The **‘Best’** Medical Advancement of the Era:
Frederick Banting and Charles Best Chart a New Frontier by Discovering Insulin

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Senior Division
Group Exhibit

Student-composed Words: 500
Process Paper: 500

Before the miracle of insulin, diabetes was a sentence to starvation diets, limited abilities, and death. With no proper treatment, it was considered hopeless to those diagnosed. It was a frontier deemed unchartable until a shocking discovery on a summer day in July. In 1921, Frederick Banting and Charles Best successfully kept a dog exhibiting symptoms of diabetes alive using an extract from cattle, sparking the development of insulin, an international treatment to save the lives of diabetics.

When we heard this year's National History Day theme, "Frontiers in History," we were at a loss for ideas. With endless fascinating topics, we hoped to do something in the medical field. After a wealth of research, our group came across the discovery of insulin. We read widely on the topic and ultimately came to a decision. We chose to create an exhibit detailing the captivating story of the development of insulin and research the scientists who conquered an unbelievable frontier. All of our group members have close connections to someone diagnosed with diabetes, and we hoped to gain more perspective into their life.

Our research began through a number of primary resources including newspapers, letters, and other valuable artifacts. The University of Toronto was our most valued source containing an insulin library with a plethora of information. We gained much insight from a notebook written by Frederick Banting detailing his scientific process. As a group, we found a balanced number of primary and secondary resources, both contributing greatly to our project.

After months of researching, writing, and perfecting our understanding of the topic, it was time to construct an exhibit. Using a wooden display and covering it with a cream fabric, we had our backdrop. Our vision was to recreate the laboratory that Banting and Best experimented in by building shelves including medicine bottles and scientific equipment. With endless ideas, we knew it would be challenging to execute them. Before we could build our exhibit, we had to

cut out information, photos, quotes, and our timeline. This process was long and tedious, but we remained meticulous and eventually could begin our favorite part. The creation of our project required a lot of thought and an incredible amount of trial and error. Trying to attach the shelves to the board tested our patience and problem-solving abilities. Eventually reaching success, we spent much time discussing the lay-out and rearranging items. Though the process was challenging, our skills learned from History Day can be applied to virtually anything.

A frontier represents an area that has yet to be explored. This could be a geographical location, a barrier of some sort, or a field of research that has yet to be mastered. Prior to 1921, people diagnosed with diabetes withered away, malnourished and starved. Frederick Banting, Charles Best, James Collip, and John Macleod did the unthinkable and developed a pharmaceutical drug called insulin. It took a small group of people with brilliant minds to develop a forever evolving product that has changed the world.

ANNOTATED BIBLIOGRAPHY

PRIMARY SOURCES

BOOKS

Herbert, Charles Best. *Frederick Grant Banting*. Royal Society, 1942. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AT10191. Accessed 17 Mar. 2023.

In 1942, Charles Best wrote a memoir about his partner, Frederick Banting. The writing included his time spent in the war, his career, his success, and other information about the scientist. This primary resource provided knowledge from the perspective of Best, and we learned a lot from it.

NEWSPAPERS

"Dr. J.B. Collip Tells Story of Discovery of Diabetes Cure." *Calgary Daily Herald*, 30 May 1923. Insulin Library, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10011. Accessed 20 Jan. 2023.

Telling of a speech given by Dr. J. B. Collip, this newspaper clipping gives an interesting perspective on the discovery of insulin. Dr. Collip informs the Canadian Club Luncheon of all the research behind the development. Primary resources like this give us helpful insight on our topic.

Edmonton Journal (Firm). "Co-Discoverer of Insulin, Dr. J.B Collip, Honored by Citizens of Alberta." *Edmonton Journal* , 25 May 1923. Insulin Library, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10010 . Accessed 19 Jan. 2023.

This newspaper article speaks of a banquet hosted by the University of Alberta to honor Dr. J. B. Collip and his contributions to the invention of insulin. Dr. Collip was a faculty member at the University and was shown great respect at this event. The article shows how truly great of an achievement the creation of insulin is.

"Insulin and Yeast." *England Times*, Apr. 1923. Insulin Library, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10170. Accessed 19 Jan. 2023.

