

Alison Mally

Honors Collegium 14

Medical Denialism: Where Must Society Draw the Line?

Introduction

From germ theory to modern physics, the continual questioning and challenging of the established norm has been the source of scientific progress and growth. In fact, science would not be where it is today without its history of opposition to the prevailing paradigm. However, not all challenges to established medical fact are productive, and in fact, can be very dangerous. In some cases, particularly in medicine, publicly and vocally opposing and challenging what has been well established and supported has dire consequences, costing innocent lives. Thus, the question is raised: At what point does it become unacceptable to deny well-established medical fact? This investigation seeks to answer this question through a series of case studies. To show when a challenge to the established norm is not only acceptable, but vitally important to the progress of medical science, the example of the establishment of germ theory is presented, particularly through the contributions of John Snow and Robert Koch. First, the prevailing medical theories of the time will be described, followed by a description of John Snow's investigation of cholera during the epidemic in London in the mid-19th century. His investigation will be shown to have challenged those medical theories which dominated at the time, but that this was done with the support of meticulously gathered evidence. The contributions of Robert Koch will also be illustrated to demonstrate how a positive challenge to a paradigm necessarily relies on a large body of evidence. To exemplify when a challenge to the norm is unacceptable, the cases presented are that of the denial of the link between HIV and AIDS by Peter Duesberg, and its consequences, as well as the current anti-vaccination movement, and its consequences.

The history and science of AIDS as well as the background of Peter Duesberg's denialism will be outlined, followed by a delineation of the consequences of his denialism. Then, the history and sciences of vaccines will be explained, as well as the background of the anti-vaccination movement. This will be then followed by an illustration of the implications and consequences of the anti- vaccination movement, along with recommendations for actions going forward. These cases demonstrate how a line must be drawn for the benefit of the public, and thus this investigation ends by addressing the larger issues that underlie these cases, with proposed actions for the future.

There are two major consequences when medical fact is unjustifiably challenged. First, and most importantly, lives may be put at stake, even those of innocent bystanders. Second, challenges made based on fraudulent or flawed evidence can further promote a distrust of science. In turn, this can cause further denialism among the public. Thus, once the line has been drawn to distinguish when it is unacceptable to deny medical fact, certain policies need to be proposed and then acted upon.

John Snow and Germ Theory: When Challenging the Norm is Beneficial

Medical Theories Pre-Germ Theory

Prior to the advent of germ theory, various medical theories sought to explain the source of disease in the human body. One theory that had been particularly prevalent for hundreds of years leading into the 19th century was humoral theory, and thought to be originated by Hippocrates. According to humoral theory, the body contains four humors: black bile, yellow or red bile, blood, and phlegm. Disease was thus explained as an imbalance among these humors, with balance being restored through purging methods, such as induced vomiting or bloodletting,

as well as lifestyle changes (1). Another popular theory was miasmatic theory, which attributed illness to exposure to noxious agents or poisonous air in unsanitary conditions. This was the prevailing theory at the time of the cholera epidemic in London in the mid-19th century (2). Others were contingent contagionists, who believed that disease was only contagious under certain circumstances (3). It was these theories, considered medical fact at the time, which John Snow would oppose in his investigation of cholera during the epidemic in London.

John Snow and His Challenge to Established Medical Fact

Early in his investigation of the cholera epidemic, John Snow found that the disease spread too quickly to be consistent with miasmatic theory, and that the disease could spread without direct contact with the infected, which was inconsistent with contagionist theory. In light of these facts, Snow embarked on his own investigation. He consulted chemists who had studied the stools of cholera victims, gathered information from water and sewer authorities, and read accounts of the 1832 cholera epidemic. From this, he developed his own theory, which opposed the established medical paradigm of the time. He asserted that cholera was in fact spread by an ingested agent, either through direct contact with waste matter of the infected, or drinking water that had been contaminated with such waste matter. Unlike other diseases, Snow argued that cholera was contagious via contaminated water, and thus improving sanitary conditions was critical in fighting outbreaks of the disease (2).

