

Making it personal: science communication for the masses

William J. Sullivan Jr

Steffanie A. Strathdee

Peter J. Hotez

The dismal response to coronavirus disease 2019 (COVID-19) in some technologically advanced societies tracks with a distressing resurgence of antiscience [1.]. Resistance to the counsel of scientists is nothing new, as unexpected revelations often demand a shift in traditional worldviews and habits. Understandably, fans of the status quo can be particularly skeptical, making it challenging to persuade them to adopt behaviors that may impose upon their identity, livelihood, or values. To make matters worse, the information superhighway is littered with error, lies, and disinformation which makes navigating it laborious and frustrating. Exhausted minds tend to shut down and make dubious decisions based on 'gut feelings'. Worse, they surrender to a political party or flimflam artist telling them what they want to hear. Disturbingly, within the context of COVID-19, nefarious groups have weaponized this opportunity to sow discord, thwart the pandemic response, and undermine democracy [2.]. Consequently, we live in hyperpolarized times where civil discourse is virtually nonexistent and extremists are locked in a Darwinian battle over who can be the most outrageous.

The antiscience movement should not be underestimated – it has grown into an enormous beast that will require an aggressive, sustained, and multifaceted campaign to slay it. Part of the effort

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must involve engaging citizens, journalists, and political leaders both locally and globally. Given the scale of this challenge, it is imperative that more scientists step out of the ivory tower to engage in outreach to demonstrate the benefits science bestows on society and the humanity of those conducting the science [3.]. We need to illustrate how the scientific method can work like a magnet to pull filings of truth from the chaos.

Science is being applied to understand antisience [4.]. A key goal is understanding how antiscientific attitudes develop so that we can identify improved means for intervention. An effective approach in the art of persuasion is to communicate a personal story. A compelling and relatable narrative stands a better chance of making a lasting impression than stark logic or tedious charts [5.]. Each of the authors of this article has recently written popular science books that leverage personal experience to highlight the value of science and medicine.

Vaccines Did Not Cause Rachel's Autism addresses the rise of the modern antivaccine movement that accelerated in the early 2000s [6.]. It began with claims that the measles–mumps–rubella (MMR) vaccine causes autism, followed by similar assertions for thimerosal preservative, vaccine spacing, or aluminum adjuvants. Each time, the scientific community has worked to disprove such links through epidemiologic studies or laboratory investigations. The book takes the reader through this information, but then explains the neurobiological basis of autism, which is now associated with more than 100 genes linked to early fetal brain development [7.]. In parallel, Hotez discusses his daughter, Rachel, and her daily challenges resulting from her associated intellectual disabilities, and the process of whole-exome sequencing his family underwent to help contribute to knowledge about the genetic and epigenetic bases of autism. He

gives a frank account of the impact of all of this on his family. Indeed, his efforts to debunk fake vaccine–autism links come at a price, as he reports on how antivaccine aggression is directed increasingly towards both Hotez and his family. In addition, he describes the challenge to balance his career as a vaccine scientist with a parallel one in public engagement, leading efforts to combat antiscience in the areas of public policy and advocacy.

Hotez further describes how the antivaccine movement has since expanded beyond fake autism assertions to become a political movement, now linked to right-wing extremism and even Russian disinformation. Some of this information is in a more recent 2021 book, *Preventing the Next Pandemic: Vaccine Diplomacy in a Time of Anti-science*, which includes Hotez’s activities as US Science Envoy for vaccine diplomacy in the Middle East and North Africa, and his observations on the expansion and globalization of antivaccine and antiscience activities [8.]. Increasingly, antivaccine activities are no longer the purview of grassroots antivaccine groups, but rather organized campaigns from well-funded groups and even state actors such as the Russian Government [2.]. The consequence is a dangerous antiscience global empire that requires attention from agencies of the US Government and the United Nations [9.].

The Perfect Predator: A Scientist’s Race to Save her Husband from a Deadly Superbug is a memoir that weaves together personal narrative, the science behind the superbug crisis, and the strange history behind a forgotten cure [10.]. A real-life medical thriller, the book describes how Strathdee, an infectious disease epidemiologist, and a global village of health providers, researchers, the US Navy, and the FDA raced against the clock to save Strathdee’s husband (Patterson) from a deadly multidrug-resistant bacterial infection using bacteriophage therapy.

Readers first meet the authors not as scientists, but as Tom and Steff, a husband and wife whose vacation in Egypt turns into terror when Tom acquires a deadly superbug infection. Told primarily from Steff's perspective with interludes from Tom as he spirals into delirium, *The Perfect Predator* is a personal account of the science of discovery, resilience, the power of scientific collaboration, and the passion that fuels it. Five years later, the 'Patterson case' has not only been published [11.] but it also launched the first dedicated phage-therapy center in North America, the Center for Innovative Phage Applications and Therapeutics (IPATH), helped usher in a new era of phage therapy in the West, and dispelled a geopolitical bias that had relegated phage therapy to the backburner for decades.