The University of Toronto provided us with hundreds of valuable primary resources. This newspaper told the public that an insulin-like substance could be extracted from yeast, which was a very significant discovery. These sources are still relevant today and are essential to understanding our topic.

“Insulin: a Patient's Point of View.” *Times*, 7 Aug. 1923. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10172 . Accessed 20 Jan. 2023.

No one can truly fathom the importance of insulin without understanding the experiences of a diabetic. This newspaper article is from the perspective of a patient whose life was saved through insulin. The patient shared his initial skepticism of the drug and explained how insulin improved his livelihood immensely.

“New Canadian Medical Discovery.” *Eastern Daily Press*, 9 May 1923. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10174. Accessed 20 Jan. 2023.

This article by the Eastern Daily Press gave us insight on people’s experiences and opinions of insulin. It shared the vast success of the drug and expansion to foreign countries including the United States. While in the final stages of diabetes, insulin revived many patients.

Saleeby, C.W. “The Triumph of Insulin.” *The Daily Chronicle* , 17 May 1923. Insulin Library, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10173. Accessed 19 Jan. 2023.

“The Triumph of Insulin” was a newspaper clipping written in 1923. The article referred to insulin as a “precious product” and explained how crucial it was to preserve it. The tremendous impact of insulin is indisputable and proven by primary resources like this one.

“The Cure of Diabetes.” *Westminster Gazette*, 20 Apr. 1923. Insulin Library, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10169. Accessed 19 Jan. 2023.

This is a newspaper clipping from 1923 informing the people of Westminster of a life-altering medical advancement. Finally available to all serious cases, insulin was a miracle to diabetics. This primary resource gave us insight and perspective in regards to our topic.

“Treatment of Diabetes.” *England Times*, 1 Dec. 1922. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AC10175 . Accessed 20 Jan. 2023.

In this newspaper article, Sir Charles Sherrington updated the people about new advancements in the treatment for diabetes that were being made at Toronto University. He said that they had created a new substance that acts just as insulin does in someone’s body. This primary source gave us great insight on how the public felt as they anxiously awaited a better treatment for diabetes.

JOURNALS

Banting, Frederick Grant. “The Discovery and Early Development of Insulin.” *Laboratory Notebook 3*, 12 Sept. 1921. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AN10007. Accessed 17 Mar. 2023.

> This laboratory notebook was an intriguing primary resource provided by the University of Toronto. It was written by Frederick Banting and contains results from his experiments with dogs. This journal is a precious artifact that shows the amount of hard work and persistence put into charting this frontier.

Banting, Frederick. “Note from Frederick Banting's Loose Leaf Notebook .” *Diabetus*, 31 Oct. 1920. *Insulin Library* , https://doi.org/N10002_0001. Accessed 16 Mar. 2023.

> This primary resource is a notebook entry from Frederick Banting. In his writing, he mentioned ligating the pancreatic ducts in dogs, which is exactly what he accomplished and what led to the discovery of insulin. It is fascinating to see the process of this incredible advancement on paper and in the writing of Banting.

University of Toronto Insulin Committee. “The Discovery and Early Development of Insulin.” *Insulin Committee Account Book*, 1923, pp. 1–152. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AN10022. Accessed 17 Mar. 2023.

> The University of Toronto contains thousands of primary resources that pertain to our topic, including an Insulin committee account book. 152 pages of receipts and payments, this book shows the efforts to mass-produce insulin. The last pages are journal entries from several members of this committee.

PHOTOS / DIGITAL IMAGES

“Banting and Best Laboratory.” *The Discovery of Insulin*, Toronto, 17 Dec. 2021, https://www.thecanadianencyclopedia.ca/en/article/the-discovery-of-insulin#.

> This is an image of the laboratory Banting and Best conducted their experiments in. We used this picture as a model for our exhibit, and we attempted to recreate the scene. It’s interesting to see the workplace where these brilliant minds developed a miraculous invention.

“Banting and Best with the First Dog Ever Treated with Insulin.” *UMass Chan Medical School*, Toronto, 27 July 1921,

https://www.umassmed.edu/dcoe/diabetes-education/patient-resources/banting-and-best-discover-insulin/. Accessed 16 Mar. 2023.

