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The Children's Health Project: Creation of a Community Model for Increasing Vaccination Rates in
Children

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Since the invention of vaccines in the late 1700s, the world has seen a dramatic decrease in infectious disease rates worldwide. Certain diseases such as smallpox have been eradicated from the planet, and others such as polio and measles have seen dramatic reduction in numbers, nearly to the brink of being fully removed in certain areas of the world. However, due to recent controversy surrounding the manufacture and use of childhood vaccinations, many parents are choosing to forgo these immunizations. As a result of this decision, first-world societies such as the United States are subsequently seeing increases in the prevalence of diseases that had previously been rare in our modern world.

The purpose of this paper is to present a community-based model aimed at improving the health of children through increasing compliance with the recommended vaccinations. This model can be adapted to both rural and urban societies, and heavily relies on both community involvement and public health action. It will address both families who choose not to immunize out of fear of complications as well as families who maintain a non-vaccination stance due to inconvenience, and it will outline a plan for protecting those who obtain exemptions for the vaccination requirement.

THE IMPORTANCE OF VACCINES

Vaccination works in decreasing infectious disease rates by boosting herd immunity in the population. Herd immunity, where a high percentage of the population is effectively immune to a certain pathogen, prevents the spread of disease by removing its ability to infect living hosts. Due to the severity of many of these diseases, this immunity is often obtained through controlled exposure to the pathogen using immunization. Typically, the effective threshold for herd immunity requires greater than 75% of the population to be vaccinated; however, certain diseases with high mutation rates or lower infectious doses may require higher percentages for herd immunity to be fully effective (Bauman).

Vaccines work by introducing the cause of the disease, often a bacterium or virus, into the body in a controlled fashion. This triggers the individual's immune system to respond, allowing it to recognize and destroy the pathogen and create lasting defenses toward the disease to guard against any future exposure(s). This type of adaptive immune response is possible because of antigens present on the exterior of the bacterium/virus: regions of unique three-dimensional structure that are recognized by immune cells as being foreign. These antigens can be exogenous (exterior structures such as secretions, toxins, or membrane components of the pathogen), endogenous (structures created by the bacterium/virus to allow them to invade host cells), or even autoantigens (self-derived structures on host cells allowing the immune system to distinguish body cells from foreign invaders) (Bauman).

Within the immune system there are two important types of cells, often referred to as "B-cells" and "T-cells", which act to protect the individual against disease. While the B-cells remain stationary within the body, T-cells circulate through the bloodstream and lymphatic system to provide surveillance to monitor the system for signs of invasion. T-cells recognize the antigens on the exterior of the pathogen, commit them to memory, and communicate back to the B-cells, which create specific antibodies targeted at destroying the bacterium/virus. Each of these antibodies contains an antigen binding site, which allows the cell to bind to the antigen and eliminate the pathogen through toxin neutralization, phagocytosis, oxidation, agglutination, or cell-mediated responses (Bauman). These cells are vital in fighting disease, and are the cells with which vaccination interacts. By introducing pathogens into the body through controlled immunization, the immune system is triggered to create this memory and a supply of specific antibodies aimed at destroying the pathogen quickly in the event of future exposure.

There are many types of vaccines available, and their use depends on the method employed by the bacteria/virus when infecting the host cells. These include attenuated, inactivated, toxoid, and

combination vaccines. Although the safety of attenuated vaccines (which contain live and/or modified versions of the pathogen) is one of the strongest arguments used by the anti-vaccine movement, these types of immunizations make up a very small percentage of recommended childhood vaccines, with only the Varicella-Zoster and MMR vaccines being produced in this fashion. These inoculations stimulate a full immune response by causing mild infection, and can also cause contact immunity due to the ability for the bacteria/virus to be spread between the vaccine recipient and those they may come in contact with. The infections by this form of vaccine, however, are rarely severe enough to cause full forms of the disease, as they have been genetically modified or cultured in tissue for many generations under poor conditions to reduce their virulence (Bauman).

