

THE ETHICAL IMPLICATIONS OF MANDATED VACCINATIONS: A UTILITARIAN AND BIBLICAL ANALYSIS

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Abstract

Vaccines have become increasingly controversial over the years as more parents have raised concerns in regards to their efficacy and safety. This has led some to call for government-mandated vaccines to ensure that the public is protected against infectious diseases. This study considers the ethical implications of government-mandated vaccinations from both utilitarian and Christian perspectives. It examines the evidence on both sides of the debate for vaccines' safety and efficacy, as well as considers the value of parental rights. This study concludes that, depending on the evidence one appeals to, utilitarianism could support either point of view. A biblical analysis of the issue reveals that, while community is valuable and should be protected, there does not seem to be a scriptural basis for forcing parents to vaccinate their children against their will, regardless of the possible benefits.

Introduction

It was one of the greatest scientific accomplishments of the 20th century. Mankind had finally overcome one of the greatest medical obstacles that existed, and this breakthrough was sure to save lives. After its introduction, thousands were spared from diseases that would have previously amounted to a death sentence. Doctors could now go a step beyond treating illnesses; they could actually ensure their prevention. The revolutionary discovery of the vaccine transformed medicine and put humans one step ahead of viruses and bacteria. Or did it?

Though vaccines have been touted as the ultimate solution to many diseases and have been credited with saving thousands or even millions of lives, many people have begun to doubt their perceived benefits. Parents especially have become concerned that vaccines can cause a multitude of adverse side-effects, such as autism, and that they are not effective at preventing diseases in the first place. In response to parents' outcry, others have pushed back, claiming that science demonstrates that vaccines are beneficial and effective. Proponents of vaccines worry that those who choose not to be vaccinated pose a health risk to the general population and could easily reintroduce diseases that have been eradicated for years. Their solution to this health crisis is to mandate vaccinations for all children. Those who oppose vaccines take issue with this proposed solution, asserting their parental right to make the decisions they believe are best for their children's health. However, there is concern that respecting parents' rights on this matter could lead to an outbreak of illness that would have consequences reaching far beyond individual parents and their children.

To analyze the competing interests of parental rights and the overall health of a society, this study asks two research questions. First, from a utilitarian perspective, is it ethical to mandate vaccinations against the wishes of parents in order to protect communities at large? Second, what does the Bible have to say about government-mandated vaccines from an ethical perspective? By examining the scientific facts relating to vaccines and considering the biblical implications of a government-mandated vaccine policy, this study will answer the research questions as they relate to both utilitarianism and Christianity. This study hypothesizes that utilitarianism cannot come to a definitive judgement and that Christianity gives a precise solution by giving more weight to philosophical matters and relying less on facts that can be reinterpreted based on one's perspective.

Literature Review

A 2013 article by the United States Department of Health and Human Services outlined the importance of vaccines and the concept of herd immunity. It stated

that a critical mass of people must be vaccinated in order for an entire community to be protected from a particular disease (“Community Immunity,” 2013). This indicates that in order for the public to be safe from a particular disease, a large percentage of the population must receive their vaccinations. Anderson and May (1985) estimated that, depending on the disease, this number is upwards of 80% (or 90% in some cases). They claimed that, when sufficient herd immunity levels have been reached, the disease will eventually be eliminated (Anderson & May, 1985). Despite the seemingly high percentages that are necessary to eliminate disease, the Centers for Disease Control and Prevention estimated that vaccines have prevented 732,000 deaths in the last 20 years (Whitney, Zhou, Singleton, & Schuchat, 2014). In a 2007 study conducted by Roush and Murphy, the rates of illness and death from vaccine-preventable diseases were examined in relation to the times at which their corresponding vaccines became available. This historical analysis showed that there was a decrease in the number of cases of each disease shortly after their vaccines were introduced, indicating a link between lower rates of illness and the administration of vaccines, even when the required herd immunity levels are not fully reached (Roush, Murphy, & Vaccine-Preventable Disease Table Working Group, 2007).

