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Maija-Liisa Ehlinger April 6, 2014

Writing the numbers: The role of statistics in vaccination campaigns and Progressive Era public health literature

by

Maija-Liisa Ehlinger

Elena Conis
Adviser

Department of History

Elena Conis
Adviser

Cynthia Patterson
Committee Member

Susan Tamasi
Committee Member

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Maija-Liisa Ehlinger

Elena Conis
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Abstract
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The history of public health is more a story of false starts than it is a triumphalist narrative about creating a healthier society. This is particularly true in the history of American vaccination campaigns, when social and scientific shifts during the Progressive Era created a strong anti-vaccinationist movement in cities like Boston and Philadelphia. An examination of circulars, pamphlets and newspapers - written by prominent members of health departments and opposition groups alike - displays how statistics informed the public about medical advances during the Progressive Era. Both sides of the debate gathered statistics from four distinct areas – foreign countries, previous epidemic studies, individual doctors and from their own investigative research within recently vaccinated communities. Distributing such statistics changed how the public understood preventative health measures like vaccination and how ideas about health were communicated.

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Introduction
Vaccination and statistics in society

When the first volume of *The Anti-Vaccination News and Sanatorium* was distributed in 1895, most Americans were a generation removed from experiencing a full-fledged smallpox epidemic first hand.[1] The disease that once marred the faces of thousands of children each year was reduced to isolated outbreaks brought in by outside travelers. From the perspective of public health officials, vaccines were winning the war on smallpox and creating a healthier population.

But each subsequent publication against vaccination expanded its partisan reach to a larger and more diverse audience, ranging from high-level East Coast industrialists to religious Midwestern families. These pamphlets, circulars and newspapers pushed back on the very science that could alleviate the world from what Thomas Jefferson called the greatest scourge on the "calendar of human afflictions."[2] Within each article, prominent anti-vaccinationists pulled passages from the Constitution, the Bible and famous philosophers to showcase that vaccines were sacrilegious and even un-American.[3] It was not uncommon for anti-vaccinationists' publications like *The News and Sanatorium* to distribute religious imagery that equated vaccines to poisonous trees and vaccinators to godless people willing to slay children with their lancet. Each page highlighted parental fears by distributing the names of individual children killed by "lancet-rapists" who defied God's commandment in Leviticus to not cut or mark human skin.[4] But most importantly, anti-vaccinationist literature around the country started to supplement their fear-riddled literature with statistics that showcased the negative side effects of vaccines. In

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[1] 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc.' The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.
[2] Donald R. Hopkins, *Princes and Peasants: Smallpox in History*, (Chicago, University of Chicago Press, 1983), 310.
[3] 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. Manuscript. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.
[4] Ibid.

order to stand up to public health innovations, anti-vaccinationist leagues across the country fervently employed statistics.

Ironically, opposition to vaccination increased just as smallpox prevalence decreased and public health took a more prominent role in American daily life. Their publications ran up against Boards of Health's literature distributed in urban and rural American towns, which displayed vaccine science as a positive innovation for the public. Health Departments in major cities like Philadelphia and Boston printed their own literature steeped with frustration that smallpox still existed in their respected cities. In an attempt to directly appeal to Philadelphia's citizens, the Medical Society of the State of Pennsylvania distributed a detailed eighteen-page pamphlet that not only showed horrific pictures of what smallpox did to children; it also included "convincing" statistical evidence from European countries that had already stamped all but 1.9 per cent of smallpox cases through vaccination.[5] To public health officials, such statistics provided solid evidence that their vaccination was associated with better health outcomes. When distributed to the public, health officials hoped to successfully render opposition groups' claims obsolete.

Anti-vaccinationist literature carefully handpicked population statistics that highlighted the perceived fanaticism of vaccination. This thesis sets out to explore the role of these statistics in Progressive Era health communication efforts, particularly within the contested area of vaccination. An examination of circulars, pamphlets and newspapers written by prominent members of health departments and opposition groups alike shows how statistics informed the public during the Progressive Era. The introduction of statistics into vaccine literature gave both sides of the argument what they saw as more validity in the public eye. They gathered statistics

[5] Vaccination: A Message from the Medical Society of the State of Pennsylvania, (1902). The Historical Society of Pennsylvania, Philadelphia.

from four distinct areas – foreign countries, previous epidemic studies, individual doctors and from their own investigative research within recently vaccinated communities. In order to unpack the role of statistics within the vaccination debate, it is necessary to analyze health communication literature distributed in places where vaccines were most contested. At the turn of the century, this included vibrant and densely populated cities like Boston and Philadelphia. Both of these cities had a growing public health system in place to combat infectious diseases like smallpox. But they were also the cities where vocal opposition parties grew.

A closer analysis of anti-vaccinationist and health department literature from within these contested American cities provides an interesting case study into the changing role of statistics. The Countway Medical Library, located at Harvard Medical School, holds the archives for groups such as the American Medical Liberty League and the Massachusetts Anti-Compulsory Vaccination Society, as well as literature from other outspoken Bostonian public health officials, such as chairman of the board for the Boston Board of Health in 1901 Dr. Samuel Holmes Durgin. Analysis of sources from both sides of the debate display the mounting tensions that vaccination caused within diverse cities like Boston. Philadelphia's Mutter Museum also houses a varied collection of anti-vaccinationist literature, including works from the Philadelphia Anti-Compulsory Vaccination League and The Anti-Vaccination Society of America. A study of printed literature from the Board of Health of Pennsylvania, located at the Philadelphia branch of the Historical Society of Pennsylvania, gives insight into how health officials combated vaccination skepticism and communicated with the public. Additional understanding of how vaccination was talked about by medical and lay readers can be found in the *Journal of the American Medical Association* and *The New York Times*.

By the start of the twentieth century, the public already had a long history with preventive health. Inoculation –the Turkish idea of introducing the smallpox virus to the body in order to generate immunity to the pathogen before outside exposure – gained popular support among some American doctors during a 1721 smallpox epidemic.[6] However, this invasive and time consuming procedure was not an easy sell to health and government officials, who needed a prevention technique that could handle a diversifying and urbanizing population. They would find their answer in an English physician's experiment with cowpox and milkmaids. Edward Jenner used cow lymph as a safer, cheaper and more effective way to provide individual immunity to smallpox. This, coupled with the introduction of germ theory and laboratory sciences, solidified vaccination as the best method to rid individual bodies and entire communities of smallpox. Science and medicine now had a reason to focus on the individual as the causal factor for disease spread. This new paradigm in health required statistics that showcased the need for healthy individuals to be vaccinated in the name of communal good.

English experiments and Germany laboratories brought vaccine science and bacteriology to the forefront of scientific understanding.[7] So there was no surprise when the newly independent Germany introduced the Imperial Vaccination Law of 1874, making compulsory vaccination a "basic duty of citizenship."[8] Throughout the nineteenth and twentieth centuries, American health officials looked to Germany for evidence that compulsion was a necessary component of public health.

Epidemiological realities of the smallpox virus itself also shaped the way in which writers in health literature discussed vaccines. As the strain of smallpox switched from variola

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[6] Elizabeth A. Fenn, *Pox Americana: The Great Smallpox Epidemic of 1775-82,* (New York, Hill and Wang, 2001)., 263: Gareth Williams, *Angel of Death: The Story of Smallpox*, (New York, Palgrave Macmillan, 2010), 126.: Giblin, *When Plague Strikes: The Black Death, Smallpox, AIDS*, 69.
[7] Thomas D. Brock, *Robert Koch: A Life in Medicine and Bacteriology*, (Washington, ASM Press, 1999), 90.
[8] Willrich, Pox, 39.

major to variola minor, patients dealt with a superficial, less invasive manifestation of the virus.[9] At its worst during the eighteenth and nineteenth centuries, variola major killed close to fifty percent of those inflicted. Those who survived an epidemic would be awarded immunity, but often at the price of permanently disfigured skin.[10] As vaccination campaigns increased in the later part of the nineteenth century, Americans witnessed more cases of variola minor, which killed only two in every thousand people infected and made only 20% of people sick enough to seek medical treatment. As the morbidity and mortality rates decreased, many doctors never experienced smallpox first hand and misdiagnosed patients with chickenpox. This made it more difficult for health officials to convince the public that vaccination and revaccination were still necessary for total eradication of the scourge.

Yet when smallpox epidemics reappeared in a seemingly spontaneous fashion in the winter months of 1901, health officials tried to bolster vaccination and revaccination campaigns as the most viable preventive measure. Historian Robert T. Johnston points out the irony of early twentieth century vaccination, when safer vaccines fought a much less dangerous disease. Communicating their goals was not always an easy task for health officials, who had to battle public confusion, apathy and an increase number of opposition groups. In an attempt to prevent widespread epidemics before they occurred, health officials increased their campaigns and targeted parents, infants and school children in their communities and in their schools. Health officials and community members clashed frequently throughout the United States, leading to pockets of violence and the eruption of riots in places as diverse as Milwaukee, New York, rural

[9] Michael Willrich, *Pox: And American History*, (New York, Penguin Books, 2011), 41.
[10] Shyrock, *The Development of Modern Medicine,* 216.

Kentucky and Boston.[11] From this dissent emerged the anti-vaccinationists, an eclectic group that clung to no singular thesis as to why vaccination was a social evil. They all ultimately rejected vaccination as a standard procedure, claiming that "the health of the social body" could not be preserved by something that was ineffective and had the potential to spread syphilis, tetanus and death itself.[12] Their ideas were radical by scientific standards, but anti-vaccinationists' pushback showed the shifting social landscape at the time. Because of their vocal dissent, anti-vaccinationists forced health officials to change how they informed the public about their disease eradication work.

