**MIS581 Portfolio Milestone**

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**ABSTRACT**

Data has shown that citizens of the United States experience increased healthcare spending. Similarly, prescription medicine prices have seen tremendous price increases due to the United States not adopting price-regulation laws. The purpose of this research study was to analyze if increased spending in healthcare and prescription medicines had any relationship to increased life expectancy. Additionally, life expectancies from countries who have adapted value-based care models as opposed to fee for service models were also analyzed for a relationship. Data on healthcare spending, pharmaceutical spending, and life expectancies by country were gathered from the Organization for Economic Co-operation and Development. Data regarding countries that have adopted value-based care plans were gathered as well. The data was then analyzed utilizing correlational analysis for any relationships that may exist. The only significant finding is that increased health care spending does relate to a higher life expectancy. More research on the benefits of price-regulation caps on pharmaceutical companies and the benefits need to be conducted within the healthcare field. Furthermore, the benefits of value-based care models over fee-for-service models also need to be analyzed more comprehensively.

**INTRODUCTION**

Costs within every industry has seen increases over the last several years healthcare was no exception. According to the Center for Medicare and Medicaid, the recent COVID-19 pandemic drove “a 9.7% growth in total national healthcare spending, bringing spending to $4.1 trillion” within the United States (Centers for Medicare & Medicaid Services, 2021). The increasing cost has created many challenges for Americans, even those who have adequate health insurance. When compared to other countries of similar economic development, the United States has seen a much higher increase in health spending. While Americans may be spending more for healthcare, the question next is, is it worth it?

One issue with the current healthcare system in the United States is the lack of value-based care. Value-based care is “a healthcare delivery model in which providers, including hospitals and physicians, are paid based on patient health outcomes” (Catalyst, 2017). The main focus of value-based care is prevention rather than management. Currently, the United States operates on a fee-for service approach “in which providers are paid based on the amount of healthcare services they deliver” (Catalyst, 2017). This means, the more services a physician provides, the more the physician will be paid. Other countries have already adopted value-based care models, and the United States has yet to follow in their footsteps. Value-based care has shown to be beneficial for not only patients, but physicians, insurance providers, and other healthcare entities. According to Catalyst (2017), countries with value-based care models have lower healthcare spending, better control of healthcare costs, reduced risk, higher healthcare provider efficiencies, and ultimately a healthier society.

Another issue with healthcare costs is the cost of pharmaceutical. According to Commission (2001), pharmaceutical costs are “80 to 160 percent higher” in the United States than in other countries. While other countries have adapted price-regulation laws to keep patients medicines affordable, the United States has yet to follow in their footsteps. Americans also historically have spent more on “prescription drugs than citizens in other developed countries” (Latham, 2011). If the United States adopted pharmaceutical price-regulation laws, how our healthcare system could potentially benefit remains unknown.

**OBJECTIVES**

The goal of this research project will be to analyze and compare the pharmaceutical spend and implementation of a value-based care model in various countries around the world to that of the United States. Along with pharmaceutical spend, average life expectancy, mortality rates, and healthcare related debt will also be analyzed. The objective is to determine how pharmaceutical price regulation and a value-based care model could benefit the United States and ultimately, what the effects would be across all metrics within the healthcare industry. Data on healthcare spending by country, pharmaceutical spending by country, number of medical professionals, hospital demographics, life expectancy and mortality rates, quality of life, and healthcare debt will be collected from The Organization for Economic Co-operation and Development, or OECD. An analysis on which countries have adopted a value-based care model will also be completed.

The outcome of this research project has the potential to increase quality of life for many Americans currently struggling under our healthcare system today. Healthcare spending topped out at $4.1 trillion dollars in the US for 2021 (Centers for Medicare & Medicaid Services, 2021). It is estimated that 23 million people have healthcare debt over $250 with around half owing more than $2,000 (Claxton & Rae, 2022). Debt can have a major impact on people’s lives. If as a nation, the United States is able to reform the current healthcare systems while still maintaining or even improving our mortality rate or life expectancy, then so many Americans could have an improved quality of life. Not only could quality of life ultimately be improved, but healthcare costs could be lowered leading to potentially better mortality or life expectancy rates as well. Also, if prescription medicine costs experience better regulation, more American’s could afford lifesaving medications and as a country, we could better focus on “disease prevention rather than disease management” (Dalen, 2010). Along with pharmaceutical cost regulations, the implementation of a value-based care model also has the opportunity to lower the United States healthcare spending. As a united country, there should be a common goal to allow all citizens the access to affordable, quality healthcare. Currently, our healthcare system does not allow for such goals, and citizens are struggling.

