

# Restoring trust in vaccines

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Growing up in Hartford, Connecticut, one's aspirations are to either pitch for the New York Yankees or the Boston Red Sox. Peter Hotez, MD, PhD, however, threw a curve ball when he decided at a young age to be a physician scientist who studies tropical diseases and vaccines.

As an adolescent, Dr. Hotez—dean of the National School of Tropical Medicine and professor of Pediatrics and Molecular & Virology and Microbiology at Baylor College of Medicine in Houston—could be found sampling stagnant water from the small brook near his home and bringing it back to his bedroom laboratory.

He spent a good part of his youth peering through a microscope while carrying a worn paperback copy of *Hunting with a Microscope* by Gaylord Johnson, Maurice Bleifeld and Joel Beller.

“I had an unusual background in that even when I was a teenager and adolescent, I had a fascination with microscopes and tropical and parasitic diseases,” he says.

His unique path took flight as an undergraduate at Yale University when he learned about a Rockefeller University program that would allow him to complete simultaneous PhD and MD studies with Cornell Medical College to become a physician-scientist working on parasitic infections.

At the Rockefeller University library, he “read the paper called ‘Hookworm Infection: The Great Infection of Mankind,’” which led him on a hunt through literature for more information. To his “astonishment, almost no molecular work had ever been done on hookworms.” This was his in.

It was a great way to make a public health impact based on his science “to work on a parasite of tremendous public health importance” that affects “hundreds of millions of people and to be one of the first to apply molecular biology to the study of this parasite,” says Dr. Hotez.

He also realized that some of his molecular discoveries could be potential vaccine candidates, which caused him to become “really enamored with the idea of developing molecular vaccines for hookworm.” Thirty years later, it “has resulted in the first series of clinical trials for that vaccine, and now several other vaccines for parasitic diseases,” he explains.

“I thought this would be the ideal career to become a pediatric infectious disease physician scientist with a focus on vaccines. And that’s ultimately what I became,” says Dr. Hotez.

## **Rise of the anti-vaccine movement**

Dr. Hotez met his wife, Ann, while attending Rockefeller. Their oldest son, Matt, was born during his pediatrics residency at Massachusetts General Hospital's Children's Service and Harvard Medical School.

Shortly after moving to New Haven, Connecticut, after his residency to complete his pediatric infectious diseases and molecular parasitology postdoctoral fellowship at Yale, Dr. Hotez and his wife welcomed their second child, a daughter named Emy.

With an ideal job at Yale and a roof over their heads, the Hotez family had everything worked out. However, their lives would change drastically after the birth of their third child, Rachel, in 1992. Dr. Hotez's commitment to enhancing the public conversation on vaccines would also take a stronger turn.

At 19 months old, little Rachel was diagnosed with a pervasive developmental disorder not otherwise specified, also known as PDD-NOS, which was later replaced with the more universal term "autism spectrum disorder." After Rachel, Dr. Hotez and Ann welcomed a fourth child, a son name Daniel.

As Rachel grew up, Dr. Hotez witnessed the rise of a powerful—and seemingly unstoppable—anti-vaccine community attempting to connect vaccines with autism. Yet he never thought of this as the cause of her autism.

"To me it didn't sound right. Just seeing firsthand, being a parent of someone with autism, you recognize how the impact is on global neurologic development," he says. "I just couldn't imagine any plausible scenario by which something like a vaccine could produce actual anatomic changes in the brain.

"This had to be something that's happening early in pregnancy. And, sure enough, the neuroscience has borne that out."

Even after the 1998 paper that first linked autism to the measles, mumps and rubella vaccine was retracted in 2010, the anti-vaccine community remained rampant and persistent.

To battle this growing movement, Dr. Hotez speaks on podcasts, through news outlets and by testifying in front of Congress. But as he has become more vocal, he has "run into this very aggressive and well organized anti-vaccine movement that really took off in Europe and in the United States," he explains.

He was "aghast" at the "phony accusations that vaccines cause autism and other things."

Looking at the current state of the anti-vaccine movement in the U.S., Dr. Hotez believes there are two major elements to it.

“There’s the political arm that’s lobbying state legislatures to make it harder to vaccinate our kids and easier to opt out. But then there is the—what I call the ‘anti-vaccine media empire,’” he says, adding that there are “over 500 misinformation websites.”

The growing trend of anti-vaccine books, articles and other information has large implications for parents. If a parent wants to download important health care information about vaccines, it is almost impossible because they are inundated with misinformation.

“If you put the word vaccine into your search engine, chances are you’re going to get garbage,” says Dr. Hotez, adding that “these parents, in some ways, are the victims of this aggressive anti-vaccine” movement.

What he worries about now is when parents read and hear misinformation about vaccines, they think twice about vaccinating their children. To him, even when his daughter was diagnosed with autism, he never doubted the importance of vaccinations. Unfortunately, there has been a dramatic uptick in the number of children who are currently denied access to these vaccines.

For example, in Texas there are “more than 60,000 kids who are not being vaccinated and those are the ones we know about.” With more than 300,000 homeschooled children in Texas, the number might be higher for those who are not vaccinated, which means “we probably have over 100,000 kids denied their vaccines,” says Dr. Hotez.

“We’ve seen the consequences of that happening in New York. With over 50 hospitalizations, including more than a dozen ICU admissions, from the measles epidemic this year,” he says. “Now it’s going to happen on a much bigger scale in states like Texas.”

## **Impacting policy on vaccines for the poor**

While he continues to be a loud voice against anti-vaccine groups, Dr. Hotez also remains focused on neglected tropical diseases. In 2011 he moved to Houston to create the National School of Tropical Medicine.

Expanding on their research at the Texas Children’s Hospital, he now works on vaccine development beyond hookworm to include schistosomiasis, Chagas disease and leishmaniasis.