Despite the seemingly strong case for vaccines, multiple studies revealed contradictory results. In a study by Barclay et al. (2012), the malaria virus was shown to have the capability of mutating and becoming more virulent in order to overcome the immunity provided by a vaccine. This raised the concern that the over-administration of vaccines, much like antibiotics in the past, could contribute to the resistance of various viruses and actually cause more diseases than they cure. In another study, Rota et al. (1995) detected measles virus RNA in the urine of children who had received a measles vaccine. This indicates that those who receive the measles vaccine might actually be at risk of spreading it to others through bodily fluids, increasing the risk of illness as opposed to decreasing it. Researchers have even demonstrated the futility of getting yearly vaccines that protect against minor illnesses, concluding that they do not offer the protection many believe they do. A study conducted by McLean et al. (2014) showed that those who received the flu vaccine every year were actually more likely to get the flu than those who were vaccinated less often. Other researchers have pointed to apparent correlations between the administration of vaccines and other health problems. A study by Kemp et al. (1997) discovered a link between childhood vaccination and an increase in cases of asthma and allergies. For example, Kemp et al. found that children who received the diphtheria, pertussis, and tetanus vaccines showed higher rates of asthma and allergies than those who did not receive it.

Research

There are two viewpoints a utilitarian could take depending on the facts he appeals to: one in favor of mandating vaccinations and one against such a policy. The former will be examined first.

Utilitarian Perspective: For Mandatory Vaccinations

To determine the morality of mandatory vaccines from a utilitarian point of view, one must examine the facts in order to determine the costs and benefits. Some utilitarians argue that, based on the preponderance of evidence, it is immoral not to vaccinate oneself or one's children because of the negative consequences caused by those who are unvaccinated. They claim that vaccines have saved thousands of lives. According to a report by Whitney, Zhou, Singleton, and Schuchat (2014), vaccines have prevented 322 million illnesses, 21 million hospitalizations, and 732,000 deaths among children born between 1994 and 2013. Medical professionals believe that communities gain the highest amount of protection when a critical mass of people are vaccinated. This is a concept referred to as herd immunity. Roy Anderson and Robert May (1985) explained,

The persistence of infectious disease within a population requires the density of susceptible individuals to exceed a critical value such that, on average, each primary case of infection generates at least one secondary case. It is therefore not necessary to vaccinate everyone within a community to eliminate infection; the level of herd immunity must simply be sufficient to reduce the susceptible fraction below the critical point. (p. 323)

The article further stated that, in order to achieve herd immunity, 92-96% must be vaccinated against measles and pertussis, 84-88% against rubella, and 88-92% against mumps (Anderson & May, 1985).

Despite the possibility of eradicating disease through herd immunity, many have expressed concern that vaccines can cause illnesses, complications, or severe side-effects. The Centers for Disease Control and Prevention addressed this concern in an article on their website titled "Possible side-effects from vaccines" (n.d.), stating that there is a possibility of severe side-effects from vaccines, such as allergic reactions, seizures, deafness, and brain damage. However, the CDC clarified that the risk of experiencing a severe side-effect or death due to a vaccine is extremely small, and the risks associated with contracting a vaccine-preventable illness far outweigh the risk and likelihood of vaccine injury. Nonetheless, Anderson and May (1985) explained that, as the number of people who are vaccinated approaches

the critical mass necessary for herd immunity and the risk of getting a vaccine-preventable illness comes closer to zero, the risk of severe side-effects from vaccines begins to overtake the dangers of being unvaccinated. Anderson and May (1985) stated:

At the start of a mass-immunization programme, the probability of serious disease arising from vaccination is usually orders of magnitude smaller than the risk of serious disease arising from natural infection. As the point of eradication is approached, the relative magnitude of these two probabilities must inevitably be reversed. The optimum strategy for the individual (not to be vaccinated) therefore becomes at odds with the needs of society (to maintain herd immunity). This issue...can be overcome by legislation to enforce vaccination (as in the United States), but its final resolution is only achieved by global eradication of the disease agent (so that routine vaccination can cease). (p. 325)

Anderson and May took a utilitarian approach to solving the vaccine problem, recognizing the interests individuals have to protect themselves but placing it squarely below the interest of the community to protect all members from epidemics and eventually eradicate these diseases entirely. Since a utilitarian would argue that the most moral action is that which does the greatest good, it seems clear that vaccination passes the test for morality in a utilitarian analysis.