**OVERVIEW OF STUDY**

This research study aims to analyze the potential a value-based care model has on healthcare spend and average life expectancy. Since different countries offer different healthcare models, the goal is to identify a healthcare model that could be a gold standard for higher life expectancy rates. The next part of this research study will analyze pharmaceutical spend and if there is any correlation as well to life expectancy. Continuing with pharmaceutical spend, countries with price regulations implemented will be analyzed against those countries that do not have price regulations on prescription drugs. If there is a price regulation, the effects on life expectancy and overall healthcare debt will be analyzed as well.

**RESEARCH QUESTIONS AND HYPOTHESIS**

The first research question to be addressed will examine if pharmaceutical spend has any correlation with higher life expectancy. As stated by Crémieux et al., (2004), in regard to higher drug costs “the cost must be compared with the benefits provided”. If a society is paying more than others for prescription drugs, one would assume they are receiving better medicines to offset the cost. Also, if the prescription drugs are costing more, are they increasing results? The null hypothesis states that there is no correlation in life expectancy and pharmaceutical spend. The alternative hypothesis states that there is a correlation between pharmaceutical spend and life expectancy.

The second research question will examine if a value-based care model has any correlation with higher life expectancy. As previously stated, the goal of a value-based care model is disease prevention rather than disease management (Catalyst, 2017). Theoretically, if physicians can prevent disease or the need for medications before they occur, life expectancy and disease rates could improve. Therefore, the null hypothesis states that there is no correlation in life expectancy and value-based care models. The alternative hypothesis states that there is a correlation between a value-based care model and life expectancy.

The third research question will examine if the implementation of a pharmaceutical price cap has an impact on healthcare debt. According to Latham (2011), Americans have historically spent more on “prescription drugs than citizens in other developed countries”. In addition, it is estimated that 23 million people have healthcare debt over $250 with around half owing more than $2,000 (Claxton & Rae, 2022). In the United States, healthcare spending reached $4.1 trillion dollars in 2021 (Centers for Medicare & Medicaid Services, 2021). Also, East (2022) stated that significant debt can impact your physical and mental health which could lead to certain stress related health problems. Would a cap on prescription drugs actually have a positive effect on quality of life and life expectancies? Similarly, would the implementation of a price cap on prescription medicines help limit healthcare debt or would it not make a significant impact on the current debt. The null hypothesis states that there is no significant impact on a country’s healthcare debt or life expectancy with the implementation of a pharmaceutical price cap. While the alternative hypothesis states that there is a significant impact on a country’s healthcare debt or life expectancy with the implementation of a pharmaceutical price cap.

**LITERATURE REVIEW**

The increasing costs associated with one’s health has created many challenges for Americans including, difficulty in affording any healthcare, preventing people from getting appropriate care or prescriptions, and the accumulation of medical bills. Even those Americans who have adequate health insurance are not immune to these consequences, and “uninsured adults, black and Hispanic adults, and those with lower incomes” are more disproportionately affected (Kearney et al., 2021). According to Wager, Ortaliza, & Cox (2022), the United States health consumption expenditure was at 18.8% of GDP in 2020, whereas comparable countries were at an average of 12% of their respective GDP. In addition, it is estimated that 23 million people have healthcare debt over $250 with around half owing more than $2,000 within the United States (Claxton & Rae, 2022). It is also important to note that according to East (2022) significant debt can impact your physical and mental health which could lead to certain stress related health problems.