The majority of the immunizations given in early childhood are of the inactivated variety. These can be either whole agent (where the entire microbe is used) or subunit (containing only antigens). In all of these vaccines, the bacteria/virus has been killed, often using very small doses of naturally metabolized chemical compounds such as formaldehyde. Similar to the attenuated vaccines, these also cause an immune response; however, it is much smaller in comparison, which means inactivated vaccines typically require multiple doses and/or boosters to ensure the proper level of immunity to the pathogen has been reached. Examples of this form of vaccine include Hepatitis A, Hepatitis B, Meningococcal, Polio, and Influenza (Bauman).

Making up the remainder of the childhood immunization schedule are the toxoid and combination vaccines, including MMR and Tdap, which cover Measles, Mumps, Rubella, Tetanus, Diphtheria, and Pertussis. These vaccines combine weakened versions of the toxins present on the surface of certain bacteria with attenuated or inactivated versions of a particular pathogen, allowing them to provide protection against multiple diseases with a single immunization. Due to the toxoid portion of the combination vaccines, however, these require regular boosters; because there are no

antigens present in the toxin to be recognized by the T-cells, these vaccines create only a B-cell antibody response with no associated memory. As antibodies, like every cell type, have a limited lifespan, it is often required that an additional dose be given to “boost” this immunity back to effective levels (Bauman).

THE DECLINE OF VACCINATION RATES

Childhood immunization is undoubtedly one of the most controversial subjects of the 21st century. While the technological advances of today’s modern society have helped in many ways, they have also created a generation of patients and parents who turn to the internet as their primary source of health care advice, often believing what they read online over the experience and expertise of their medical practitioners. Without proper education, however, it is often difficult for the lay person to determine what qualifies as credible information on the worldwide web, and it is for this reason that many of the issues surrounding vaccination have arisen.

Possibly the biggest objection to childhood vaccination today is the idea that the side effects of the vaccine are more severe or cause more lasting consequences than the disease itself. It is widely believed in the medical community that this way of thinking can solely be attributed to the fact that we have nearly eliminated many of our vaccine-preventable diseases from society, and therefore the once horrific images of children suffering from these conditions are no longer at the forefront of the community’s mind. Both the Center for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA) have released statements attesting to the fact that the side effects of all approved vaccines are far less serious than the result of contracting these preventable diseases (Bauman), and the current statistics are quite supportive of this fact. For example, while a child receiving the MMR vaccination has a 1 in 6 chance of contracting a fever, a 1 in 20 chance of a mild rash, and a 1 in 4 chance

of temporary pain and/or stiffness near the injection site, they only have a 1 in 75 chance of any form of glandular swelling and their risk of having an allergic reaction to the ingredients of the vaccine is less than 1 in 1,000,000 (Centers... Possible Side-effects...). Children who contract the measles, however, which the MMR vaccine was created in part to protect against, have a 1 in 10 shot of permanent hearing loss due to the severe ear infections that are common with the disease, a 1 in 20 chance of contracting pneumonia (the most common cause of death in children who suffer from the measles), a 1 in 1,000 chance of encephalitis causing convulsions and brain damage, and a 1 in 500 chance of dying of the disease. The risks do not stop there; the measles virus is often capable of going “latent”, becoming dormant in the body for many years before being reactivated. This can often cause a condition known as Subacute Sclerosing Panencephalitis, a fatal central nervous system disease that does not appear until seven to ten years following the initial onset of the measles (Centers...Complications of Measles). Similar statistics have been gathered regarding the Tdap vaccine, which protects against Pertussis, better known as “whooping cough”. With a 1 in 16 chance of redness or swelling at the injection site, 1 in 250 chance of a fever, 1 in 100 chance of associated nausea, and less than a 1 in 1,000,000 chance of an allergic reaction (Centers... Possible Side-effects...), these risks far outweigh those of the disease, where children have a 1 in 4 chance of pneumonia, 2 in 3 chance of apnea (where breathing may slow dramatically or even stop), and 1 in 50 chance of dying from the disease (Centers...Complications).

Another common argument from the anti-vaccine community is that the protection provided by vaccines is less robust than that of the natural immunities given by breastfeeding and natural exposure. While it is true that breastfeeding provides the opportunity for antibodies to be transferred from mother to child, it is important to remember that these cells are short-lived and have no memory capability. While an infant may receive these antibodies during the breastfeeding period, this protection quickly wanes as the child is weaned in favor of solid foods, leaving them again vulnerable these vaccine-preventable illnesses. Also, while it is true that natural exposure causes a rapid and powerful

immune response that can create a life-long protection against disease, this can often be dangerous and leave lasting consequences (as mentioned previously regarding side effects). Vaccines function by mimicking the natural exposure process utilizing pathogens or pathogenic parts that have been modified to make them less virulent, allowing the body to get the necessary information it needs to mount a protective response without risk of complications that would arise with the wild-type form of the disease (Bauman).

