did do was really change the way that we think about global health security. It certainly gave people a very, very big fright, and it established a whole mechanism for how we respond to new infectious diseases through the International Health Regulations that are—internationally, an instrument that drives many countries across the globe to respond to and share data in response to an outbreak.

And interestingly, this was first adopted back in 1969 when it only dealt with three diseases, cholera, yellow fever, and plague, but now obviously we are dealing with many, many infectious diseases and it has had to be tested many, many times since this was developed in 2005.

And then Zika virus brought out a whole lot of other new challenges. Zika virus was not a new virus, it was a virus that we knew a little bit about, but it had predominantly been in the Pacific. And then, through international travel, it entered into the Americas, particularly South America, where there suddenly was an entire population of people that had never been exposed to Zika, so managed to spread through that population with great rapidity. This just shows you the epidemic curve, or the peak of Zika virus infections, and you can see it was entirely in the South America, the Caribbean, Central America, with a rapid decline.

What was a lesson with Zika virus was that the manifestations of Zika virus looked very different in South America to what had traditionally been described as just a fever and a self-limited illness, and there was this extraordinary complication that took a very long time to actually identify, understand, and fully characterise, which was congenital Zika syndrome. So, Zika virus was able to infect and cross the placenta in pregnant women and impair neurological development.

And there was some very chilling stories of quite significant stigma and discrimination re-appearing with Zika virus, which is very obvious, as you now see from children who have been infected.

Zika virus also highlighted the importance of vector control. The same mosquito that transmits Zika virus also transmits dengue and other infectious diseases, chikungunya and yellow fever. And there's a lot of very interesting work now tackling the vector, or the source of transmission, rather than treating the virus itself.

So, I think many of us that work in this field think about what's next, and how we're going to identify what might be next and what impact that might have, and more importantly, how can we prepare for it.

Well, there's some people in the field that think that we can protect—potentially predict the next epidemic or virus through genetic sequencing. So, just like the big breakthroughs that we've all heard about for sequencing the human genome, you could potentially sequence every virus or environmental sample, or widespread animal testing, to see and identify potential new viruses.

And this is a project called the Global Virome Project, a 10-year partnership to detect a majority of our planet's unknown viral threats, a huge and ambitious goal, and very controversial, because this would cost millions and millions of dollars, and we may never know whether the viruses we're going to identify will actually go on to cause human disease.

So, I think we probably need to focus on what is more predictable to occur. Certainly, bats are key features of past and future outbreaks. So, understanding the biology of how and why these viruses can infect bats is key. If you just look at that list, five of the most significant emerging infectious diseases that have occurred in the last two decades have all been spread by bats.

I think we also need to think about the infectious diseases that we know, and almost certainly, will keep coming back. And the big one here is, of course, influenza. Influenza virus will keep changing and will keep returning, and this map just shows you the different types of influenza. We name them based on proteins that sit on the surface of the virus, by the letter H, by the letter N, and any time a new virus appears, that people have very little immunity to, there is a far greater likelihood that that virus will spread more widely.

So, there's lots and lots we can do in preparing for influenza. There's a lot of work being done, making sure we've got clear and defined plans to do that.

In addition, science here could make a big effect as well. If we had a capacity to make a single shot of a flu vaccine, that would also make a very big difference in how to respond to flu, and is a key target of scientific investment currently.

Anti-microbial resistance is also something that we can predict and do need to be prepared for. This data comes from a new report, which was performed in the UK, and estimated the numbers of deaths that will occur from anti-microbial resistance, or AMR, by 2050, if we don't do anything different to what we're doing now.

And the estimated number of deaths shown there in the purple box is 10 million as compared to about 700,000 deaths that occur currently from anti-microbial resistance. And to put that in perspective, you can see deaths from cancers, estimated currently at around 8 million. So, the impact could be very, very significant.

And when we think about anti-microbial resistance, I think we need to think about the established infectious diseases, such as TB, or multi-drug resistant tuberculosis, with one of the highest rates just to our near north in Papua New Guinea, about resistance to malaria to commonly-used drugs, or artemisinin, again, in our near neighbourhood, as well as these new strains of bacteria that are now being reported that are resistant to all available antibiotics.

So, tackling anti-microbial resistance is going to need a very large investment, not just in the science. I don't think it's new antibiotics that we necessarily need in tackling anti-microbial resistance, but it's very much around the anti-microbial practices in both human and animal health that are going to be absolutely key, and something that needs to be tackled at a regional or global level.

So, in closing, I'm going to briefly talk about what Australia's doing, both locally and regionally. There's certainly a very established and well-developed, coordinated, all-of-government response plan that we have predominantly directed towards influenza, because that has the highest certainty for occurring, but also, to other communicable diseases.

And that plan is extensive and detailed. It's an all-of-government response, so it involves the Commonwealth and every State government.