This picture is a visual representation of the breakthrough on July 27, 1921. The photo shows Banting and Best standing by the dog they kept alive using an insulin extract from cattle. We thought it was important to include this monumental moment in our exhibit.

"Banting and Marjorie." *Diabetes Breakthrough: the Discovery of Insulin*, Toronto, https://canadiangeographic.ca/articles/diabetes-breakthrough-the-discovery-of-insulin/. Accessed 16 Mar. 2023.

This is an image of Frederick Banting and the experimental dog Marjorie. Within our exhibit, we tell the story of the trial and error that occurred prior to the success of insulin. We mention that the scientists were able to keep the dog, Marjorie, alive using an extract from cattle, which began the treatment.

"B-D Insulin Syringe: First Self-Administered Insulin Syringe." Smithsonian, 16 Feb. 1932, https://www.si.edu/object/b-d-insulin-syringe-dr-bushers-automatic-injector%3Anmah_730844. Accessed 11 Apr. 2023.

This is an image demonstrating the first advancement of insulin. We chose to include this photograph in our exhibit because it highlights how much insulin has evolved over time. The pharmaceutical drug has become widely accessible to a large number of people and has improved continuously.

"Canadian Scientists Frederick Banting (Right) and Charles Best circa 1924, Three Years after They Successfully Isolated Insulin for the First Time." Penn Today, Toronto, 26 July 2021, https://penntoday.upenn.edu/news/100-years-insulin.

A portrait of Frederick Banting and Charles Best, this image shows the two minds responsible for the development of insulin. These two men, with the help of others, made an astounding discovery that has saved countless lives. Since they are the focus of our exhibit, we knew it was essential to picture them.

"Cases before and after Insulin." *Cases Before and After Insulin Treatment*, https://wellcomecollection.org/works/nunm8cg3?query=CUNYNGHAM%2C%20WILLIAM%2C%201531-AFTER. Accessed 2023.

This picture demonstrates the dangers of diabetes along with the benefits of insulin. A before and after photo is the perfect way to display the immediate effects of this drug. We chose to incorporate this image into our exhibit to show our viewers how diabetics lived prior to insulin and how their life has changed greatly.

"Early Eli Lilly and Company Advertisement Featuring Some of Its First Products." *Encyclopedia of Indianapolis*, Indianapolis, https://indyencyclopedia.org/eli-lilly-and-company/. Accessed 18 Mar. 2023.

This is an advertisement promoting Eli Lilly and Company to the general public. Eli Lilly and Company commercialized insulin for the first time, so we included the picture to show the other important roles this company played in health care.

"Formal Photograph of Leonard Thompson." *Insulin Library*, Toronto, 1930, https://insulin.library.utoronto.ca/islandora/object/insulin%3AP10046. Accessed 16 Mar. 2023.

Leonard Thompson was the first patient to receive the insulin injection, so we found it necessary to include him in our project. This image is a portrait of the teenager who made history.

"Girl Injecting Herself with Insulin (Lilly Girl)." *New York Historical Society*, New York , 1930, https://www.nyhistory.org/exhibitions/breakthrough-insulin-traveling. Accessed 16 Mar. 2023.

Dated from 1930, this image shows a young girl injecting herself with insulin. Eli Lilly and Company commercialized the drug, so it could be available to all people including children like this one. We displayed this picture on our exhibit to demonstrate the variety of people insulin has impacted.

"Grinding Pancreases for Insulin at Eli Lilly and Company." *Insulin and Diabetes Management*, 1930, https://www.si.edu/spotlight/insulin-and-diabetes-management/insulin. Accessed 18 Mar. 2023.

A photograph from the 1930's, this image shows a worker at Eli Lilly and Company grinding pancreases to produce insulin. The mass production of insulin was a landmark event that led to the relief of millions of diabetics.

"Old Insulin Bottle." *UMass Diabetes Center of Excellence*, Toronto, https://www.umassmed.edu/dcoe/diabetes-education/patient-resources/first-insulin-injection/. Accessed 17 Mar. 2023.

This is an image of an insulin bottle when the drug was administered for the first time. We chose to include this image in our exhibit for several reasons but mostly because we have medicine bottles displayed.