However, one could argue that the positive utility gained by vaccination is not as great as it seems, as the severe side-effects of vaccines can cause permanent damage in an individual's life, while many of the diseases that vaccines protect against are not likely to be fatal or cause permanent injury. Given that the risk of an individual experiencing severe side-effects surpasses the risk of infection as herd immunity is reached, it would appear that there would be more utility in preventing the most immediate risk to the individual that is caused by mass vaccination than in protecting against a disease that herd immunity has ensured a next-to-zero chance of contracting.

The problem with this thinking, according to the utilitarian perspective, is that a community must maintain a critical mass of vaccinated members in order to ensure that the chance of becoming infected is as close to zero as possible. If individuals begin to protect their own interests, they will sacrifice the good of the community when vaccination levels fall below the critical mass required for herd immunity. According to this perspective, the only reason that the chance of injury or death from vaccine-preventable diseases is so low is due to the widespread administration of vaccines. Therefore, the utility gained by protecting people from measles or

polio is much greater than that gained by protecting individuals from side-effects of vaccines, which they have a very slim chance of ever experiencing according to the CDC (“Possible Side-Effects,” n.d.). In order for injuries due to vaccines to be consequential from a utilitarian perspective, they would have to impact a greater number of individuals than infections due to vaccine-preventable diseases. As this is hardly ever the case, one can argue that there is net positive utility gained from community-wide vaccination.

Given the evidence in favor of the efficacy and safety of vaccines, a utilitarian who adheres to this perspective would favor government-mandated vaccinations. As explained earlier, if vaccines are effective at preventing disease through herd immunity, it is in the public’s best interest to ensure that as many people as possible are vaccinated. Anderson and May (1985) claimed that the most effective way to reach the required critical mass is to enact public policies that require all people to receive their vaccinations. The moral imperative to do everything necessary to protect citizens seems to necessitate legislation.

Critics of this perspective may raise the issue of parental rights. However, under a utilitarian framework, this consideration only serves to strengthen the argument for government-mandated vaccinations. If a parent chooses not to vaccinate their child, the child could become infected with a vaccine-preventable illness and suffer terrible consequences as a result. Children have no means of ensuring their own safety against such pathogens and could lose their lives to their parents’ incorrect choices. Furthermore, violating parental rights does not carry any tangible negative implications. While a child could die from a disease because they were not vaccinated, when the government mandates that a parent vaccinate their child, the parent does not put their life at risk. Instead, all that is lost is the parent’s ability to exercise his personal beliefs and convictions. When a child’s life is on the line, it is not hard to see which outcome is more favorable. Therefore, according to this strand of utilitarianism, there is no reason to oppose legislation that will require all children to be vaccinated.

Utilitarian Perspective: Against Mandatory Vaccinations

While this ethical question might seem settled from a utilitarian assessment, there are many more sides to the issue. One of the weaknesses of utilitarianism is that it is beholden to the facts it has available to determine likely consequences, and often the facts are unclear. Such is the case with the question of vaccines. Some utilitarians might appeal to contrary evidence and make a case against government-mandated vaccinations on the basis of their questionable efficacy and safety. Though vaccines are intended to produce an immune response in the patient’s body that builds up antibodies in order to create immunity to a particular disease, there is research that shows some vaccines can cause the recipient to shed the virus in their bodily fluids,

therefore making them contagious to those around them. A study conducted by Rota et al. (1995) in the *Journal of Clinical Microbiology* demonstrated that measles virus RNA can be found in the urine of children who have been vaccinated against measles. Because the measles virus can be shed in bodily fluids even fourteen days or longer after administration of the vaccine, those who receive the vaccine could potentially spread the disease to others though they themselves are both vaccinated and asymptomatic.