We also certainly need the physical capabilities to cope with these new infectious diseases. And this is a photograph of Dr Julian Druce, a virologist at the Doherty Institute, dressed in a space suit, which is what we need to actually isolate certain organisms, like Ebola, or SARS, certainly not something that we need in every city in every town across Australia, but we do have a capability should that be needed within the country.

The Australian government, through the NHMRC, have also funded a national network called APPRISE, and we have some members from APPRISE in the audience here. Ross Andrews is one of the key senior co-investigators. This is a national network that is focusing on research, entirely related to preparedness and response.

And I could highlight a whole lot of different projects that are happening within APPRISE, but I think one of the key projects is one that Ross actually leads, and that is working with indigenous communities. When we had a severe outbreak, we had a severe strain of influenza, H1N1, several years ago, indigenous communities were significantly adversely affected. There's also an extensive history around infectious diseases and terrible outcomes in indigenous communities.

And this is a great example of why we can't do something on the run as soon as a new infectious disease emerges. You need to build a capacity, an understanding needs to be established before something happens, and that's a big focus of what Ross is leading, as others within APPRISE.

And although a lot of our work focuses on preparedness within Australia, we're very conscious about how we work with neighbouring countries, and we are part of an international network for the treatment of something called SARI, or severe acute restricted illness, which could be flu or could be another infectious disease.

And this is led by another chief investigator, Steve Webb, who is part of a network with about 200 sites across 33 countries developing what's called Shovel-Ready Protocols, pre-approved, pre-planned research infrastructure for the advent of a new infectious disease, which is actually critical for sample collection, observational studies, as well as interventions with vaccines or antivirals.

Capacity-building and training obviously are very important and key factors both locally, that's what APPRISE does, but certainly within the region. And obviously, that's a big focus of the Indo-Pacific Centre for Health Security. Those partnerships and capacity-building are absolutely key.

And I'm showing this photograph because I was recently actually in Cambodia, in Phnom Penh, and went to a lunch hosted by the Ambassador, Ambassador Corcoran, and it was striking to me that many of the key leaders in public health, two of them photographed here, Doctor Dr Tia

Phalla, and Doctor Chhea Chhorvann, actually had their training in UNSW in the mid-90s, and they all came from a background actually working in HIV. I should add that Cambodia has one of the most effective responses to HIV in the Asia-Pacific region, has one of the highest rates of treatment uptake, a real success story.

And it was very interesting to me that many of these public health leaders actually now are working in other areas. You can see here, Doctor Chhea, now the Director of the National Institute of Public Health.

So, the impact of this, these sorts of relationships and capacity-building, are really enduring, and I was so—I was struck so strongly about that in my visit to Cambodia.

And finally, there of course are many bilateral and multilateral partnerships that Australia is involved with, and I'm just highlighting a few of them, the important key ones here.

First of all, the Global Fund for AIDS, TB, and Malaria. Australia is the 13th largest donor to the Global Fund, and we have given over $600 million. And our contributions are so important to the Global Fund, largely because of our location in the Asia-Pacific region, especially in HIV. The burden of HIV is so high in Africa, it's quite easy for Asia-Pacific region to receive less focus, and our presence there makes a big difference.

Secondly, a very recent and innovative idea of a global alliance to finance and coordinate the development of vaccines against infectious diseases, and a focus on neglected infectious disease, or diseases in which the private sector are less likely to invest. So, particularly, their current focus is on Nipah and Lassa virus, and Australia also, obviously, contributes to that fund. But they're going to do some really exciting things through developing platforms for rapid development of new vaccines.

And finally, I should mention the Global Virology Network, or GVN. It's a new network in which Australia is playing a very active role. And this links virologists globally for training and capacity-building, shares resources from viral banks, and though not yet tested, we hope it will make a significant contribution in the event of an emergency response.

So, I wanted to close by highlighting what really might be possible when you have a bold and ambitious goal and bipartisan support. And the best example of that for me, in my own experience in global health, is PEPFAR, the Presiden's Emergency Plan for AIDS Relief.

It was actually established in 2003, under the leadership of George Bush, which people are often surprised to hear.

It is the largest commitment by any nation to address a single disease in history, and the US government's committed over $15 billion over the last five years to allow access to antiretroviral

therapy. And there's no doubt that that investment, along with all of the other factors I've described about, has changed the face of the HIV epidemic.

And so, although Australia, we're a much, much smaller country, a 20th the size of the US, it's something that I think we should all be dreaming about, thinking about, and perhaps, could deliver an impact on this scale.

So, I wanted to close by saying, again, that I think Australia has an incredible opportunity to be a major global leader in health security. We are a country that can discover and innovate, just like Ruth Bishop did, to identify new pathogens rapidly, and also, design novel therapeutics and vaccines. And we do that really well.

But we certainly can't stop there. The next steps are of translation, and most importantly, implementation through capacity-building, health systems strengthening, trusted, enduring partnerships in health. That's the way we can really be prepared for what might be next.

So, I wanted to just close in thanking a number of colleagues and friends that I had the opportunity to discuss this talk with, who also provided a number of slides, and I'm happy to take any questions. Thank you.