"The dead are soon forgotten, but man left mutilated, man paralyzed, is a source of guilt and shame to everyone who regards him. He cries out for action in a way that the dead can never do," wrote British Doctor John R. Wilson regarding the fight against polio. (Allen 160) The poliovirus outbreaks crippled thousands of people every summer, making it the most dreaded disease of the 1900s. Then, Dr. Jonas Salk concocted the first polio vaccine. Dr. Albert Bruce Sabin later created a vaccine as an alternative to Salk's. **The innovative Polio Vaccine had early negative effects, but has impacted untold millions from the consequences of this deadly disease. Polio outbreaks have forever changed the world, but it is now well on its way to following in Smallpox footsteps and being permanently abolished.** Salk told reporters in correlation with his vaccine, "The most important result of the vaccine was freedom from fear." (Sherrow 37)

The virus that caused polio was identified as poliovirus. Polio outbreaks have probably caused death for most of history. The oldest identified case dates back to Ancient Egypt. A picture of a man with a withered leg and a walking cane is depicted on a stone slate and is believed to be the first recorded case of polio. (A Brief History of Polio) In 1894, this disease was named poliomyelitis or polio. Polio would infect anyone, but the most vulnerable were children. This horrid infection was called Infantile Paralysis. It was very contagious, malignant, and unfortunately had no cure. The virus entered the body through the nose or mouth and then traveled to the intestines where it reproduced. Then, the infection moved into the blood stream. In some cases, while in the blood stream, the body developed antibodies against the virus, and the person developed natural immunity. Unfortunately, in other cases, it traveled from the bloodstream to the nervous system and destroyed the motor neuron cells, which control the muscles for swallowing, circulation, your torso, and your arms and legs. If the infection reached

this stage, it caused paralysis. (NMAH) One out of every two-hundred people who contracted polio became permanently paralyzed. (Bedoyere 18)

With or without symptoms, the virus could be spread to others. Polio was extremely hard to contain because people could transmit it to others without knowing they were infected. The virus spread through particles in the air, water, food, and infected body waste. (Development)

Many complications occurred as a result of this horrific disease, such as weakened muscles, paralysis, and even death. Before a vaccine was developed, there were treatments available to help recover from polio, including heavy metal leg braces, crutches, wheelchairs, and the iron lung. An iron lung was an artificial respirator used when a patient had paralysis of their chest muscles. Iron lungs covered the patient's whole body except for their head. The pumps changed the pressure inside the lung forcing air in and out of the victim's lungs. The iron lung kept the patient breathing until his or her muscle function recovered enough to breathe without assistance. Many victims spent extensive time in an iron lung; some spent years even decades immobile in an iron lung. (NMAH)

Sister Elizabeth Kenny became famous for her innovative treatment methods in the 1930s and 1940s. Sister Kenny did not believe that immobilizing patients with plaster casts and heavy leg braces was effective. She believed that hot packs to soothe muscles, exercise, physical therapy, and moving the weakened muscles would help patients recover quicker. (Bedoyere 23) In a personal experience essay written by Ann L. McLaughlin, she recalls her and her husband's physical therapy experience, "Charlie and I went to Mass General three times a week for therapy. Charlie walked between parallel bars and lifted weights and pulleys to strengthen his arms. I

walked in the bars too and spent time talking into a tape recorder. I did acquire a short leg brace which seemed to lessen my limp and give me more strength." (Daniel 64)

Polio cases in the United States rose dramatically in the 1900s. "In 1916, a polio epidemic affected nearly 30,000 across twenty states. More than 7,000 died. In New York City alone, 9,000 were affected and about 2,500 died." (Bedoyere 19) "Typically polio killed five percent of its victims, but in New York City in the summer of 1916 for reasons that remain unclear twenty-seven percent of those infected died." (Offit 9) After 1916, serious outbreaks occurred every summer, and the number of victims every year continued to increase. In 1952, the United Sates reported the worst outbreak recorded in history. There were 58,000 cases reported, 3,000 people died, and 20,000 were paralyzed. (Salk)

Polio epidemics caused huge emotional impact. People avoided large crowds and public facilities, such as swimming pools, playgrounds, and movie theaters. Even some churches closed. Parents kept their homes spotless, and their windows tightly sealed. (Durrett 12) Many people fled cities trying to escape the constant threat of polio. Hospitals even became afraid to care for infected patients. (Bedoyere 21)

In addition to public panic, victims were also discriminated against. Special government controlled schools and homes, like "The Home for the Destitute Crippled Children," were assigned specifically for polio stricken patients. The Children's Hospital in Akron, Ohio was a separate polio treatment hospital. (Sherrow 14) Many places were quarantined when cases were found, but the disease still spread. The U.S. Public Health Service soon realized that an immense number of people were unaware that they were carrying and spreading the disease to others;

therefore, quarantining only the known cases was ineffective. They needed a vaccine to be truly successful in protecting people against polio.