In another study by McLean et al. (2014), those who received flu vaccinations less frequently were seen to have higher levels of protection against the flu. The study found that “[c]urrent and previous season vaccination generated similar levels of protection, and vaccine induced protection was greatest for individuals not vaccinated during the prior 5 years” (McLean et al., 2014, p. 1375). If the flu vaccine was most effective for those who had not received it within the previous five years, perhaps frequent vaccinations are in fact causing a greater susceptibility to the disease they claim to prevent.

Other studies point to possible adverse side-effects of vaccines. For example, Kemp et al. (1997) found that vaccinated children are more likely to experience asthma or allergies. Vaccines might also cause a decrease in the natural production of antibodies. Leuridan et al. (2010) published a study demonstrating that women who had been vaccinated had much lower antibody levels than those who had not. Furthermore, they found that the children of vaccinated mothers had lower antibody levels than the levels of children who had unvaccinated mothers (Leuridan et al., 2010).

Marcelo Argüelles and his colleagues found that the antibodies created by vaccination are temporary and provide incomplete protection. Their study, which was conducted on Argentinian children vaccinated against measles, showed that while 84% of children ages one through four had what are deemed “protective levels” of antibodies against measles, only 32% of teenagers had antibody levels above what was necessary for protection from the disease (Argüelles et al., 2006). Not only does this demonstrate that vaccine-acquired immunity against measles is temporary, it calls into question the belief that the introduction of vaccines caused a decrease in disease.

The measles vaccine was introduced in the United States in 1963 (“Measles History,” n.d.). A 2014 CDC report showed a downward trend in the number of measles cases from 1964-1988, which the CDC attributed to the measles vaccine (“Reported cases,” 2014). However, a utilitarian who opposes mandatory vaccinations would argue that the immunity acquired by the measles vaccine often wears off around one’s teenage years. This means that many of those who received the vaccine in 1963 would have antibody levels below what was necessary to protect them from the disease starting around 1975. A booster shot for four to six year olds was not

introduced until 1989, and the booster shot given at eleven or twelve years old was not introduced until 1995 ("Age for routine administration," 1998). This means that for a period of around fourteen to twenty years, pre-teenage children were the only segment of the population with a majority of members who had measles antibodies above protective levels. However, instead of seeing an increase in the number of measles cases from 1975-1989 when older children became susceptible, the same downward trend continues ("Reported cases," 2014). A utilitarian arguing against the utility of widespread vaccination might call into question whether vaccines were truly the reason for the decrease in disease or if there were other factors that would have led to such a decrease if vaccines were never introduced.

From a utilitarian perspective, if vaccines are not as effective as they are made out to be, it does not make sense to implement a mandatory vaccination policy. Based on the evidence given against the efficacy of vaccines, it does not appear that there is net positive utility produced through vaccinations. However, there is research on both sides of this debate that leads to contradictory conclusions, so a critic of the utilitarian perspective against vaccines might ask why it is not possible to simply mandate vaccines in the case that they do work and end up preventing disease. One might say that, in addition to the money and time that an individual must devote to comply with the vaccine mandate, there is also the possibility that vaccines are actually contributing to lower immunity and the spread of disease. If this is the case, mandating that all people must receive them is wrong, because individuals are required to give up their time and money to receive a vaccine that will cause more people in society to become sick and die. The negative utility created by vaccines from this perspective outweighs the negative utility that would be created if no one were to receive a vaccine and disease ran rampant. A utilitarian who holds to this perspective might very well argue that the government should mandate no one receive vaccinations unless it can be definitively proven that they prevent disease and do not contribute to other significant illnesses or side-effects. If an action is perceived as a threat to society, a utilitarian will gladly advocate for policy that would force action, even against individual autonomy, to ensure that such consequences never come about, whether that be mandating the administration of vaccines or banning them due to perceived risk.