Other concerns many parents have regarding the decision to immunize their child is whether or not to follow the prescribed vaccination schedules set forth by their pediatrician. Even those who plan to fully vaccinate may feel apprehension regarding the number and frequency of inoculations their child will receive within the first few years of life. Without a full understanding of the inner workings of the immune system, it is easy to see how a parent would be concerned with the idea of having their child exposed to so many pathogens so early on in development, as well as the various preservative agents that may be used to keep these vaccines stable during transport and use. The vaccine schedule, developed in conjunction with health care professionals and governmental organizations such as the CDC and FDA, is structured to ensure that all children receive their necessary vaccines at the time in which their immune system will respond best. It is important that these vaccines be given at the earliest possible age to prevent contraction of the disease, particularly for any vaccines that will require multiple doses to be fully effective, and the immune system changes rapidly throughout early life, often giving set “windows of opportunity” in which a particular vaccine will provide the most protection. While a child is exposed to anywhere between 2,000 to 6,000 pathogens per day in their typical life, the entire childhood vaccine schedule (including the multi-dose vaccines and early booster shots) contains only 150 pathogenic antigens in total. This means that throughout their first 5 years of life, the pathogens a child’s immune system receives from vaccination makes up only 0.001-0.004% of their total exposure (American Academy...). Similarly, while toxicity from preservative agents such as formaldehyde is a valid

concern, children are exposed to this naturally occurring chemical on a daily basis through interaction with substances like cleaning agents, cigarette smoke, cosmetics, medicines/vitamins, carpeting, and many of the foods they consume. This chemical is found in much lower doses in a vaccine than they will encounter through daily exposure, and it is naturally produced and metabolized by the body, broken down and excreted via urine or as carbon dioxide (Agency...).

Possibly the most well-known anti-vaccine controversy is that surrounding the potential interaction between the mercury compound Thimerosal (originally a stabilizing ingredient of many childhood vaccines, particularly the MMR immunization) and the development of autism in children. This link was originally publicized by Dr. Andrew Wakefield, a British surgeon, in a 1998 study that was later discredited in a 2004 investigation of the work. It was through this investigation that researchers discovered Wakefield to be guilty of “four counts of dishonesty involving his research... [including] a dishonest description of the children enrolled in [his study]”, which ultimately led to the loss of his medical license (Raphael). It later came to light that he had been paid over £55,000 by a law firm that had been attempting to craft a lawsuit against vaccine developers, which created a serious conflict of interest as his study development began. His study contained only twelve subjects, all of whom suffered from autism and whose parents believed the vaccination to be the cause and he also paid many of the children £5 each in return for blood samples to be taken at his own son’s birthday party. Even Wakefield himself has since acknowledged that no link between the MMR vaccine and development of autism in children exists (Edwards). Additional studies have since been completed, consistently showing no evidence to claim any link between autism spectrum disorders and the use of any vaccines on the early childhood immunization schedule. Despite this fact, however, the CDC removed Thimerosal from all childhood vaccinations in 2001 in an attempt to dissuade the propagation of the anti-vaccine movement (Centers for Disease Control...). It seems that the damage has already been done, however; despite increasing amounts of scientific evidence to the contrary, the anti-vaccine movement and many of its

celebrity supporters (including actress Jenny McCarthy and United States Senator Rand Paul) still reference this fraudulent study in support of removing vaccine requirements and encourage parents to circumvent vaccinating their children at all costs (Edwards).

THE MODEL



As previously stated, because this model is so community-driven, it is designed to function equally well across all cultural, religious, and socioeconomic boundaries. It is organized to be one hundred percent adaptable to any community, rural or urban, which may find itself in need of a change to their current state of public health compliance. By utilizing members of the community rather than outside sources of assistance, the above model ensures that the community will feel a vested interest in the changes being made, likely increasing agreement with any proposed alterations to the current state of the health care and public health systems in the region.

