INTRODUCTION

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VACCINATION AND POLITICS

On December 21, 2002, President George W. Bush rolled up his sleeve, presented a deltoid muscle on his left arm, and was pricked 15 times with a tiny, bifurcated needle, whose prongs held between them a droplet of vaccinia virus derived from an infected calf. The Commander in Chief's vaccination was the keystone of a public health campaign to immunize 10 million police and health workers against smallpox by the fall of 2003, preparing the nation for a terrorist germ warfare attack. "We believe that regimes hostile to the United States may possess this virus," Bush said. He didn't name Iraq, but two of his highest aides did, under cover of anonymity.[1]

The president's vaccination was a highly politicized public health gesture, a symbolic act demonstrating that Saddam Hussein's capabilities and plans were real and evil enough to justify aggression against his regime. The last samples of smallpox virus in the world were supposedly kept in locked freezers at the CDC in Atlanta and in Novosibirsk, Russia. But the Soviets, we had learned from defectors, had secretly produced 20 tons of smallpox, and with the Soviet biowarfare complex dispersed to the four winds by economic collapse, no one was entirely sure that a cynical Russian expatriate might not be fiddling with some of that virus in a laboratory in Baghdad.[2] The government had no evidence whatsoever, it would eventually be learned, that Saddam had acquired smallpox. But in those feverish days the mere suggestion that he might have done so provided a peculiar, circular justification for smallpox vaccination, and for

war. If we vaccinated our president, surely we were doing it because Saddam wanted to deploy smallpox against us. If Saddam was indeed evil enough to start an epidemic of this dread disease, and armed with the power to do it, then his overthrow was an urgent necessity. If we invaded Iraq, then he might use smallpox as a terror weapon. This was how we came, at the beginning of the twenty-first century, to vaccinate our president against an extinct disease.

Americans had not been routinely vaccinated against smallpox for 30 years, and the vaccine had not been updated in any way. The inoculation Bush received was little different in its technique from that first described by Edward Jenner, an English country doctor, in 1796. Vaccinia, which Jenner found growing on cows, was the "shot" that put the *vacca* in vaccination; Louis Pasteur gave the name *vaccines* to his concoctions against rabies and fowl cholera a century later in tribute to Jenner. Smallpox vaccination was one of the first successful medical interventions; because of it, smallpox became the first and only contagious disease ever eradicated. In a rare case of cold war cooperation, the Soviet and U.S. governments worked together through the U.N. World Health Organization marshalling thousands of medical personnel to chase down the deadly virus and administer the knockout blows of vaccine that quelled smallpox. Its defeat, in 1980, was the culmination of an era of passionate medical idealism; campaigns to eliminate other infectious diseases—malaria, polio, measles, and hepatitis B—came on its heels.

Many of the scientists and doctors who cornered the smallpox virus in remote African and Indian villages now occupied senior positions in public health in America, and a few sat on the Centers for Disease Control's advisory committee for immunization practices, which the White House asked in 2002 to decide how to proceed on smallpox vaccination. The public health administration was profoundly ambivalent on the subject. Evidence of weaponized Iraqi smallpox was scanty; John Modlin, the Dartmouth pediatrician who headed the advisory committee, was given a CIA briefing on the evidence and later said he learned no more than had already been published in *The Washington Post*.[3] There were public health officials who recognized that the vaccination enterprise had long relied upon military and other social mobilizations. Without fear, history had shown, it was difficult to get people vacci-