Utilitarianism relies entirely on the facts it has at hand to determine the consequences of an action. When those facts disagree, as in this case, it makes it difficult for a utilitarian to decide what to do. Surely they will examine the evidence and choose what they believe to be the most compelling, but other utilitarians are bound to come to different conclusions about which facts were most convincing. It is extremely difficult to make moral judgments when one's own method of moral decision-making cannot even agree with itself about the correct course of action to take.

Biblical Perspective

While utilitarianism tackles the issue of vaccination mandates from a consequentialist mindset, the Bible offers a different way of looking at the matter. Instead of evaluating the possible outcomes of policy that would require vaccines, the Bible focuses on the spiritual and social implications of such a policy. The family unit is especially valuable from a biblical perspective. It is seen as the foundation on which societies are built. The community would not and could not exist without the family. If the family is undermined, the entire community is undermined; therefore, the family is more important than the community and must be protected. Martin Luther explained this idea through his use of the three estates or hierarchies. Price (2015) quoted Luther's *Of the Councils and the Church*, in which Luther stated:

The first government is that of the home, from which the people come; the second is that of the city, meaning the country, the people, princes and lords, which we call the secular government... Then follows the third, God's own home and city, that is, the church, which must obtain people from the home and protection and defense from the city. (p. 379)

Luther recognized that God ordained the home and the family to be an institution separate from the civil government of society, but one that is related to it and exists in a hierarchy with it. In another of his works, Luther explained the order of this hierarchy, placing the family before the government. He explained that the family or "household government" was set up after the Church and realized through the institution of marriage, as seen in Adam's union with Eve. The civil government, however, was created after the institution of the family and was not necessary before the Fall, as Luther argued (1535-1536/1958). He went on to state, "Therefore, if man had not become evil through sin, there would be no need of civil government" (Luther, 1535-1536/1958, p. 104). While Luther saw the family as an institution of creation, he believed God ordained government out of necessity due to man's sin. This means that the family supersedes the society in this understanding of the three estates or orders. Not only was secular government lower in Luther's hierarchy than the family, but he also concluded that the family is the basis upon which the church and society rest. He said, "Marriage should be treated with honor; from it we all originate, because it is a nursery not only for the state but also for the church and the kingdom of Christ until the end of the world" (Luther, 1535-1536/1958, p. 240).

Because of the importance this understanding places on the family unit and the detriment that will come to society if it is weakened, a Christian would likely argue that parental rights on this issue are far more important than ensuring the protection of all members of a community through public policy. A biblical perspective would

hold that parents bear the responsibility to protect their children in the ways they see fit. This responsibility gives parents the freedom to act without oversight from the government or even the church in many cases.

Some might argue that, if parents are not adequately caring for their children, the government and community should step in to ensure that those children are not neglected or harmed. Christians recognize that the Bible does not condone parental mistreatment of children. It instead commands fathers to avoid provoking their children and to bring them up in the instruction of the Lord (Ephesians 6:4, English Standard Version). It would be wrong for parents to neglect or abuse their children to the point of causing them illness or death. At that point, the church and the government would be right to step in and remove the children. However, this does not mean that it is good to remove all of the choices parents are allowed to make for their families in the name of protecting children. A person who holds to a biblical perspective might bring up the concern that allowing the government to take the place of parents sets a dangerous precedent. Every time parents made a decision that could even remotely be construed as harmful to their children, the government could remove parental liberties and force them to take an action that they do not believe is best for their family.

As underscored by Luther earlier, a biblical perspective would hold that, apart from clear and obvious neglect or abuse, parents have the liberty and the responsibility to raise their children in the way they believe is best. Vaccinating or not vaccinating one's child does not lead to clear and obvious neglect. A Christian would likely point out that there are children who are vaccinated every day who live long, healthy lives, and there are also children who are not vaccinated who live equally long, healthy lives. Because of the ambiguity over the issue of vaccines and the biblical precedent to value parental liberty as it strengthens the community as a whole, a Christian looking at the question from this perspective would come to the conclusion that there should not be a policy mandating all children receive vaccinations and that it should be left up to the parents to decide on a family-by-family basis.

