



LSHTM Viral
S3 E2: A brief history of vaccines
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SPEAKERS

Naomi Stewart, Gareth Millward, Amy Thomas, Liam Smeeth, Karl Byrne

Naomi Stewart 00:01

Welcome to LSHTM viral season three, a podcast exploring the science behind global and public health. I'm Naomi Stewart.

Karl Byrne 00:09

I'm Karl Byrne.

Amy Thomas 00:11

And I'm Amy Thomas.

Naomi Stewart 00:13

And every fortnight we'll explore the latest developments in the covid 19 pandemic and take a deep dive into vaccines and vaccinations. 117 million people worldwide have now tested positive for COVID-19 since the pandemic began, with 2.6 million deaths. Globally, almost 294 million people have received a first dose of the vaccine, of which the United States has delivered over 90 million doses to its own population. Based on recommendations from the Centre for Disease Control. The United States is now allowing people who have been fully vaccinated to meet indoors without wearing masks. Here in the United Kingdom, over 34 million have received at least their first dose of vaccine 7 million more people since our last episode. Israel continues to lead the way in rollout with almost 44% of the Israeli population having received a full dose of the vaccines. After some delays, they have also agreed to start vaccinating Palestinian labourers. Perhaps the most significant news though, is COVAX, the global initiative that aims to create equitable access to COVID-19 vaccines has started shipping worldwide. In Africa, Ghana was the first country to receive doses through the programme some of which are being delivered by drones from the air. Other countries that have received vaccines through COVAX so far include Cote d'Ivoire, Ethiopia, India, the Republic of Korea, Afghanistan, Sudan,

Moldova, and others in Africa and Asia. These steps are crucial with COVID-19 - no one is safe unless we are all safe. In today's episode, I speak with two researchers about the history of vaccines and how they came to be in their modern forms. First, I am speaking with historian Dr. Gareth Millward from the University of Warwick, a former Research Fellow with the Centre for History and Public Health at LSHTM, and author of "Vaccinating Britain: Mass vaccination and the public since the Second World War. Welcome, Gareth.

Gareth Millward 02:19

Hello.

Naomi Stewart 02:19

So I know your work has primarily looked at vaccines since the Second World War, but to set the scene in terms of vaccine history more broadly - can you tell us how and why vaccines first came about?

Gareth Millward 02:33

Yeah, well, the idea of immunising somebody is quite an old one. We have records from ancient India or ancient China of people using or trying to give their children or other people in their community small doses of smallpox in order to give the person just a mild case of the disease, which would then prevent a more serious case of the disease developing later on. And that was called variolation, after variola, which is the Latin for smallpox. And that technique had existed for centuries. And there are different ways of doing it. In places like China - this is bit graphic, I apologise - you use the scabs of the smallpox and then blow it up a child's nose in order to give the child a mild dose, which seems a bit kind of squeamish, to me anyway. Well, the way that it was done in India, which was then exported to modern day Turkey and the Middle East, was to make a cut on the arm, and then you'd put a little bit of smallpox material into the cut on the arm. And it's that technique, inoculation, which found its way to Britain in the early 18th century, after Lady Mary Montague, who was a British aristocrat, and who was married to the British ambassador to the Ottoman Empire, brought the technique back to Britain and it became a kind of a fashionable thing to do with your children back in Britain amongst the aristocracy. And so that's really where we get the beginning of this technique from and then when Edward Jenner popularised the use of cow pox or vaccine year, that's when it became vaccination, and where you use a small dose of cow pox in the arm rather than a small dose of smallpox, which is safer and causes less scarring and was much easier to then export to the rest of the British Empire and also around Europe and around, eventually the world.

Naomi Stewart 04:15

So then by the mid 20th century, which is focused everywhere, after the Second World War, there's an increasing number of vaccines available to tackle infectious diseases both in the UK and worldwide. Can you walk us through how immunisation programmes came to be after World War Two and what the general public attitude or approach to them was then and how that changed?