nated. Many of the president's advisors, including Vice President Dick Cheney, his chief aide Irwin "Scooter" Libby, and Marvin Olasky, the author of Bush's "compassionate conservatism" philosophy seemed to regard the return of smallpox with *schadenfreude*, almost as if they were hoping for an occurrence of the scourge that would validate their worldview. The threat, according to Olasky in a *Washington Times* newspaper column, revealed the "ignorance" of the Centers for Disease Control (CDC) and the World Health Organization (WHO) campaign to eradicate the disease. "Because liberalism dominates American and European culture, we stopped inoculating against smallpox**,** and now we are more vulnerable to it than at any time over the past two centuries," Olasky wrote.[4] The majority of physicians, even the specialists, were part of that liberal culture and were skeptical of the smallpox campaign. According to one insider, the White House had to "kick, punch and stomp" the CDC panel into accepting its plan. Another described the panel as "sheep"; faced with a risk they couldn't properly evaluate, the panel voted 8–1 (Paul Offit, a pediatric immunologist from the University of Pennsylvania, was the sole dissident) to recommend the vaccination of 500,000 hospital workers, police officers, and firefighters in the first month of 2003, and 10 million others by the end of the summer.

Within a year of its portentous start the smallpox vaccination campaign had sputtered out. County and state public health officials complained of the costs and liability risks posed by the vaccine. Many said their time and money would be better spent encouraging vaccination against the flu, a quantifiable killer. (The administration did not turn its full attention to the threat of pandemic flu until three years later, when hurricanes Katrina and Rita finally forced it to reckon with the likelihood—and political impact—of natural disasters.) The nurses' unions and scores of hospitals were refusing to join the smallpox vaccination campaign, following the precedent set by 6,000 Washington and New York mail sorters who balked at getting prophylactic vaccination in the aftermath of the anthrax mailings of October 2001. The postal workers had heard about reports of dangerous side effects from the Pentagon's anthrax vaccination of troops that began in 1998; rather than risk the autoimmune and neurological disorders claimed by some military veterans, the postal employees preferred to face the small risk

that residual anthrax spores in their bodies would germinate after antibiotics had worn off.

In a nation ambiguously mobilized for warfare, smallpox vaccination had become thoroughly tangled in politics. So, as we'll see, had vaccination in general. The way in which smallpox vaccination returned showed something about the broader view of public health and how it had changed in the last half-century. There was a time not so long ago when nearly all Americans, grateful for the defeat of polio by Jonas Salk's famous shots, eagerly embraced vaccination. But the nurses and mail sorters were not the only vaccine resisters of the new millenium—far from it. Many parents of small children were concluding that vaccination was not an immutable part of life, a wholesome and unavoidable rite of passage, but rather a medical procedure that clashed with their concepts of personal autonomy, informed consent, and acceptable risk.

I became curious about vaccination shortly after my son was born in 1996, when I heard that an older vaccine against whooping cough—at the time I hardly knew what whooping cough was—had been replaced by a safer version. As a parent, I was a little surprised that any vaccine given to millions of babies had been considered dangerous enough to be replaced; vaccines seemed as simple and as unassailably good for you as mother's milk. The possibility that they weren't whetted my journalistic instincts. As I looked into the history of the whole-cell pertussis vaccine I came across a still-unfinished debate about the relative dangers of vaccination in general. Gradually, as I examined vaccines in a series of articles for *The New Republic*, *The Washington Post Magazine*, *The New York Times Magazine*, and *Salon*, it seemed to me that the best way to gain an understanding of why our children were vaccinated against particular diseases—and why some people were challenging these choices—was to delve into the history of vaccines.

WHAT IS A VACCINE? Under the definition I'll be using in this book, a vaccine is a substance that introduces a whole or partial version of a pathogenic microorganism into the body in order to train the immune system to defend itself when the organism threatens to cause an infection through natural means. A vaccine works by stimulating the immune

system to create antibodies and immune cells that recognize the pathogen and are thus prepared to battle it when it presents itself at the portals of the body. From a scientific perspective, vaccination has evolved from a purely empirical procedure into a technology that benefits from our growing ability to understand and manipulate germs and the immune system. Although vaccination works by protecting an individual, it rarely works perfectly to protect all individuals who receive it, and some individuals cannot be vaccinated. Thus, vaccination campaigns that seek to protect large populations require cultural as well as scientific innovation. Unlike cancer pills, asthma sprays, or insulin shots, vaccines prevent rather than actively fight illness. Like these drugs, vaccines carry some measure of risk to the patient. To convince people to take this slight risk in the interest of fighting a disease that is not currently harming them, or their children, doctors and public health officials must try to shape how people think about infectious disease. Whatever the idealistic objectives of a vaccine, the authority of its administrator is key. The history of vaccines as a disease-fighting measure is thus partly the story of how authorities imposed a medical procedure on people, and how people responded.