John Snow is most famous for his work during the cholera outbreak that occurred in London on Broad Street in August of 1854. During this outbreak, six hundred people died, all within the same neighborhood. While he had collected water samples from various sources, including the Broad Street pump, Snow was not able to gain any useful information from these

samples. However, he used statistics obtained from William Farr to literally map out the deaths in the area from the outbreak. He marked the deaths at each house with a line for each death that had occurred, and soon found that the outbreak was centered at the Broad Street pump. After conducting interviews, Snow found that in the sixty one out of eighty three cases he examined, the afflicted either always or sometimes obtained water from the pump. In addition, he found that the death rates showed a significant decrease in areas where it was easier to use a pump that was not the one on Broad Street (4). In addition, he found that in a workhouse only fifty yards from the pump, as well as in a brewery that was also close by, almost none of the employees had fallen victim to cholera, despite proximity to the pump. What both of these establishments had in common was a private water supply, so their workers never needed to use the pump (2).

When he first presented his carefully constructed case to the Board of Governors, he was at first met with incredulity. Here was a man whose theory was completely opposed to the prevailing theory of miasma-caused disease, claiming that the disease was caused by contaminated water. However, the wealth of evidence he presented ultimately convinced the board to remove the pump handle, and soon after, the outbreak ended (2).

Consequences and Implications

The significance of the pump handle removal is not just that it ended one of the worst cholera outbreaks in London; the true significance lies in the fact that the board decided in Jon Snow's favor, and "for the first time a public institution had made an informed intervention into a cholera outbreak based on a scientifically sound theory of the disease." It was a decision based on "reason, not superstition" (2). What is even more astonishing is that the basis for this decision was a complete digression from the established medical theories of the time.

Of course, this one decision did not mark a complete revolution in paradigms. It would take time as well as further research and evidence for germ theory to displace the previous theories. However, this was a bold first step. Here, opposition to the norm was beneficial to science and society, as it has led to the basis of modern medicine. What truly makes germ theory so powerful, though, is that it is based on not just one scientist's research, but has a foundation built by the research of a multitude of scientists, from Louis Pasteur to Robert Koch.

A positive paradigm shift, particularly one that may have a great impact on public health, requires a great deal of meticulous research. One of the other contributors to the development of germ theory is Robert Koch. Koch's investigation of various diseases, including cholera, led to his identification and isolation of various bacteria. From these investigations, he developed what is known as Koch's postulates:

1. The pathogen must be present in all cases of the disease.
2. The pathogen must be isolated and grown in pure culture.
3. The pathogen must cause the disease in a healthy animal.
4. The pathogen must be able to be re-isolated from that animal and must be identical to the original isolated pathogen (5).

These postulates established criteria to show causality between a pathogen and a disease. In fact, his research led to the growth of the field of medical bacteriology as well as contributed to the establishment of germ theory as the dominant theory of disease etiology (6).

As shown here, it takes a combination of various studies to safely challenge an established paradigm. In doing so, though, a huge leap was made in the history of medicine. In fact, germ theory lies in the basis of the following case studies.

AIDS Denialism and Peter Duesberg

AIDS History and Background

When AIDS, or Acquired Immune Deficiency Syndrome, first appeared in the US, it was a disease surrounded by fear, confusion, and a great deal of prejudiced misinformation. It initially presented itself as a strange new illness afflicting gay men, destroying their immune systems. Initially termed GRID, or Gay-Related Immunodeficiency Disease, AIDS was initially thought to have had various (albeit incorrect) causes. These included promiscuous behavior and an “overload” of sexually transmitted diseases resulting in immune failure. Following its emergence, more and more cases were being reported each week, raising fear among the public (7).

The history of this disease is marred by stigmatization that ultimately led to a slow response to its progression. For example, gay men were resistant to changing their behavior of having many, anonymous sexual partners, perceiving it as just another form of homophobia intended to oppress them. On the other side, because this was a disease that largely afflicted the gay community, an already stigmatized population, and was a disease that was associated with promiscuity, a largely conservative America showed less concern for the welfare of this population and as a result were slow to act. In essence, “[h]owever persuasive the evidence of a dangerous epidemic might be, they were unlikely to win points with the White House by calling for urgent concern over what appeared to be a gay sexual disease... The Reagan revolution brought into positions of power and influence Americans whose politics and personal beliefs predisposed them to antipathy toward the homosexual community” (7).

However, the disease was soon found in women who were not prostitutes, straight intravenous drug users, and others who were not gay. In addition, there were reports of AIDS

cases among immigrants from Haiti. Soon, the disease became known for afflicting four main groups: homosexuals, hemophiliacs (who contracted AIDS through contaminated blood transfusions), intravenous drug users, and Haitians. Evidence began to show that this was a disease not related only to being gay, but was likely passed via a transmissible agent. As research continued, the agent was determined to be what we now call HIV, or Human Immunodeficiency Virus, with immense evidence supporting this finding (7).