Gareth Millward 04:37

Yeah, well, the first mass vaccination programmes developed out of the early 20th century. In particular, the one that sort of is held up as a sort of interesting case study is BCG, which is an anti tuberculosis vaccine that was developed in France and spread quite quickly in France and in the Nordic

countries as a way of preventing TB. Because in those countries TB was a major problem. Whereas in Britain, there hadn't been a huge amount of TB relative to those countries Britain had developed a system based on sanatorium. So if somebody got TB, they'll be taken to a hospital and they'd be semi isolated from the rest of the community and given time to recover. And that system had reduced TB rates in Britain. They wouldn't have had randomised control trials at the time, but they did have various forms of medical trial and not thinking that the French had really developed this enough. And typical kind of empire rivalry between the British and the French meant that Britain didn't take on BCG. But the one that they did take on was diphtheria, which had become very popular in particular health authorities. And the two that really stand out are New York and Toronto, English speaking cities that had managed to use this new diphtheria immunisation, which was developed in the 20s and 30s, and massively reduced the rates of diphtheria in those cities - not through saying you must have your children immunised, but by offering it to the population and using advertising campaigns similar to what we would know of today a sort of health promotion, and we've had great success with it. So there were some trials are back in London with some limited success, but it's when the Blitz starts. And the Ministry of Health starts to get quite worried that if you're going to have a lot of children cramped into air raid shelters, particularly in London and the major cities, that this would be a hot box for infectious diseases, they started to fund free immunisation of children in 1940. It very, very quickly proved itself to work, the rate of disease dropped significantly in Britain. And they started to have voluntary but very well funded and well publicised vaccination programmes which the British state wants to use, because they want to reduce the burden of disease. And they want people to be able to work and to look after their children and to get through childhood without major health complications and disability. But also the British people themselves see that this works. And they themselves obviously don't want to have to live with these kinds of diseases. And they start to see this then, as one of the modern things that modern Britain gives you. You know, you can have a motorcar. You can have a wireless, you can have a television, you have your vaccines,

Naomi Stewart 07:14

And you've mentioned New York and Toronto, what was it like in other places in the world? Was there similar vaccination programmes? Was there similar public interest?

Gareth Millward 07:23

In the Western European states, and what we perhaps now call the global north, had embraced vaccination quite quickly. It'd been part of that kind of state building project in the 19th century to get your troops particularly vaccinated against smallpox, but also the general population in the richer countries and certainly the sort of the metropole of the Empire, you get a lot of vaccinations, and then it's the French, it's British, it's German scientists that are really investing then in things against anthrax, diphtheria, tuberculosis, etc. In the non Western world, in the non global north, however, it really was a bit hit and miss. And it depended on the priorities of the colonial countries really, which, depending on how that went about. For example, if you were a white person in the Indian subcontinent, in the 1930s, 1940s, you probably would have been able to get a smallpox vaccination if you'd wanted one. But you have problems there with all sorts of quite understandable attitudes around the smallpox vaccine that caused major problems with how that was then able to be brought out for the general population in India. On the one hand, you've got restrictions to access obviously, if you've only got a limited amount of vaccine, it's going to go to the people that the Empire prioritises, and that is typically going to be

either people in close contact with white people or white people. And then further on from that you've got the issues of whether you trust something that has been given to you by a colonial overlord. The smallpox vaccine I sort of alluded to earlier, it's based on cow pox. So it's based on cows, it's cultivated in cows, and therefore, there's all sorts of problems though with the Hindu population as to whether they feel that they can accept smallpox vaccination, and the hangover of that lasts after the war and after independence of many of these countries in Asia, and Africa. So the access to vaccination really does depend on what the colonial overlord left behind you also, then, after the Second World War, get a lot of particularly between the United States and the USSR. There's this post Cold War post colonial battle for hearts and minds. And one of the ways they do that is to offer vaccines to countries that have massive infectious disease problems. On a European level, you have the Nordic countries who are offering BCG vaccine to Eastern Europe in order to try and help those countries rebuild after the devastation of the Second World War and the destructive policies of Nazi Germany and the Soviet Union. That's a way to try and build sort of relationships with countries like Czechoslovakia, Austria, that are under Soviet occupation immediately after the war. But then later on in 1960s, you have the French who are moving into modern day Burkina Faso trying to push measles vaccinations. You have the Americans who are doing the same in West Africa. And then you have this big one, which is the global eradication programme for smallpox, which involves the United States and the USSR really pumping men and material into Latin America, Africa, and Asia, trying to eliminate the disease in order to build strong links with these countries that they're trying to court, but also to protect themselves by eliminating the disease and making sure the disease never comes back to these countries that have long since eradicated the disease. So the global picture on vaccination is still very complicated, but it's certainly very complicated in the mid 20th century.