"Top Row: Dr. Frederick Banting, Dr. John Macleod. Bottom Row: Dr. James Collip, Dr. Charles Best." *Canada Accelerates Diabetes Research*, Toronto, 17 Nov. 2021, https://cihr-irsc.gc.ca/e/52706.html. Accessed 18 Mar. 2023.

This image is a portrait of all of the brilliant scientists behind the development of insulin. We included this photograph on our display to give credit to the dedicated researchers who made this advancement possible.

"Toronto Doctors On Track Of Diabetes Cure Newspaper." *Banting & Best: Discovery of Insulin*, Toronto, 22 Mar. 1922, https://www.umassmed.edu/dcoe/diabetes-education/patient-resources/banting-and-best-discover-insulin/. Accessed 16 Mar. 2023.

This newspaper clipping informed the Toronto community about the scientists working to develop insulin. The article referred to insulin as a 'message of hope' for diabetics. Insulin could not have fulfilled their desires better, and now diabetics can experience life to the fullest.

CORRESPONDENCE

Clowes, G. H. A. "Letter to Dr. J. J. R. Macleod" Received by Dr. J. J. R. Macleod, *University of Toronto,* 3 July 1923,. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AL10242. Accessed 22 Jan. 2023.

This letter to Dr. Macleod from G. H. A. Clowes provides a summary of their previous meeting. Clowes brought up the Insulin Committee's inclination to share lletin with the public and their desire to publish some of the clinical trials that have been conducted. The letter gave us an idea of how the committee went about informing the public about their advancements in treatments.

Falconer, Robert. "Letter Offering Dr. F. G. Banting an Appointment at the Diabetic Clinic in the Toronto General Hospital." Received by Dr. F. G. Banting, *University of Toronto,* 29 June 1922,. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AL10285. Accessed 20 Jan. 2023.

Addressed to Dr. Banting, this letter offered him an opportunity to expand the use of insulin. The Toronto General Hospital wanted to make insulin available to their patients,

which would impact the lives of many. This is just another example of the demand and importance of this drug.

Falconer, Robert. “Letter to Mr. C. H. Best.” Received by Mr. C. H. Best, *University of Toronto*, 5 Nov. 1923,. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AL10286. Accessed 22 Jan. 2023.

This letter to Charles Best was written after the meeting of the Board of Governors where they discussed the Banting-Best Bill. It discussed the funding of the medical research that Best needed to proceed with in order to further develop their pancreatic treatment. The letter gave us some insight into the support Best and Banting were receiving from the government to continue with their work.

Hughes, Elizabeth Evans. “Letter to Mother” Received by Mrs. Charles E. Hughes, *University of Toronto,* 22 Aug. 1922,. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AL10006. Accessed 22 Jan. 2023.

This letter is from Elizabeth Hughes, an early recipient of insulin. She is writing to her mother, speaking of her interactions with Dr. Banting, who is excited about a new development. This primary resource shows first hand the impact of our topic and the vast amount of people insulin helped and continues to help to this date.

Smith, M. A. B. “Letter forwarded to the Insulin Committee from Dr. A. McPhedron” Received by Dr. A. McPhedron, *University of Toronto,* 29 Nov. 1922,. *Insulin Library*, https://insulin.library.utoronto.ca/islandora/object/insulin%3AL10222. Accessed 22 Jan. 2023.

This letter, dated November of 1922, is from a man who was in search of Dr. Banting’s Pancreatic Extract. The man said had tried contacting Dr. Banting as well as a few other doctors, but he had been told the wait time would be about six months. This letter gave us some insight about what people were going through during their wait for the treatment.

INTERVIEWS

Best, Charles, et al. “Talk About Insulin.” *Wellcome Collection*, 1959, https://wellcomecollection.org/works/xg4emsnd. Accessed 20 Jan. 2023.

Dr. Liston interviewed Charles Best and a diabetic patient who had undergone insulin treatment. Hearing both perspectives provided us with a better understanding of our topic. Primary resources are essential to comprehending the true impact of the incredible pioneers behind insulin.

SECONDARY SOURCES

WEBSITES

About the authors Susannah ChenPrior to joining The diaTribe Foundation in 2023, et al. “Once-Weekly Insulins Could Soon Be the Key to the Future of Insulin Treatment.” *DiaTribe*, 13 Mar. 2023, https://diatribe.org/once-weekly-insulins-could-soon-be-key-future-%C2%A0insulin-treatment.