Although Salk is credited for saving America from the deadly polio virus with his vaccine, there were many scientists before him that made crucial discoveries. Dr. Carl Kling discovered that polio spread from person to person and that some infected people had no symptoms. In 1908, Karl Landsteiner discovered the virus that caused polio. In the 1930s, Macfarlane Burnet and Jane Macnamara found that there were at least two types of the polio virus and that a vaccine against one strand did not protect you from the others. Dr. Simon Flexner discovered that the body formed antibodies. Researchers at Hopkins hospital learned that polio had to travel through the blood stream to attack the spinal cord. Dr. Maurice Brodie discovered that formaldehyde could kill the poliovirus but still allow antibodies to form in children. (Offit 11)

In 1935, amidst the rush to create a cure for the terrifying polio disease, Dr. John Kolmer and Maurice Brodie frantically created a vaccine that they believed was harmless. Without properly testing it, they vaccinated 12,000 children. Unfortunately, six of them died, and three were paralyzed. “The vaccine trials of John Kolmer and Maurice Brodie had a chilling effect on polio vaccine research. Twenty years passed before anyone dared to try again.” (Offit 18)

In 1934, Jonas Salk enrolled in the New York University School of Medicine and developed the first successful influenza vaccine with Dr. Francis. (Durrett 9) This gave Salk a better understanding of the human immune system. He also learned, “You must cram your vaccine with every strain you can lay your hands on.” These lessons proved incredibly crucial in the development of his successful polio vaccine. (Durrett 20)

Before a successful vaccine was possible, Salk had to determine how many different strains of poliovirus existed. In the fall of 1949, it was confirmed that there were only three types of the poliovirus. “Type one is the usual cause of epidemics and frequently results in paralysis of the limbs and the breathing muscles. Type two is the least likely to cause paralysis, but infection can result in severe damage to the brain stem. Type three is the rarest but also the most dangerous; it causes paralysis of the limbs as well as brain stem damage.” (Bedoyere 25)

Next, Salk had to experiment with ways to kill the virus for his vaccine. He discovered that the chemical formalin would completely kill the virus. Too much formalin damaged the antibodies, but too little induced a full blown case of polio before the antibodies developed. Finally, Salk discovered the right amount of formalin and completed the “inactive” polio vaccine or IPV. Salk then began testing his vaccine on monkeys. (Bedoyere 28)

According to an interview with Don Wegemer, Dr. Salk’s lab assistant at the University of Pittsburg, the monkey testing was used to ensure that the vaccine was safe. Don said that they used monkeys to test Salk’s vaccine because they would experience all of the symptoms of Infantile Paralysis. If the vaccine was successful, the monkey would remain perfectly healthy. Don explained that the monkey had to be autopsied to confirm that the virus in the vaccine had been 100 percent killed and effective. When Salk was satisfied that the vaccine was safe, he began human testing of his vaccine. (Seavey 191-194)

In 1952, Salk vaccinated himself, his wife, and his three sons. Don Wegemer said that everyone in Salk’s laboratory was vaccinated. Salk tested it on himself and people close to him because he believed, “You wouldn’t do unto others that which you wouldn’t do unto yourself.” (Sherrow 33-34)

In April of 1954, Salk's clinical trials began in the U.S. and Canada. All of the children tested in his clinical trials became known as polio pioneers. He tested in 44 states and used 1.8 million school children. The children ranged from ages six through nine, grades one through three, and were located at 215 different test sites. Salk conducted a double-blind trial, meaning, 650,000 received the actual vaccine, 750,000 received a placebo, and 430,000 children received neither. Very few vaccinated children were stricken with polio. (NMAH)

Finally, on April 12, 1955, Dr. Francis announced that the Salk vaccine was 90 percent effective and was safe and potent. The government then granted permission for children to receive Salk's vaccine. It quickly spread to other countries. In 1955 to 1957, after the Salk vaccine became available, the number of polio cases decreased 85 percent to 90 percent. Before Salk, scientists thought only a live virus vaccine would be effective against a virus, but Salk proved that a killed virus vaccine could be equally effective. (Salk)