Naomi Stewart 10:37

So we've discussed quite a lot of 19th, early mid 20th century. Can you tell me how things evolved in the mid to late 20th century when it came to vaccinations, say, post Cold War.

Gareth Millward 10:49

Well, in the global north, the focus shifted from reducing the burden of disease, to eliminating disease. And that's one of the issues that really has reared its head in more recent times, where we've been talking about declining vaccination rates. And we've been talking about vaccine hesitancy and anti vaccination ism around things like measles, and COVID-19. Once it became clear how powerful vaccines could be, you move them to wanting to eliminate disease. So one of the things that really changed in the 1980s was a real fascination with the statistical and the power of vaccines to eliminate diseases like measles, you start to get a lot more emphasis on diseases that are that are deadly like measles, but are nowhere near have nowhere near the fatality rate of, for example, early childhood diphtheria, polio. But the flip side of that is that in order to do those sorts of things, you need very, very high vaccination rates. So with measles, 75% is almost as bad as nothing, you really do need 95% plus vaccination rates in order to really eliminate measles. But that final sort of 15% also requires a lot more resources than the first 75 to 80%. And it's here that we've started to see the real sort of changes in the way that we communicate the risks around vaccination for that small group that are hesitant. There are ways there for those kinds of interactions to happen between healthcare professionals and the population.

Naomi Stewart 12:22

And so at the turn of the century, moving into the 21st century, what was the situation when it came to vaccines? How was the public attitude to them? What was it like?

Gareth Millward 12:31

Well, again, my main experience is with Britain, but the story is very similar across a global north. People accept vaccinations and the vaccination rate, from a historical perspective, is incredibly high. I mean, you try to get 80% of the population to agree on anything, even what you might think might be the most uncontroversial subject whatsoever, and yet, we are consistently seeing in countries across Europe, children receiving at least one dose of one of the key vaccines is well above 90%. In Britain, it's above 95%. I mean, they don't necessarily complete every single one that they that they're supposed to. But basically the idea that there is a large amount of anti vaccinationism in Britain at the turn of the 21st century, or or in most European countries, and most of the global north is certainly from my research, I found unsustainable. Although the vaccination rate did drop to do with MMR in the late 90s and early 2000s as a result of a an alleged link between a specific form of autism and the measles vaccine that was used in MMR. You did see a drop in rates, but you didn't see a massive drop in rates for the other vaccines. This was a specific issue with a specific vaccine at a specific time, it wasn't an issue with vaccination. In general, the idea that vaccination works and is safe seems to be pretty universally held.

Naomi Stewart 13:52

So from a historians perspective, what are your thoughts on where COVID-19 fits into this broader story of vaccines, both in terms of where we are now with the vaccine rollout and where we might end up in the future?

