AMERICAN MEDICAL WRITERS ASSOCIATION AMWA JOURNAL V38 N1 / 2023

CONFERENCE

2022 John P. McGovern Award Address

Global Vaccines and Vaccinations: Science Vs. Antiscience

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The John P. McGovern Award is named in honor of John P. McGovern and is presented to a member or nonmember of AMWA to recognize a preeminent contribution to any of the various modes of medical communication. The McGovern Award is presented during AMWA's Medical Writing & Communication Conference.

Thank you very much for the honor from AMWA and the opportunity to be able to speak with you. This means a lot to me, not only as a science communicator, but also because I've been writing books about the geopolitics of vaccines and global infectious diseases. Having this kind of recognition, for me, is particularly special. I'm sorry I can't be there with you in Denver, but please understand how important this honor is for me and my association with AMWA.

My career as an MD/PhD vaccine scientist is an interesting one and has kind of a dual aspect to it. For the last almost 40 years now, since I started as an MD/PhD student in New York in the 1980s, I've been working to develop vaccines for poverty-related neglected tropical diseases as well as viral infections. I'll talk about our work to develop a new COVID vaccine now in use in India, Indonesia, and elsewhere.

The other side is because I have four adult kids, including Rachel—who has autism and intellectual disabilities—and wrote a book a few years back called *Vaccines Did Not Cause Rachel's Autism* because that was kind of the phony assertion from antivaccine groups. Going up against them, by default, I became an expert not only in the vaccine science but the antiscience. I've been writing and speaking about that.

Today, what I want to do is speak to you about both aspects: the positive side and fight for developing vaccines for poverty-related diseases as well as coronaviruses, but, at the same time, increasingly I'm being called out to combat widespread antiscience activism and antiscience aggression.

To start out on the positive side, I'm a professor at Baylor College of Medicine, where I'm also the dean of our School of Tropical Medicine. Together with my science copartner for the last 20 years, we cohead the very interesting Center for Vaccine Development that has been making vaccines for parasitic infections in Africa, Asia, and Latin American countries, such as schistosomiasis, hookworm, Chagas disease, and leishmaniasis. Then, about 10 years ago, we started developing coronavirus vaccines for SARS and MERS and, ultimately, COVID-19. The Center for Vaccine Development is based at Texas Children's Hospital (coheaded by myself and my science partner for the last 20+ years, Dr Maria Elena Bottazzi), part of our enormous Texas Medical Center, which is the world's largest medical center.

We sometimes call our vaccines for parasitic diseases antipoverty vaccines because they're vaccines for disease that not only affect health but also trap people in poverty through their effects on child development, work or productivity, and pregnancy outcome. The vaccines also are a potent antipoverty tool, so we call them antipoverty vaccines. I first wrote about them in my first book, which is called *Forgotten People, Forgotten Diseases*.

One of the things that we do at our Center for Vaccine Development—it's not a typical academic center and is actu-

ISSN 2163-5315

ally developing the vaccines—is we use technologies, whenever possible, that are compatible with those used by vaccine producers in low- and middle-income countries (LMICs) that have banded together to call themselves the Developing Countries Vaccine Manufacturers Network (DCVMN). There are about 40 of these institutions in Asia, Africa, and Latin America. One of the common technologies that is widely used is microbial fermentation in yeast to make recombinant protein vaccines, which is the technology used to make the recombinant hepatitis B vaccine. For instance, countries like Bangladesh, China, India, Indonesia, etc., all make their own recombinant protein hepatitis B vaccine. If you want to plug and play into the system so that vaccines could be made locally in LMICs, this is a pretty good technology to use. Another aspect is that it's a vegan technology—no animal cells, human cells, animal proteins, or human proteins—so it has the capacity, for instance, to be made as a halal vaccine for Muslim-majority countries, which is also extremely helpful at times.

Our parasitic disease vaccines include vaccines for human hookworm infection and schistosomiasis, which is in phase 2 clinical trials. There's a lot of interesting science behind it that I won't go into, but we're trying to develop and distribute vaccines on the African continent, Southeast Asia, and Latin America. The point is if you were the CEO of a biotech, this would probably not be the map you want to have in your business plan because most of the pharma industry and biotechs are focused on the Global North, meaning North America, Western Europe, and Japan. So, the science that we're doing is interesting, but we're also trying to identify sustainable financial models for them to recognize that the return on investment is going to be very modest compared with vaccines intended for North America or Europe or Japan.