Smallpox eradication owes its success as much to scientific advances as it does to social understandings of the disease and vaccination during the nineteenth and twentieth centuries. The introduction of vaccination statistics provided health officials with a way to write about eradication to the public and the medical professional alike. However, it also opened the door for opposition parties to voice their dissent. Like their public health counterparts, anti-vaccinationists introduced statistics to gain a sympathetic ear in society. The way in which they highlighted the definition of liberty, 'Progressive' society and individual rights gave them the needed boost to survive against growing health departments. The following chapters look at how both sides of the vaccination debate honed in the power of statistics to survive the shifting social and scientific landscape of American Progressive society. Chapter one will explore how the shifting social landscape and evolving medical field made statistics a valuable part of health communication. Chapter two examines how health officials used statistics to inform the public

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11 James Colgrove, *State of Immunity: The Politics of Vaccination in Twentieth-Century America*, (Berkeley, University of California Press, 2006),21.
12 Nadja Durbach, *Bodily Matters: The Anti-Vaccination Movement in England, 1853-1907,* (Durham, Duke University Press, 2005), 150.: Michael Willrich, *Pox: And American History*, (New York, Penguin Books, 2011), 117.

about their vaccination campaigns. Chapter three expands upon the social and scientific changes that allowed anti-vaccinationist sentiments to grow during the Progressive Era. Specifically, anti-vaccinationists expanded their reach by implementing the same sort of statistical findings to communicate their ideas with the public. By looking at a collection of anti-vaccinationist literature, popular newspapers and medical journals from the time, we begin to see a more complete picture of how vaccines influenced Progressive society.

CHAPTER ONE
Social and scientific trends informing vaccination campaigns in the Progressive Era

The study of health communication efforts requires careful analysis of both scientific and social trends. A new American spirit emerged from waves of immigrants, industrial growth, and changing ideas about the rights of the individual. Within an age of social ferment came new scientific innovations that provided new definitions of health. In order to provide solid and convincing evidence to the public, the pro-vaccination camp searched for "statistical rather than laboratory verification" of their effort.[13] This chapter provides background on the changes in American society, medicine and public health that ultimately influenced vaccination and health communication efforts.

Progressive Era Society

By the turn of the century, American health officials noted that "every civilized country" embraced vaccination as an essential tool for social good. [14] But American society had a unique set of challenges to tackle in order to create successful vaccination campaigns. The very political, economic and social views once ascribed to the American spirit transformed around the turn of the century. As Carl Resek points out, the Progressive Era was a sharp move away from the "deterministic and utopian ideology" of the Gilded Age and the mid nineteenth century.[15]

Between 1880 and World War I, a complicated mix of international and domestic issues increasingly placed the United States on the global stage. Empires emerged in the aftermath of war and new colonies grew in tandem with increased trade. While there is no doubt that

13 Rosenkrantz, Public Health and the State, 97.
[14] Michael Willrich (2008). "The Least Vaccinated of Any Civilized Country": Personal Liberty and Public Health in the Progressive Era. Journal of Policy History, 20, pp 76-93. doi:10.1353/jph.0.0003.
[15] Carl Resek, *The Progressives*, (New York, The Bobbs-Merrill Company, 1967), xx.

international pressures informed American identity at the time, domestic social and economic tensions sparked the most reform. Immigration reshaped ideas regarding what a progressive, democratic urban society looked like. Whether pushed out by European turmoil or pulled in by economic opportunities, immigrants arrived in the United States in record numbers from the 1880s onwards. Searching for citizenship and employment, millions of Europeans first set foot on American soil in the closing decades of the 1800s, producing a very different picture of the American public.[16] While immigration brought in a larger work force, it also created a sort of identity crisis, as society struggled to define what 'American' meant. Xenophobia ran through daily urban life, starting the trend of quotas and political action against perceived foreigners.

Reformers responded to the plight of immigrants in varied ways. Progressive reformers in American cities and rural towns alike worked to destroy social insecurities associated with immigration.[17] Since the Social Gospel's "moral idealism" was not necessarily tied to a particular religious denomination, problems with health and civil liberties were tackled from outside of church doors.[18] Prominent writers such as Jacob Riis and Upton Sinclair exposed the horrors faced by the poor within tenement housing.[19] Settlement houses, built to provide charitable uplift, became a staple of urban life. Others brought this struggle to the streets and to the courthouse, where strikes and workers' rights campaigns struggled for social change in an industrial society. Still others, like Robert La Follette and Theodore Roosevelt, took political action to raise the profile of the progressive agenda.[20]

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[16] Michael R. Haines and Richard H. Steckel, *A Population History of North America*, (Boston, Cambridge University Press, 2000), 345-7.
[17] Carl Resek, *The Progressives*, (New York, The Bobbs-Merrill Company, 1967), xx.
[18] Robert T. Handy, *The Social Gospel in America*, (New York, Oxford University Press, 1966), 3.
[19] See general Jacob Riis, *How the Other Half Lives* and Upton Sinclair, *The Jungle*
[20] John Morton Blum, *The Progressive Presidents: Roosevelt, Wilson, Roosevelt, Johnson*, (New York, W.W. Norton & Company, 1980), 25-59.

Industry also highlighted tensions that defined the Progressive Era. Urban development redefined the American city, as a complicated mix of individualism, commercialism, and laissez faire capitalism lifted up American Big Business. Social Darwinism, along with other sociocultural theories, blended with "religious fatalism, materialism and individualism" and applied perfectly to the corporate business world.[21] But the economic opportunities that industrialization offered to the emerging working and middle class were small compared to the gains of corporate investors who forged new American cities. Divisions between the rich and poor classes grew, making property and liberty seemingly "indistinguishable" and class lines less permeable.[22] But industrialization also created intense moments of economic insecurity throughout the country. As a small percentage of American businessmen gained political leverage, dropping agricultural prices in the 1880s and a global economic recession in 1893 sparked fear throughout the industrial world.[23]

Despite hopeful reform efforts, the Progressive Era was steeped in social ferment and sharp dichotomies. Urbanization, industrialization and immigration changed the role of the individual within a democratic, evolving society. The court system was particularly powerful in highlighting these social tensions. Even though reformers fought for equality of opportunity within the workplace through cases like *Muller v. Oregon*, the 1896 Supreme Court decision *Plessy v. Ferguson* provided legal backing to segregation, making reform appear, in the words of historian C. Vann Woodward, "progressive to the white man only."[24] At the same time, *Lochner v. New York* (1905), which revisited the Fourteenth Amendment's due process clause and protection of an individual's Constitutional rights, promoted free market economics and laissez-

[21] Noel Jacob Kent, *America in 1900*, (New York, M.E. Sharpe, 2000), 32.
[22] Ibid, 29.
[23] Ibid, 8-10.
[24] Resek, *The Progressives*, xiv.

faire capitalism. Tensions increased as a "highly decentralized" government clashed with Progressives' call for social welfare and social uplift.[25]

Health in the Progressive Era

The Progressive Era's reform spirit even transformed health and medicine, as health officials, charitable workers and government officials alike tried to create a Progressive, modern society. Their reform efforts helped pass the Biologics Control Act (1902) and the Pure Food and Drug Act (1906). Within the vaccination debate, the idea of compulsory vaccination had long been debated in local courts in cases like Philadelphia's *Field v. Adelaid McGlumphy*.[26] When the issue moved outside of the classroom and into the national spotlight after the 1901/2 epidemic, the Supreme Court case *Jacobson v. Massachusetts* (1905) gave judicial approval to state-run compulsory vaccination and police force based on "necessity, reasonable means…and harm avoidance."[27] The Court upheld the governmental right to protect the population from a "known hazard" in order to sustain community health.[28] While the Jacobson case did not end all debate over vaccination, it did underscore the prevailing tensions between individual and community health.

Before bacteriology, public health focused on changing the "social environment" in order to improve health, decrease disease and eliminate poverty.[29] Such holistic ideas seemed to parallel the Progressive Era's quest for a healthier, stronger society. However, scientific

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[25] Shyrock 240.
[26] Anti-vaccination reports on alleged causalities from compulsory vaccination in Philadelphia area, 1902. Monograph. The College of Physicians of Philadelphia, Philadelphia.**:** James Colgrove, *State of Immunity: The Politics of Vaccination in Twentieth-Century America*, (Berkeley, University of California Press, 2006), 35.: Willrich, Pox, 315.:
[27] Lawrence P. Gostin, 'Jacobson v Massachusetts at 100 Years: Police Power and Civil Liberties in Tension,' *American Journal of Public Health*, Vol. 95, Issue 4 (April 2005), 576
[28] Colgrove, *State of Immunity*, 40.
[29] Duffy, 66-7.: Colgrove, 199.

advancement created even more tensions. While the Bacteriological Revolution was embraced by both public health and medicine as a way to garner more control, it ultimately reshaped the "boundaries between private curative medicine and public preventive medicine."[30] According to John Duffy, bacteriology provided "new means of identifying, curing and preventing contagious disease" without the cost of major social change. Gone were the days when health officials' power ended at the quarantine station and relied on the limited knowledge of sanitation. For the first time, public health and medicine became professional fronts based on allopathic principles, as associations set up unifying standards for doctors and officials alike.[31]

The Bacteriological Revolution changed science and society in several key ways. First, it allowed for the sharp rise of the public health profession. According to Paul Starr, both collaboration and contention between medicine and public health during the Progressive Age influenced the growth of these two fields as distinct entities. Specific organizations – like the American Medical Association and the American Public Heath Association – shifted the role of protecting the health of the community towards a professional medical staff.[32] Even though American medical schools consolidated into stronger professional entities in the earlier parts of the nineteenth century, the process of informing the public about new medical innovations was a much slower process. Early partnership did occur because physicians hoped to gain a more legitimate voice through local or state intervention,[33] which was largely promoted under the