Gareth Millward 14:06

What fascinates me as a historian about COVID-19 is the focus on adults, the idea of a mass vaccination that can be rolled out to the entire population. And again, we don't know whether we're going to need to be revaccinated every free every few years, or even if we only have to do it once. It's the focus on adults that makes this fascinating to me. Every other vaccination system that I've really kind of looked at has been either aimed at infants before they get to school, or it's been done through the school system, thinking about things like TB and HPV or infant kind of vaccinations before reaching school age, the differences even though a lot of these issues around trust in the government and around funding and around infrastructure are all going to be the same. And we've seen those play out at warp speed over the past sort of 12 months or so. The only other even close to this thing that I've seen through my historical research has been the polio vaccine In the 1950s, where it was important to make sure that young adults were vaccinated against polio as well, although the iconic image of polio is the child in the crutches or the iron lung, young adults got polio less regularly. But when they did get it, they were far more likely to die from the disease that did require the Ministry of Health at the time to adapt its advertising, to focus away from parents to try to get young adults to get vaccinated. So they did things like in Bristol, there was an 'Injections while you dance' event run in Bristol, where they were getting people to sign up for the vaccine. So there's a lot of ways in which this COVID-19 vaccine and the way that it's being rolled out are a very novel. And the idea that you start with the oldest in the population and work backwards is very new and very interesting. There are historical parallels around

organisation. But in terms of the speed that this has been rolled out, and the focus on adults, there's also something very new about it. And as a historian, what interests me is to see the parallels with the childhood mass vaccination programmes, but also those differences. And I think COVID in a few years time will be a really interesting comparateur.

Naomi Stewart 16:09

I'm curious about what you think about where we'll go from here with COVID. I won't use the term 'lessons learned', but is there a way we can understand or foresee or think about where we might end up with COVID-19, based on what's happened in the past?

Gareth Millward 16:25

It's put a massive magnifying glass on various systems and structures and processes that are historical in nature, and they've been blown up for the entire world to see in terms of vaccination. Like I said, it's shown the chronic neglect in infrastructure and funding that really is needed in order to get those really, really high vaccination rates that public health authorities are now demand in order to reduce and eliminate infectious disease. From a historical perspective, what COVID might show us in the future, is what happens in the aftermath of such a massive crisis like this, and the economic and various of the knock on effects of, of this at this COVID crisis. Even if vaccination works brilliantly, those knock on effects are again going to be felt for four years. It's how do we as a society, and how do our political structures respond to that?

Naomi Stewart 17:23

Certainly some sobering thoughts there, Gareth. Thank you for speaking to us today. Next, we're speaking to Liam Smith, who is the Dean of the Faculty of epidemiology and population health and a professor of clinical epidemiology here at the London School of Hygiene & Tropical Medicine. He's also general practitioner in North London. That's doctor for you on my side of the pond, and he will become the next director of LSHTM. this August. Welcome, Liam.

Liam Smeeth 17:52

Thank you.

Naomi Stewart 17:53

So Liam, you were a paediatrician and a GP in the 90s. What were things like when it came to vaccines then?

Liam Smeeth 18:01

I mean, in some ways similar. There's more of them now more available. Certainly as children, the childhood schedule has expanded the number of vaccines children get, particularly in the very early, the first few and they had a lot of vaccines. But otherwise, other than that, they haven't been major changes in the annual flu vaccine, which has been around for a long time. There's been more combining vaccines into single doses, which has been great. It's less than the number of jobs you have to give. But no, there haven't been that many major changes just steady progress in terms of the number of organisms we can cover, which is of course been great. And I certainly well remember when Haemophilus influenzae vaccination - hib - as it's known, was introduced, and I was actually working in

paediatrics at the time. This was before I was a GP, and that had a dramatic effect. I mean, even on my own workload, I think it was because cases of haemophilus meningitis in particular was so devastatingly awful, and I had the misfortune to see three in my first year in paediatrics. Essentially, the vaccine has taken that disease away from the UK and most remarkable, tangible effect for me personally.

Naomi Stewart 19:09

So it's my understanding you also did quite a lot of critical work in the 90s - and I'm guessing this would have been you were a GP - on establishing trust in the safety of vaccines for children and for adults. Can you talk us through that and why that was important to you?