This is a disease which kills through suppression of the immune system. The virus targets the T-cells of the human immune system, which are cells that help in mounting an immune response. HIV uses the T-cells as hosts to replicate itself, killing the T-cells in the process. After a certain amount of T-cells have been destroyed, the body's immune system becomes so suppressed that it is no longer able to fight off infection. In this way, HIV/AIDS does not kill a person directly, but by suppressing the immune system so much that the body becomes susceptible to opportunistic infections. Left untreated, everyone who is HIV positive will progress to having AIDS. AIDS is the last stage of an HIV infection, when a person's T-cell count gets below a certain point, and the person is susceptible to opportunistic infections (8). The infections and diseases that tend to afflict people with AIDS are often uncommon ones that are only found in people with severely compromised immune systems, including Kaposi's sarcoma, *Pneumocystis carinii* pneumonia, and *Toxoplasmosis* (7, 8).

Peter Duesberg

Currently a professor of Molecular and Cell Biology at University of California, Berkeley, Peter Duesberg is perhaps best known for denying the link between AIDS and HIV. Instead, he claims that "AIDS is a collection of chemical epidemics, caused by recreational

drugs, anti-HIV drugs, and malnutrition.” Consequently, he asserts that HIV is just a passenger virus, that AIDS is therefore non-contagious, and can be prevented by “adequate nutrition and abstaining from drugs” (9). In fact, he even claims that anti-HIV medications, such as AZT, can be toxic and even cause AIDS (10, 11).

Despite dismissal of his claims by most mainstream AIDS researchers, Duesberg has still managed to garner support. For example, he is backed by, and is a member of, a coalition that is called the “Group for the Scientific Reappraisal of the HIV/AIDS Hypothesis.” He also gained support from another controversial scientist, Kary Mullis, whom the New York Times criticized as having “dove head first off the platform” in his support of Duesberg’s ideas among other denialist scientific claims (11, 12). Some of Duesberg’s followers have even gone as far as to suggest that there is a conspiracy to suppress Duesberg’s research and the “truth” (11).

The Consequences and Implications

The consequences of Duesberg’s denial of HIV as the cause of AIDS are significant for two main reasons. First, he is a professor at a respected university who is making claims about a topic within his field of expertise, and thus people trust and listen to him more so than they would a layperson. Second, he is completely and irrevocably wrong.

The evidence that HIV does in fact cause AIDS is immense and well-researched. In fact, various articles were published in response to Duesberg’s claims, providing evidence against them. One specifically addresses every claim made by Duesberg in one of his denial papers, providing evidence for HIV being not only the causative agent of AIDS, but also a transmissible, infectious agent (13). An investigation by *Science* magazine found various pieces of evidence against Duesberg’s claims. First, there is a large amount of evidence that HIV causes disease and

death among hemophiliacs, a group which Duesberg himself considered to be the best test group for the HIV hypothesis. Second, some AIDS researchers have found that HIV follows Koch's postulates for disease causation. Third, the Thailand AIDS epidemic seems to confirm the causative role of HIV. Finally, the immune deficiency characteristic of AIDS is not caused by recreational drugs or AZT, which Duesberg claims cause AIDS (11). One of Duesberg's papers was even withdrawn by Elsevier, citing the fact that they had "received serious expressions of concern about the quality of this article, which contains highly controversial opinions about the causes of AIDS, opinions that could potentially be damaging to global public health" (14). As put by Warren Winkelstein Jr., a Berkeley AIDS epidemiologist, it is "irresponsible, with terribly serious consequences" to describe HIV as harmless (11).

However, despite the fact that Duesberg is completely wrong, people have listened to him, and because of this, the tragic consequences of his claims are realized. Duesberg's believers have died by following his theories, and in the face of these deaths, he continues his denial. There are various anecdotes of people who, upon hearing Duesberg's hypothesis, believed him, chose to stop taking or not to take the medications they needed, and ultimately died. However, faced with one of these stories, specifically one about a woman who died after stopping her AIDS medications, Duesberg responded, "'Big deal. It's nothing. It's consistent with everything I know'" (15, 16).