[30] Evelyn Maxine Hammonds, *Childhood's Deadly Scourge: The Campaign to Control Diphtheria in New York City, 1880-1930*, (Baltimore, The Johns Hopkins University Press, 1999), 9.
[31] Terra Ziporyn, *Disease in the Popular American Press: The Case of Diphtheria, Typhoid Fever, and Syphilis, 1870-1920*, (New York, Greenwood Press, 1988), 13-7.: Ruth Clifford Engs, *The Progressive Era's Health Reform Movement: A Historical Dictionary*, (London, Praeger, 2003), 14-7.
[32] Ruth Clifford Engs, *The Progressive Era's Health Reform Movement: A Historical Dictionary,* (London, Praeger, 2003), 14-7.
[33] Richard Harrison Shyrock, *The Development of Modern Medicine: An Interpretation of the social and scientific factors involved*, (New York, Alfred A. Knopf, 1947), 240.

emerging field of public health.[34]

As medicine, science and the medical professional took a more central role in daily life, Progressive Era health was shaped by the same tensions that underscored American society. Since the founding of the Marine Hospital Service in 1789, public health had been mostly confined to military quarantine regulations. Early Boards governed only as advisory councils,[35] lacking the professional or legal power to implement many of the necessary sanitary measures. However, this changed with the emergence of germ theory. Spearheaded by European scientists in the mid-nineteenth century such as Robert Koch, John Snow, Louis Pasteur, Joseph Lister and Friedrich Loeffler, germ theory provided a new look at how pathogens interacted with individuals. With the knowledge that germs definitively caused disease, health reform efforts focused on the individual body and not just the overall environment. The individual as the vector of disease changed the very core of public health and medicine.[36] This individualized approach to medicine was spearheaded by vaccination. Safer, more effective vaccines paralleled reformers' visions for a healthier society, promising to bring the latest in epidemiology and immunology to the masses. With new understanding that individual behavior impacted community health outcomes, bacteriology, immunology and germ theory made vaccination the central tool for eradicating smallpox. The emerging public health system saw vaccine science as a way to solidify their "one size fits all" approach.[37] So when smallpox suddenly broke out in the early months of 1901, officials such as Samuel Durgin quickly pointed out that smallpox's reappearance was associated with lack of revaccination.[38]

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[34] Paul Starr, *The Social Transformation of American Medicine: The rise of a sovereign profession and the making of a vast industry*, (New York, Basic Books, 1985), 185.
[35] John Duffy, *The Sanitarians: A History of Public Health*, (Urbana, University of Illinois Press, 1992), 148.
[36] Colgrove, 213
[37] Jacob Heller, *The Vaccine Narrative*, (Nashville, Vanderbilt University Press, 2008), 25-6.
38 Karen Walloch, *The Hot-Bed of the Anti-Vaccination Heresy*, (Madison, University of Wisconsin Press, 2007), 120.

Vaccines in the Progressive Era

The Countway Medical Library houses relics from some of America's most prominent medical innovations. It also holds what remains from some of the most contested, and even sometimes violent, moments in American health history. Today, Benjamin Waterhouse's portrait hangs prominently in the marble corridor leading into The Countway Medical Library – a testament to his contributions to American health. Waterhouse, co-founder of Harvard Medical School, was an influential Boston physician known for introducing European vaccination to the United States in 1800.[39] But one hundred years after his work, vaccination still served as a divisive scientific advancement within his hometown. As literary critic Katherine Hayles stated, "science is not a monolithic source, but a complex field of discursive and experimental activities with its own dissonances, fault lines and convergences."[40] The growing field of vaccine science became one of the most contested scientific advances of the time, especially in densely populated American cities.

Since they required the participation of health individuals, anti-vaccinationists found reason to debate the ethical as well as the scientific flaws of vaccination. Their dissent highlighted the tensions throughout Progressive society. Many activists at the time believed that individuals could determine whether vaccination was worth the risk on their own. Because it was an individual procedure used to benefit the collective, vaccines made it difficult to assess exactly what could be considered 'progressive' and forward-looking reform. While disease had long been associated with incoming ships and itinerant travelers, increased smallpox rates within

[39] Shyrock, *The Development of Modern Medicine*, 216,
[40] N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science*, (Baltimore, Johns Hopkins University Press, 1990), 317.

settled, urban immigrant enclaves ultimately tested the powers of public health. [41] In ethnically diverse cities like Milwaukee, Philadelphia, New York and Boston, public health officials saw the need for direct vaccination campaigns or even raids on immigrant communities, where skepticism towards compulsory vaccines sparked higher disease prevalence and more vocal protests. According to historian Michael Willrich, the predominant idea at the time was that government intervention was necessary to ensure individual liberty for all.[42] For health officials, this solidified the use of vaccines in order to protect the communal good.

While health officials often pushed for vaccination as the ticket into primary education, the debate did not stay within classroom walls. Some businessmen, churchgoers and immigrant families rejected public health's professional legitimacy, opting out of the procedure because of perceived negative side effects stemming from vaccination. Eradication efforts were stronger in certain communities, where "aggressive practices" were used if health officials deemed a population uncooperative or predisposed to spreading smallpox. [43] Police power often supplemented health department measures to ensure widespread vaccination occurred, particularly in communities where contact with doctors was limited.

Acceptance of vaccination was not always an inevitable reality, but instead occurred as a result of great social and medical change. In fact, vaccines played their own part in dividing the fields of public health and medicine. While some literature presents public health as a direct counterpart to medicine, Progressive Era public health officials followed medicine's standardization method by creating more specialized bureaus and divisions that included public

[41] Michael Willrich, *Pox: An American History*, (New York, Penguin Books, 2011), 100.: See generally Alan M. Kraut, *Silent Travelers: Germs, Genes and the Immigrant Menace*, (Baltimore, The Johns Hopkins University Press, 1994).
[42] Willrich, *Pox*, 272.
[43] Ibid, 17.

relations experts, chemists, statisticians as well as physicians.[44] But collaboration between the two fields fell short as physicians wanted to use their clinical experience to be the sole providers of vaccine operations. While health officials set up free clinics in densely populated areas like New York City and Boston, private physicians and vaccine distribution companies debated whether or not the procedure could be advertised to parents outside of the private practice setting.[45] While public health officials focused on the success of community-based vaccination campaigns, physicians saw such programs as an interference with the doctor- patient relationship and their professional standing. This relationship quickly escalated the Progressive Era's debate between individual and collective good at the local and federal level. Health officials, with vaccines in hand and police by their side, entered urban and rural areas alike searching for those unvaccinated or those recently exposed. In order to combat the contested nature of vaccination, health officials increasingly disseminated statistical information.

Statistics in the Progressive Era

Scientists and health officials alike saw the power of statistics as a way to keep up with a society in flux. Health officials in places like Philadelphia displayed startling smallpox death rates from pre-vaccination ages as a way to convince the public of their overall good.[46] Even vaccination companies, like the Boston-based New England Vaccination Co., run by bacteriologists William and Charles Cutler, searched for mathematical evidence that their product was the safest and most effective. Their store pamphlets included charts displaying that their type of vaccination product successfully decreased the rate of smallpox cases throughout

[44] Duffy, 202.
[45] Colgrove, *State of Immunity*, 100.
[46] 'Information for the people of Pennsylvania in regard to the Influence of Vaccination of Smallpox,' (1907), Pennsylvania Department of Health. Historical Society of Pennsylvania, Philadelphia.

Europe by more than 85%.[47] While "astronomers, [scientists], biologists and physicists" developed the field of statistics, Progressive Era medical workers used this mathematical study, along with new bacteriological understandings, to prove that vaccination did indeed decrease smallpox rates.[48] As the country diversified on both ethnic and socio-economic lines, health officials across the country needed to find a unifying communication tool in order to solidify their message to all. In order to gain more legitimacy and professional backing, statistics became the trusted tool for pro-vaccinators and health officials alike. Now with statistical methodology, disease and mortality rates could be analyzed in order to inform health officials on the success of their intervention programs.

This trend was as much a response to social pressures as it was to the reality of the pathogen itself. As variola minor emerged as less of a public menace, health officials had to prove that vaccination was still necessary. Frightening statistics on the reemergence of the scourge gave health officials the leverage with which to continue their campaigns. But apathy and skepticism made health official's vaccine operations more difficult. Because of this, health officials had to identify new ways to establish their work as necessary and successful. Health officials relied on basic statistical data in order to navigate public concerns regarding vaccines, providing quantifiable support to individual success stories about smallpox eradication. But vaccination's success in the public eye depended on health officials' ability to provide a cohesive, professional, more statistically based message.

When a sporadic outbreak did occur, as it did in 1902 throughout the United States, public health officials tried to capitalize on this fear to solidify their campaign efforts. Statistics from

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[47] 'Variola vaccinia: history and description; hints relating to the propagation of vaccine virus. Certain anomalies in the course of vaccine disease.' New England Vaccine Company. Countway Medical Library, Boston.
[48] Theodore M. Porter, *The rise of statistical thinking: 1820-1900*, (Princeton, Princeton University Press, 1986), 8-27.

across the nation and around the world were a necessary health communication tool for a group searching for scientific and societal validity. When words and fear-mongering literature were not enough, health officials had a lot to gain from using statistics.