Our vaccine for schistosomiasis, which is in phase 2, is also helping a major problem of women's reproductive health, that is, female genital schistosomiasis, which affects 40 million girls and women on the African continent.

Our Chagas disease program targets a parasitic infection in the Latin American region that affects about 6 to 7 million people living with Chagas disease, of whom about 20% to 30% can go on to develop heart disease, Chagasic cardiomyopathy, which is caused by the parasite depositing, inducing the formation of collagen and fibrotic deposition as well as inflammation. This happens even despite antiparasitic chemotherapy. Dr Kathryn Jones, who heads our Chagas disease pathogenesis program, has been working with our vaccine center to develop a new prototype Chagas vaccine that will go into phase 1 clinical trials in Mexico next year.

This gives you an example of the type of parasitic disease targets that we're interested in. Of course, the problem with COVID-19 vaccinations was that the mRNA vaccines developed by Pfizer and Moderna were not readily available for LMICs. All the doses got swept up pretty rapidly by North American and European countries. This left a huge unvaccinated population gap, so huge numbers of people went unvaccinated on the African continent and in India and Southeast Asia.

A consequence, unfortunately, other than the obvious humanitarian concern, was that Delta arose out of an unvaccinated population in India and South Asia and Omicron out of an unvaccinated or undervaccinated population in Southern Africa. These were vulnerabilities that were created because of this vaccine equity gap, so our plan was to say, "Look, we've developed this low-cost technology that we think works as well for SARS and MERS vaccines; we can now do the same for COVID-19." In fact, we've actually done this now—we transferred the technology (without patents) to India and other countries where they've scaled up production. In India, the vaccine has been produced at scale by Biological E, a vaccine manufacturer based in Hyderabad that has produced the vaccine that they call Corbevax. So far, it has gone into more than 75 million adolescent arms in India and now is being used as a booster for adults. Biological E owns the technology, so it's a way of decolonizing the vaccine ecosystem by transferring ownership to an LMIC vaccine producer. We provide a proof of concept that you do not have to be a multinational pharma company to do big things. We did this through our academic home at Texas Children's Hospital and Baylor College of Medicine, our Center for Vaccine Development, in partnership with LMIC vaccine producers. We're hoping to hit the 100 million–dose threshold by the end of 2022 or early 2023.

One of our major activities is vaccine diplomacy, working to do the technology transfer of our vaccine technology—without a patent, in this case—to countries such as India, Indonesia, and Bangladesh and Botswana in Southern Africa. We've been doing this largely without a lot of public support in terms of the fact that we were cut out of Operation Warp Speed from the US government and have not really gotten that much support from the G7 countries; we are trying to do this with local governments as well as private philanthropy.

Corbevax was approved for emergency use authorization last year and first went into adolescent arms starting on March 15th. As I mentioned, now we've reached over 75 million doses in adolescents 12 to 14, and the numbers are going up; we're hoping soon for World Health Organization approval. Biological E, which owns the vaccine, is now pursuing its possible uptake in other LMICs. In parallel, we've done a similar vaccine antigen in Indonesia with their big vaccine producer, BioFarma, and it was just announced that this vaccine has been approved for Indonesia, where they

call it IndoVac. Because it's a vegan technology, this will be one of the first halal vaccines for Muslim-majority countries, which we're extremely excited about.

Now, that's the good-news aspect of the story. The not-so-good news is the fact that, because of 21st century social determinants as well as climate change, we are slowing, halting, or, in some cases, even reversing our global gains, both for control of neglected diseases as well as vaccine-preventable diseases. I've written about this in my last book, called *Preventing the Next Pandemic: Vaccine Diplomacy in the Time of Anti-science*. One of the forces I'm particularly concerned about is the rise in antivaccine/antiscience activism, which is really turning out to be aggression.

Let me give you an example that we've seen in this time of COVID-19. The official number of deaths for COVID is roughly around 5 to 6 million, but some estimates from the Institute for Health Metrics and Evaluation, *The Economist*, and others say up to 20 million deaths. The World Health Organization is now saying 15 million deaths. In the United States, we've had 1 million deaths, second only to India. The figure shows the familiar pattern of deaths that many people will recognize that goes through various peaks and valleys as we course through the pandemic.