BOARD OF TRUSTEES

The board of trustees for this model includes prominent business members from the community, local and/or state policy makers, attorneys, members of the public health department, and various representatives from the health care field. Each of these members is crucial to the success of this model, as they each play a vital role in the community in which they serve. It is important to include attorneys to assess the legality of any proposed changes to public policy, policy makers to help draft these potential changes, representatives from health care and public health to outline the health-based needs of the community and provide valuable data and insight into the overall function of the system, and prominent business members (who are trusted members of the community) to advocate these changes to the masses in an attempt to increase cooperation. It is through the combined collaboration between these individuals that the proper changes can be brought to light. Together, they will define the program's standards of care and operating procedures, determine what qualifies as medical neglect or a violation of community ethics, and evaluate current public policy and vaccination exemptions for legality, ensuring that all proposed changes that arise from this model are within the confines of the law.

COMMUNITY ADVISORY BOARD

Similar to the board of trustees, the community advisory board will consist of members of health care (such as physicians and RNs). However, this will also include religious and cultural leaders, members of the educational system, and the creation of many public forums to encourage community participation throughout the process. This is the area of the model where the most specific information will arise regarding why children are not being vaccinated, as well as assisting in defining the perceived needs of the community as a whole. The members and events involved in this advisory board will help determine what (if any) exemptions are necessary in the area, what values the community holds dear, as well as what avenues of public health education will be most effective in the given population. It is this portion of the model that will give the most “power” to the citizens of the community, and therefore this area is the most likely to increase overall compliance within the public.

PUBLIC HEALTH COLLABORATIVES

Collaboration with the various public health organizations of the area is crucial to evaluating and encouraging the success of the model. It is through this partnership that ongoing statistics regarding vaccination rates, infectious disease prevalence, and other children’s health measures can be obtained. This is also important not only for community outreach and evaluation/improvement of the health literacy of the community, but also to outlining and evaluating both the disease prevention policies and infectious disease outbreak procedures currently present in the community. This will help to ensure that all measures implemented to promote compliance within the community are effective in both technique and result. It is through this collaboration that the two boards should select their target goal (i.e. increasing vaccination compliance to 95% within the next five years) and monitor progress toward achieving this aspiration. This will also provide program leaders with easy access to various changes in

health insurance and HIPAA law, and it is also the most effective area in which to assign a finance committee, as it will be much simpler to utilize the pre-existing public health partnerships to fund any necessary projects.

COMMUNITY COLLABORATIVES

Similar to the Community Advisory Board, the collaboration with community programs is where majority of the change will arise within this model. As with any large scale change from the norm, particularly controversial changes such as vaccination regulations, the key is to place the power within the hands of the people who will be affected most. The more they feel involved in the process the more likely they are to comply with the increased vaccination rules, which will help to boost the overall herd immunity rate and bring down the prevalence of these resurging diseases. The biggest goal of these collaboratives is to educate the public on both the importance of vaccination, as well as the options available to them in regards to obtaining the necessary care for their children. This will involve advertising, communications, and fundraising efforts to spread the word about the goals and offerings of the program, as well as extensive participation with the education, health care, and religious/cultural groups to coordinate volunteer programs and alter the educational curriculum to provide optimal education and access to care for all children within the community.

SERVICES PROVIDED

The organization of this model provides many opportunities for unique services to be implemented throughout the target communities with the hopes of bringing about the desired outcomes needed to reach the public health goals. Many of these services should focus on education

within the community to help combat the myriad of misinformation about the use and side effects of vaccines within society. This can be accomplished through the use of educational materials provided to expectant parents during prenatal visits and education through public advertising, as the goal is to make the adult population (who are responsible for the health care of today's children) fully informed on the truth behind immunization so they can make the most appropriate choice for their families.

It is also important, however, to target health education curriculum within the local high schools to bring about the desired changes. While many may not believe this to be a vital part of improving the current problem, it often goes unseen that the children in these schools are soon to become the future parents of our society. The high school years are the point in a child's life where they are beginning to form their own opinions on hard-hitting issues and preparing to enter the adult world, and thus targeting the curriculum to educate the next generation makes a perfect avenue for increasing vaccine awareness. This can also be a double-edged sword, particularly in lower income communities, as teen pregnancy is still fairly high throughout the country; educating these students would allow us to reach a population of parents who have formerly been pushed to the wayside due to stigma and struggle.