The advantage of Salk's vaccine was its safety. Because it could not cause polio, people with compromised immune systems could be vaccinated. The disadvantage was the possibility of shortened immunity because the body recognized the formalin killed virus differently from the live virus. (NMAH)

"No vaccine should be made with this dangerous virus in it," (Offit 34) said Albert Bruce Sabin, regarding type one poliovirus, before creating his own vaccine which contained the type one virus. Sabin criticized Salk's vaccine and complained that an inactive vaccine was not strong enough to provide long term immunity, that his vaccine didn't stop the spread of polio, and that the antibodies produced only protected the nervous system. So in 1957, Dr. Albert Sabin created a new oral polio vaccine or OPV. He believed the weakened virus would replicate in the

intestines, and cause the body to produce antibodies, but was not capable of invading the central nervous system. (A Brief History of Polio)

The clinical trials for Sabin's vaccine occurred overseas in the Netherlands, Sweden, Soviet Union, Mexico, Chile, and Japan. According to an interview with Dr. Joseph Melnick, Dr. Sabin's assistant, the clinical trials were conducted in the Soviet Union because Sabin's vaccine could be given by mouth, and the Soviet Union did not have enough syringes for the Salk vaccine. Within the first five months of Sabin's 1959 trials, 10 million kids in the Soviet Union had been vaccinated with OPV. (Seavey 229)

Sabin's oral polio vaccine became available in the United States in 1963. The advantages of OPV were that it provided long lasting immunity, that it prevented re-infection of polio in the digestive tract, and that it was cheaper and easier because it did not require sterile syringes or needles. If the weakened virus spread to non-vaccinated people, their body would make antibodies and become immune. The disadvantages of OPV were that it could not vaccinate people who had a compromised immune system or worked with someone who had a compromised immune system because they could contract polio. The weakened virus in the vaccine could mutate into a dangerous form. People with underlying stomach viruses could not receive the vaccine because the existing virus could prevent the production of antibodies. (Development) From 1963 to 1999, Sabin's "live virus" vaccine replaced Salk's "killed virus" vaccine. In 1999, because OPV caused some polio cases, Salk's vaccine replaced Sabin's in the United States. (NMAH)

Neither Sabin nor Salk patented their vaccines. They both donated their vaccines as a gift to humanity. When Salk was asked who owned the patent on his vaccine, he answered that the

vaccine belonged to the people, and then he added, “There is no patent. Could you patent the sun?” (Durrett 33-34)

The success of the polio vaccine was immense, but it was also at the expense of innocent people’s lives. The problem with complete inactivation of the poliovirus in the vaccine was constantly lurking and became a reality one month after the release of Salk’s vaccine. The nub of the issue was that a batch of IPV from Cutter Laboratories in Berkley California contained live poliovirus. The bad batch induced 260 cases of polio in 25 states and 11 deaths. In Idaho, 25 children caught polio and passed it onto 61 others. Seventy of the 86 affected children were paralyzed. (Bedoyere 33) The Cutter incident was not the only distribution of infected vaccines; Wyeth Laboratories’ vaccines also caused polio. Wyeth Laboratories caused eleven cases of paralytic polio when only two were expected. Cutter Laboratories was accused of the polio outbreaks because Wyeth had buried their mishap from the government, the media, and healthcare workers. Cutter took most of the blame and financial consequences and battled many law suits. (Offit 102)

Sabin’s vaccine also had its negative effects. In 1964, 57 cases of paralytic polio were caused by OPV in the United States. One of every 3.5 million people contracted polio from Sabin’s oral vaccine. Sabin continuously denied that his vaccine ever caused polio, but the Soviet Union later confessed that their perfect OPV safety score was a lie. There had been cases of polio induced by Sabin’s vaccine, but Sabin discouraged them from reporting the actual results. (Allen 209)

“The Cutter incident majorly impacted health organizations causing the first coordinated national response to a public health emergency in the history of the United States.” The CDC has

now repeated the process with SARS, smallpox, AIDS, and influenza, including the recent H1N1 outbreak. In 1972, vaccine regulatory powers transferred from the National Institute of Health to the Food and Drug Administration. (Offit 178-179)