Pleased to Meet Me: Genes, Germs, and the Curious Forces that Make Us Who We Are communicates the science of human behavior, lifting the curtain to expose its biological underpinnings [12.]. The book describes Sullivan's quest to understand why people his age who grew up in the same general environment have such dramatic differences in personality and beliefs. He hunts for the scientific basis of his own personal quirks and demons, along with those of familiar pop-culture icons like Ozzy Osbourne and Robin Williams. Framed as a reintroduction to the self, *Pleased to Meet Me* acquaints the reader with sophisticated cutting-edge topics including epigenetics and the microbiome, explaining how they operate in conjunction with genes to shape personality and influence behavior. The goal was to demonstrate that many of our traits and actions are not fully under our control, which should engender greater empathy when trying to understand someone who is unlike you. Furthermore, the final chapter, 'Meet Your Future', illustrates how this knowledge is power and holds tremendous promise for the treatment of many health conditions of interest to general audiences. But it is not free of

important ethical concerns. With the advent of CRISPR gene editing, epigenetic drugs, and psychobiotics, it is essential that the public be informed by qualified experts so this newfound power is used responsibly. Translated into a dozen languages, *Pleased to Meet Me* has educated audiences across the globe about the differences between people, including why some struggle with obesity, addiction, depression, or violence, so that more productive and compassionate conversations can be had between those who do not see eye to eye.

Our experiences authoring science books for general audiences taught us several principles that are applicable in any realm of science communication. Appropriately, we use our scientist vernacular when writing papers and grants. But to be relatable to the masses, experts recommend that we 'don't be such a scientist' and focus instead on our wonder, humor, emotions, and curiosity [13.]. Tapping into our primordial desire for mystery and intrigue is an enthralling way to frame a scientific question and present data as clues to solving the puzzle [14.]. When exercising your narrative voice, use accessible language and a colloquial style that is free of jargon. Use relatable analogies or examples from familiar people or events in the news and pop culture. Pretend that you are speaking to a nonscientist friend at the pub.

By design, science was not the central feature of our books. Readers will not absorb the science if the story is not enticing. Readers of our work come for the story about a doctor's autistic daughter, a wife's fight to save her dying husband, and one person's quest to find out why he is different than other people. Interspersed in the drama are lessons about vaccines, antibiotics, superbugs, microbiomes, genetics, epigenetics, and more. Readers gain an appreciation for how clever and passionate teams of scientists and meticulous experimentation – sometimes over the

course of centuries – eventually bring the universe and our place in it into clearer focus. Crucially, they see that science is done by regular people just like them, not a stereotypical madman bent on world domination.

We hope this article inspires more scientists to tell their story, whether it be through books, articles, or community outreach activities. We strongly believe that everyone working in a laboratory has an interesting story to tell. For those thinking about writing a popular science book, Sullivan has written a helpful guide [15.]. Together, we can turn the tide on the antiscience movement and make evidence great again.

Declaration of interests

There are no interests to declare.

Authors

William J. Sullivan Jr

Department of Pharmacology and Toxicology, Indiana University School of Medicine, Indiana, IN, USA

Steffanie A. Strathdee

Division of Infectious Diseases and Global Public Health, University of California at San Diego School of Medicine, San Diego, CA, USA

Peter J. Hotez

Texas Children's Hospital Center for Vaccine Development, Houston, TX, USA

Department of Pediatrics, Baylor College of Medicine, Houston, TX, USA

Department of Molecular Virology and Microbiology,

Baylor College of Medicine, Houston, TX, USA

National School of Tropical Medicine, Baylor College of Medicine, Houston, TX, USA

References

1. Smith, T.C. and Reiss, D.R. (2020) Digging the rabbit hole, COVID-19 edition: anti-vaccine themes and the discourse around COVID-19. *Microbes Infect.* 22, 608–610
2. Hotez, P.J. (2021) Anti-science kills: from Soviet embrace of pseudoscience to accelerated attacks on US biomedicine. *PLoS Biol.* 19, e3001068
3. Hotez, P.J. (2020) Combating antiscience: are we preparing for the 2020s? *PLoS Biol.* 18, e3000683
4. Kenrick, D.T. et al. (2018) The science of antiscience thinking. *Sci. Am.* 319, 36–41
5. Dahlstrom, M.F. (2014) Using narratives and storytelling to communicate science with nonexpert audiences. *Proc. Natl. Acad. Sci. U. S. A.* 111, 13614–13620
6. Hotez, P. (2020) *Vaccines Did Not Cause Rachel's Autism: My Journey as a Vaccine Scientist, Pediatrician, and Autism Dad*, Johns Hopkins University Press.
7. Satterstrom, F.K. et al. (2020) Large-scale exome sequencing study implicates both developmental and functional changes in the neurobiology of autism. *Cell* 180, 568–584 e23
8. Hotez, P. (2021) *Preventing the Next Pandemic: Vaccine Diplomacy in a Time of Anti-science*, Johns Hopkins University Press
9. Hotez, P. (2021) COVID vaccines: time to confront anti-vax aggression. *Nature* 592, 661
10. Strathdee, S.A. and Patterson, T. (2019) *The Perfect Predator: A Scientist's Race to Save her Husband from a Deadly Superbug*, Hachette Books

11. Schooley, R.T. et al. (2017) Development and use of personal-ized bacteriophage-based therapeutic cocktails to treat a patient with a disseminated resistant *Acinetobacter baumannii* infection. *Antimicrob. Agents Chemother.* 61, e00954
12. Sullivan, W., Jr (2019) *Pleased to Meet Me: Genes, Germs, and the Curious Forces that Make Us Who We Are*, National Geographic Books
13. Olson, R. (2018) *Don't Be Such a Scientist*, Island Press
14. Sullivan, W., Jr (2018) Want to serve up a killer research seminar? Here's how. ASBMBTODAY Published online May 1, 2018. <https://www.asbmb.org/asbmb-today/careers/050118/how-to-serve-up-a-killer-research-seminar>
15. Sullivan, W., Jr (2019) Want to write a popular science book? Here's what you need to know. *PLOS SciComm*. Published online August 27, 2019. <https://blogs.plos.org/scicomm/2019/08/27/want-to-write-a-popular-science-book-heres-what-you-need-to-know>