Not only has healthcare costs in general risen, but prescription drug costs have also increased exponentially. The cost of pharmaceutical drugs alone in the United States has long been a topic of discussion within healthcare. As previously stated, pharmaceutical costs are “80 to 160 percent higher” in the United States than in other countries (Commission, 2001). Similarly, Latham (2011) stated that Americans experienced a 15.73% cost increase in prescriptions from 2000-2001 and historically have spent more on “prescription drugs than citizens in other developed countries”. Crémieux et al., (2004), stated in regard to higher drug costs “the cost must be compared with the benefits provided”. If a society is paying more than others for prescription drugs, one would assume they are receiving better medicines to offset the cost.

Furthermore, the United States has a healthcare focus of disease management whereas other countries have a bigger focus on disease prevention. The United States currently operates on a fee-for service approach “in which providers are paid based on the amount of healthcare services they deliver” (Catalyst, 2017). This means, the more services a physician provides, the more the physician will be paid. Additionally, the goal of many physicians within the United States is to control what patients are currently experiencing instead of how a patient can prevent encountering health issues.

Value-based care is “a healthcare delivery model in which providers, including hospitals and physicians, are paid based on patient health outcomes” (Catalyst, 2017). The main focus of value-based care is prevention rather than management, the opposite of fee for service. In many value-based care models, physicians are paid based on quality of care and patient outcomes rather than quantity of patient visits. If a physician is able to stop a disease progression before the patient experiences a medical emergency, then the physician will be compensated more than if the patient had to be hospitalized. In addition, if physicians can prevent disease or the need for medications before they occur, life expectancy and disease rates could improve. Value-based care has shown to be beneficial for not only patients, but physicians, insurance providers, and other healthcare entities. If physicians educated patients on preventative primary care, there is a chance comorbidity prevalence and even hospitalizations could decrease in the United States.

**RESEARCH DESIGN**

**Methodology**

Quantitative data will be collected from an online data warehouse that is maintained by The Organization for Economic Co-operation and Development, or OECD. Data on healthcare spending by country, pharmaceutical spending by country, number of medical professionals by country, hospital demographics, life expectancy and mortality rates, and healthcare debt will be collected. The data will be collected for a 10-year period from 2011-2020. Initially, data from 36 countries will be analyzed. For data on healthcare spending, prices per capita will be collected in the country’s currency and will be converted to USD in order to normalize the data. The same will be done for pharmaceutical spending by country and healthcare debt. Once the data collection process is complete, SAS will be used to perform appropriate correlation and regression analyses in order to answer the research questions.

Number of medical professionals by country will also be gathered. This data will be categorical when divided by profession type, for example, nurses, physicians, or technicians. However, when looking at the total count, this will be an interval variable. Hospital demographics data will be similar to medical professionals in that it will be categorical but also can be numerical depending on the analysis being performed. When looking at simply the number of hospitals a country has, it will be numerical. However, when analyzing the location of hospitals and rural vs city, that will be a categorical variable. Life expectancy and mortality rates will also be gathered by country. These variables will be interval or numerical variables as well. The last variable analyzed will be whether or not a country utilizes a value-based care system (VBC) or a fee for service (FFS) system. Each country will be classified as either a VBC or FFS. This data will be a categorical variable.

**Methods**

For this research project I will be using R and SAS. Since my dataset is coming from multiple spreadsheets, I will need to combine the spreadsheets into a workable format. For this I will be using R. Within R I can combine the datasets into one giant dataset and format the data how I need. I will also clean the data within R. Currently the data has countries that are not classified as either a VBC or FFS country. These will be removed in R. From there I will upload the dataset into SAS where I will perform my analytics on the data. Within SAS, descriptive statistics will be performed. Then a correlation and regression analysis will be performed to analyze all of the cost variables associated with a VBC or FFS country. Another correlation analysis will be completed to analyze any relationship between healthcare spend and life expectancy. All pharmaceutical costs will also be compared in a correlational analysis with life expectancy.

The goal of this research project will be to analyze and compare the pharmaceutical spend and implementation of a value-based care model in various countries around the world to that of the United States. Along with pharmaceutical spend, average life expectancy and healthcare related spend will also be analyzed. The objective is to determine how pharmaceutical price regulation and a value-based care model could benefit the United States and ultimately, what the effects would be across all metrics within the healthcare industry. defining future plans to analyze the data within the dataset. According to Dalen (2010), other countries “pay 20% to 40% less for prescription drugs compared with what Americans pay”. If life expectancy and mortality are similar when compared to countries with prescription drug cost limits, then why are Americans being forced to pay for something that does not improve health outcomes? Similarly, if a value-based care model can lower healthcare costs and reduce patients risks like research has stated, then why is there not a bigger push to implementing value-based care plans within the United States (Catalyst, 2017)?