CHAPTER TWO
STATISTICS AS A PUBLIC HEALTH COMMUNICATION TOOL

When smallpox reemerged in 1901 in Boston, health officials took to newspapers and their own professional publications to convince the public to revaccinate themselves and their families. According to Dr. Edward Jarvis (1830-1884), Bostonian physician, statistician and public health advocate, the collection of such vital statistics was a "critical determinant of harmonious social order.[49] Public health was central to daily life during the "age of enthusiasm,"[50] as disease eradication, not just containment, became an overall goal of medicine. Germ theory placed vaccination at the center of public health's interventionist tactics. Throughout the smallpox epidemics of the late nineteenth and early twentieth centuries, health communication efforts needed to appeal to skeptics, the wider public and medical professionals alike. The use and distribution of statistics proved to be an important tool in order to create such an appeal. Since statistics gave stronger context to scientific campaigns, they provided health officials with additional sources to tell the public about their work. [51] A careful analysis of popular press outlets, such as *The New York Times* and medical publications like the *Journal of the American Medical Association,* delivers a unique look into the role of statistics in Progressive Era health communication efforts.

Statistics to persuade the public

[49] Barbara Gutmann Rosenkrantz, *Public Health and the State: Changing Views in Massachusetts, 1842-1936*, (Cambridge, Harvard University Press, 1972), 47.

50 George Rosen*, A History of Public Health*, (Baltimore, The Johns Hopkins University Press, 1993), 259.
51 Sarah E. Igo, The Averaged American: Surveys, Citizens and the Making of a Mass Public, (Cambridge, Harvard University Press, 2007), 26.

When smallpox found its way onto the skin of Philadelphia's children in the winter months of 1901, the Pennsylvania Department of Health directed their attention towards informing the public on the necessity of vaccination and revaccination. Their printed pamphlets and circulars claimed that the city was "ripe for smallpox" if they forgot the lessons from previous epidemics.[52] Informing the public about statistics from previous generations was one important way health officials used statistics to inform the public. In order to be successful, health officials had to prove themselves in the public's eye. Increased reliance on statistics within literature swayed public opinion, providing weight and precedence to vaccination campaigns.[53] Since the American public had not experienced a widespread outbreak of smallpox since the 1870s, apathy increased during the 1902 epidemic in most Eastern and Southeastern cities.[54] Unlike the confluent form of the disease, which killed close to three-fourths of those it inflicted, the discrete form of variola minor allowed for a full recovery with very little scarring. Without the perceived fear that was normally associated with smallpox, public health officials had to find the best way to convince both urban and rural communities that vaccination was a crucial preventive measure. In search of a centralized, authoritative voice, public health officials started publicizing statistical findings to legitimize their work within community health.

From the American health official's perspective, German statistics provided a strong example of vaccine's power. European smallpox trends helped solidify statistics, the "calculus of probabilities," into public health campaigns and vaccine distribution efforts.[55] Making

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[52] 'Information for the people of Pennsylvania in regard to the Influence of Vaccination of Smallpox,' (1907), Pennsylvania Department of Health. Historical Society of Pennsylvania, Philadelphia.
[53] WF Byum, Stephen Lock and Roy Porter, *Medical Journals and Medical Knowledge: Historical Essays*, (London, Routledge, 1992), 109.
54 Michael Willrich, *Pox: An American History*, (New York, Penguin Books, 2011), 41-2.
55 Shryock, The Development of Modern Medicine, 137.

statistics appealing to a wider public was an interesting challenge for health communications. In order to make statistics relevant to a lay audience, officials tapped into the American collective memory, reminding the public about the horrors smallpox brought to previous generations. They did this by printing statistics from foreign countries and previous epidemics within the popular press and their own printed literature. When smallpox reappeared throughout 1901/2, New York health officials took to *The New York Times* to note that vaccination had helped to decrease smallpox mortality rates throughout the country, even in places where smallpox was once seen as endemic.[56] Chicago's health commissioner Reynolds even relied on the city's previous smallpox statistics to market their new free vaccination initiative in late 1901.[57] Hoping to improve the fact that only the 28% of Chicagoans followed through with voluntary vaccination, Reynolds reminded the public that the 1874 epidemic was quelled only when officials actively sought out unvaccinated citizens.[58]

A pamphlet distributed by the Pennsylvania Board of Health warned citizens that "if there were in existence no other statistical evidence of the efficacy of vaccination, the history of smallpox in Germany since 1874 would be a sufficient testimony."[59] Health Departments used foreign statistics as one source of validation for their domestic vaccination efforts. After Germany passed compulsory vaccination laws, government statistics reported that the annual mortality rate fell to 1.91 per 100,000, a significant decrease from previous rates. American health officials were quick to juxtapose German statistics with those of Austria, where compulsion laws were not put in place and mortality rates increased dramatically to 94.79 deaths

56 "Smallpox in Manhattan: The Value of Vaccination,' *New York Times*, November 28, 1902.
57 "Health in Chicago: Quarterly Report of Health Commissioner Reynolds, Increase in Mortality Due in Large Measure to Conditions of the Weather, Smallpox stamped out as a result of the vaccination campaign*, Chicago Tribune*, March 1902.
58 Ibid.
59 Vaccination: A Message from the Medical Society of the State of Pennsylvania, (1902). The Historical Society of Pennsylvania, Philadelphia.

per 100,000 patients in the 1870s and 80s.[60] German health officials noted that close to 30% of those afflicted had carried the disease over from the Austrian Empire, a statistic used by American health officials to showcase successful institutionalization of vaccination campaigns did indeed work within German borders. Health officials believed drawing on previous statistics from other countries would be the best way to validate their work with this preventive health measure.

Comparing health records between foreign countries also became an important communication tactic during times of war. War has always been synonymous with displacement and destruction; but it was also synonymous with disease. Both within the United States and around the world, pathogens spread quickly across contested battlegrounds. For public health officials, The Franco-Prussian War further solidified European findings on the success awarded by vaccination. According to historian Michael Willrich's assessment, the Prussian army had 457 deaths from smallpox, while the French army suffered 23,375 casualties.[61] Vaccination within the French army was administered poorly, with only about 35% of soldiers actually received proper vaccination.[62] As war with Prussia hung on the horizon, the French army made a costly mistake to forgo compulsory military vaccination. Of course, the Franco-Prussian War redefined European borders and set the stage for new ideas on nations and citizenship. But decades later, it would also be evoked by American health officials to fight skepticism and apathy regarding the preventive power of vaccination.

In a similar fashion, health officials turned to contemporary war statistics to garner stronger evidence for their cause. As it reshaped American imperial efforts, the Spanish-American War (1898) became a contemporary example of vaccination's success and the power

60 Ibid.
61 *Pox*, 39.
62 SL Kotar and JE Gessler, *Smallpox: A History*, (North Carolina, McFarland & Co. Inc, 2012), 174.

of "science in a democracy."[63] Prominent health officials like Walter Wyman, Surgeon General from 1891 to 1911, and Major General Lloyd Wheaton saw vaccination in the Philippines as part of a "civilizing" mission, thus providing "moral and political legitimacy" for America's overseas involvement.[64]

But telling the public about vaccination's previous success required current evidence that hit closer to home. While large newspaper outlets reported on raids that took place in lower-income, immigrant neighborhoods in Boston, Philadelphia and New York, they held up the belief that health departments had the ability to target those who carried the perceived smallpox threats.[65] With a media platform to spread their message, local health departments used statistics that showed a positive correlation between widespread vaccination use and decreased smallpox incidences.[66] Health officials' use of the press in their 1902 campaign efforts shaped public confidence in vaccination. With the proper intervention mechanisms, officials worked to safeguard against smallpox returning with "renowned violence" in the winter months of late 1901.[67] Health officials, interviewed by *The New York Times* in November of that year, dispelled the notion that new cases were linked to unsafe or ineffective vaccination. According to their case studies, officials had tracked four out of the six smallpox patients to traveling African American women, thus distancing their campaigns from claims of inefficiency.[68] Highlighting this correlation removed any blame from their city vaccination campaigns. Such rhetoric was a sharp departure from how previous smallpox epidemics had been written about in the past. During the violent epidemic of the 1870s, public health efforts and the writing about

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[63] James Colgrove, *State of Immunity: The Politics of Vaccination in Twentieth-Century America,* (Berkeley, University of California Press, 2006), 45.
64 Ibid, 163-5.
65 'Fighting Smallpox in Boston,' *New York Times*, January 27,1902.
66 New York Times, 'Smallpox and the Health Department,' *New York Times*, March 11, 1902.
67 'Fighting Smallpox in Boston,' *New York Times*, January 27,1902.
[68] 'Smallpox in Manhattan,' *New York Times*, November 28, 1902.

them focused on maintenance and control of the disease. But new scientific understanding, improved vaccine laboratories, and the rise of a professional public health system put eradication at center stage. Apathy and rates of mild infections around 1902 forced health officials to galvanize the public, and particularly urban parents, to support vaccination and revaccination campaigns. Boards of Health in cities like Philadelphia and Boston targeted their statistics and message to "hard working" families.[69]

Smallpox reemergence in 1901 was particularly frightening to Bostonian members of the American Public Health Association, who saw the disease as a sign of lagging revaccination campaigns and not as a failure of vaccine science itself.[70] Their work now focused on helping the public understand the need to vaccinate even during milder strains, which still carried a slight risk.[71] In order to ensure that their message regarding vaccination and revaccination reached a growing and diversifying American public, health officials supplemented their statistical analysis within the popular press with their own broadsides, posters and other ephemera.[72] Calling on the "experience of a century" as evidence to support the need for vaccination and revaccination, these printed works mixed fear mongering with statistical findings. These brief, evocative works tended to be more inflammatory in nature and rhetoric, depicting the horrors and "realities of smallpox" with a picture of an inflicted child. Statistics were startling, but pictures were beyond shocking for a country trying to live up to its progressive ideals. A short pamphlet distributed by the Medical Society of the State of Pennsylvania in 1902 actually reprinted findings from The

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[69] 'As To Vaccination,' *New York Times,* March 30, 1902.: It is important to note the tensions that vaccinations brought up between newly arrived immigrants and their American counterparts. While health officials saw immigrants as a main vector for the spread of smallpox, in reality quarantine regulations made them one of the most vaccinated communities. Despite widespread fear of immigrants, it was actually second-generation families and 'native' American families that often spread the disease. See Arthur Allen, *Vaccine: The Controversial Story of Medicine's Greatest Lifesaver,* (New York, WW Norton & Company, Inc., 2007), 89.