In America, vaccination is the first act the state requires of a person; without it, or a legal exemption, a kid can't even get into nursery school. But while vaccination seems anodyne to most people, it has often been dogged by controversy. Over time, vaccines have become a victim of their own success: since the great majority of children in this country no longer come down with the terrible infectious diseases that shots protect against, the other diseases of childhood—autism, juvenile diabetes, ADHD, asthma—have become more visible; the prevalence of some of these diseases is even on the rise. A recent survey published in *The Journal of the American Medical Association* found that a quarter of all American parents are now reluctant to have their children vaccinated.[5] The social history of vaccines, which is to say their use and acceptance in America, does not always parallel the scientific history. While vaccination seems to be more efficient and safer than ever before, public ambivalence about the practice has rarely been higher.

In the first 200 or so years of vaccination's history in America, it could only prevent smallpox. Starting in the early 1900s and especially after

World War II, the pace of development accelerated and vaccines conquered a plethora of major diseases. Optimism about their potential made the postwar a Golden Age of public acceptance for vaccination, although there were plenty of troubles along the way. It was only in the 1970s, when most vaccine-preventable diseases had been soundly beaten back, that the angst began: first there were claims that vaccines were unnecessary and dangerous, and that some caused brain damage; later came the hypothesis that they were causing the increase in chronic illness. While only a small minority of American parents openly shunned vaccination, a 30-year groundswell of dissent has led us to a point where vaccination might be said to be in crisis. Parents armed with Internet educations, manufacturers wary of legal liability, a cost-cutting government obsessed with germ warfare—all have made an already dissonant debate over vaccines harsher. In 2006, despite emerging microbial threats such as West Nile Virus, SARS, AIDS, and avian flu, the public was almost as skeptical of vaccinating its children as it had been a century earlier.

But if science had improved vaccines, public health had learned to be more circumspect in their use. As the smallpox vaccination campaign got under way in 2003, it was accompanied by words of caution. A few old doctors could recall a previous bioterrorism scare, in 1942, during the course of which the military had accidentally infected 300,000 men with hepatitis B, killing more than 100 of them with a contaminated yellow fever vaccine. One of the infected men was Harold Hinman, a public health service doctor en route to El Salvador. The physician's son, Alan Hinman, went on to become a pillar of the postwar U.S. vaccine establishment, with a reputation built partly on his creation of the first vaccine-safety monitoring system. Other admonitory voices recalled the 1976 swine flu fiasco, in which 40 million Americans were vaccinated to prevent a flu pandemic that never came and after which the government paid $100 million to people who claimed the vaccine had caused an autoimmune disease. And then there was the last mass smallpox vaccination campaign, in 1947, when 6 million New Yorkers were vaccinated after a traveling businessman brought a case from Mexico to Manhattan. During that campaign, the smallpox vaccine had caused far more casualties than the disease had.

In 2003, the leaders of the public health service drew lessons from this

thorny past. They held public forums to discuss the vaccination campaign, screened out people whom the vaccine might harm, and established a surveillance system to detect adverse reactions. The result of all of these elaborate precautions was a vaccination campaign that never got off the ground—which was probably a good thing. Doctors and nurses face lethal bugs in their hospitals every day and tend not to be credulous types. By 2005 fewer than 40,000 people had chosen to be vaccinated against smallpox. The Bush administration had seemingly distorted the truth and manipulated public fears to achieve its goals. Just as the failure to find weapons of mass destruction in Iraq had cast doubt on the war's necessity and soured the public on its harsh costs, the CDC's smallpox vaccination requirements had exacted a price in trust. It was clear that the CDC had endorsed a policy many of its wiser heads did not believe in. Because the CDC could not offer a solid justification for the figure of 10 million vaccinees, it suffered the first major crisis of credibility in its history. Many professionals in state health departments felt that the vaccination campaign was not based on one of the sober risk assessments for which the agency was justifiably known, but on an attempt to build national consensus for war by stoking fear. In that sense it was a perversion of the social contract that had always been at the heart of vaccination programs in America.