About 20 million people, who contracted polio at its peak, survive today. Many of them still suffer from the affects of "post-polio syndrome", which occurs when certain muscles are overworked. Survivors have fewer healthy nerves and muscles, and aging weakens the remaining healthy muscles. Some symptoms of post-polio syndrome are muscle weakness, problems breathing or swallowing, muscle pain, and unusual tiredness. (Sherrow37) My grandmother, Joan Galich, was stricken with a mild case of polio at age eight. She is now an active 74 year old woman, but she still deals with the effects of post-polio syndrome. She walks with a limp, has poor balance, and her right leg is smaller, shorter, and weaker. Her limp has also worsened with age, proving that polio affects survivor's muscles throughout their life. (Galich)

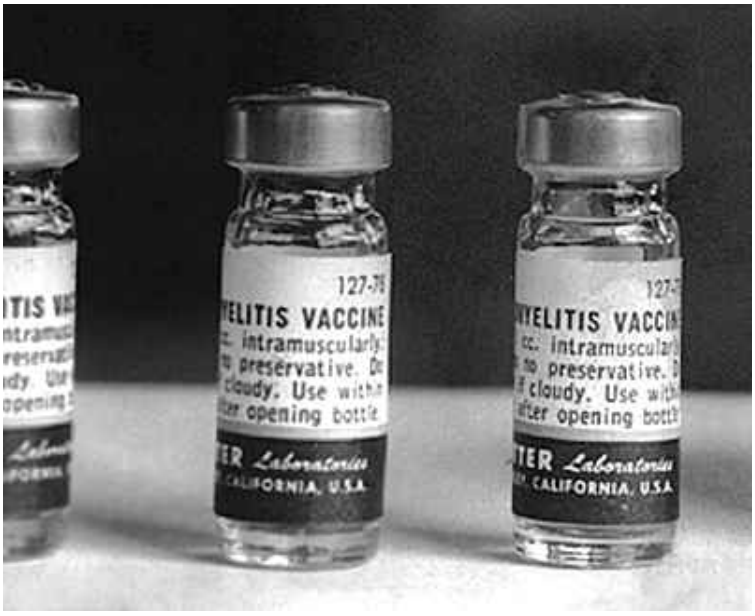
Polio cases declined dramatically through the years. In 1960, there were 2,525 cases of paralytic polio in the U.S, and in 1965, there were only 61 cases. From 1980 through 1990, there was an average of only eight cases per year, and most were caused by the vaccine. There has not been a case of wild polio virus since 1979. In 1988, The World Health Organization set a goal of worldwide polio eradication by the year 2000. In 1994, polio was declared eradicated in the Americas. (Development) Type two has not been reported worldwide since 1999. Wild polio virus type one and three still circulate in the four remaining polio endemic countries: Nigeria, India, Pakistan, and Afghanistan. (Polionews) Smallpox was the first disease to be deliberately annihilated by human beings, and polio could soon be the second. (A Brief History of Polio)

The innovative Polio Vaccine had early negative effects, but has impacted untold millions from the consequences of this deadly disease. Polio outbreaks have forever changed the world, but it is now well on its way to following in Smallpox footsteps and being permanently abolished. The polio vaccine has had an immense physical and emotional impact and change on the modern world today. The virus no longer paralyzes or kills thousands of humans. "The emotional effect was even more extraordinary, the frightening vision of crutches, wheelchairs, and iron lungs have been banished from both parents' and children's nightmares." (A Brief History of Polio) Dr. Jonas Salk, Dr. Albert Sabin, and many other credible scientists should be recognized for their incredible, lifesaving discovery. As we now encounter the new H1N1 outbreak, people are remembering the horrific polio epidemics of the 1900s. Although it's hard to overlook the devastation that polio caused, people need to remember that Americans united and defeated the poliovirus.

Appendix

This picture showed me that there were many elements that, when combined, made the ultimate final product, the vaccine.

This picture showed a crowded polio hospital in 1955. It showed me how vast the effects of the polio outbreaks really were.



This picture showed three vials of IPV from Cutter Laboratories. It showed me what the vaccine physically looked like when it was first distributed.

This was a picture of the stone slate that was uncovered from ancient Egyptian that is believed to depict the first recorded polio case. This picture helped me describe the slate in my paper.