A weekly insulin dose is in progress as of February, 2023. Developments to this drug will continue, and the average life of a diabetic will keep on improving. Though insulin was discovered in the 1920s, there are more frontiers to conquer.

Alltucker, Ken. “More than 1.3m Americans Ration Life-Saving Insulin Due to Cost. That's 'Very Worrisome' to Doctors.” *USA Today*, Gannett Satellite Information Network, 17 Oct. 2022, https://www.usatoday.com/story/news/health/2022/10/17/high-cost-insulin-prompts-1-3-million-americans-ration-drug/10498626002/.

This is a recent article from USA Today speaking of the outrageous prices of insulin. The source revealed that more than 1.3 million Americans skipped their required doses of insulin due to the cost. Insulin is a precious product that has saved countless lives, and the creators always had the intention of keeping it affordable.

Assistant Secretary for Public Affairs (ASPA). “New HHS Report Finds Major Savings for Americans Who Use Insulin Thanks to President Biden's Inflation Reduction Act.” *HHS.gov*, 24 Jan. 2023, https://www.hhs.gov/about/news/2023/01/24/new-hhs-report-finds-major-savings-americans-who-use-insulin-thanks-president-bidens-inflation-reduction-act.html.

The Inflation Reduction Act has successfully made insulin more affordable to diabetics. This website informed readers how much money will be saved due to this act. Published in 2023, this resource gave us the current stance on insulin prices in America.

Commissioner, Office of the. “100 Year Anniversary of Insulin.” *U.S. Food and Drug Administration*, FDA, 8 June 2022, https://www.fda.gov/about-fda/fda-history-exhibits/100-years-insulin.

The FDA wrote an article in honor of 100 years of insulin, a pharmaceutical drug that has saved countless lives. It spoke of the prior treatment to diabetes, which included low-carbohydrate and high-fat diets often leading to malnutrition and starvation. The website focused on recent insulin developments and shared how this medical discovery has impacted the lives of many.

"Definition: Insulin (for Parents) - Nemours Kidshealth." *KidsHealth*, The Nemours Foundation, 1995, https://kidshealth.org/en/parents/insulin.html#:~:text=Insulin%20is%20a%20hormone%20that,or%20stored%20for%20future%20use.

This article helped us understand the complex science behind insulin and explained the cause of diabetes. We learned that the human body produces insulin in the pancreas in attempts to lower blood sugar. The source gave us a strong foundation for the continuation of our research.

"Drugmaker Eli Lilly Caps the Cost of Insulin at $35 a Month, Bringing Relief for Millions." *NBCNews.com*, NBCUniversal News Group, 1 Mar. 2023, https://www.nbcnews.com/health/health-news/eli-lilly-caps-cost-insulin-35-month-rcna72713.

The price of insulin has been a problem for millions of Americans, but recently the distribution company cut the cost to thirty-five dollars a month. This source by NBC News again demonstrates the demand for insulin. It is fascinating that an invention from the 1920s is still relevant today and many people rely on this product for survival.

"Fact Sheet: President Biden's Cap on the Cost of Insulin Could Benefit Millions of Americans in All 50 States." *The White House*, The United States Government, 2 Mar. 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/03/02/fact-sheet-president-bidens-cap-on-the-cost-of-insulin-could-benefit-millions-of-americans-in-all-50-states/.

This is a recent publication from the White House explaining President Biden's cap on the cost of insulin. It also contained a graph showing the percentage of American adults diagnosed with diabetes. In Iowa, 8.8% of adults are diabetic which amounts to over 217,000 people.

Groot, Kristen de. "100 Years of Insulin." *Penn Today*, 2022, https://penntoday.upenn.edu/news/100-years-insulin.

An all-telling history of insulin, this article shares about the scientists involved and the entire timeline of its development. Beginning with the isolation of the insulin hormone, and ending with its lasting impact, there is no question about the importance of this drug. Penn Today's website included viable information that we will use throughout our entire project.

Hirsch, JH James S. “Insulin at 100: An Inspirational but Complicated History.” *DiaTribe*, 15 Feb. 2022, https://diatribe.org/insulin-100-inspirational-complicated-history.