The results of this project have the ability to impact every American’s life who has had to endure the current healthcare system within the United States. Healthcare spending topped out at $4.1 trillion dollars in the US for 2021 (Centers for Medicare & Medicaid Services, 2021). It is estimated that 23 million people have healthcare debt over $250 with around half owing more than $2,000 (Claxton & Rae, 2022). Debt can have a major impact on people’s lives. If as a nation, the United States is able to reform the current healthcare systems while still maintaining or even improving our mortality rate or life expectancy, then so many Americans could have an improved quality of life.

**Limitations**

This study will present some limitations. The data for this project is being gathered from a single source due to limited access to data. Also, lifestyle factors cannot be controlled for. Therefore, certain health metric changes cannot solely be correlated to pharmaceutical spend or healthcare model.

**Ethical Considerations**

Acknowledging all ethical considerations, guidelines advised by The Menlo Report and The Belmont Report will be adapted. Since the data being collected may contain personal information, the respect for persons will be addressed through treating all “individuals as autonomous agents and entitling individuals to protections” (Klose et al., 2020). All data collected will respect the individuals privacy where the data may have been derived from and all individuals will be treated independently from external controls. Informed consent will also be provided to the individuals where necessary regarding the research for this project specifically. The data will also be null of any personal identifiers to further protect an individual’s privacy. All analyses will also be conducted without bias or flaws. The analyses will also “not target specific people or groups based on attributes such as technical competency or personal demographics” (Klose et al., 2020). While the data will be grouped according to an individual’s geolocation, that will be the only dividing factor. Finally, all research for the sole purpose of this project will remain compliant, transparent, and accountable within the legal jurisdictions.

The outcome of this research project has the potential to increase quality of life for many Americans currently struggling under our healthcare system today. Not only could quality of life ultimately be improved, but healthcare costs could be lowered leading to potentially better mortality rates or life expectancy rates as well. If prescription medicine costs experience better regulation, more American’s could afford lifesaving medications and as a country, we could better focus on “disease prevention rather than disease management” (Dalen, 2010). Along with pharmaceutical cost regulations, the implementation of a value-based care model also has the opportunity to lower the United States healthcare spending. As a united country, there should be a common goal to allow all citizens the access to affordable, quality healthcare. Currently, our healthcare system does not allow for such goals, and citizens are struggling.

**FINDINGS**

Once the data was collected, the averages were calculated by country for number of doctors per 1000 people, number of nurses per 1000 people, healthcare spend per capita, pharmaceutical spend per capital and life expectancy. These averages were calculated as 10-year averages for each country. The spend was also converted to US dollar to normalize the data. Then, each country was classified as either 1- a FFS care model, 2- a VBC care model, or 3-neither. The data on types of care models by country was gathered from a report by (The Economist, 2016). The Economist (2016) ranked each country on a scale of alignment with VBC practices. Any countries that were listed as very high or high were classified as VBC for the purpose of this assignment. Countries that were classified as moderate VBC alignment or lower were classified as still FFS care models. The countries that were listed as neither were removed through data cleaning.

The first analysis completed was to determine if there was a correlation between healthcare spending and life expectancy. The results of the analysis are displayed in figure 1 below. The correlation coefficient was found to be r = 0.55075 with a p value = 0.0220. Ideally, an r value closer to 1 indicates a strong relationship may exist (Elliott & Woodward, 2016). An r value closer to 0 indicates little to no correlation. For this analysis, there may be a weak correlation between healthcare spend and life expectancy. Since the p value <0.05, the null hypothesis can be rejected, and it can be concluded that there is statistical significance that there is a correlation between healthcare spend and life expectancy. Figure 2 below also displays the scatter plot matrix for healthcare spend and life expectancy. There is a slightly positive trend within the graphs that show as healthcare spend increases, so does life expectancy.