Some may not be content with this conclusion. It is possible that thousands of children could die because some parents chose not to vaccinate their families. The choice of whether or not to vaccinate is one that affects not just one's own family but the entire city, county, state, and country a person lives in. Vaccination may be the only way to prevent epidemics, and giving parents the ability to make the wrong choice could be dangerous. However, Christians understand that humans were made in God's image (Genesis 1:26), which means that they have the ability to act apart from instinct according to their reason and to make choices in line with their reasoning. This ability must be respected, even if it leads to consequences that negatively affect an entire population. A biblical perspective holds that the church or community can intervene to stop an individual's action when they act immorally

or in opposition to Scripture (1 Corinthians 5:12-13), and Luther (1535-1536/1958) upheld that the government exists to punish sin.

Nevertheless, the decision to vaccinate or not vaccinate one's children is not a moral issue dealt with anywhere in the Bible, so the government has no right to force a parent's hand in the matter. The government would not be acting to prevent an inherently immoral action; instead it would simply be acting to obtain the results it desires while simultaneously acting in direct opposition to the foundational unit of the family. Though it is possible that lives could be saved through such a government mandate, the basis of society, the family, would be undermined. In the end, it is much worse to destabilize society in this manner than it is to allow disease and death to occur as a result of individuals' choices, especially since Christians believe that the fallen nature of the world makes disease and death inescapable. Christianity does not see physical suffering as the worst possible outcome, so it insists on valuing family over the risk of widespread disease and reasons that society as a whole is better protected when it has strong families as its basis.

Conclusion

The utilitarian analysis of the question of mandatory vaccines is unsatisfactory. Instead of offering a clear and absolute solution to the controversial issue, it complicates the matter by allowing a person to justify either outcome depending on the evidence that he favors. Ethical issues certainly cannot be decided in this manner, as it leaves the door open to ambiguity and ensures that the matter will never be settled. On the contrary, an ethical framework should provide a clear-cut solution that is applicable regardless of the changing or bias-laden facts of a case. This allows an agreement to be reached, assuming both parties adhere to the same ethical framework. For this reason, a biblical perspective is superior to the utilitarian method when deciding the morality of a government-mandated vaccine policy. It is internally consistent, and the conclusion one reaches does not evolve depending on the information he uses to make his determinations. In addition, it is based on the inerrant and unchanging Word of God, which is perfect in the ethical judgments it makes and will not lead us astray. For this reason, it can be concluded that a government-mandated vaccination policy is unethical, taking freedom from parents to do what they believe is best for their child and placing that responsibility in the hands of the government, which was created solely for the purpose of restraining sin, not for maximizing the public good in every conceivable way. The family supersedes the government in the hierarchy of established institutions, and usurping the authority of parents over their children can cause nothing but harm to society, regardless of the effects of vaccination.