What is perhaps more tragic, however, are the deaths of those who had no choice in the matter. There are two populations who fall under this category: The people of South Africa and infants whose HIV was passed from their mothers. Former South African president Thabo Mbeki's policies surrounding AIDS was in part influenced by Peter Duesberg, whom he called to consult as part of a panel of experts on AIDS, as he believed that "HIV was not the cause of

AIDS and that antiretroviral (ARV) drugs were not useful for patients and declined to accept freely donated nevirapine and grants from the Global Fund” (17, 18). The results of this were significant – an estimated “330,000 lives or approximately 2.2 million person-years were lost because a feasible and timely [Anti-retroviral] treatment program was not implemented in South Africa. Thirty-five thousand babies were born with HIV resulting in 1.6 million person-years lost by not implementing a mother-to-child transmission prophylaxis program using nevirapine” (18). These were not people who simply chose to believe Duesberg’s teachings and chose to not take medications of their own accord, but rather, people who had no say in the matter. Furthermore, Helene Gayle, associate director of the Centers for Disease Control and Prevention office in Washington, D.C. explains that the harm caused by these claims to the efforts to combat AIDS in other countries is significant, as “people already want to deny” HIV and AIDS’ presence in their nations.

Here lies the true problem with Peter Duesberg’s denialism. Not only did he choose to challenge established medical fact with weak, flawed evidence, but in doing so, he led to the deaths of those who trusted him as an expert in his field, and even those who were innocent bystanders. However, he has already faced certain consequences of his own, as he has been called a “pariah” among the scientific community, and “more than 20 of his grant proposals for government funding have been turned down. AIDS activists have denounced him in public protests and media campaigns” (19). Obviously, this does not make up for the lives that have been lost, but it does give provide an example of how these sorts of claims can be handled by society.

Vaccines

History and Background of Vaccines

For thousands of years, prior to the advent of vaccinations, infectious disease decimated populations. Inoculations were used as early 1000 C.E. in China, where people were inoculated against smallpox by transferring matter from smallpox lesions. In 1660, smallpox inoculation received support from the Chinese emperor. However, the first true vaccine was created by Edward Jenner, who, in 1796, successfully used cowpox to inoculate against smallpox. Jenner made this discovery after learning of a milkmaid who had contracted cowpox, and subsequently found herself seemingly immune to smallpox. In 1803, the term vaccination began to be used. Less than 200 years later, Jenner's discovery would ultimately lead to the complete eradication of smallpox. As time went on, various other vaccines against deadly and virulent diseases were developed. Some of these were vaccines against common childhood diseases, such as measles, mumps, rubella, and polio – diseases which can lead to childhood death or a lifetime of disability. In fact, endemic measles was considered eradicated from the U.S. in 2000 (20, 21). Another incredibly significant achievement was the creation of the polio vaccine by Jonas Salk. Polio is a devastating disease that can leave its victims crippled for life, a famous victim of the disease being former president Franklin Delano Roosevelt. However, because of the vaccine, polio was considered eliminated from the Americas in 1994, and from Europe in 2002. Achievements such as this have led people to consider vaccines as one of the greatest public health success stories. In fact, “[o]n a global level, it is one of the few cost-effective medical measures that result in population-level broad benefit across the age spectrum” (22).

Vaccines work by imitating an infectious agent, such as a virus or bacteria. These agents are normally identified and recognized by the body by the antigens on the outside of the pathogenic cells. When the body first encounters an infection, it produces antibodies and T-

lymphocytes specific to that pathogen. Thus, after the body has fought off the infection, some T-lymphocytes remain as “memory cells”, which can immediately act if the same pathogen is recognized again. In vaccines, this immune response is stimulated, so that the body produces memory cells, but does not cause illness, although in some cases some minor symptoms may occur. In this way, vaccines confer immunity to a disease (23).

Anti-vaccination Background

There has been resistance to vaccinations for years. In as early as 1926, health officers who had come to a town to vaccinate its citizens were driven out by an armed mob. One of the early fears surrounding modern vaccines was regarding febrile seizures in children, as many people pointed to vaccines as the cause of such seizures. However, the Centers for Disease Control (CDC) addressed these claims, explaining that vaccines can in fact prevent febrile seizures, and that the only possible link was that there was an increased risk for febrile seizures when the influenza vaccine was administered around the same time as PCV13 and TDap vaccines (24).