**Figure 1**

Correlation between Healthcare Spend and Life Expectancy

Table

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Note: Created with SAS.

**Figure 2**

Scatterplot matrix between Healthcare Spend and Life Expectancy

Chart, scatter chart

Description automatically generated

Note: Created with SAS.

The second analysis completed was to determine if there was a correlation between pharmaceutical spending and life expectancy. The results of the analysis are displayed in Figure 3 below. The correlation coefficient value was found to be r = 0.43641 with a p value = 0.0799. However, since the p value > 0.05, the null hypothesis will be not be rejected, and it can be concluded that there is no statistically significant correlation between pharmaceutical spend and increased life expectancy. Figure 4 below shows the scatterplot matrix for pharmaceutical spend and life expectancy. Visually, there is no pattern within the graphs. This further solidifies that the null hypothesis should be not be rejected.

**Figure 3**

Correlation between Pharmaceutical Spend and Life Expectancy

Table

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Note: Created with SAS.

**Figure 4**

Scatterplot matrix between Pharmaceutical Spend and Life Expectancy

Chart, scatter chart

Description automatically generated

Note: Created with SAS.

The third analysis completed was to determine if there was a correlation between care model and life expectancy. The results of the analysis are displayed in figure 5 below. The r value was found to be r = 0.33136 with a p value = 0.1939. Consequently, since the p value is again >0.05, the null hypothesis will not be rejected. It can be concluded that there is no significant correlation between types of care model and life expectancy. Figure 6 below shows the relationship between care model category and life expectancy. From the graphs, there is no relationship between the data. This further proves that the null hypothesis will not be rejected.

**Figure 5**

Correlation between Care Model and Life Expectancy

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Note: Created with SAS.

**Figure 6**

Scatterplot matrix between Care Model and Life Expectancy

A picture containing calendar

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Note: Created with SAS.

**CONCLUSION**

In conclusion, the only significant finding was that there is a weak correlation between increased healthcare spending and life expectancy. As healthcare spending increased, life expectancy increased as well. For the first hypothesis, the null hypothesis can be rejected, and the alternative hypothesis will be accepted. The relationship between healthcare spending and life expectancy is about 50%.

Unfortunately, for pharmaceutical spending, no relationship was found with life expectancy. The goal of this research project was to see if increased spend had an effect on life expectancy. Since no significant relationship was found between the two, it could be concluded that higher pharmaceutical spend does not have an effect on a higher life expectancy. For the second hypothesis, the null hypothesis will not be rejected, and the alternative hypothesis will be rejected. Since a positive or negative relationship was not found between the two variables, this does favor the idea that if the United States implemented a price cap on pharmaceuticals, life expectancy would not change.

The final hypothesis was examining a relationship between care model type and life expectancy. Again, no relationship was found to be significant between the two. Literature shows that value-based care models result in a better quality of life, however the data from this research did not conclude changes in life expectancy. Therefore, the null hypothesis was also not rejected, and the alternative hypothesis was rejected; stating that there is no significant relationship between care model and life expectancy.

**RECOMMENDATIONS**

While only one of the three null hypotheses was disproved, further research within this area should be conducted. Going forward, better tracking of countries type of care model should be addressed while also, data should look at what year a VBC model was implemented. Additionally, some countries have government funded healthcare while others require private insurance. This also could cause changes in healthcare spending. In the future, healthcare funding should also be normalized to account for variations in the data.

**References**

Catalyst, NEJM. (2017). *What is value-based healthcare?* NEJM Catalyst. Retrieved March 27, 2022, from <https://catalyst.nejm.org/doi/full/10.1056/CAT.17.0558>

Centers for Medicare & Medicaid Services. (2021). *Press Release National Health Spending in 2020 increases due to impact of COVID-19 pandemic*. CMS. Retrieved March 27, 2022, from https://www.cms.gov/newsroom/press-releases/national-health-spending-2020-increases-due-impact-covid-19-pandemic#:~:text=Press%20release-,National%20Health%20Spending%20in%202020%20Increases,Impact%20of%20COVID%2D19%20Pandemic&text=As%20with%20so%20many%20aspects,bringing%20spending%20to%20%244.1%20trillion.