The first peak was 2020 in New York, followed by the summer in Texas and the southern states; the big Alpha wave was in that terrible winter of 2021, and the Delta wave was in the last half of 2021, followed by the Omicron wave; then, there's a big blue arrow in the figure. That big blue arrow points to May 1, 2021, which is the date that the Biden administration announced that anyone who wanted to get a COVID vaccine could do so, but you can see that the deaths continued afterward. These were individuals who were defiant and refused to get vaccinated because they were victims of antivaccine activists.

My estimate is around 200,000 Americans needlessly lost their lives because they refused the COVID vaccine and became tragic victims to these new, very dark antivaccine activist forces. I want to go there next to explain what's happening with antivaccine/antiscience activism and aggression because people too often think it's just some random events that occur on the internet or social media, but it's far more deliberate than that. Let me take you through how I see that the antivaccine/antiscience ecosystem has evolved or devolved.

Again, I got involved in this being the parent of four adult kids, including Rachel, who has autism and intellectual disabilities, and explaining why vaccines did not cause autism, which was version 1.0 of the movement. Then, about 7 or 8 years ago, it became more of a political movement rallying around this banner of health freedom/medical freedom, and now it's become a full-on globalized empire. I want to finish up by taking you through versions 1.0, 2.0, and 3.0 to help you understand what's happening with antiscience (Box 1).

Box 1. The Antivaccine Ecosystem in the United States

V.1.0 Vaccines and Autism
V.2.0 Vaccines and "Health Freedom"
V.3.0 Globalization

Version 1.0, vaccines associated with autism itself, has a lot of complexities. The original assertion, back in a paper published in *The Lancet* in 1998, claimed that the measles/mumps/rubella (MMR) vaccine had the ability to replicate in the gut of kids, and then that led to autism—or what, at that time, was called pervasive developmental disorder. The scientific community responded in a big way, showing that kids who got the MMR vaccine were no more likely to acquire autism than kids who didn't.

That was very, very important for debunking the assertion, and you would have thought that would be the end of it. But antivaccine groups grew in strength and size and kept on switching up or moving the goalpost in terms of what the actual assertion was; they switched it over to thimerosal preservative in vaccines, spacing vaccines too close together, and alum in vaccines. For a while, they even switched out of autism and said it was the HPV vaccine for cervical cancer or other cancers that was causing infertility or autoimmunity.

If that sounds familiar for COVID-19 vaccines, that's where they got it from—they just copy/pasted the false assertion onto COVID-19 vaccines. As I said, I got involved in this, having Rachel as my youngest daughter, and I detail this in the book, *Vaccines Did Not Cause Rachel's Autism*, which was published by Johns Hopkins University Press. It does a deep dive explaining the science of vaccines and the evidence showing there's no link with autism, but also what autism is and how it begins in early fetal brain development through the action of autism genes. Through Baylor College of Medicine Genetics we actually did a whole-exome genomic sequencing on Rachel, and my wife and I and were able to identify Rachel's gene associated with autism; it's involved in neuronal communication, which makes a lot more sense for something like autism.

Of course, I was heavily targeted by antivaccine activists because of that. They began calling me the OG villain—I had to look it up—the original gangster villain. I think it did have some effects on taking some of the wind out of the sails of antivaccine groups, but they found a way to reenergize about 9-10 years ago in a way that I not necessarily would have predicted. It began in Southern California, where so many parents had opted their kids out of getting vaccinated that, not surprisingly, it led to a large breakthrough

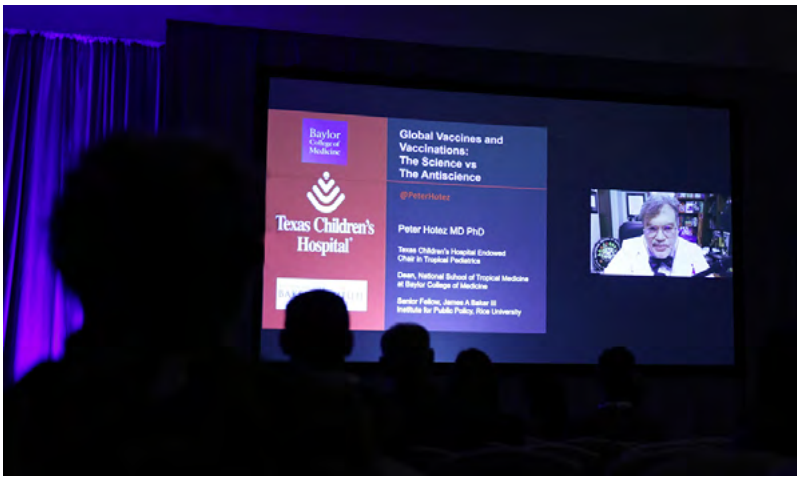
measles epidemic in 2014–2015. The California legislature responded appropriately by shutting down vaccine exemptions, and I supported that, but it also led to a backlash under this banner of medical freedom and health freedom, with people saying, "Hey, you can't tell us what to do in terms of vaccinating our kids."