Liam Smeeth 19:23

Well, it was a little bit later. It was actually amazingly it was while I was doing the Masters at the school, Andrew Wakefield published the study in The Lancet suggesting that measles vaccine in particular, which by that time was part of the MMR, the measles mumps, rubella combined vaccination. And he brought in a study suggesting that measles vaccine could cause autism in children which of course, had a huge impact there, a lot of publicity and indeed, to the extent that measles vaccine coverage started to fall in the UK, but not just in the UK, actually, in many countries around the world. It was predictable that this was going to lead to measles outbreaks and indeed it did lead to measles outbreaks. And we did see children getting very, very ill and some deaths. And I got very interested in this question and really thought maybe we could use general practice data because at the time general practices and started using computers for clinical care and the UK was way ahead of the rest of the world in this and I thought maybe that we could do this quite quickly and easily. But it turned out to take quite a few years and was actually really difficult to study, but we did it. And we eventually published around at the same time as studies in the States and from Denmark as well, equivocally between us showing there were really no association between measles vaccine and autism. I mean, I could draw a nice graph to show that, you know, the minute we published our study with worldwide measles coverage in vaccination picked up, but it wasn't just us, there was a huge global effort to restore faith in the vaccine and tackle this issue. And by this time, people are starting to question Wakefield's findings and his methods, the faith in the vaccine did recover coverage went back up. And we've managed to get measles back under control in most areas of the world, which is great.

Naomi Stewart 21:01

So part of the issues around MMR was people reading the Wakefield study and attributing that to sort of the medical science and medical literature, and that stuck in public consciousness. Is there any interaction between the amount of data or information or things that are being said on the internet that's flowing around a mass scale, and maybe scepticism that the public might have now that they might not have had before?

Liam Smeeth 21:25

Yeah, I think there's been such such big movements, I think, I mean, clearly, in the late 90s, with Wakefield publishing, social media hadn't really taken off. And it was very much the lay media reporting that one study, and then things started to circulate. Whereas of course now we have social media. So things are just flying around all the time and the mass of information. And I think it's been quite mixed,

because to some extent, people perhaps don't expect everything they read on the internet or in social media to be true. There's a kind of healthy scepticism, there's another healthy part to it, which is I do think people are a little bit more questioning and perhaps in a good way. And you know, we introduced a new technology and a new COVID vaccine, for example, and we've developed it very, very quickly. There's a healthy kind of, "I wonder if this is actually safe. And I'm going to question this and I want to know more about mRNA technology. And is this right for me?" By definition, we only invented the vaccine several months ago, we can't know about long term effects. And what does that mean for human beings. And I think that kind of discourse and that openness and transparency is a really welcome part of the greater circulation of information and social media, and just people are just much more tuned in and turned on to this kind of thing. And that's great. The bit where it goes wrong, of course, is that people with a very clear agenda about an issue where they're, you know, what they want is to get their viewpoint across and to influence other people with their viewpoint, have much easier access to people and have very wide ranging platforms available to them to use. Anti vaxxers, as they're known, or there are various names of people who are virulently against the idea of vaccination, not on any scientific grounds or on health grounds or anything else, just because that is their fundamental belief, have these big wide scale platforms. And that can be really problematic. If my perspective, I really, really don't mind what people think, you know, people want to believe the earth is flat, or that climate change isn't happening. Vaccines don't do any good. I don't mind that they believe those things, what I object to is if they try and influence others in ways that will lead to harm to those people or to other individuals. And that's where I think we have to draw the line really. So it isn't about censorship, or telling people what to think. But I do think if people are propagating anti scientific ideas that are clearly against all the evidence and the those ideas will harm people. I do think we have to draw a line somewhere.

Naomi Stewart 23:43

Yeah, and I do really like what you're saying, I think a lot more people are interested in science now than ever before, which is kind of nice when you work in science and science communication. As a GP, with the COVID-19 vaccine, what are you seeing in terms of people coming in, how was their response to it, is it different than previous vaccines?