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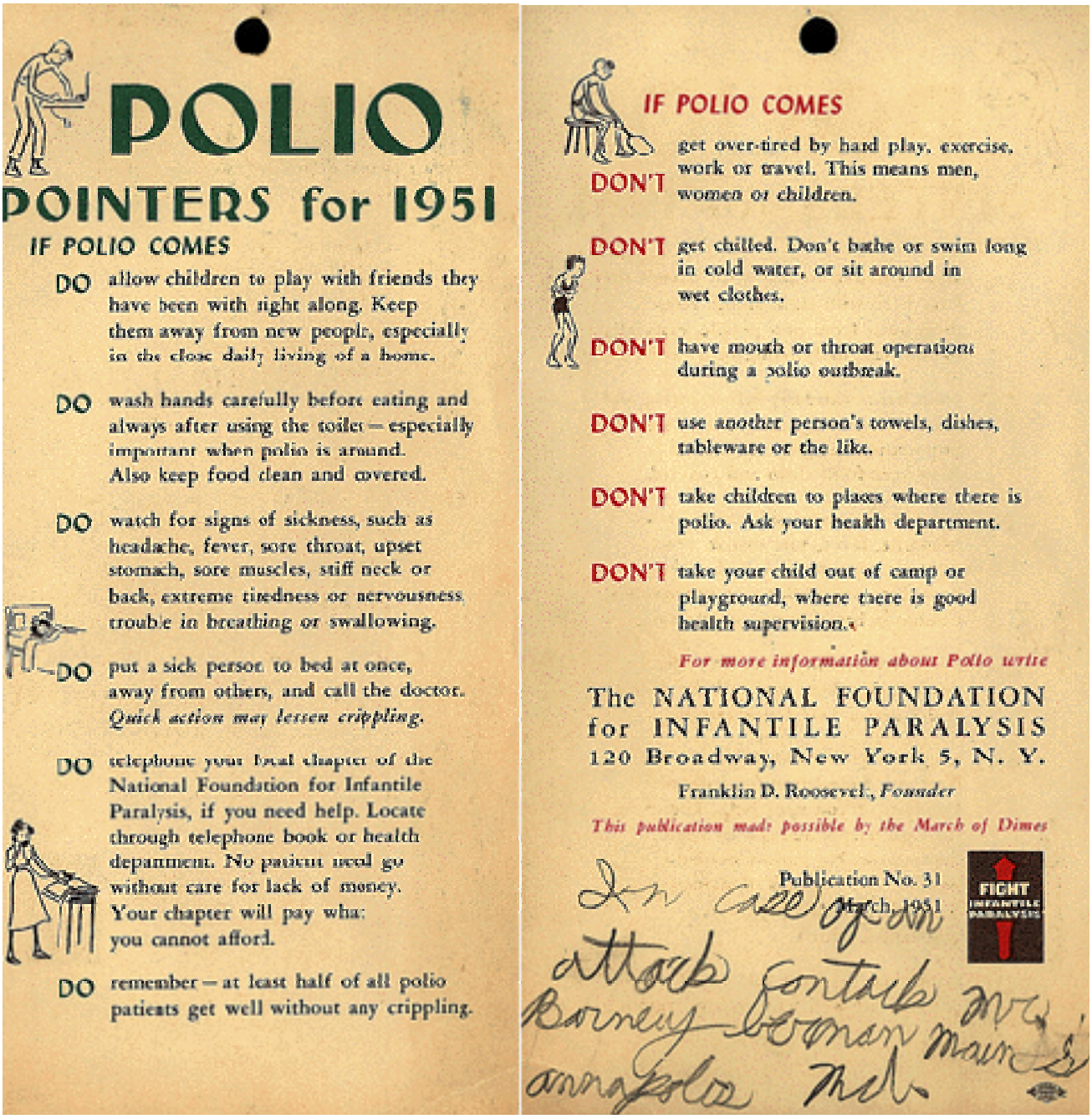

POLIO POINTERS for 1951

IF POLIO COMES

DO allow children to play with friends they have been with right along. Keep them away from new people, especially in the close daily living of a home.

DO wash hands carefully before eating and always after using the toilet — especially important when polio is around. Also keep food clean and covered.

DO watch for signs of sickness, such as headache, fever, sore throat, upset stomach, sore muscles, stiff neck or back, extreme tiredness or nervousness, trouble in breathing or swallowing.

DO put a sick person to bed at once, away from others, and call the doctor. *Quick action may lessen crippling.*

DO telephone your local chapter of the National Foundation for Infantile Paralysis, if you need help. Locate through telephone book or health department. No patient need go without care for lack of money. Your chapter will pay what you cannot afford.