That was fairly disturbing, but it's what took off, especially in states like Texas, where this idea of health freedom or medical freedom got adopted by the Republican Tea Party, and they formed their own political action committee around not getting vaccinated. There was pressure put on the state legislature to make it harder and harder to vaccinate our kids and easier and easier to opt out. As a result, we're up to almost 100,000 kids not getting all their vaccines in the state of Texas, especially around the Austin area, and this doesn't even account for the more than 300,000 homeschooled kids. We have a huge problem now in states like Texas, where too many kids are not receiving their vaccines required for school entry.

It's taken this very dark turn in Texas and elsewhere. At one point, antivaccine activists paraded with yellow Jewish stars at rallies and actually, in my opinion, mocking the Holocaust and using words like NO VAX in letters that look like Hebrew letters. I think it's incredibly offensive and divisive, and yet this is what's been going on here in Texas and elsewhere. And now, in this time of COVID-19, it's accelerated even further among this banner of health freedom/medical freedom to protest social distancing, contact tracing, and wearing masks. We've had some podcasters weigh in, and it's created quite a dark environment around getting vaccinated, and, of course, this has extended now to COVID vaccination.

In Texas, COVID vaccinations have higher rates along the border and some of the cities of the Texas triangle, but in the conservative areas of central Texas and the panhandle of east Texas, there are some of the lowest vaccination rates in the country. It mirrors the political map of Texas. The higher-vaccinated areas are in the more liberal/Democratic areas, whereas the low vaccination rates are in the more conservative/Republican strongholds. It's really quite striking, and this is what we're seeing now happening nationally.

Studies from Charles Gaba, the health analyst, as well as *The New York Times*, *Axios*, National Public Radio, and other groups show how in the last half of 2021, the deaths are overwhelmingly in red states, and the redder the county, the lower the vaccination rates and the greater the deaths, so much so that *The New York Times* actually calls it "Red COVID." This partisan divide of politicization of people not getting vaccinated is something, for me, that's been one of the hardest things I've ever had to talk about because all our training, as physicians and scientists, says you're not really



supposed to talk about Republicans and Democrats or liberals or conservatives. But I've not found a way to talk about it other than to talk about it in a quest to save lives.

Everyone's entitled to their conservative views, but please don't adopt this one because it's leading to my estimate that 40,000 Texans (and possibly up to 200,000 Americans) may have died unnecessarily during this Delta wave, and the numbers are continuing among the unvaccinated in the Omicron wave. It's extending now to all childhood vaccinations. There's a survey looking at how the distrust of COVID vaccinations along the partisan divide is extending to all childhood vaccinations, so I'm quite worried about the return of measles and pertussis and other childhood infections.

Another big concern I have with this is not only the rise of antivaccine activism, but how it parallels antisemitism as well; this has been reported by multiple outlets with people circulating antisemitic flyers blaming Jews for COVID-19. Because I'm Jewish, I'm aware of it more than others, and I'm frequently targeted not only for being a scientist but in particular for being a Jewish scientist. The emails that I'm getting are pretty frightening, and they often take a very violent tone, such as that I'll be charged with treason and other crimes against humanity and many expressing their desire to see me executed by various measures. There is also a lot of Nazi imagery. I'm sometimes compared to Dr. Mengele, the infamous Nazi doctor who experimented on humans.

This has been present not only with me but also my other colleagues—this idea that not only the science is being targeted but the scientists themselves. It's incredibly offensive stuff, very racist, and white supremacist in nature, with threats the army of patriots will come and hunt me down, very much leaning toward political extremism on the right. This is the new aspect of antivaccine activism—this adoption by far-right extremists—but it's also coming out of the Conservative Political Action Conference (CPAC). We

heard it multiple times that first they're going to vaccinate you, then they're going to take away your guns and your Bibles (https://www.newsweek.com/madison-cawthorn-says-door-door-vaccines-could-lead-taking-guns-bibles-1608503).