Reference List

- Age for routine administration of the second dose of measles-mumps-rubella vaccine. (1998). *Pediatrics*, 101(1), 129-133. Retrieved from <http://pediatrics.aappublications.org/content/101/1/129.full>
- Anderson, R. M., & May, R. M. (1985). Vaccination and herd immunity to infectious diseases. *Nature*, 318(28), 323-329. Retrieved from https://www.researchgate.net/profile/Roy_Anderson2/publication/19256346_Vaccination_and_Herd_Immunity_to_Infectious_Diseases/links/0deec52b959bdd4c51000000.pdf
- Argüelles, M. H., Orellana, M. L., Castello, A. A., Villegas, G. A., Masini, M., Belizan, A. L.,... Glikmann, G. (2006). Measles-specific antibody levels in individuals in Argentina who received a one-dose vaccine. *Journal of Clinical Microbiology*, 44(8), 2733-2738. doi:10.1128/JCM.00980-05
- Barclay, V. C., Sim, D., Chan, B. H. K., Nell, L. A., Rabaa, M. A., Bell, A. S.,... Read, A. F. (2012). The evolutionary consequences of blood-stage vaccination on the rodent malaria plasmodium chabaudi. *PLOS Biology*, 10(7). Retrieved from <http://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.1001368>
- Community immunity (“herd immunity”). (2013). *U.S. Department of Health and Human Services*. Retrieved from <http://www.vaccines.gov/basics/protection/>
- Kemp, T., Pearce, N., Fitzharris, P., Crane, J., Fergusson, D., St. George, I.,... Beasley, R. (1997). Is infant immunization a risk factor for childhood asthma or allergy? *Epidemiology*, 8(6), 678-680. Retrieved from http://journals.lww.com/epidem/Abstract/1997/11000/Is_Infant_Immunization_a_Risk_Factor_for_Childhood.15.aspx
- Leuridan, E., Hens, N., Hutse, V., Ieven, M., Aerts, M., & Van Damme, P. (2010). Early waning of maternal measles antibodies in era of measles elimination: Longitudinal study. *BMJ*, 340, 1-7. Retrieved from <https://doi.org/10.1136/bmj.c1626>
- Luther, M. (1958). *Luther's works: Lectures on Genesis chapters 1-5* (J. Pelikan, Trans.). St. Louis, MO: Concordia Publishing House. (Original works published 1535; 1536).

- McLean, H. Q., Thompson, M. G., Sundaram, M. E., Meece, J. K., McClure, D. L., Friedrich, T. C., & Belongia, E. A. (2014). Impact of repeated vaccination on vaccine effectiveness against influenza A(H3N2) and B during 8 seasons. *Clinical Infectious Diseases*, 59(10), 1375-1385. Retrieved from <http://cid.oxfordjournals.org/content/59/10/1375>
- Measles history. (n.d.). *Centers for Disease Control and Prevention*. Retrieved from <http://www.cdc.gov/measles/about/history.html>
- Possible side-effects from vaccines. (n.d.). *Centers for Disease Control and Prevention*. Retrieved from <https://www.cdc.gov/vaccines/vac-gen/side-effects.htm>
- Price, T. S. (2015). Luther's use of Aristotle in the three estates and its implications for understanding *oeconomia*. *Journal of Markets & Morality*, 18(2), 373-389. Retrieved from <http://www.marketsandmorality.com/index.php/mandm/article/view/1099/961>
- Reported cases and deaths from vaccine preventable diseases, United States, 1950-2013. (2014). *Centers for Disease Control and Prevention*. Retrieved from <https://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/e/reported-cases.pdf>
- Rodrigues, P., Doutor, P., Soares, M., & Chalub, F. (2016). Optimal vaccination strategies and rational behaviour in seasonal epidemics. Retrieved from <https://arxiv.org/pdf/1507.02940.pdf>
- Rota, P. A., Khan, A. S., Durigon, E., Yuran, T., Villamarzo, Y. S., & Bellini, W. J. (1995). Detection of measles virus RNA in urine specimens of vaccine recipients. *Journal of Clinical Microbiology*, 33(9), 2485-2488. Retrieved from <http://jcm.asm.org/content/33/9/2485.full.pdf>
- Roush, S. W., Murphy, T. V., & Vaccine-Preventable Disease Table Working Group. (2007). Historical comparisons of morbidity and mortality for vaccine-preventable diseases in the United States. *Journal of the American Medical Association*, 298(18), 2155-2163. Retrieved from <http://jama.jamanetwork.com/article.aspx?articleid=209448>
- Whitney, C. G., Zhou, F., Singleton, J., & Schuchat, A. (2014). Benefits from immunization during the vaccines for children program era – United

States, 1994-2013. *Morbidity and Mortality Weekly Report*, 63(16), 352-355. Retrieved from <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6316a4.htm>