This means he co-leads a team with Maria Elena Bottazzi, PhD, “making all the vaccines that the

drug companies are not in a position to make because they're for the diseases that affect the poorest of the poor."

Their team works with "developing country vaccine manufacturers" to ensure access to the world's poorest people, which has gotten him into the policy side of vaccines. This "took a giant leap forward" in 2015 and 2016 when the Obama administration invited Dr. Hotez to look at "how we partner with countries in the Middle East and North Africa where no new vaccines are developed to kind of build that capacity."

"That was a tremendous opportunity," he says, adding that it has taken him "beyond the lab and looking at how vaccine development can be conducted as part of a U.S. foreign policy." Dr. Hotez names this concept, "vaccine diplomacy," adding that this is "something that I think an MD-PhD made me very uniquely qualified for in many ways."

He uses his platform to look at how to ensure vaccine access to the world's poorest people. With 12 million Americans living with a neglected tropical disease, says Dr. Hotez, raising awareness has been very tough.

"We're working with Sen. Cory Booker's office to try to introduce some legislation in the Senate to raise awareness of this and to create some capacity for responding to it," he adds.

Over the years, Dr. Hotez's fascination with the pure science of his work has remained fervent, but now he is looking more closely at how the sciences can solve problems that have "enormous humanitarian importance."

His term as "U.S. Science Envoy" officially ended in 2016, but Dr. Hotez continues to spend time abroad speaking to scientists and other countries, and partnering with other research institutions, universities and vaccine manufacturers. In the current Trump Administration, Dr. Hotez serves on the Board of Governors of the US-Israel Binational Science Foundation, in addition to the Board of the Korean RIGHT (Research Investment for Global Health Technology) Fund, a partnership between the Korean Government, Korean Industry, and the Bill & Melinda Gates Foundation.

However, now that he is a senior investigator, he balances traveling and being in the lab while staying in contact with scientists. This is in addition to finding time to complete papers, maintaining public outreach, and keeping up with science and vaccine diplomacy.

"The first one requires me to be in Houston. The second one requires me usually to be everywhere except Houston. And so, there's always that kind of dynamic tension, which is very exciting, but it also brings with it a certain level of stress as well," says Dr. Hotez.

While completing his medical graduate training, it was widely accepted and understood that vaccines are both safe and lifesaving. However, "there was never a deep urgency or need to try to explain why

there was support to develop new vaccines for these neglected tropical diseases.”

Vaccine hesitancy continues to spread across the globe, which led the World Health Organization to list this among their top 10 greatest global health threats. The growing anti-vaccine movement has now infiltrated nearly every corner of the globe, from Africa and Asia to Latin America.

## **It's time to speak out**

Knowing that the anti-vaccine movement is a major threat to public health, Dr. Hotez headed down the path less traveled, which has allowed him to be a strong voice for vaccines. However, amid all the backlash, it can be hard when there is not a lot of positive reinforcement for physician scientists like himself.

“Martin Luther King said that it's not the words of your enemies but the silence of your friends that's the most troublesome,” says Dr. Hotez, adding that he has often felt alone, occasionally proceeding without enough backing from federal agencies or even some of the academic societies.

While anti-vaccination ideology has been around since the early 1800s, it was brought into the limelight in 1998, only four years after Rachel's diagnosis. But then in 2017, measles cases spiked in multiple countries all over the world with parents in Western countries refusing to vaccinate their children for a variety of reasons and perceived fears.

The number of people becoming vaccine hesitant continued to rise, yet few physicians, scientists, individuals or organizations were speaking out in favor of immunizations.



“I decided that since there was largely silence from many of our public health leaders, that here I was once again uniquely qualified, not only because I was a pediatrician scientist, but also a parent of an adult daughter with autism. I felt that I could really make a difference in taking this on.”

This is why he wrote his very personal book in 2018 about his daughter, Rachel, and why vaccines did not cause her autism—the anti-vaccine movement had grown so strong and powerful with no one standing in its path to prevent further expansion. In the book, *Vaccines Did Not Cause Rachel's Autism*, he wanted to “spell out why vaccines are both safe and extraordinary lifesaving technologies.”

However, he received a very aggressive, hostile reaction from the anti-vaccine community, which had grown tremendously over the last 20 years.

“I quickly became a big threat to the anti-vaccine lobby and they’ve thrown just about everything they can at me, but so far I’m still at it,” says Dr. Hotez. Members of the anti-vaccine lobby had ganged up and flooded Amazon with over 100 one-star reviews of his book.

He believes part of the problem is there is not a “commensurate response” to the anti-vaccine movement because “we need to hear more from our federal agencies about a strong pro-vaccine campaign or message.”

The pro-vaccine voices such as that of Dr. Hotez are “totally outgunned by this media juggernaut called the anti-vaccine movement.”

“We’re also not hearing enough from the scientists themselves,” says Dr. Hotez, adding that now is



the time for physician-scientists to take a stand and speak out against the anti-science trends.

While it is a new role for physician-scientists, it is vital for combatting this growing anti-vaccine regime.

“We’re uniquely qualified to debunk misinformation and we now have to be willing to step outside of our laboratories and speak out on this because the American public is not hearing from our scientists.”

According to the advocacy group Research!America, more than 80% of Americans cannot even name a living scientist. Of those who could, they name TV personalities such as Bill Nye or Neil deGrasse Tyson.

“The American public has no idea what a physician-scientist does and that’s partly our fault because we’ve been so inward-looking and so focused on writing and speaking for each other, and focused on our grants and papers, that we’ve not taken the time or the interest to really embark on public engagement in a meaningful way. And now it’s coming to hurt us,” says Dr. Hotez.