Funding a Cure: Why the Scattering of Research Funds

 Delays the Race to Finding a Cure

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Abstract

Each year billions are given to research teams seeking a cure for chronic diseases affecting Americans. This paper proves that by scattering research funds among the search for a cure of five chronic diseases, will actually delay the desired result for each one. Using the top-down approach for my research activity, discovery focused on summary statistics of insurance claims for treatment of each disease. This data was provided by the Center for Medicine and Medicaid Services Chronic Conditions Data Warehouse. If the funds scattered are not enough to carry out the necessary research to find a cure, by pooling all funds to focus on the cure for one chronic disease at a time will achieve better results. Using the data provided, the results proved that by pooling resources to focus on one disease first and then moving onto finding a cure for the next chronic disease is a much better approach to tackle these diseases more effectively.

 *Keywords:* research funds, pooling funds, funding a cure

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# Funding a Cure: Why the Scattering of Research Funds

# Delays the Race to Finding a Cure

# **Introduction**

Health costs in the United States are expected to reach $3.5 trillion in 2018 (Abutaleb, 2018). Aging baby-boomers, new technology, and the rising cost of prescription and *designer* drugs are the cause for the increase. Despite advances in treatments, and years of research, cures for chronic diseases still seem far away. With more individuals focusing on personal health goals, there has been much discussion on the money spent on researching certain chronic diseases. The research question answered in this paper specifically is; where best to apply money for research among these chronic five diseases: Asthma, Diabetes, COPD, Heart Failure, and Hypertension.

## **Background**

Each year nearly 4 million people die from Asthma and COPD (Health, 2017), in 2016 claims exceed more than 20 billion. Diabetes affects 9% of Americans (Kemmis, 2017), and is the seventh leading cause of death in the United States. In the last 20 years, the number of adults diagnosed with Diabetes has tripled (Diabetes, 2018), and Heart Disease effects one out of three Americans, causing 800,000 deaths each year (Jackson, 2017).

## **New Technology**

Many of the chronic diseases above are caused by genetics. Currently there is a lot of evidence that the gene-editing enzyme CRISPER will aide in and cut years off of scientific study to find a cure these and many other diseases. This new technology has already shown promise on curing targeted diseases such as certain types of Cancer, Huntington’s disease, and Cystic Fibrosis to name just a few (Speights, 2018). This technology is very new, and advances are observed each month. With the right amount of funding, advancements would increase at an astronomical rate.

Often, funds raised to find a cure for chronic diseases come from individuals emotionally charged and who were personally impacted by a specific disease. Likewise lobbyists are paid by those emotionally charged to push for government funding for a specific disease. This mentality, while genuine, has created an adverse effect in finding a cure for any diseases. To make a real difference, we must unite our causes for one purpose. If the funds scattered are not enough to carry out the necessary research to find a cure for any one disease, pooling all funds to focus on the cure for one chronic disease at a time will achieve the desired results. To achieve success, we must narrow down which chronic disease should be addressed first.

## **Previous Research**

Previous research has proven that to solve long-term chronic diseases more effectively, pooling research and resources is a better way to go. The German Centers for health Research carry out research of common diseases at several centers across the country, all focusing on the same disease before moving to the next (pooling, 2016). The Center for Global Health also looked at benefits from pooling resources to cure *neglected diseases*. Researches have access to a pool of money to use for research (Grace, Pearson, & Lazdins, 2011). The focus of collaborative research strengthened the ability for scientists to develop drugs to better cure *neglected diseases*.

While pooling resources and funds may work well on a global scale, in America, drug companies, and research facilities which are primarily segregated, count on profit acquired on developmental drugs. Unfortunately, these drugs do not usually provide the cure. Nonetheless, this paper will explore the benefits to American citizens of pooling funds to find a cure for Chronic Diseases, tackling one disease at a time.

# **The Chicken or the Egg**

 In this chicken before the egg scenario, where one disease leads to another, or the treatment for one leads to another disease, is it possible to narrow down which disease to address first?

## **Data**

The data chosen to answer this research question was found in the Chronic Conditions Data Warehouse (CCW). The CCW collected data from claims filed through Medicare and Medicaid creating a useful virtual research data center. Data captured include variables for 27 common chronic conditions, including Asthma, Diabetes, COPD, Heart Failure, and Hypertension.

## **Population**

The data used are from Medicare patients across the United States only. The data can be broken down by illness and by the patient demographic. The costs associated per claim and per illness is used to determine conditional probabilities which lead to *disease creep* for the five chronic diseases.

# **Disease Creep and Treatment Costs**

When diseases go untreated, many patients transition to, or develop other diseases. Even in a case where treatment exists such as the use of insulin for diabetic patients, this treatment can creep to kidney and heart failure.

## **Variables**

Costs associated to the treatment of the aforementioned five diseases and their variables are listed in Table 1. These are the number of current patients for a particular chronic disease, the whole dollar amount spent on claims for treatment of the disease, and the likelihood that the disease will worsen and turn into one of the other five chronic diseases.