Claxton, G., & Rae, M. (2022). *The burden of medical debt in the United States*. KFF. Retrieved April 3, 2022, from https://www.kff.org/health-costs/issue-brief/the-burden-of-medical-debt-in-the-united-states/#:~:text=This%20analysis%20of%20government%20data,debt%20owe%20more%20than%20%242%2C000.

Commission, P. (2001). International Pharmaceutical Price Differences. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.277602

Crémieux, P.-Y., Meilleur, M.-C., Ouellette, P., Petit, P., Zelder, M., & Potvin, K. (2004). Public and private pharmaceutical spending as determinants of Health Outcomes in Canada. *Health Economics*, *14*(2), 107–116. https://doi.org/10.1002/hec.922

Dalen, J. E. (2010). We can reduce US health care costs. *The American Journal of Medicine*, *123*(3), 193–194. <https://doi.org/10.1016/j.amjmed.2009.12.011>

East, S. (2022). *How debt and financial stress affects your mental health and ways to Cope*. MoneyGeek.com. Retrieved April 6, 2022, from <https://www.moneygeek.com/debt/resources/how-debt-can-harm-your-health/#:~:text=Overwhelming%20debt%20can%20result%20in,constant%20presence%20in%20your%20life>.

Elliott, A. C., & Woodward, W. A. (2016). *Sas Essentials: Mastering Sas for data analytics*. Wiley.

Elliott, A. C., & Woodward, W. A. (2016). *Sas Essentials: Mastering Sas for data analytics*. Wiley.

Kearney, A., Brodie, M., Stokes, M., & Hamel, L. (2021). *Americans' challenges with health care costs*. KFF. Retrieved March 27, 2022, from https://www.kff.org/health-costs/issue-brief/americans-challenges-with-health-care-costs/

Klose, M., Desai, V., Song, Y., & Gehringer, E. (2020). *EDM and privacy: Ethics and legalities of data collection, usage, and storage.* International Educational Data Mining Society. Retrieved April 5, 2022, from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Ffiles.eric.ed.gov%2Ffulltext%2FED607820.pdf&clen=286574

Latham, S. (2011). *Pharmaceutical costs*. Taylor & Francis. Retrieved March 26, 2022, from <https://www.tandfonline.com/doi/abs/10.1080/713832157>

OECD (2022), "Data warehouse", *OECD.Stat* (database), <https://doi.org/10.1787/data-00900-en>

O'Leary, Z. (2021). *The Essential Guide to doing your research project* (4th ). Sage.

The Economist. (2016). *Value-based healthcare: A global assessment*. Economist Intelligence Unit. Retrieved May 1, 2022, from https://www.eiu.com/n/

UCLA Advanced Research Computing. (2021). *WHAT IS THE DIFFERENCE BETWEEN CATEGORICAL, ORDINAL AND INTERVAL VARIABLES?* OARC Stats. Retrieved April 3, 2022, from https://stats.oarc.ucla.edu/other/mult-pkg/whatstat/what-is-the-difference-between-categorical-ordinal-and-interval-variables/

Wager, E., Ortaliza, J., & Cox, C. (2022). *How does health spending in the U.S. compare to other countries?* Peterson-KFF Health System Tracker. Retrieved March 27, 2022, from https://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries-2/#:~:text=Health%20spending%20per%20person%20in,half%20that%20of%20the%20U.S.

**Appendix**

**Figure 7**

R code and output for data cleaning

Table

Description automatically generated

Note: Created with R.

**Figure 8**

SAS code for data import

Graphical user interface, text, application

Description automatically generated

Note: Created with SAS.

**Figure 9**

SAS output for data import

A screenshot of a computer

Description automatically generated

Note: Created with SAS.

**Figure 10**

SAS code for correlation between healthcare spend and life expectancy

Graphical user interface, text, application

Description automatically generated

Note: Created with SAS.

**Figure 11**

SAS code for correlation between pharmaceutical spend and life expectancy

Graphical user interface, text, application, email

Description automatically generated

Note: Created with SAS.

**Figure 12**

SAS code for correlation between care model and life expectancy

Text, application

Description automatically generated

Note: Created with SAS.