[70] Walloch, *The Hot-Bed of the Anti-Vaccination Heresy*, 120.

71 'Illinois State Health ephemeral,' 1907, (Pamphlet), Historical Society of Pennsylvania, Philadelphia.

72 'Vaccination and Smallpox,' in Scrapbook of anti-vaccination clippings, 1902, (Pamphlet), Mutter Museum at the College of Physicians of Philadelphia, Cage 8c242, Philadelphia.

State Board of Health of Illinois, which warned that all fifty-eight people inflicted during the latest epidemic were unvaccinated, and ten of them had died. [73]

It is important to note that journalism and communication witnessed a sharp change during the Progressive Era. Muckraking "placed a premium on public opinion to right wrongs, alter institutions, attitudes or values."[74] A new era of investigative journalism advocated for a skeptical look at government, drawing attention to areas of industrial society where they felt civil liberties were under attack. However, such skepticism did not leak into popular press and discussion on vaccination campaigns, which raised questions regarding individual liberties within community health. Popular press at the time centered on the era's spirit of advocacy, as displayed in the *New York Times*' 1902 call to create a "community of immunes" against the curse of smallpox through the use of vaccination.[75] Health officials' press presence pushed positive statistics to the public at a time when forced vaccination raids brought science to family's doorsteps.

Statistics in the health profession

Winning over the public regarding their vaccination goals and tactics was only one part of successful health communications; the need for public health to prove itself as an integral and unique field in the medical profession further shaped health communication tactics and vaccination campaigns during the Progressive Era. The need for an organized, cohesive health message was not lost on any in the medical profession. Although founded in 1847, the American Medical Association created a professional journal, the *Journal of the American Medical*

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73 'Vaccination: A Message from the Medical Society of the State of Pennsylvania,' (1902). The Historical Society of Pennsylvania, Philadelphia.

74 John M. Harrison and Harry H. Stein, *Muckraking: Past, Present and Future,* (University Park, The Pennsylvania State University Press, 1973), 15.

75 'Smallpox and the Health Department,' *New York Times*, March 11, 1902.

Association (JAMA) in 1883, to provide readers with commentary and evaluation of European and North American studies.[76] The American Public Health Association, established in 1872, struggled financially until creating a unified journal around the turn of the century.[77] These types of publications set the precedent that medical publications should have both mass appeal and supply statistics that "[threw] a light upon" the necessary and beneficial aspects of their campaigns.[78] Despite tension between public health and medicine during the time, publications from both fields used statistics as part of their written analysis of vaccination efforts.

Throughout 1902, JAMA's Medical News section emphasized the number of cases and deaths in urban areas, as reported by local Boards of Health. The Marine-Hospital Service provided JAMA with weekly data about smallpox, yellow fever, cholera and plague cases around the country.[79] In a new age of global connection, each Medical News section included statistical findings on smallpox from Europe, Arabia, British Honduras, Germany and Egypt, setting a clear American precedent of looking at public health efforts in other countries. While AMA members in Philadelphia excitedly reported that "only" 62 smallpox cases were reported in their city during the first week March of 1902.[80]

The definition of health can be difficult to compute and to articulate to the public. This was particularly poignant around the turn of the century, when vaccination redefined the role of science and the professional in everyday life. On top of reprinting statistics from both previous and current epidemics, health officials needed to express that vaccination did indeed carry a

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[76] WF Bynum, Stephen Lock and Roy Porter*, Medical Journals and Medical Knowledge: Historical Essays*, (London, Routledge, 1992), 150.

[77] Theodore M. Brown, Birth of the American Journal of Public Health, Am J Public Health. 2010 January; 100(1): 66–67.

78 Richard Harrison Shyrock, Development of Modern Medicine: An interpretation of the social and scientific factors involved, (New York, Alfred A. Knopf, 1947), 137.

[79] *The Journal of the American Association of Medicine*, March 8, 1902, Vol. XXXVIII, No. 10, pg. 565.

80 *The Journal of the American Association of Medicine*, March 8, 1902, Vol. XXXVIII, No. 10, pg. 565.: Willrich, *Pox*, 10.

"calculated risk."[81] Even with the best scientific understanding at the time, city health officials could not ignore the fact that disease rates had increased by thirteen percent since vaccination campaigns had been implemented.[82] Gathering accurate smallpox morbidity and mortality requires us to rely on public records gathered by health officials, but the actual raw number of smallpox deaths can be difficult to gather across populations and time. While it was difficult even for the best statisticians to calculate the number of injuries correlated with faulty vaccination, health officials found mathematical processes to uplift their scientific work. This meant determining charts and percentages that most closely represented the data while still highlighting the importance of their work. The percentages that most reached the public were those that compared American smallpox records with those of other countries, which health and medical professionals interpreted as signs that their work was for the public good.

JAMA publications in 1902 displayed the changing roles of physicians and public health officials within daily American life. Health officials needed to find a way to ensure that their communications dismissed skeptics' fears about secondary infections, and what they saw as "infinitesimal" side effects associated with the procedure.[83] Instead of focusing on the problematic case studies regarding faulty vaccines, they highlighted the need for more trained vaccinators. This was an interesting communication choice, as pro-vaccination literature discharged any criticism that came from vaccination campaigns or raids. Viewing dissenting voices as nothing more than quacks, health literature rarely directly addressed those that disapproved of the practice.

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[81] 'Vaccination: A Message from the Medical Society of the State of Pennsylvania,' (1902). The Historical Society of Pennsylvania, Philadelphia.
[82] 'Vaccination and Smallpox,' 1902, (Pamphlet), Mutter Museum at the College of Physicians of Philadelphia, CAGE 8c242, Philadelphia.
83 *The Journal of the American Association of Medicine*, 'Tetanus After Vaccination,' March 22, 1902, Vol XXXVVVIII, No. 12, 679.

According to Dr. Stephen Kunitz, medical historian and former medical professor at the University of Rochester, public health underwent an epistemological revolution as it worked to explain that vaccination offered "universally available preventive and curative interventions" that could do more than any individual physician's practice could.[84] This was an important step if public health was to move away from just marine quarantine administration and into the realm of active health regulators. The rise of the professional made it necessary for public health to prove itself against the work of individual physicians. It also created an environment in which science was given an "authority of higher law" and was removed from public criticism.[85]

Each state's Board of Health began circulating their individual statistical findings to a wider audience, trying to solidify public health's aggressive tactics as necessary for the public good. However tensions within the pro-vaccination camp arose as doctors wanted to implement vaccination from within their own practices, while health officials saw gaps in this approach and looked to create pointed, community-based vaccination efforts. The AMA emphasized that each smallpox case manifested differently and recovery rates varied. Because of this, they wanted to rely more on "observation and comparison" while they figured out all the specifics of vaccine science and distribution.[86] Yet, public health officials from the American Public Health Association and local Boards of Health presented that decreased disease prevalence rates were positively correlated with their own campaigns that reached all members of the community, regardless of their ability to access a private practice.

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[84] Stephen Kunitz, *The health of populations: general theories and particular practices,* (New York, Oxford University Press, 2007), 286.
85 Barbara Gutmann Rosenkrantz, *Public Health and the State: Changing Views in Massachusetts, 1842-1936,* (Cambridge, Harvard University Press, 1972), 77.
86 The Journal for the American Medical Association, March 1, 1902, Vol XXXVIII, No. 9.

As historian Wilson Smilie suggests, European countries were the first to apply statistical analysis to vital data in order to make health a "function of the public good."[87] In fact, The British Medical Journal supported vaccination campaigns on the premise that statistics had forged an "inseparable connection" between compulsory vaccinations and decreased smallpox mortality rates since the mid 1830s in Great Britain.[88] American public health officials focused on the fact that American cities had a higher smallpox mortality rate than places like London, Manchester and Glasgow – where opposition parties and conscientious objectors reeked havoc on vaccination campaigns – as a way to earn confidence in statistical-based disease eradication efforts.[89] The Medical Officer of Health for London blamed "comparative ignorance of smallpox," and the ensuing skepticism over vaccination around 1902, as a growing problem in Europe.[90] While pulling from English and German scientific legacy, American cities' health departments found that statistical data could be a powerful and unifying health communication tool.

As health intervention measures, such as vaccination, took a more prominent role in American life, statistics became a more integral part of health communication efforts. Statistical findings gave public health officials a method with which to communicate with other health officials, the press, the public, and even dissenting voices. However, the very nature of statistics is that they can be skewed depending on perception, sample size and analysis. Realizing this power, anti-vaccinationists used statistics to elevate the medical and legal problems they saw in regards to vaccination.