The more significant, and impactful, current denial of vaccines began with a paper by Andrew Wakefield, which claimed that MMR (measles, mumps, and rubella) vaccinations can be linked to autism. However, he was not only wrong, but also fraudulent, with a major undisclosed conflict of interest – “it was reported that some of the subjects of Wakefield’s paper had been recruited by a lawyer involved in a lawsuit against vaccine manufacturers.” In addition, he falsified data, including fabrication of children’s medical histories (25). Eventually, the majority of his co-authors retracted the interpretation that there was a link between vaccines and autism, and various other studies provided evidence that no such connection exists (20).

Ultimately, the paper was formally retracted from the *Lancet*, citing that “it has become clear that several elements of the 1998 paper by Wakefield et al are incorrect, contrary to the findings of an earlier investigation. In particular, the claims in the original paper that children were “consecutively referred” and that investigations were “approved” by the local ethics committee have been proven to be false” (26). As a result, Wakefield lost his medical license (20). Furthermore, investigations have shown that there is no link between vaccinations and autism.

However, this has not stopped his ideas from gaining traction among certain groups, due to a variety of factors. The popularity of this false hypothesis has increased with support from semi-celebrities such as Jenny McCarthy (27). In addition, the advent of prevalent social media allows information, true or not, to spread rapidly while credibility may be murky at best (28). For example, one study found that “at the current time we were able to identify well over 300 anti-vaccine internet sites from a single simple search” (22). Finally, Andrew Wakefield’s claims were particularly relevant to a large population – concerned parents. Because vaccines are so prevalent and widespread, as a huge percentage of the U.S. is vaccinated routinely, because developmental disability is a major fear for many parents and the causes of autism are not yet well understood, Wakefield’s paper struck a nerve. In addition, the benefits of vaccinations are not as immediately obvious today, as outbreaks of many infectious diseases have been successfully eliminated through high vaccination rates. Thus, “as the widespread use of a vaccine diminishes or eliminates the risk of a disease, the public’s perception of the vaccines’ value paradoxically diminishes — because the public no longer observes the disease or its aftermath, and hence perceives little or no benefit.” In essence, the success of a vaccine can lead to a decrease in the perception of its benefits (22). This has also worked in conjunction with changing social norms. For example, in the 1950’s, “the danger of infectious disease outbreaks such as

polio was real and evident. Hence a ‘good mother’ also insured that her children were immunized”, while today, a “good mother” is skeptical of the possible harm that may be caused by a vaccination (28). Another factor that has contributed to the staying power of the anti – vaccination movement is the fact that those who support vaccines and their benefits are more passive, while the minority opposed tends to be more vocal in their opposition. In fact, “[i]n many cases, they may become the only individuals who voice their opinions, thus causing a societal sense that the vaccine leads to more harm than good” (22).

As a result, a growing number of people have stopped vaccinating their children. It is important to note that some people have chosen not to vaccinate not out of a fear of autism, but rather due to a more general, although still unfounded, fear of placing foreign substances into their bodies or their children’s bodies. Low rates of vaccination have actually become a particular problem in affluent communities. For example, in wealthy Los Angeles neighborhoods, “up to 60 to 70 percent of parents have filed [personal belief exemptions]” in some schools. These personal belief exemptions indicate that parents are not vaccinating their children for any number of reasons. To put this into perspective, this statistic indicates a vaccination rate “as low as that of Chad or South Sudan,” where the low rates of vaccination are instead due to the fact that warfare has limited access to immunizations. However, it does not take large numbers of people refusing to vaccinate to cause significant problems. This is because “a community can only be protected when 92 percent or more of a population is immunized” (29).

The Consequences

Put simply, a decrease in rates of vaccination leads to outbreaks of entirely preventable diseases. Recall the fact that measles was considered eliminated from the U.S. in 2000. However, in 2008, “the Centers for Disease Control and Prevention received reports of 134 cases of measles in the United States, the most cases in a year since 1996. Of these cases, more than 90% had not been vaccinated or had an unknown vaccination status”. Measles outbreaks have continued to make news, as 644 cases of measles were reported in 2014, the most in any year since 2000. In fact, in December of 2014, a measles outbreak was traced to Disneyland, with “at least 100 cases associated with the Disneyland exposures” reported by the end of January of 2015 (20).

Pertussis has also seen similar increase. In California, a 418% increase in pertussis cases was reported from 2009 to 2010, 89% of which were infants who were too young to be fully immunized. 5 deaths occurred, all infants (20). According to one study, “Pertussis incidence was 10 to 100 times lower in countries where high vaccine coverage was maintained than in countries where immunization programs were compromised by anti-vaccine movements” (30).