Liam Smeeth 24:02

It's certainly different in a couple of ways. We're slightly one step removed. So if you think of a typical vaccine programme, be it the babies, you know that parents bring their babies in and we vaccinate them in the surgery. Flu vaccine is largely done in people's own surgeries or sometimes at pharmacies, but largely during their own surgeries. Whereas the COVID vaccines in the UK, mostly to date have been organised in large scale vaccination centres which have taken the delivery of large numbers of vaccines and had hundreds of people turning up every day, based on general practice list. At the same time, a lot of us have been involved in the vaccination centres and in helping and of course, patients have turned to us a lot for advice on when they're going to hear should they have the vaccine or and all sorts of questions. So we're kind of involved but not quite as heavily involved in the direct day to day deliveries. We perhaps have been with other vaccines, I think they'll slightly change over time. And he's clearly been very successful. And we've managed to roll out very quickly, which has been great,

Naomi Stewart 24:55

Have you had a vaccine yet? And if so, can you describe it?

Liam Smeeth 25:00

Oh, yes, I certainly have and it was fun. It was quite exciting. There was a whole group of colleagues, we turned up at the end of a long, long, long day in clinic, and partly to use the spare vaccines. We were in the priority group anyway. Yeah, it was quite a quite a moment. Actually, many of us having lived through these devastating several months, it was actually kind of quite moving. And I've seen actually a few patients, particularly older patients who perhaps have been living in fear, I suspect, knowing how worried their relatives and their younger relatives are about them seeing this tremendous sense of relief when they get the vaccine. And I mean, I've seen tears come, but it was a tremendous sense of relief. I didn't get ill - a few people had minor sort of fevers, what you'd expect from any any decent vaccine, really. My arm hurt a bit, sort of like for two days bit longer than you might see with the flu vaccine. But other than that, it was great. And yeah, delighted to have had it.

Naomi Stewart 25:49

That is very exciting and sort of thinking about the broader picture - so you're the non executive director of the UK's Medicines and Healthcare Products Regulatory Agency, which, as it says on the tin, regulates medicines in the UK. So in terms of the historical newness of the amount of COVID-19 vaccines being developed, the speed at which they're being deployed, what do you think about how this is affecting public perception and uptake?

Liam Smeeth 26:15

Yeah, I mean, it's, it's interesting, it's a huge success story, is the first thing to say, going back to February 2020, I was starting to get quite ill with COVID, at the same time getting quite involved in the research. And really, if someone had said, "You know what, by Christmas, we'll have we'll have a few effective vaccines against this virus", I'd have thought they were living in cuckoo land or something, I'd have been ecstatic at the thought. I would have thought there's no possible way we could mass produce effective vaccines when, you know, in several months, it's incredible what's been achieved. And I've seen it again and again, I pored over the data and pored over the regulatory stuff. It's really been a matter of adequate investment, very large investment, obviously, and prioritisation of every single step. And in a way, it's if you look at it and think, if only whatever in your science could be done this way. If only all science could essentially have whatever funds it needs, and at every moment in the process, be just prioritised to the nth degree. So you know, if you think of your average time you send a document to a regulatory authority, and it might take a few months, they come back with queries, and then you spend a few days vacillating and not quite dealing with it. And then you deal with it and send it back a couple of weeks later, and then it comes back again. And then it's delay of a month, and then something gets lost. And none of that happened. It was boom, boom, boom. You know, people were prioritising stuff within seconds as things arrived. So it wasn't cutting corners. And it wasn't going too quickly, In my opinion, every evidence I've seen is that this was an absolute correct prioritisation and then the ongoing efforts to monitor and ensure safety and clearly crucial. And it's a matter of bringing the public with us on that, clearly. We need to be constantly looking and checking the vaccines remaining effective against new variants. And of course, establishing safety, particularly over long term because there's no no one's going to even try and pretend that the vaccines aren't new, of course.

Naomi Stewart 28:08

But, ultimately, it's a global problem. We've heard this many times everybody needs to be part of the vaccination programme. Are you hopeful about the rollout of vaccines, both within the UK and globally in ending the pandemic?