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87 Wilson G. Smilie, *Public Health Administration in the United States*, (New York, The Macmillian Company, 1936), 149, 254.
88 *The British Medical Journal*, 'Anti vaccination Advocates.' October 15, 1881,
89 'The British Vaccination Law: Attempt in the Lords to Secure the Abolition of the 'Conscientious Objector' Clause Fails, *New York Times*, February 18, 1902.: Paul Starr, The Social Transformation of American Medicine: The rise of a sovereign profession and the making of a vast industry, (New York, Basic Books, 1982), 80.
90 'London County Council Report from the Medical Officer of Health for the London County Council, 1902, (Report), Reference numbers 618252515, Wellcome Library, London.

CHAPTER THREE
STATISTICS FOR ANTI-VACCINATIONISTS

By the turn of the century, the latest in medical innovation had long since rendered most anti-vaccinationist sentiments obsolete. But as historian Michael Willrich points out, the "tumultuous transformation of American society, culture, and government" gave credibility and significance to opposition activism.[91] Dissenting parties maintained that the "medical tyranny" of vaccination within schools, communities and in the courthouses destroyed health and society.[92] Religious imagery and allusions were popular within anti-vaccination literature, as they built a narrative about the corruptive nature of vaccines on the body. Early cynics distributed provocative literature comparing vaccination to a foreign tree that bore only fruits such as rickets, cancer, ulcers and even death.[93] But if anti-vaccinationists wanted to make claims that health officials were indeed "worse than Herod," they needed to provide statistics to back up their case. [94]

From its first publication, *The Anti-Vaccination News and Sanatorium* asserted "the medical fraternity, beaten at every point of the argument, [has] fallen back on statistics, nothing else being left [to prove their point]. The whole vaccination theory is now, as it ever has been, built upon shifting sands."[95] In dense urban areas like Boston, two-thirds of all residents were vaccinated by 1900, thanks to a mixture of legislative, medical and police power. Yet in December of 1901 when Boston saw 504 smallpox cases and 72 deaths after vaccination, anti-vaccinationists believed they had statistical evidence to solidify the ineffective, and perhaps

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[91] Willrich, *Pox,* 251-2.
[92] Colgrove, *State of Immunity,* 52.
[93] 'History of Anti-vaccination Movements,' The History of Vaccines: A Project of the College of Physicians of Philadelphia, http://www.historyofvaccines.org/content/articles/history-anti-vaccination-movements.
[94] The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.
95 The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.

more deadly, nature of this preventive measure .[96] Sporadic smallpox outbreaks and incidences of faulty vaccines allowed anti-vaccinationists to gain a footing during the Progressive Era in two important ways. Anti-vaccinationists also capitalized on the power of specific statistics, gathered from previous and foreign epidemics, as a way to solidify their case and counteract the medical field's growing acceptance of vaccine science.

Statistics to fight the medical profession

In order for anti-vaccinationist sentiments to grow during the Progressive Era, they needed to attack the science and the communication strategies used across the medical profession. While anti-vaccinationists focused on the fact that health department's statistics were blatantly wrong, they did not waste the opportunity to included the same 'language' of statistics in order to gain sympathetic ears within the medical field.

Anti-vaccinationists, like those in the prominent New York-based Anti-Vaccination League of America, used skeptical doctors' statistics and negative personal anecdotes as a way to recruit more within the medical field to their cause.[97] Dr. BF Cornell MD, President of the Homeopathic Medical Society of New York, was quoted in an anti-vaccination pamphlet saying, "every physician knows that cutaneous diseases have increased in frequency, severity, and variety, to an alarming extent." Anti-vaccinationists pointed out that celebrated doctors from England, Canada, and across the United States believed that vaccination spread nothing more than "smallpox and death."[98] Despite claims that all medical professionals uniformly supported

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[96] Arthur Allen, *Vaccine: The controversial story of medicine's greatest lifesaver,* (New York, W.W. Norton & Company, 2007), 75.

97 Dr. MA Wesner, Effects of Vaccination, 1903. Pamphlet. The Historical Medical Library at The College of Physicians of Philadelphia, Philadelphia.: J.W. Hodge MD, Why Doctors who Vaccinate Should Abandon the Practice, in 'Anti-vaccination scrapbook,' 1902, (Monograph), Call number Z8c11, The College of Physicians of Philadelphia, Philadelphia.

98 Pamphlets on Vaccination, 1903. Pamphlets. The Countway Medical Library, Boston.

widespread vaccination, city opposition groups from Oregon to Illinois to Massachusetts highlighted individual physicians supportive to their own position. Some of these societies focused completely on the vaccination question, such as the Philadelphia Anti-Compulsory Vaccination League and the Anti-Vaccination League of America. Still other societies, like the American Medical Liberty League, saw vaccination as one sign of social ills within the emerging medical field.

From their early publications, anti-vaccinationists searched for legitimacy through doctors and physicians all over the Western world. For example, vocal anti-vaccinationists in Philadelphia quoted Dr. K. F. Kolb, a member of the Royal Statistical Commission of Bavaria, in a pamphlet distributed to members.

> "From childhood I have been trained to look at cowpox [vaccine] as an absolute and unqualified protective. I have from my earliest remembrance, believed in it more strongly than any other clerical tenant or ecclesiastical dogma.... In the course of time, the question of vaccine compulsion came before the Reichstag...This awoke the statistician within me. On inspection, I found the figures were delusive, and a closer examination left no shadow of a doubt in my mind that the so-called statistical array of proof was a complete failure."[99]

Anti-vaccinationists eagerly reprinted quotes from recent converts from within the medical community who had once supported vaccination. As printed in pamphlets by the prominent Anti-Vaccination League of Philadelphia, Dr. John Epps, twenty-five year director of the Jennerian Institute in London, changed his opinion on the subject after vaccinating 120,000 individuals. In a similar fashion, the Massachusetts Anti-Compulsory Vaccination Society recounted that one Boston physician who discovered vaccinations were nothing more than "poison" that "paralyzes the expansive power of a good constitution."[100] It is important to note that these sorts of statistics did not provide evidence as to whether these were credible doctors in

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99 Scrapbook of Anti-vaccination Clippings, 1892-1897. Monograph. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.
100 Pamphlets on Vaccination 1903. Pamphlets. The Countway Medical Library. Boston.

the United States or abroad. And anti-vaccinationist literature certainly did not provide information about how it collected data sympathetic to their cause. But their use of statistics as a fear-mongering ploy definitely influenced pockets of the American public.

If their statistical crusade was to be successful, they needed to attack the very science of vaccines. In reports from the Anti-Vaccination Society of America, a New York-based doctor stated that since 1875 he had "personally investigated over 70 [smallpox] cases" and found that 64 had been vaccinated and even revaccinated.[101] Anti-vaccinationists held this up as a reason to distrust the medical community. Revaccination was a contentious issue for all, as there appeared to be no agreement about just how long a childhood vaccine provided proper immunity. During epidemics, health officials often revaccinated children and adults alike regardless if they had the arm scar or not. If health professionals could not determine whether revaccination was necessary, dissenting voices found it likely that the whole science was flawed. Revaccination not only introduced another glaring scar to a persons' arm, anti-vaccinationists believed it offered yet another opportunity for faulty science to enter the body.

Opposition groups also highlighted other scientific they found within vaccines at the time. Anti-vaccinationists were also quick to reprint case studies that casted doubt upon the use of cow lymph, glycerin and vaccination shields.[102] When leading bacteriologist Joseph McFarland gathered statistics on the horrific childhood side effects seen on the eastern seaboard during the turn of the century, his findings ran up against official government records. [103] According to the Surgeon General, fourteen cases of secondary infection and tetanus following

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101 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. Manuscript. The Mutter Museum at the College of Physicians of Philadelphia, Philadelphia.
102 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence. Monograph. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.: Scrapbook of anti-vaccination clippings, 1902. Pamphlet. The Historical Medical Library at The College of Physicians of Philadelphia, Philadelphia.
[103] Willrich, *Pox*, 179.

vaccination had been associated with faulty vaccines in 1901; however, McFarland's research, printed in the minutes of a 1901 Anti-Vaccination Society of America meeting, included a list of 95 possible cases of tetanus occurring right after vaccination, with as many as 45 childhood fatalities.[104] Such numerical contradictions highlighted anti-vaccinationists distrusted of official statistics disseminated at the time.

Indeed, 1901 sparked a vocal debate over secondary infections stemming from vaccination, as parents in place like Camden, New Jersey, Philadelphia, Pennsylvania and Cleveland, Ohio saw outbreaks of tetanus and lockjaw associated with increased childhood vaccination.[105] According to the Journal of the Boston Society of Medical Sciences, rumored and confirmed cases of post-vaccination tetanus spiked during the winter of 1901.[106] When glycerin – first introduced in 1892 as a state-of-the-art germ-killing agent – was found to be associated rising tetanus rates, anti-vaccinationists saw even more evidence that vaccination was not worth the risk.[107]

Anti-Vaccination literature went so far as to conclude that statistics displayed a strong correlation between compulsory vaccination and cancer rates in American cities. Pamphlets and newspaper clippings from the American Anti-Vaccination League of America reprinted that places like Chicago and New York had cancer rates increase 815 per cent in 40 years, paralleling increased vaccination efforts. In England and Wales, 'the antis' claimed that 4,967 cancer deaths were associated with vaccination.[108] American anti-vaccinationists hoped to prove causation

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104 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. Manuscript. The Mutter Museum at the College of Physicians of Philadelphia, Philadelphia.
105 Willrich, *Pox,* 172-6.
106 Joseph McFarland M.D., 'Tetanus and Vaccination: An Analytical Study of 95 Cases of this Rare Complication', (Journal of the Boston Society of Medical Sciences), May 1902, 7(4): 474-475.
107 Ibid, 190-1.
108 Pamphlets on Vaccination, 1903. Pamphlets. The Countway Medical Library, Boston.