As ridiculous as that sounds to us, there's a segment of the country who believes it, or members of the House Freedom Caucus and the US Congress comparing people, like myself, whom they call medical brown shirts, using Nazi paramilitary analogies. Of course, it's revved up every night on Fox News by the nighttime Fox News anchors specifically targeting scientists, and these kinds of threats tend to ramp up every time. I'm particularly targeted on Fox News. They target Dr. Fauci a lot, of course, but when they get tired of beating up on Tony, I tend to be Fauci Lite. These are the kinds of threats that I'll often get after a prominent conservative news site picks this up or if it's amplified on Fox News.

So, the question is, what are we facing? What can we do, and what can AMWA's contribution be? Well, it's not easy, because this really does go outside the health sector. It's become a political problem. But I think it's important that we at least recognize the problem and its potential for unraveling our biomedical infrastructure. It's not only vaccines; it gets to COVID origins and COVID conspiracy theories, and we need to recognize that it's not an academic discussion—lives are being lost—and this goes way beyond just a theoretical discussion. Science and scientists are under attack, and it's deliberate and organized. These are not random events on the internet.

Proposing solutions, as I've mentioned, is not so straightforward, because so much of this has gone beyond the health sector. The US Surgeon General has tried to address this by talking to social media companies, such as Meta and Twitter, and I think that's useful, but it doesn't really get to those generating the content, and that's the problem. I think we need expertise in political science and other disciplines outside the traditional biomedical sciences to get some help.

Unfortunately, now it's going global. We're seeing this extend up into Canada and into Western Europe. *The New York Times* and BBC report it has been linked to QAnon and even neo-Nazi groups. This is a globalizing force. My worry now is that with the disruptions from the COVID-19 pandemic, we have seen a decline, for the first time, in childhood immunizations. We saw the largest drop in the last 30 years, and we're even seeing breakthrough polio cases in New York and elsewhere. My worry is that we're not going to come back to baseline—that something permanent and wrenching has happened.

The targeting of scientists, from my view, increasingly looks like what we saw during the '30s and '40s in the Soviet Union under Stalin—this kind of targeting of individual scientists seen as enemies of the state. And finally, I think this US-style antivaccine activism—and I've written about this in *Nature Reviews Immunology*—could start reversing global gains and global goals for vaccinating the world's children. I think this is starting to happen now on the African continent and elsewhere. I think we're going through a very dark period, with a lot of it coming from authoritarianism on the far right in the United States, but we're also seeing some of this now among authoritarian regimes in Brazil, Hungary, and elsewhere.

This is a time to recognize the politicization of health, but it's much more than that. It's specifically the targeting of scientists and, in the United States, prominent US scientists. I know it's not the happiest note to end on, but I think it's an important one. Until we can describe it and put our arms around it, it's hard to combat it. I think, for too long, we've seen this as random events on the internet or not really having a huge public health or geopolitical impact, and it's clear that now it does.

Thank you, again, for the recognition and the opportunity to speak with you. I look forward to a long association with AMWA. Thank you so much.

Acknowledgment

I thank Kelly Byram, Writer, Editor, and Founder of Duke City Consulting, LLC, for her help in bringing the transcript to the page.

Author declaration and disclosures: *The team of scientists at Texas Children's Hospital Center for Vaccine Development including its co-director, Professor Peter Hotez, is a co-inventor of a COVID-19 recombinant protein COVID vaccine technology owned by Baylor College of Medicine (BCM) that was recently licensed by BCM non-exclusively and with no patent restrictions to several companies committed to advance vaccines for low- and middle-income countries. The co-inventors have no involvement in license negotiations conducted by BCM. Similar to other research universities, a long-standing BCM policy provides its faculty and staff, who make discoveries that result in a commercial license, a share of any royalty income. To date, BCM has not distributed any royalty income to the co-inventors on the COVID-19 recombinant protein vaccine technology. Any such distribution will be undertaken in accordance with BCM policy. He is also an inventor on non-revenue-generating patents for neglected tropical disease vaccines. Prof. Hotez is also the author of several books published by Johns Hopkins University Press and ASM-Wiley Press and receives royalties from those books.*

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