With these outbreaks come fatalities. As of March 8, 2015, there have been 8,973 preventable deaths from diseases for which vaccines are available (31). What is even more tragic is that many of the casualties are not in families that have chosen not to vaccinate, but are those who are immunocompromised or cannot be vaccinated, either because they are too young or unable to be vaccinated for another medical reason.

Another consequence, one that is specific to the problems of publishing a fraudulent paper, is a greater distrust in science. Already, “a growing segment of the public (and of health care workers) mistrusts industry, government, and public health in regards to vaccine safety and efficacy” (28). This sentiment is only fueled further by the publishing and then exposure of a

fraudulent paper. Exacerbating this problem is the reality that “in western culture we have become so risk adverse and risk conscious that the expectation is that no product will ever lead to any harm, under any conditions, in any person—an obviously impossible standard to attain” (28).

Another, more overlooked, consequence of the portion of the anti-vaccination movement that specifically chooses not to vaccinate because of a fear that their child will develop autism is that it is utterly offensive to those with autism – an already stigmatized population. This is because the anti-vaccination movement is essentially saying that they would rather risk subjecting their children to infectious, possibly crippling or even fatal disease, than risk their child developing autism. This implies that they consider autism a fate worse than death, an idea made even more ridiculous by the fact that this fear is completely unfounded. In an article written by a woman with autism in response to the anti-vaccination movement, the author expresses that, “someone who refuses to vaccinate their children because they’re afraid of autism has made the decision that people like me are the worst possible thing that can happen to their family, and they’re putting everyone at risk because of it” (32).

However, this is not intended as an attempt to vilify parents who choose not to vaccinate their children. It is clear that these parents are acting out of concern for their children’s safety, which is justifiable. It was perhaps even justifiable to question the use of vaccines when there was still some controversy. As mentioned previously, a “good” parent in today’s society conducts research, often on the internet, to examine the safety of the things that their children will be exposed to. What is not justifiable, however, is the fact that these parents are now ignoring the abundance of evidence in favor of vaccinations, and are thus willing to risk the health of other’s children to “protect” their own. While this mentality may have originated with good intentions, it has now become dangerous ignorance.

Going Forward: Vaccines

Unlike the case with Peter Duesberg, the anti-vaccination movement presents an urgent and immediate problem that needs to be resolved. The most effective way to prevent this from becoming an even greater public health crisis is to mandate vaccines, on a case by case basis, in public schools, only allowing medical exemptions. This would mean an elimination of personal belief and religious exemptions from vaccinations. There is actually a historical precedent for this. In 1777, George Washington mandated smallpox inoculations for the continental army, and the first law that mandated vaccinations for children to attend schools was passed by Massachusetts in 1855 (20). While to some, this measure may seem to be an overstepping of the government into private matters, but as one journalist put it, “we do make sacrifices for the privilege of living here. We pay taxes for the common good. We buy collision insurance to protect those driving beside us... There’s no free ride” (33). Others may argue that this is a violation of civil liberties, but there is a certain hypocrisy here. In many schools, students aren’t allowed to include certain food items, e.g. peanuts, in their lunches to protect children with severe allergies, yet parents are allowed to not vaccinate their children, thus potentially bringing harm to other children who may be particularly susceptible to infectious, but vaccine-preventable diseases (34, 35). In addition, consider drunk driving: It is perfectly legal for someone over the age of 21 to drink as they please in their own home, even if this behavior poses harm to themselves. However, the moment they get behind the wheel of a car while intoxicated, they not only put themselves in danger, but they endanger innocent lives as well. As a result, driving while intoxicated is illegal, even if it may, according to some, violate certain civil liberties.

An argument against the elimination of religious exemptions to vaccinations is that it compromises religious freedom. However, we already do not allow religious practices that can pose harm to the public.

In addition, it is important to note that compensation should be provided for those who have suffered true harm from a vaccine. The main goal here is to protect the public, and thus this would be a necessary component of this policy. Along with this, even higher safety standards in the manufacturing and testing of vaccines should be maintained if vaccines become compulsory. Furthermore, a policy of mandated vaccinations should be accompanied by policies that allow vaccines to be more affordable and more easily accessible, so that mandated vaccinations do not become an added burden on families.

Until vaccines are mandated, though, other actions must be taken. Healthcare providers should provide parents with as much information about the benefits of vaccines as possible, while also listening to and addressing parents' concerns. In addition, public health officials need to use the media to help foster support for vaccinations, emphasizing a commitment to vaccine safety and stressing the benefits of vaccines not only for individuals, but for communities as a whole. This is likely more effective than ad-hoc refutations of claims against the safety and importance of vaccines.