Described as “complicated,” the creation of insulin was not an easy endeavor. This article clears up several common misconceptions about insulin, and explains the challenging history. This source details the major breakthrough in Toronto, Canada in 1921.

Hubacz, Lisa. “Diabetes Success Stories: UMass Diabetes Center of Excellence.” *UMass Chan Medical School*, 4 Mar. 2022, https://www.umassmed.edu/dcoe/diabetes-care/success-stories/.

This website gave us a tremendous list of people who have benefited from insulin. It allowed us to gain a greater understanding of how insulin has assisted many. It is truly amazing to read the countless stories of diabetics and see the extreme help insulin provided them.

IU School of Medicine. “100 Years after the Discovery of Insulin, Scientists Reflect on the History, Trajectory of Diabetes Research.” *Indiana University School of Medicine*, 28 July 2021, https://medicine.iu.edu/news/2021/07/100-years-of-insulin

Telling of the past of diabetes and the development of treatments coming ahead, this article was a tribute to the hundred year anniversary of insulin. We were interested to learn that there is currently a preventative vaccine for Type 1 Diabetes under the works. This is just another example of the major impact of insulin and how it continues to inspire change and improve diabetic’s lives.

Jauerman, John. “Animal Research.” *Animal Research*, https://www.harvardmagazine.com/sites/default/files/html/1999/01/mice.html .

The Harvard Magazine wrote an article and informed readers about the animals used to test insulin. Experimenting on dogs, the researchers ligated the pancreatic duct in attempts to produce symptoms of diabetes. Though controversial today, the discovery of insulin would be impossible without these trials.

Kesavadev, Jothydev, et al. “Evolution of Insulin Delivery Devices: From Syringes, Pens, and Pumps to DIY Artificial Pancreas.” Diabetes Therapy : Research, Treatment and Education of Diabetes and Related Disorders, U.S. National Library of Medicine, June 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7261311/.

This article by the National Library of Medicine informed readers about the evolution of insulin devices. In chronological order, the website starts off with the use of syringes and explains how devices work all the way up to the invention of the insulin inhaler.

Kim, Jae Hyun, et al. "History of Insulin Treatment of Pediatric Patients with Diabetes in Korea." *Annals of Pediatric Endocrinology & Metabolism*, Korean Society of Pediatric Endocrinology, 31 Dec. 2021, https://e-apem.org/journal/view.php?number=908.

The first documentation of diabetes was in Egypt in 1500 B.C, but until the 1920s, there was no proper treatment. This article went into detail about early cases of diabetes and focused on foreign countries such as Korea. All due to the work of persistent scientists, insulin has been available for 100 years.

Lewis, Gary F., and Patricia L. Brubaker. "The Discovery of Insulin Revisited: Lessons for the Modern Era." *The Journal of Clinical Investigation*, American Society for Clinical Investigation, 12 Jan. 2021, https://www.jci.org/articles/view/142239.

Covering all historical aspects of insulin, this article spoke of the first successful administration of insulin, the scientists involved, and discoveries made prior to 1922 that influenced the discovery. It contained several pictures which we will likely use in the construction of our exhibit. Resources like this one have greatly impacted our understanding of the topic and will contribute to the rest of our research.

Locklear, Mallory. "Insulin Is an Extreme Financial Burden for over 14% of Americans Who Use It." *YaleNews*, 5 July 2022, https://news.yale.edu/2022/07/05/insulin-extreme-financial-burden-over-14-americans-who-use-it.

The price of insulin has since risen significantly over the years becoming a financial burden for diabetics. Yale University conducted a study and learned that 14% of Americans struggle affording insulin. This website is a relevant and recent resource that helped us understand the current issues regarding insulin.

"New Islet Transplant Method Leads to Insulin Independence." *Penn Medicine*, 17 Oct. 2022, https://www.pennmedicine.org/news/news-releases/2022/october/new-islet-transplant-method-leads-to-insulin-independence.

This is a news article from 2022 explaining a recent insulin development. A new method allows diabetics to stop taking insulin for several years at a time. As we mentioned in our

storyline, insulin is an ever changing product and there's no telling what will come in the future.