## **Variables Not Included**

Of course there are other variables not included in this data. For instance while data from smokers are included, the time lapse that a smoker has quit is not included in these findings. Including variables such as this will change the probabilities and outcome. Additionally, not recorded here are children who suffered from Asthma and their risk to develop COPD as adults.

# **Data Appraisal**

The data found in the CCW is used to provide information on a variety of chronic diseases affecting patients in the U.S. The CCW was established by the Center for Medicare & Medicaid Services (CMS). The data was to be used to improve the quality of care and reduce costs associated with Chronic Diseases. Data found in the CCW represent variables for 62 conditions. 27 are chronic and 35, potentially disabling conditions. The variables were developed by an algorithm program that scoured claim data for specific diagnosis codes. The algorithm counted at least one patient diagnosed with a disease during the period of one year. Valid ICD-10/ CPT4/ HCPCS Coders were used to determine which chronic disease to associate the patient with (Chronic Conditions Data Warehouse). Typically, this data is used to determine if treatments to fight against the diseases over time are working. Meaning, are there more or less US citizens diagnosed with a chronic disease year over year.

For this exercise, the full amount of data was not used, only that which contained individuals affected by one of the five diseases aforementioned. There were no limitations or data missing. The first data set used came from the Medicare Beneficiary Counts for Chronic Conditions for 2007 through 2016, table B.1.b. From that table, the number of patients who were diagnosed with Asthma, COPD, Diabetes, Heart Failure, and Hypertension were noted for the year 2016.

Next, data was retrieved from the number of Claims Paid for Medicare Services in 2016 by Claim Type and Chronic Condition Classification table C.2. Variables used from this report was a calculation of the total amount paid for claims that were filed for services rendered only in relation to one of the five diseases aforementioned.

Subsequently, having the number of people affected with each disease, and the dollar amount spent on claims in the year 2016 per disease, calculations were performed to retrieve the following variables:

* Number of claims per person
* Dollar amount per claim
* Dollar amount per person

These are found in Table 1 (Appendix A)

The five Chronic Diseases encompass 78.2% of all Chronic Diseases. Using the costs data from Table 1, we calculated that the average cost of treatment for the five diseases per person is $8,741.00. Each disease has a probability that if left untreated can develop into a new disease. Asthma has a 45% probability it will progress into COPD (O’Brien, 2016). COPD has an 18% probability it will cause the patient to have Heart Disease. Diabetes, if left unchecked has a 50% probability it will cause Hypertension and Heart Disease (The Cost of, 2018). Hypertension leads to Heart Failure 30% of the time.

Using these stats, further calculations were done on the probability that the disease has progressed, resulting in:

* The new number of people affected for each disease
* A new dollar amount per claim
* A new dollar amount per person
* A new dollar amount per disease for the year 2017

These are found in Table 2 (Appendix A)

Chart 1 and Chart 2 below, quickly reveal the total costs incurred in 2016 and increased costs for 2017 for each disease given the probability of *disease creep*. Heart disease was left off purposefully to create a cleaner chart, and because it does not lead to a different disease, it leads to death.

Chart 1

Chart 2

Finally, calculations were made using the conditional probability technique, which led to the decision tree and sensitivity analysis (Appendix B and C).

## **Methodology and Model**

 Using the top-down design principle, it was obvious that four of the five diseases measured had some baring on another disease. In other words, except for heart failure, all other diseases crept. The long run goal was to see which disease should be focused on first, therefore using this principle, the individual variables were used to gather data on the impact, but were not the forefront or the stopping point.

 Next, the data was converted to a useable form to be used in a decision tree by analysis applying a conditional probability model (see Appendix A). The data used for the probability tree focused on the dollar amount spent if the disease did not creep and the dollar amount spent given the probability that it did.

 There were no extreme or missing values, however, to develop a consistent data model, the data for Heart failure was purposefully removed. The reason the data for Heart Failure was removed was because, if left untreated, patients who had heart failure did not progress into a worse disease, they simply died, therefore presenting the data on Heart Failure in the probability table for the dollar amount spent before *disease creep* was not beneficial because no extra money was spent on claims because the disease did not creep.

 Natural check points were built into the probability model. Using the data attained for the probability a disease will creep, made it easy to see that in the long run, all diseases led to Heart Failure. The model was established to calculate how much each disease crept and which disease caused the most harm. Naturally, Asthma led to COPD which led to Hypertension which led to Heart Failure. Likewise Diabetes led to Hypertension which led to Heart Failure.

# **Ethical, Legal, and Societal Issues**

 The very first party of interest in this research are the people. Citizens of the United States who have or may develop chronic diseases. The data was extracted from the claims paid out in the United States for the five diseases. None of the data was manipulated so there were no ethical issues in the collection of data. It is very possible that independent study conducted from drug manufactures who could manipulate data may cause ethical issues. Additionally, to cure diseases, some people feel it is unethical to use genetic snipping to improve ones health. There are however legal and societal issues connected to the results of this study.