When I vaccinate my child against tetanus, which grows in the soil, shelters in rusty nails, and does not spread from child to child, I am protecting my child alone. But I also vaccinate her against measles, polio, whooping cough, chickenpox, mumps, meningitis, hepatitis, diphtheria, and pneumonia. In doing so I help eliminate the safe haven from which these organisms might launch an attack on somebody else's child, on a teenager whose immunity has waned, or on an adult who was never vaccinated. Public health means recognizing that complete personal responsibility is unattainable. Within limits, we must all help look after one another—that is our social contract.

In telling the story of vaccination this book makes an assessment that is as fair as I can make it, based on the available evidence. I am neither a scientist nor someone with personal experience of a severe vaccine reaction (you will read about both in these pages). I am neither a parent like George Mead of Oregon, propelled into antivaccine activism by dismay

over his child's decline into autism, nor a vaccinologist like Paul Offit, driven by a belief in the lifesaving imperative of vaccines. I have tried to steer clear of the defensive posture of some public health figures who equate criticism with disloyalty or ignorance. Scientists try to base their decisions on the demonstrated facts, but even the best scientists are most confident of the facts established in their own laboratories.

I do, however, bring personal agendas to this book. First, I have a healthy respect for germs and the doctors who treat them—especially since nearly dying from a *Streptococcus pyogenes* infection that snuck up on me out of nowhere, it seemed, when my children were 4 and $1\frac{1}{2}$. Second, I grew up in a middle-class Jewish home in Cincinnati in which pediatricians and other doctors were both close friends and respected authorities. I also had an older sister, a nurse and yoga practitioner, whose alternative approaches to health challenged, puzzled, and sometimes angered the rest of us. I struggle to this day to understand whether these beliefs helped or hurt my sister, who died of breast cancer in 2003. She blamed many of her problems on environmental toxins and "toxic" childhood experiences. When I hear the parents of suffering children insist that the "vaccine machine" inflicted their pain I can't help but think that anger is a stage of reckoning with a profoundly damaged child. Anger has its purposes, after all. It can motivate and transform despair, whether or not its target is misplaced.

My discussions with parents skeptical of vaccination, I think, have helped clarify for me a certain insight into the philosophical underpinnings of health beliefs. Scientists, and scientific thinkers in general, make different assessments of risk than do most of the rest of us. The scientist is accustomed to reducing a problem to a set of solvable variables. Thus, the vaccine developer, or public health scientist, sees a disease that kills and sickens a certain number of people each year. She sees a vaccine that has the potential to combat that disease. At that point she becomes convinced that people should be given the vaccine, as long as it does not sicken people too often and can be produced inexpensively enough for health insurers to pay for it; as long as it does not counteract the effects of other vaccines or overly complicate vaccine schedules. This is the basic utilitarian equation of vaccines. But the rest of us carry around other, sometimes tangled and contradictory, often emotionally laden, criteria.

Unlike the scientist (or the scientific ideal anyway), few of us can escape generalizing from personal experience. If our child is harmed by a vaccine, we will tend to believe other parents who say their child was harmed by a vaccine. Many of us are likely to have an instinctual aversion to taking a drug unless we can be convinced it is absolutely worthwhile. Unlike the scientist, we do not quantify the risk on a population-wide scale. To do so would seem profoundly inhuman even to the most altruistic among us. Instead we ask, Why bother? or What's in it for me? In the case of a pediatric vaccine, we may think, Things are going along pretty well for my child at the moment, but you never know what the future will hold—so why take a chance? Whether we are preparing for terrorism or planning vaccine schedules, we are forced to reckon with the fact that people assess risks in different ways. This is right and necessary. The day when all our decisions are based on equations fed into computers would be a sad day indeed. Still, it's worth doing the equations, and everyone who wishes to share in the decision-making must recognize science for what it can tell us.

