Thesis Project Portfolio

Design of an Insulin Glargine Manufacturing Plant to Increase Affordability and Accessibility of Diabetes Medication in the Sub-Saharan Region of Africa

(Technical Report)

Should Insulin be Inaccessible Due to the Current Market?

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Sociotechnical Synthesis

Across the globe there are millions of people who suffer from diabetes, and more specifically in the United states the inability for diabetics to obtain the life saving drug insulin has become a major problem within the past twenty years. Although insulin is available, its price can range as high as $300 to $500 which is unaffordable for many Americans. After identifying this problem, the work done in my technical report seeks to build a cost efficient plant which produces insulin at an affordable price of $50 for monthly dosage; in contrast, my STS research paper investigates how the current prices of insulin became inflated and offers suggestions to change the system in the U.S. by performing responsible research and emphasizing innovation.

The focus of the technical paper was to develop an insulin plant in sub saharan africa which could provide insulin to 6 million people annually. This process was created by referencing previous literature by Hwang et al. (2016) on the production of insulin, and parts of the process were changed to lower costs while still recovering a large amount of insulin from each batch. It will take producing 272 batches of insulin from a 10,000 L fermentor to produce the insulin necessary for those in sub saharan Africa. The facility will be located in Ethiopia, and will help bring jobs to the area as well as improve the economy of the surrounding area. Wages will be about twice the price of the local range in order to incentivize workers and pay fair amounts. To prevent environmental harm to the land and those in the surrounding area we will also dispose of our waste properly and have safety precautions in place. Overall, the process will allow us to generate an income of $3.83 billion dollars across the twenty year life of the plant, while annually helping six million of sub saharan African residents get the insulin they need at an affordable price.

For the sociotechnical research paper the problem frame I chose was research and responsible innovation, and I wanted to identify how neglecting this theory affected the current insulin market. The most prevalent issue I found was that the abuse of the patent system has led to three major pharmaceutical companies: Novo Nordisk, Eli Lilly, and Sanofi dominating the market. Evidence suggested that by making small adjustments to current patents on the insulin manufacturing process these companies extended the life of their patents; this delayed biosimilar products from entering the market which would have led to lower prices. Following this point, the actors network theory was applied to identify parties in the insulin distribution system, and find where profit gain led to inflated prices. It was found that not only manufacturers increase the price of insulin, but so do wholesalers, pharmacy benefit managers, and insurance companies. At each point in the distribution each party sought to increase the price of insulin at the expense of the patient. Lastly the need to improve research to improve the insulin sector was identified, and possible solutions included allowing unbiased parties such as colleges to participate in research as well as allowing new technology to flood the market which would in turn reduce insulin prices.

Overall the design for the insulin plant was cost effective, and reduced the price patients would need to pay out of pocket significantly. In the future I would recommend using larger equipment to cut down on costs in this process. I think it would also be viable to find an insulin advocacy or organization to partner with the facility to further decrease the market price of insulin. For the sociotechnical paper I suggest that further mediums for research be identified, and that stakeholders in the insulin market be held accountable for inflating prices. Through this system of checks and balances medication prices can be kept lower while keeping patients rather than profit at the forefront.

I would like to thank my technical advisor Eric Anderson for the support and advice he provided in developing the insulin plant; he offered beneficial information about industry practices. I'd also like to thank Professor Norton and Professor Wylie for helping me create my prospectus and frame my research problem for the sociotechnical research paper. I gained a lot of insight about ethics and best practices as an engineer as well as knowledge about framing problems. Again I'd like to thank all of the professors who contributed to my success in creating my thesis portfolio.