## **Ethical**

 Gene-editing enzyme CRISPER poses ethical questions which will not be discussed in this paper.

## **Legal**

 Quite possible, if drug manufacturers and research facilities were to combine efforts to cure one disease and then move onto another, this may cause some legal issues. In the United States, drug companies rely patenting laws to protect profits made from previous sales to conduct future research. This is free commerce, and it is a very good thing. Without free commerce, creativity is squelched. Companies must decide how to share in the wealth and support R&D efforts as a team in future projects. The patenting of new drugs also provides a set of issues in itself. Collaboration of drug manufacturers and research facilities could easily solve common problems that they work on individually. There has been proof of this working when the Cooperative Research and Development Agreement (CRADA) was developed. This was a cooperation between a federal lab and a private organization to develop a treatment of Myeloma (Sagal, Slowinski, Freese, & Ferguson, 2009).

## **Societal**

 Society donates to charities because they feel emotionally attached to an issue. Some people may not take kindly to funds given to one cause transferred to another that they may have no feelings at all for. This is a touchy subject, and no one should have the power or ability to go against societies wishes. The opportunity we have in the US is to retrain society on the needs of the many.

 Additionally, though not a popular belief, there are some in society that believes disease is around to “thin the masses”, and without death or the longevity of life causes famine.

# **The Decision Tree**

A simple decision tree design preformed calculations from the data extracted from the CCDW and the probabilities assumed. Using the 2016 number of claims per person and dollar amount per claim, the probability model calculated the number of those affected, and a new dollar amount per claim and person given that the probability of *disease creep* did happen.

A [cost-effectiveness](https://www.sciencedirect.com/topics/medicine-and-dentistry/cost-effectiveness) analysis was performed using a top-down design principle to compute long-term costs for each disease type, before and after *disease creep*. After calculations and probability estimates were made, a decision tree was completed (Appendix C). The purpose of the structure of the model was to get the estimated expected value of each disease after *disease creep.* If recommendations were made solely on the cost of care for each disease for 2016, the cost per person for Heart Failure is the highest at $18,953, with Diabetes a close second at $16,752 per person. Using an average cost per person of $8,741 the results reverse. Diabetes was the front runner at $25,493 and Heart Failure does not change. Hypertension increases substantially from $733 to $9,474 per person. Those with Asthma are given a 45% chance that they will contract COPD however the total costs year over year do not increase that much.

After calculations are made to the decision tree, those with Asthma who test positive for COPD cost an additional $12,741. Those with COPD who test positive for Hypertension cost patients an additional $9,474. Those with Hypertension or Diabetes that test positive for Heart failure pay an additional $18,953. The outcome of the decision tree exposed that the most costly disease is Diabetes.

In addition, a SensIT plot was conduction on the four diseases (Appendix D). The sensitivity analysis shows that Hypertension surpasses COPD at $18,310,579,281. Nothing crossed Asthma, and Asthma and COPD are pretty much neck in neck. As expected, Diabetes increased quickly and held steady.

The results that Diabetes is the most costly disease is a reasonable assumption. Diabetes leads to kidney failure, heart disease, hypertension, obesity and cancer. Calculations made in the decision tree only covered heart failure and hypertension.

# **Results**

Looking at the data in tables 1 and 2 (Appendix A), while Hypertension costs claimants an additional $54,773,439,847, Diabetes, a close second, can cause other diseases such as obesity which can lead to cancer, Hypertension and Heart Failure. Cost of claims for Diabetes rose to $267,142,527,432, which is 3.4% more than Asthma to COPD, 7.6% more than COPD to Hypertension, and 7.5% more than Hypertension to Heart failure. For this reason, to answer the question, where best to apply money for research among these chronic five diseases: Asthma, Diabetes, COPD, Heart Failure, and Hypertension? Research has proven that Diabetes should be the first disease that by pooling resources and funds, science should find a cure for. Once this is accomplished, hypertension should become much lower so the next disease to tackle should be Heart Failure and then Asthma and COPD.

# **Discussion and Conclusion**

For years scientists have been studying chronic disease. They have developed pills, elixirs, and devices to make the population more comfortable but have not fully cured these five chronic diseases. Countless trillions of dollars have been spent on each disease as well and many others. Racing to fund a cure has not had the expected outcome. It is true that scattering funds just delays a cure. Polling funds will be a quicker way to the finish line and expected result.

While the data used in this study may be very good data, there is no real way to know that it is one hundred percent accurate. Data entry workers use and must remember thousands of codes to associate a cost to the correct disease. Additionally, if an insurance company pays a little more for like treatments, it is very possible the physician miss codes a patient chart. Therefore there is no true way of knowing that the data is correct. An error percent should be calculated.

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# Appendix A





# Appendix B





# Appendix C





# Appendix D