Going Forward: Society as a Whole

While the previously proposed solutions may be effective for combating the anti-vaccination movement, these case studies reveal much larger general problems. This returns to the question posed at the beginning of this investigation: At what point does it become unacceptable to deny established medical fact? To answer this, there are two groups to be

addressed – the scientists who challenge established medical fact, and the society that reacts to this.

As mentioned before, scientific progress relies on challenging the norm. In the case of John Snow and the development of germ theory, challenging the norm led to the basis of medicine as it is known today. Almost ironically, Peter Duesberg's personal website greets the viewer with a quote from Albert Einstein: "The important thing is to not stop questioning" (36). However, a line must be drawn when these challenges do more harm than good. In the cases of both Peter Duesberg and the Andrew Wakefield, they moved from being innovative scientists to intentionally inflammatory iconoclasts. Wakefield's case is made even worse by his fraudulent actions.

These situations, because of the significant harm they can cause, need to be prevented. One way to do this is through the governing body overseeing a scientist's research, whether it is a university or federal government. When a scientist decides to try to publish a paper or make a claim that is diametrically opposed to well-supported, well-evidenced, established fact, their research should be placed under an additional level of scrutiny. Two criteria would guide this investigation: potential harm to the public, and strength of the researcher's evidence to support his or her claim, with a particular emphasis on investigating potential conflicts of interest or fraud. Thus, a great deal of additional scrutiny would be placed upon research if its results had the potential for major public harm, such as Andrew Wakefield's or Peter Duesberg's research. For example, if a researcher is proposing that all birds should in fact be classified as amphibians, there is low risk of harm to the public, so a high level of scrutiny is not quite as important. What differentiates the development of germ theory, which completely challenged the prevailing medical theories of the time, from the claims made by Duesberg and Wakefield is that, despite

having a large potential for impact on public health, is the fact that germ theory is supported by a wealth of evidence, accumulated over years of research by various scientists.

If the governing body should find that certain research poses a large risk of public harm and is not sufficiently supported, then the governing body should ensure that it does not become published. The consequences of a researcher trying to circumvent this could include anything from fines to being dismissed from the institution. In this way, denialism would be stopped at the source, before it even reaches the peer review board of a scientific journal. However, the university or other governing body should employ the use of some sort of peer review board to scrutinize the research being done at the institution, in order to help ensure that the examination is fair and not subject to unfair suppression, as the goal is not to hinder the progress of science, but rather prevent harmful denialism.

While this addresses the specific issue of research that challenges established fact, there is a bigger problem here. It is reasonable when questions arise early on about, for example, the true cause of AIDS or the safety of vaccines. However, at some point, a line is crossed when there is an immense amount of evidence establishing something as medical fact, yet people still choose to deny it. At this point, they have gone from justifiable skepticism to willful ignorance. Some compare this to being a holocaust denier. Though it may seem to be a harsh comparison, it is, unfortunately, very appropriate. In the cases examined here, denying, in the face of overwhelming evidence, what has been established as fact, is also a denial of all of those who have suffered from AIDS or any of the plethora of infectious diseases that are now preventable. It denies the suffering of children permanently crippled by polio. It denies the suffering of parents who lost their children to childhood diseases, tragedies that no longer have to happen with the advent of vaccinations. It denies the struggles of those who adhere to strict and complex

medication regimens in order to live a somewhat normal life while being HIV-positive. Calling the AIDS epidemic in Africa a myth denies the suffering of those who have fallen victim to the disease and their loved ones. It denies the suffering of the hundreds of thousands of deaths that resulted in part due to Duesberg's influence on policies in South Africa. Holocaust deniers are not accepted in our society. Their denial of the suffering of the millions killed and tortured during the Holocaust is considered immoral. For the same reasons, deniers of medical fact must be found just as unacceptable, if not more so. This because this denialism is not merely offensive, but has the capacity to inflict real harm, even costing lives, as is evident in the AIDS denialism and anti-vaccine movement. This mentality leads to dangerous, tangible consequences, which is why we no longer can continue to allow it.