Quianzon, Celeste C, and Issam Cheikh. "History of Insulin." *Journal of Community Hospital Internal Medicine Perspectives*, U.S. National Library of Medicine, 16 July 2012, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3714061/.

Summarizing the history of insulin, The U.S. National Library of Medicine goes back to when diabetes was first discovered and ends the article with modern advancements of insulin. So much progress has been made on the treatment of diabetes and this article mentions specific dates, which will be used in our timeline. It is helpful to understand the timing of events to fully grasp the effect of insulin.

"The Nobel Prize in Physiology or Medicine 1923." *Nobel Prize*, https://www.nobelprize.org/prizes/medicine/1923/banting/lecture/.

This website provided the transcript of the Nobel Lecture given by Fredrick Banting. After receiving the Nobel Prize in Medicine in 1923, he gave this speech in 1925. We used this source to our benefit pulling out multiple quotes from the creator himself and found his words to be incredibly perceptive.

UMass Diabetes Center of Excellence. "Leonard Thompson Received First Insulin Injection to Treat Diabetes." *UMass Chan Medical School*, 11 Feb. 2022, https://www.umassmed.edu/dcoe/diabetes-education/patient-resources/first-insulin-injection/.

Fourteen-year-old Leonard Thompson was the first recipient of the insulin injection. Suffering from Type-1 Diabetes, Thompson would have felt doomed to death, for there was no cure for this destructive disease. However, due to the work of Charles Best and Frederick Banting, the young boy was able to live another thirteen years.

Utiger, Robert. "Insulin." *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., 2022, https://www.britannica.com/science/history-of-medicine/Insulin.

The history of insulin goes far beyond the 1921 discovery in Toronto, Canada. This article, written by Britanica, details the complicated and prolonged research that led to an essential medical advancement. We will use information from this website in our storyline, specifically the background.

Vecchio, Ignazio, et al. “The Discovery of Insulin: An Important Milestone in the History of Medicine.” *Frontiers*, Frontiers, 26 Sept. 2018, https://www.frontiersin.org/articles/10.3389/fendo.2018.00613/full .

This article focused on the untold history of insulin. It informed readers about several people responsible for the development of insulin and shared their contributions. Diabetes has affected people’s lives forever, and a treatment like insulin was revolutionary.

31, Last reviewed: August, and Last edited: August 31. “The History of a Wonderful Thing We Call Insulin.” *The History of a Wonderful Thing We Call Insulin | ADA*, 1 July 2019, https://diabetes.org/blog/history-wonderful-thing-we-call-insulin.

This article shares a brief history of insulin and details its many impacts. The American Diabetes Association contained information about the frontiers who developed this miraculous advancement. Beginning with the quality of life without insulin and ending with the tremendous effect, this website gave us a basic understanding on the topic.

PHOTOS/DIGITAL IMAGES

“A Variety of Insulin Pens, 1985-93.” Science Museum Group, Denmark, 1993, https://collection.sciencemuseumgroup.org.uk/objects/co143568/first-version-novopen-ii-insulin-delivery-device-in-carrying-case-with-dial-a-dose-facility-case-container-injection-pen-insulin-delivery-device. Accessed 11 Apr. 2023.

The insulin pen was created in 1985 and was the first convenient treatment for diabetes. This image is included in our display because it demonstrates a massive change in the average diabetic's life. People with diabetes were now able to take their insulin anywhere.

“First Artificial Pancreas.” *Path to Cures: An Interactive Timeline*, 1971, https://www.jdrf.org/path-to-cures/. Accessed 11 Apr. 2023.

As we have come to discover, insulin has changed a lot over the years. This image is just one example of a development that kept on improving. The artificial pancreas has made insulin available at all times for diabetics.

“GlucoMeter.” *Ohio State University* , 27 June 2022, https://health.osu.edu/discovery-and-innovation/treatment-advances/advancements-have-made-insulin-safer. Accessed 11 Apr. 2023.

This is a picture of a young girl monitoring her blood-sugar levels on her phone. This alone charts its own frontier by allowing people of all ages to quickly and easily check on themselves. This is a massive improvement and has no doubt increased the quality of life for diabetics.

"Insulin Inhaler." Diatribe, 2021, https://diatribe.org/switching-afrezza-inhaled-insulin-tips-diabetes-educator. Accessed 11 Apr. 2023.