between the "medical delusion" of vaccination and increased rates of skin, blood and eye diseases.[109]

Anti-vaccinationists also gained momentum by distributing ideas that the new medical field was involved in "criminal commercial behavior."[110] Anti-vaccinationists painted doctors and vaccine distribution companies as greedy groups within society, benefitting economically from compulsory vaccination and revaccination. According to their views, pro-vaccination physicians knew the high risk of the procedure but had too much financial incentive to stop the practice. Leaders in the party, like Portland's Lora Little, documented in their personal writings that public health officials and physicians in private practice alike benefited from the million-dollar vaccine industry whenever the slightest threat of smallpox occurred.[111] Opposition forces wished to showcase the dangerous "elitist" attitude that was growing in the professional spheres during this time.[112] Most importantly, the use of doctors' statistics shed light on the lack of scientific professional unity, which in turn spread skepticism in the larger public about exactly how vaccination worked. With statistics anti-vaccinationists felt confident proclaiming that is was "absurd, misleading and dangerous [for] any Medical Man to support [vaccination] in this Enlightened Age."[113]

Opposition groups saw statistics from faulty laboratories as testament to their cause and as a sign that vaccination was not worth the risk to the public.[114] When looking at the statistics

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109 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. Manuscript. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.
110 Kotar, *Vaccine*, 280.
111 Lora Little, *Crimes of the Cowpox Ring: Some Moving Pictures Thrown on the Dead Wall of Official Science*, (Minneapolis, The Liberator Publishing Co., 1906).
112 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc.,' (Manuscript), p. 5, The Anti-Vaccination Society of America minutes. Monograph. The Historical Medical Library at The College of Physicians of Philadelphia, Philadelphia.
113 Scrapbook of Anti-vaccination Clippings1892-1897. Monograph. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.
114 Michael Willrich, *Pox: An American History*, 480.

used by anti-vaccinationists, it is interesting to note that they rarely addressed the specific statistics being produced by the pro-vaccination camp. While pro-vaccination health officials used statistics to debunk anti-vaccinationists, these opposition groups rarely addressed their statistical shortcomings head one. Instead, anti-vaccinationists largely ignored whatever charts and figures health officials produced, opting instead to gather their own data and case studies. They did not relinquish their attack on vaccine distribution even with the introduction of the Biologics Control Act of 1902 monitored and inspected vaccines. They also did not stop their public crusade and intense court battles after the Supreme Court case of *Jacobson v. Massachusetts* (1905) affirmed compulsory vaccination as a way to maintain the public good.

Statistics to persuade the public

Anti-vaccination sympathizers in Union City, New Jersey claimed they were "armed with statistics from every city smallpox hospital in American and European army reports from England, France, Russia, Germany, Norway and Sweden" that proved vaccination did not prevent smallpox, and instead "scattered the seeds of syphilis and other deadly diseases."[115] The Philadelphia Anti-Compulsory Vaccination League archived opposition literature from around the country in order to solidify their claims. Anti-vaccinationists needed to find a way to make their statistics relevant and convincing to the public. American anti-vaccinationists employed a mixture of historical and foreign statistics in order to inform the collective memory on smallpox, despite the fact that vaccine technology, germ theory, and popular political support made their claims seem nothing more than crazy, radical, outdated jargon. 'Fighting fire with fire' led anti-vaccinationists to collect data from other countries and provide context for the problems of

115 Anti-vaccination scrapbook. Monograph. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.

vaccination raids. Employing public health and medicine's 'language' of statistics, anti-vaccinationists hoped to shift the narrative regarding vaccination's legacy.

Like their pro-vaccination adversaries, opposition parties reproduced statistics from previous epidemics in the United States and Europe in order to mold the narrative surrounding vaccination. As seen from the scrapbook put together by the Philadelphia Anti-Compulsory Vaccination League, prominent anti-vaccinationist societies created their own investigations of Italy's government records. Anti-vaccinationists claimed that of the 122,000 people in Milan who died of smallpox in that year, almost all had been previously vaccinated.[116] They distributed similar findings from English statistics, claiming that 41% of all British children who died of smallpox were vaccinated previously.[117] Although they did not provide evidence as to where they gathered such statistics, the fact that American anti-vaccinationists could reprint these numbers and create such an emotional public reaction served its purpose. Locally and nationally-printed material alike paraphrased the English Royal Commission Report's statistical findings, claiming that over 800 children in that country had been "compelled to die" in the wake of compulsory vaccination. [118] After presenting this data, the writers went on to say that this type of compulsion could be expected in dictatorial or monarchical countries, but was simply unacceptable in America.

The use of foreign statistics extended onto the battlefield as well. Just as pro-vaccination officials pointed to foreign military statistics as evidence, so too would anti-vaccinationists find war-time smallpox rates a convincing statistical narrative for their case. Large anti-vaccination

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[116] Anti-vaccination scrapbook. Monograph. The Mutter Museum at the College of Physicians of Philadelphia, Philadelphia.
117 Vaccination Tracts, 1895. Pamphlets. Boston Medical Library, Countway Medical Library, Boston.
118 Anti-vaccination scrapbook. Monograph. The Mutter Museum at the College of Physicians of Philadelphia, Philadelphia.: Quoted from English President of Local Government Board 1889, reprinted in 'Anti-vaccination scrapbook,' (Monograph), The Historical Medical Library College of Physicians of Philadelphia, Philadelphia.

organizations, like the one headquartered in New York, claimed that the French army's smallpox rates during the Franco-Prussian War were not associated with the lack of compulsory vaccination, (a fact that clearly contradicted health officials' findings). The Anti-Vaccination League of America stated in a pamphlet distributed around Boston in 1903 that 95.7 per cent of the 68,839 Prussian soldiers inflicted with smallpox died despite being vaccinated.[119] In their analysis, such a high mortality rate discredited vaccines as a viable preventive measure. At first glance, such a statistic seems staggering and an example of the limits of vaccination. Providing such context was of course the goal of anti-vaccinationists literature. By reprinting statistics from 1871 Prussia, anti-vaccinationists hoped to prove that military and army statistics actually solidified their stance.[120]

Using statistics to influence collective memory has clear roots in London, which also had a long history of vaccination dissent. Following their English counterparts, early American anti-vaccinationists spread alarming pictures and quotes regarding the apparent troubles of vaccination. The largest anti-vaccination societies on the East Coast, Pacific Northwest, and the Midwest, took testimonies and clippings from all over England.[121] Like their American counterparts, British anti-vaccinationists pulled support from a variety of background ideas. While some saw vaccination's tragic aftermath as a sign of London's "moral decay."[122] English anti-vaccinationists, such as John Pickering, distributed their own books that proved that science and statistics were on their side.[123] According to Nadja Durbach, English anti-vaccinationists' success came from their "sympathetic engagement" with the public while trying to provide

119 Pamphlets on Vaccination,1903. Pamphlets. The Countway Medical Library, Boston.
120 Pamphlets on Vaccination, 1903. Pamphlets. The Countway Medical Library, Boston.
121 Pamphlets on Vaccination, 1903. Pamphlets. The Countway Medical Library, Boston.
122 Vaccination Tracts: Vaccination, a Sign of the Decay of the Political and Medical Conscience in the country, 1877. Pamphlet. Countway Medical Library, Boston.
123 John Pickering, Anti-Vaccination: The Statistics of the Medical Officers to the Small-pox Exposed and Refuted, Leeds Boards of Guardians, (London, McCorquodale & Co, 1876), Library of Medicine, Boston.

scientific framework. [124] Since smallpox was a declining yet continually serious scourge, both sides of the vaccination debate understood the importance of defining the collective memory on vaccination if they were to gain popular support.[125] Dr. JW Hodge, another prominent member and writer for the British anti-vaccination cause, distributed his statistical interpretations on sanitation and disinfection campaigns that were more successful in preventing smallpox and preserving the body from all infections.[126] For this reason, opposition leagues were quick to reprint and distribute the 1860s Leicester Report, which provided what they saw as statistical proof that sanitary changes were the only way to rid a community of smallpox and other contagious diseases.[127] Most importantly, American anti-vaccinationists wished to spread the idea that "in all probability" smallpox rates would continue to decline with or without the controversial use of vaccines.[128]

The need to communicate the successes of a preventive measure made statistical evidence pivotal to vaccination's success in the public's eye. Applying statistical findings to social problems was not largely embraced until the closing decades of the nineteenth century, after it solidified as an important public health tool for the pro-vaccination party. But throughout the Progressive Era, statistics became a scientific and credible way to explain the positive social benefits of vaccination to a wider audience. To counter and debunk vaccination, American anti-vaccinationists largely relinquished their earlier religious scare tactics and instead opted to employ the same communication style that the pro-vaccination camp used.

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124 Nadja Durbach, *Bodily Matters: The Anti-Vaccination Movement in England,* 1853-1907, (Durham, Duke University Press, 2005), 40.
125 Pamphlets on Vaccination,'1903. Pamphlets. The Countway Medical Library, Boston.
126 Pamphlets on Vaccination 1903. Pamphlets. The Countway Medical Library, Boston.
127 Ibid
128 'London Society for the Abolition of Compulsory Vaccination, Testimonies of Medical Men, on the protection supposed to be afforded by vaccination from 1805-1881,' in 'Pamphlets on Vaccination 1903. Pamphlets. The Countway Medical Library, Boston.