This book deals with preventive vaccines against infectious diseases. For reasons of space and thematic unity, the book does not delve into the emerging field of therapeutic vaccines, which seek to prime the immune system to fight things like cancer, asthma, diabetes, and cocaine addiction. In general, when I speak of vaccines I am referring to substances that provoke *active* immunity, meaning that they stimulate the patient's immune system to create antibodies and to train certain immune cells to recognize a particular virus, bacteria, or parasite. I will refer to immunizing substances that provide *passive* immunity as gamma globulins, IGG (immune gamma globulin), or serums. These are therapeutic substances, antibodies to a particular germ, harvested from human or animal blood, that are injected or infused into a sick patient. In a few historical circumstances, passive immunogens have also been administered preventively on a large scale. For example, children in the early part of the twentieth century were given diphtheria antitoxin, produced in the blood of horses, to protect them from bacteria circulating in their families or communities. In contemporary practice, a patient hospitalized with a deadly infection may receive intravenous gamma globulins that are essentially a more sophisticated and safer version of the horse serums of yesteryear.

Many new-generation vaccines with complex designs are being tested as this book is being written. But in general, the vaccines against bacteria, viruses, and, to a lesser extent, parasites discussed here can be classified into several groups:

- *Live-virus vaccines:* Examples include the vaccines that protect against smallpox, measles, mumps, and rubella, as well as the oral polio vaccine. The live-virus vaccine is a disease virus that has been modified—by exposure to animal tissues, or, most recently, through genetic manipulation—so as to not cause disease while still causing an infection that generates immunity. Some newer live-virus vaccines against rotavirus, dengue fever, and other diseases are viral chimeras; scientists start with a particular virus' genetic backbone, then modify it by adding genes from other viruses.
- *Killed-virus vaccines:* Examples include the Salk polio vaccine and most flu vaccines. These are viruses that have been inactivated through exposure to heat or to chemicals such as formaldehyde.
- *Live-bacteria vaccines:* The best-known example is the Bacille Calmette-Guerin (BCG), a vaccine that has been used for decades, with limited efficacy, to combat tuberculosis. To make BCG, tuberculosis bacteria from cows were modified in culture to provide immunity without disease. New, genetically modified live-virus vaccines against tuberculosis and typhoid fever are being developed.
- *Killed-bacteria vaccines:* These vaccines include the original pertussis, cholera, and typhoid fever vaccines. Made of entire bacteria that are cultured and then killed with chemicals, most of these vaccines are considered crude and are being phased out of use in the developed world, usually replaced by bacterial subunit vaccines.
- *Bacterial subunit vaccines:* Most bacterial vaccines in use in the United States at present are what is known as subunit vaccines. They consist of bacterial proteins and sugars modified in a variety of ways. The common diphtheria and tetanus vaccines are made by chemically altering toxins from the bacteria; whooping cough vaccines by purifying certain pertussis proteins. Polysaccharide vaccines, including certain typhoid, haemophilus and pneumonia vaccines, are made from the purified components of bacterial cell walls. Newer vaccines against diseases like

Haemophilus influenzae type b (known as Hib) meningitis, and *Streptococcus pneumoniae*, were made by chemically fusing bacterial proteins with polysaccharide cell-wall components.

Be it viral or bacterial, live or killed, a vaccine's success as a public health measure relies on three legs of support: (1) the public, which must be confident of the safety and worth of the procedure; (2) manufacturers, who seek to generate profits by making vaccines; and (3) government and public health professionals, who negotiate with the others to further population-wide health goals. As you will see throughout this book, none of these legs is entirely stable.