DO remember — at least half of all polio patients get well without any crippling.

IF POLIO COMES

DON'T get over-tired by hard play, exercise, work or travel. This means men, women or children.

DON'T get chilled. Don't bathe or swim long in cold water, or sit around in wet clothes.

DON'T have mouth or throat operations during a polio outbreak.

DON'T use another person's towels, dishes, tableware or the like.

DON'T take children to places where there is polio. Ask your health department.

DON'T take your child out of camp or playground, where there is good health supervision.

For more information about Polio write

The NATIONAL FOUNDATION for INFANTILE PARALYSIS
120 Broadway, New York 5, N. Y.

Franklin D. Roosevelt, *Founder*

This publication made possible by the March of Dimes

Publication No. 31
March, 1951

FIGHT INFANTILE PARALYSIS

In case of attack contact Barney Baruch Manor Annapolis Md.

This pamphlet gave me clear information on people's state of mind when the polio outbreaks were at their peaks. It showed me what people did and didn't do as a result of a disease that most Americans today don't think about.

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Bettmann. CORBIS. Jonas Salk: Conquering Polio. By Stephanie Sammartino McPherson. Minneapolis, Minnesota: Learner Publications Company, 2002. Page 44. This picture showed Salk and his team hard at work on the polio vaccine. This picture showed me that there were many elements that, when combined, made the ultimate final product, the vaccine. It showed me that Salk did not work alone when developing his vaccine.

Bettmann. CORBIS. The First Polio Vaccine: Milestones in Modern Science. By Guy d la Bedoyere. Chicago: World Almanac Library, 2005. Page 32. This picture showed a crowded polio hospital in 1955. The hospital was crammed with iron lungs and polio patients. It showed me how vast the effects of the polio outbreaks really were.

Bettmann. CORBIS. The First Polio Vaccine: Milestones in Modern Science. By Guy d la Bedoyere. Chicago: World Almanac Library, 2005. Page 33. This picture showed three vials of IPV from Cutter Laboratories. It showed me what the vaccine physically looked like when it was first distributed.

Galich, Joan C. Personal interview. 15 Nov. 2009. This was a very fun interview to do with my grandma! It gave me insight into her life a child, and, helped me to understand first- hand the effects of polio on a person. This especially provided a regular person's perspective of polio, instead of a medical perspective.

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forms including charts on the morbidity of polio, the vaccination distribution, and the decline of cases and deaths following the vaccine, government documents and speeches, and official reports on the Salk vaccine. It gave me excellent visuals that helped me understand the tremendous impact of Polio and the vaccine.

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McLaughlin, Ann L. "One Couple's Journey from Paralysis to Post-Polio." Polio. Rochester, New York: University of Rochester Press, 1997. 47-66. This essay was very helpful in understanding the physical therapy portion of polio treatments. It gave me actual examples of treatments used to recover from polio in the 1900s. It gave me an average person's view of life with polio.

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Polio Pointers for 1951. Broadway, New York, New York: National Foundation for Infantile Paralysis, 1951. This pamphlet gave me clear information on people's state of mind when the polio outbreaks were at their peaks. It showed me what people did and didn't do as a result of a disease that most Americans today don't think about.

Pugleasa, Charlene. "The Polio Patient." Interview. Print. This interview helped me fully understand a patient's life while fighting polio, from symptoms and complications to

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Salk, Jonas. "A Future Closer to Our Hearts' Desire." Polio Exhibit: 40th Anniversary. Rackham Auditorium, University of Michigan, Ann Arbor, Michigan. The Center for the History of Medicine. University of Michigan. 10 May 2010 <http://www.med.umich.edu/medschool/chm/polio/Salk.pdf>.

This website and speech was very insightful for me. The speech gave me information on Salk's thoughts, hopes and ambitions about polio and the vaccine forty years after the successful completion of his killed polio vaccine. By reading this speech that remembers the past I was able to more clearly see how greatly it impacted today and will change the future.

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Bedoyere, Guy De LA. The First Polio Vaccine: Milestones in Modern Science. Chicago: World Almanac Library, 2005. This book gave me the most information for my report. In one, small book, I learned an immense amount about the poliovirus, both vaccines, and polio in the modern world. It was a great informational book in a form that I could easily comprehend.

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and happenings over a large range of time. It helped me recognize major dates that I had not yet included in my paper.

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