Liam Smeeth 28:21

I would like to be more hopeful. The big fear, of course, is that the richer countries will get COVID under control, and we'll be able to afford to keep it under control is likely that COVID will keep reappearing in waves. And with numerous mutations, everything seems to suggest that it's very good at mutating, and we're likely to see waves probably for years to come. And it will remain the case that I think the richer countries will be better at controlling transmission through repeated vaccination and getting very high coverage. But also, of course, the health service can cope and the economy can cope with measures that are needed sometimes to control the vaccine. The worry is in many areas of the world where none of that will be true, where vaccine coverage will be small, where updating vaccines for new variants or repeating doses to boost longer term immunity won't happen and where health services are not able to cope with waves of infection. And it really could become the case where we've created a new disease that's essentially a disease of poverty worldwide. And so I'm slightly less persuaded that the rich countries need to protect themselves by making sure that poor countries get vaccinated, I think, as a slightly unpleasant argument and one that doesn't really hold true either. I think what really matters is the moral case that populations really with the most to lose, and with the least resilience are those populations where we need for making global efforts to control this virus. There is hope. Of course, some of the newer vaccines that have been that have been licenced in the States, for example, a single dose they'll certainly make it a lot easier, and with less stringent storage requirements, but it's going to need constant global effort to get this get this vaccine rolled out and supported.

Naomi Stewart 30:00

So what does that future sort of look like, is this constantly updating vaccines or creating new vaccines in response to the variants over time?

Liam Smeeth 30:06

We just don't know. I think we're going to see subsequent waves of infection particularly in temperate climates, particularly in the winter months, a bit like we do with flu. But it does appear to be quite good at mutating, particularly towards strains that are more infectious and will spread more rapidly, which makes control harder and does make subsequent outbreaks much more likely. So I think we will see waves of infection affecting different parts of the world probably for some years to come, it's going to be pretty well impossible, even with 100% vaccination in a country to completely control this virus, it's going to mutate, it's going to circulate, it's going to be imported and export it no matter what you do, I think there probably will be a need to adapt the vaccines over time, whether that will be required every year, I doubt if it can be that frequent. There's also the issue, we don't know how long immunity lasts, we've only had cases for a year worldwide, that we've by definition, can't really know how long immunity is going to last. But we could get into a situation a little bit like flu vaccine, where we're vaccinating big chunks of the population every year or two or three years against latest strains.

Naomi Stewart 31:13

That's very interesting. Last question, for members of the public, what would your key takeaway messages be when it comes to COVID-19 vaccines?

Liam Smeeth 31:21

I think the key message is that thinking back to the the depths of despair, really, that I think many people felt not just in the first lockdown, but particularly in subsequent waves of infection where there was really a terrible feeling that society and communities and friendships and families were really getting decimated by this infection and just what a dream it would be to have effective vaccines available to us. And while yes, of course, these have been developed very quickly, I think that's a success story rather than a threat of human pings. Everything I've seen, and I've studied everything in detail, tells me that we didn't cut corners, we didn't rush, we prioritised, we went as quickly as possible. And once or twice, we got lucky in terms of developing effective vaccines. Nobody is going to stand up or nobody should stand up and say we can guarantee that these vaccines are perfectly safe in every single way and have no side effects, It'd be a silly thing to say. Ff course, there's going to be side effects. And there may well be rare side effects of in the long term that we don't fully know about yet. But you have to balance those those legitimate concerns with the huge benefits not just to individuals but to society as a whole. I urge everyone get vaccinated when you're invited, and be delighted to have it because it really is going to change everything.

Naomi Stewart 32:41

A big thanks to Gareth and Liam for taking us through a brief history of vaccines today. Now this is the part of the podcast where we answer your questions. So please do submit anything you want to ask about vaccines or vaccination programmes to comms@lshtm.ac.uk. Thanks to all of our listeners around the world, stay tuned for our next episode on how vaccines are actually created. And if you like what you've heard today, please do subscribe to LSHTM viral on your favourite player. And if you're listening on Apple, rate us and leave us a review. Until then, stay safe and informed