As a society, a shift needs to happen from constant suspicion based on evidence of little credibility gained from today's world of seemingly unlimited online resources and ubiquitous social media. This is a consequence of "[t]he consumer-driven, electronic environment we now live in, in conjunction with the proliferation of social networks and the dependence upon the Internet as a source of information [resulting] in all ideas being given equal credence" (28). To make this possible, accurate scientific information needs to be made more accessible to the public, which can be achieved through better scientific journalism, thus establishing an understandable connection between science and laypeople. In combination with this, media outlets should not give these opposition groups a forum to voice their unfounded theories. Currently, the excess of theories and ideas proliferated on the internet and social media have led to "a scientifically less literate population with a poor risk understanding and risk adverse mindset" (28). Obviously, blind trust in science is not a recommended alternative, but rather, skepticism should be placed on a credible, solid foundation.

In some cases, the line defining what is and is not acceptable in terms of questioning the medical norm may become difficult to pinpoint. For example, Stanley Prusiner's discovery of prions was at first met with a great deal of doubt and skepticism. However, his discovery was ultimately heralded as a major achievement in the advancement of the understanding of the pathology of diseases like mad cow disease. Thus, these proposed policies must simultaneously ensure that denialism is suppressed while research such as Prusiner's is not. In order to accomplish this, the potential harm to the public as well as the evidence supporting such claims must be strongly considered. In Prusiner's case, he fought the criticism he received by continually producing more research to support his claims, leading the scientific community to not only shift their attitudes and accept his findings, but eventually laud him for their significance (37). However, the line must be drawn somewhere, and that is when these oppositions, particularly when based on insufficient, fraudulent, or flawed evidence, cost lives. Cases such as that of Peter Duesberg's AIDS denialism and the anti-vaccination movement have been shown to not only promote a greater distrust in the field of science, but have needlessly cost thousands of lives and denied the suffering of countless more. Society must learn from history to prevent cases such as these from happening once again. Similarly, cases such as the development of germ theory should be regarded as examples of how a challenge to a paradigm can be beneficial to science and society. There is an obligation to the health of the public that must be upheld.

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Research Reflection

My topic of research was the product of a deep interest in the interactions of science, particularly medical and biological science, with society, and the influence they have on one another. Medicine does not exist in a vacuum, and as a pre-med student, I feel that it is fundamental to understand the social, economic, and political factors that are intertwined with the world of biology and medicine, as well as science as a whole. This led me to the topic of medical denialism, which is an issue that exemplifies the tangible effects society has on medicine.

I began my course of research by creating an outline to guide my process. I decided to structure my paper by comparing when it is and is not acceptable to challenge established medical fact, followed by proposals for the future. I decided to begin with historical research, as the history of medicine is a subject I am particularly fascinated by. I wanted to use a historical example to illustrate an instance in which questioning the established paradigm has led to progress in the course of medicine's history. The example I chose was the development of germ theory, specifically examining the contributions of John Snow and Robert Koch. To accomplish this, I used online resources, specifically Harvard University Library Open Collections Program, as well as a few books, some of which are available through the UCLA library system.

Following this, I elected to use two modern case studies to demonstrate when it is unacceptable to deny established medical fact: Peter Duesberg's denial of the link between HIV and AIDS as well as the anti-vaccination movement. This required a greater variety of sources, and was the portion of my research process for which the UCLA Library resources were invaluable. This was because I needed to access various journal articles, both for use as primary sources, when researching Peter Duesberg, as well as secondary sources. By searching various

databases in conjunction with the use of Google Scholar, I was able to find the articles I needed. The availability of these databases through the UCLA Library facilitated my search for these journal articles. In fact, the only reason I was able to access the full articles was through my UCLA access, whether through UC e-links or other means. Journal articles were a vital source of information, as they provided more reliable information than other sources.

In addition, to further enhance the scope of my research, I used online newspaper and magazine articles as well as certain websites. The newspaper and magazine articles not only supplied important information, but were also valuable as primary sources that reflect the responses to Peter Duesberg as well as the anti-vaccination movement. Possible biases had to be taken into account, though, which is why I tried to be careful in my choice of articles as well as rely on a large number and array of sources to get multiple perspectives.

The issue of reliability was particularly significant in my use of websites. Thus, I tried to use only government websites, such as the website for the Centers for Disease Control, and inspected the sources used for those that were not, such as the Anti-Vaccine Body Count website, which calculates its rates of disease incidence and death from Centers for Disease Control Reports.

By using a wide variety and large number of sources, I was able to get a thorough, effective, and reliable body of support to guide my investigation and write my paper.