The insulin inhaler is a very recent treatment created for diabetics. The device is controversial and may cause unhealthy side-effects. Nonetheless, if this piece of technology is modified and proven to be safe and effective, it could be an incredible advancement.

"Recent Artificial Pancreas." *The Juvenile Diabetes Foundation*, 22 Dec. 2017, https://jdrf.org.uk/news/people-feel-using-artificial-pancreas-psychological/. Accessed 11 Apr. 2023.

This photo shows an artificial pancreas from recent years. The technology has improved significantly since the first artificial pancreas from the 1970s. As insulin continues to improve and expand, so do the lives of diabetics.

BOOKS

Bliss, Michael. *The Discovery of Insulin*. University Of Chicago Press, 1984.

Michael Bliss wrote an extensive story about the history of insulin. We used this book to expand our knowledge and even quoted the author in our exhibit. In one sentence Bliss concisely summarized the impact of insulin stating, "With insulin, the stone was rolled away, and diabetes became a matter of the quality of life, not the speed of death."

Cooper, Thea, and Arthur Ainsberg. *Breakthrough: Elizabeth Hughes, the Discovery of Insulin, and the Making of a Medical Miracle*. St. Martin's Griffin, 2011.

Written by Thea Cooper, the book *Breakthrough* tells the story of eleven-year-old Elizabeth Hughes. The young girl was quickly deteriorating from diabetes and weighed a mere forty-five pounds. . The author told a riveting account of her experiences as one of the first insulin patients.

Hall, Kersten T. *Insulin: The Crooked Timber: A History from Thick Brown Muck to Wall Street Gold*. Oxford University Press, 2022.

A Type 1 warrior himself, the author Kersten Hall wrote a book that includes a plethora of information regarding insulin. The book began with the discovery and the efforts from Frederick Banting and Charles Best. The story covered the hidden history and controversy surrounding insulin.

Hume, Stephen Eaton. *Frederick Banting: Hero, Healer, Artist*. XYZ Publishing, 2001.

A biography written by Stephen Hume, this book details the life of Frederick Banting beyond his discovery of insulin. A scientist as well as a former war hero, Banting showed excellence in all he did. The author included a quote that we found to be incredibly truthful; "No single event in the history of medicine had changed the lives of so many people, so suddenly."

Kerbel, Deborah, and Angela Poon. *Fred & Marjorie: A Doctor, a Dog, and the Discovery of Insulin*. Owlkids Books Inc., 2021.

The children's book, *Fred and Marjorie,* tells the story of insulin in terms for anyone to understand. This resource focused on the experiments conducted and the trials with dogs. Told in a graphic novel, we learned a lot about our topic and the scientists who charted the frontier of diabetes.

Scheiner, Gary. *Think like a Pancreas: A Practical Guide to Managing Diabetes with Insulin*. Hachette Go, 2020.

Think Like a Pancreas is a guide to managing diabetes that was published in 2020. Diabetes is a serious condition and resources like this one need to be available for all patients. Overall, this book gave us more perspective into the life of a diabetic.

INTERVIEWS

Philip. "Diabetes Type 2." *Healthtalk*, 2019, https://healthtalk.org/diabetes-type-2/philip-interview-02https://healthtalk.org/diabetes-type-2/philip-interview-02. Accessed 17 Mar. 2023.

Philip was forty-six years old when he was diagnosed with type-2 diabetes, and he is now sixty-eight. In this interview, Philip shares his daily schedule with insulin and monitoring his blood-sugar levels. It's difficult to truly grasp the severity of diabetes unless you hear from someone who has the condition.

Snouffer, Elizabeth, and Doreen Rudolph. "Using My Retirement Savings to Pay for Insulin." *Diabetes Voice*, 13 Jan. 2020, https://diabetesvoice.org/en/living-with-diabetes/interview-using-my-retirement-savings-to-pay-for-insulin/. Accessed 17 Mar. 2023.

This interview is with a mother who is using her retirement savings to pay for her daughter's life saving insulin. Taking place in 2020, this interview highlights the major

expense that insulin has become. The outrageous prices of this drug has created financial burdens for a number of families, and this resource gave us perspective into the problem.