While parents have many reasons for choosing a non-vaccination route, one of the most important to recognize, particularly with the low socioeconomic status groups, are the families who forgo immunizations due to a lack of access to adequate health care. This can be for any number of reasons, including (but not limited to) an inability to seek care due to limited time off availability from their employers or difficulty traveling to and/or affording to seek preventative care. The issue with reaching these families is often not educationally-based, and further action must be taken to ensure that none of these children are lost in the shuffle. This can be accomplished in many ways, and will require strong involvement from local lawmakers and the health care setting. A good way to begin

tackling this issue is to investigate possibilities to bring the health care to the children, instead of requiring the children to come to clinics, hospitals, and other facilities to be seen. As the field of health care continues to change rapidly, a good way to begin this process would be to target Physician Assistants and Registered Nurses as potential participants in volunteer-based health care. Holding a “clinic” within schools once per month (or more frequently, if required by the health of the community as a whole) would be an excellent way to provide the necessary care to children who may otherwise not be able to receive the preventative treatment they need to remain healthy. While this program may be costly to run, partnerships with local and state government organizations, involvement of health insurance companies, private donations, and fundraising efforts could be beneficial.

Another potential solution to the issue of inconvenience could be to investigate the possible implementation of a legal policy that would require businesses to provide paid time off for parents to ensure that they will always be able to get their children the necessary preventative care they need. This would be beneficial to both the employees and the employer, as proper preventative care can help to decrease the number of “sick days” parents will need when their children become ill, thereby improving workflow within the business. By requiring this time off to be compensated by the employer, this will remove the fear many low income families have about not being able to make ends meet if they must miss a day or more of work, particularly for something that does not appear to be emergent.

While it would certainly be preferable for all of society to follow the recommendations of this program, it is required that there be a plan in place to handle the instances when parents insist upon non-vaccination for their children. Many children cannot be vaccinated due to age (certain vaccines cannot be given until a child reaches a certain age or require multiple doses given at specific lengths of time) or immune status (any child with a weakened immune system or autoimmune condition should never be vaccinated), and it is for these reasons that a high herd immunity is so necessary. To protect

these children, they should not be put in contact with potential carriers of vaccine-preventable disease, which ultimately requires that non-vaccinated children be monitored much more closely than the vaccinated population. To accomplish this task, the model includes the establishment of alternative health care facilities and/or designation of wings in existing locations that are specifically reserved for those who are unvaccinated. This would require that any non-immunocompromised child whose parents elect not to vaccinate be treated in special facilities to decrease the potential spread of disease in the population. It is also important to re-evaluate public disease prevention and outbreak policies in a combined effort with both public health officials and local lawmakers to ensure that any communicable disease cases are handled properly and swiftly, assisting in this goal. Free screenings and antibody titers should also be offered under this model, to assist parents in determining which vaccines are needed to ensure their child's full immunity.

There is no question that vaccines have been one of the most effective medical advancements in history. Through the use of vaccines, society has managed to eradicate or nearly eliminate many diseases from the population that had formerly held high mortality rates throughout the world. While many parents have expressed concern over the use of vaccines due to the myriad of misinformation and falsified data that has appeared in recent decades, including Andrew Wakefield's fraudulent autism study, claims that vaccines cause diseases such as autism have been fully unsubstantiated after extensive scientific research (Bauman). Regardless, vaccine compliance has continued to fall in recent years, bringing about a resurgence of diseases such as measles and pertussis that had been nearly removed from the United States prior to the rise of the internet-based, "self-care" model of health care that patients are adopting today. The model presented here is intended for use in a wide variety of communities of varying socioeconomic and cultural status. It outlines the necessary measures that must

be taken to both gain community trust and provide access to care for children who may not be eligible due to insurance matters or parental inconvenience, while simultaneously providing ways for the community to contain and prevent the spread of vaccine-preventable illness within the population. Through the combined efforts of the Board of Trustees and the various aspects of the Community Advisory Board, many services can be implemented that will both address the needs of the community and assist the program in reaching its goals.

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