Statistics in anti-vaccination printed literature

Whether they came to the movement to defend individualism, libertarianism, or "radical direct democracy," anti-vaccinationists made their mark in society and informed our understanding on health. [129] By showcasing the various risks associated with vaccination, opposition groups found their unique place in Progressive Era society. While they did not stop attacking vaccination through the popular press, they found a niche audience for which to create their own category of literature. Throughout the United States, official anti-vaccination press also embraced the shift to a more statistically based writing style.

To enhance foreign data, anti-vaccination societies gathered their own statistical findings by conducting fieldwork, interviews, various case studies, and studying city records from various epidemics throughout history. [130] Anti-vaccinationists traveled to cities right after major vaccination raids to collect their own data and conduct interviews with impacted families. Eager to find examples of vaccination's ills, interviews and case studies supportive to their cause, one investigator appeared at the immigrant-rich Reed Tenement Houses on Vine Street in Philadelphia within weeks after an alleged vaccination raid. Hired to go door-to-door to collect interviews, this investigator returned to the Anti-Compulsion League in early 1902 to analyze his inquiry. Parental interviews confirmed close to fifty-two negative health outcomes associated with the health department's vaccination raids within the one tenement house alone. While it is unclear what percentage of Reed House residents this actually included, people who had been forcibly vaccinated experienced a range of mental, physical and infectious diseases.[131]

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[129] Ibid, 199-208.
130 Pamphlets on Vaccination, 1903. Pamphlets. The Countway Medical Library, Boston.
131 Anti-vaccination reports on alleged causalities from compulsory vaccination in Philadelphia area, 1902. Monograph. The College of Physicians of Philadelphia, Philadelphia.

Investigations, like the one conducted at The Reed House, provided anti-vaccinationists with their own set of statistics to analyze and reprint to the public.

An interesting contradiction emerges when we look at the actual influence of anti-vaccination literature in the wider public. Of course, societies across the United States printed material to gather new members and raise skepticism around vaccination science as a whole. However, they never created a unified press outlet that could rival platforms like *The New York Times* or *JAMA,* which were largely sympathetic to the vaccination cause. But this did not stop dissent, be it from officials members or not, from rising. Societies still managed to produce strong sentiments in urban and rural communities, which in turn reached the ears of members and non-members alike.[132] Anti-vaccinationist literature gained prominence because of the contributions from outspoken and well-known community leaders. Advertising itself as the 'Journal of Health and Freedom,' *The Liberator* relied on activists like Lora Little in Portland and John Pitcairn Jr. in Philadelphia to elevate the conversation and community engagement.[133] According to historian James Colgrove, anti-vaccination leaders were "astute in their use of statistics," employing epidemiological data in their attempt to persuade everyone from community members to the Surgeon General at the United States Public Health Service.[134]

Lora Little's *Crimes of the Cowpox Ring*, and subsequent contributions to *The Liberator*, relied on statistics to tell parents about what she saw as the threat of vaccination.[135] In *Crimes of the Cowpox Ring*, Little meticulously recounted 336 vaccination cases, gathered from newspaper

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[132] It is important to note that specific circulation numbers for anti-vaccination literature, as well as most readership statistics from the time, are difficult to tabulate. See WF Bynum, Stephen Lock and Roy Porter, *Medical Journals and Medical Knowledge: Historical Essays*, (London, Routledge, 1992), 128. Judith W. Leavitt, *The Healthiest City: Milwaukee and the Politics of Health Reform,* (Madison, University of Wisconsin Press, 1996), 79.: Colgrove*, State of immunity*, 56.: Robert T. Johnston, *The Radical Middle Class,* (Princeton, Princeton University Press, 2003), 199.

[133] Colgrove*, State of immunity*, 56.

[134] James Colgrove, S*tate of Immunity: The Politics of Vaccination in Twentieth-Century America,* (Berkeley, University of California Press, 2006), 63.

[135] Johnston, The Radical Middle Class, 199.

reports and from her own investigations, that ended in serious complications and even death. Her account detailed individual names and bent official death records to highlight her claims.[136] Little created an emotional connection with statistics by including Case Study 30, which chronicled the death of her own son, Kenneth. Employing the popular muckraking style from the time with statistical findings gave backbone to a group whose claims were being diminished by science and the courtroom alike.

It is important to note that while the use of statistics within anti-vaccination literature rose during the early part of the 1900s, the movement was never as cohesive or unified as one might anticipate. Dissenting doctors came to hold their opinions from a wide variety of perspectives, although many of these physicians fell outside the narrowing definition of allopathic medicine. However, anti-vaccinationists were able to capitalize on apathy and misunderstanding about the variola minor in 1901. To build on this fear, Boston anti-vaccinationists spread a circular throughout Boston and the hard-hit Cambridgeport communities, and included a list of physicians in the area who admittedly opposed vaccination. The reemergence of smallpox in 1901 forced health officials and anti-vaccinationists alike to reevaluate their communication tactics with the wider public.

The fear of secondary infections, along with the debate over the constitutionality of compulsory vaccination, brought the two groups into greater conflict. While actual anti-vaccination society membership was limited and mostly in urban areas, skepticism extended beyond just members. Appealing to parents allowed the movement to grow beyond just its paying members and to find its way into popular debate at the time. They created the largest problems in places like Milwaukee and Boston, where members and non-members alike rose up

136 'The Anti-Vaccination News and Sanatorium, Minutes, correspondence, etc. Manuscript. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.

against compulsion.[137] Their interpretations of statistics solidified the idea that state-initiated vaccination was the "antithesis of sanitary science and common sense."[138] By adding statistics into their printed material, 'the antis' capitalized on Progressive Era fears that communities were "bullied into health" by forced vaccination campaigns.

If the statistics were to impact a wider readership, anti-vaccinationists understood that they would have to provide definitive proof that vaccine superstitions held up against the most modern scientific understanding. The idea that smallpox vaccination was both unsafe and unsuccessful sent a conflicting message to the scientific reports provided from Boards of Health and the local and national level, thus setting a confusing precedent for the public. As health officials wavered on the correct timing for revaccination, the opposition leagues capitalized on this uncertainty by highlighting that there was no clear medical consensus on the issue.[139] Changes in literary trends within anti-vaccination literature provides us with a perfect example of how deficiencies within health communication efforts can open the door for critique of science and civil liberties during the Progressive Era.

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[137] Leavitt, *The Healthiest City*, 82.

138 Scrapbook of Anti-vaccination Clippings, 1892-1897, Monograph. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.

139 Vaccination is the curse of childhood, 1901. Circular. Countway Medical Library, Boston.

CONCLUSION

Anti-vaccinationist attitudes today are not quietly housed in bound manuscripts on the shelves of city archives. Their voice did not die with court cases such as *Jacobson v. Massachusetts* or even with the global eradication of smallpox in the 1970s. By the Progressive Era, health officials had the federal standing, police support, and scientific backing to continue their vaccination and revaccination campaigns. Despite these realities, anti-vaccinationists underscored Progressive ideas in order to remain a relevant to the American public. Their use of statistics was a reaction to social and scientific shifts that required stronger evidence to convince a diverse and growing public.

The history of public health is more a story of false starts than it is a triumphalist narrative about creating a healthier society. Health is as much dependent on cultural interpretations of science as it is on the science itself. Community health requires action from individuals, local organizations, national governments and epidemiological experts. The idea of creating a healthier public raised the profile of vaccines during the Progressive Era and beyond. In the United States, new health communication standards emerged as the population tried to figure out what a 'progressive' society looked like. While we can hold up smallpox eradication as a crowning moment for health sciences, we must remember the legacy it leaves us on how we write and talk about disease. In the words of Dr. Herman Biggs, public health may be "purchasable," but it requires tactful and relatable communication efforts if the public is to accept it.[140]

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[140] Ronald Bayer, *Public Health Ethics: Theory, Policy, and Practice*, (England, Oxford University Press, 2007), 358.

As science historian Laura Otis points out, scientists and historians alike have a keen "fascination with origins."[141] Yet no part of history can be fully contextualized just by studying starting points on a timeline. This is particularly important in the history of public health, where the first discovery of vaccination did not launch a swift end to smallpox. It also did not create a uniform health communication plan. Understanding any time period requires unpacking the language commonly used. In the history of medicine and public health, this means looking at specialized health journals, popular press pieces and opposition literature together in places where vaccination was most contested. During the Progressive Era, vaccination required a succinct communication method that all in American society could understand. In response to the shifting landscape, health officials and anti-vaccinationists in urban cities like Philadelphia and Boston introduced statistical analysis. Both sides of the argument gathered statistics from foreign countries, previous epidemics and individual doctors' studies. They also conducted their own case studies to provide solid statistical evidence sympathetic to their cause.

Statistics, as nineteenth century Swiss scientist Alphose De Candolle suggested, "do not have the power to act," but instead have the power "to reveal."[142] By analyzing vaccination's success through the lens of statistics – and then distributing these statistics to the wider public – health officials set the standard for how all groups disclosed medical ideas. Vaccination opened a new chapter for medical innovation and authority in public health. The use of statistics on both sides of the debate was a reaction to epidemiological realities of smallpox as well as public understanding of the disease. Depending on interpretation of a population's smallpox statistics,

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[141] Laura Otis, *Organic Memory: History and the Body in the late Nineteenth & Early Twentieth Century*, (Lincoln, University of Nebraska Press, 1994), 3.
[142] Porter 29.

the decision whether to vaccinate or not was viewed as a purposefully harmful decision.[143] What started as a war of words between pro and anti-vaccinationists ended as a war of numbers.

[143] Scrapbook of Anti-vaccination Clippings, 1892-1897, Monograph. The Historical Medical Library at the College of Physicians of Philadelphia, Philadelphia.

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