A Financial Evaluation of Impending Disruptors in the Healthcare Industry

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Written for the 2016 Case Competition Sponsored by

The Society of Actuaries

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FOREWORD

When I initially accepted this case competition, my expectation was to receive an Excel file with data neatly laid out and a task of simply putting numbers together, just like case competition I had participated in before, but I soon realized I was dead wrong, especially since we received the case about one month into the competition. Quickly, this case competition turned into the absolute biggest project of my academic career and by the time we finished, I personally had put much more time into this than I spend in lecture for a class in a whole quarter. I will never forget the grueling process of reading and searching for hours upon hours to find the pieces of each puzzle and those brilliant moments where our team finally fit the picture together. In the end, we had learned more than we could ever have hoped for from an activity. From gaining some legitimate insight into the healthcare industry and experiencing the process of rigorous research to learning and playing with Excel simulations and other various models, this was truly the one of the most immersive projects we have ever worked on.

I speak for my team when I say that between the sweet closure of wrapping up one section and the frustrations of chasing countless dead ends, we thoroughly enjoyed this case competition and would like to thank the Society of Actuaries for hosting it. We also extend a thank you to all the actuaries, researchers, scientists, and doctors of the healthcare industry for the data and reports they have shared. This experience will surely stay with us in our quest to become fully fledged actuaries. That being said, as actuarial mathematics majors of UCLA, we never cease to exert our best efforts into everything we do, and this report certainly reflects that attitude. We hope you enjoy our paper!

- Brian Hsu

EXECUTIVE SUMMARY

Recently, there have been vast changes in every aspect of the healthcare industry. The activities of medical service providers, receivers, and researchers, in junction with recent developments in legislation and the political climate, have drastically changed the way the healthcare industry needs to operate to properly handle benefit costs. While the recent onslaught of disruptors is impossible to control, our team has developed a systematic strategy to identify and predict the financial impacts in each of the four primary benefit costs.

Pharmaceutical Disruptors

Through data provided by the CMS, we have obtained a list of drugs that produce a significant impact on benefit costs. To quantify the financial impact of this list, we partition the group by disease and develop a generalized method of analysis. Our examination of pharmaceuticals accounted for shifts in the diseased population and drug prices, which also accounts for the potential of new high-spending drugs as well as price hikes by producers. We proceeded to write these variables into an equation and combine it with probabilistic models to translate the variables to finance and estimate future impacts. Though this report does not produce a financial projection for every pharmaceutical, substitutions can be made into the created formula for various drug types and more sophisticated projections without jeopardizing the flow of the equation's logic. However, the general trend is that drug spending should be expected to increase rapidly and sometimes wildly. When we applied our estimates to three diabetes drugs, the formula produced an estimated increase of $1.5 million in spending per year by 2020.

Physician Fees

We determined that a 2015 overhaul of traditional physician fee schedule acted as the main disruptor of physician fees. This was determined by first linking Medicare and private insurance coverage through research into historical ratios between the two values. Then we found that the central component to determining Medicare fees, introduced in this report as the conversion factor, and explored the various factors that affected it. After constructing a formula which involved probabilistic models and accounting for uncertainty error, we ran multiple simulations to project future physician fees. According to our model, we concluded that physician fees were bound to increase by approximately 2% per year for 2016-2019, and then 5% per year in 2019-2021, which leads to an aggregated 24% change in fees in the next five years.

Outpatient Services

For our outpatient analysis, we used CMS outpatient data to culminate the effects of changing beneficiaries and cost of outpatient services. We then established a threshold for spending increases to determine potential disruptors and individually examined each outpatient service matching our criteria in terms of the source of rising payments - whether it is beneficiaries, costs, or some extraneous factor. Ultimately, our research of news reports and medical journals combined with our regression analysis yielded six particular outpatient services that we thoroughly researched and translated into financial impacts towards the Company. The result is that strong linear increases (with small error margins) in spending can be expected in the upcoming years for those specific procedures. Other outpatient procedures were disregarded as either anomalies in data, or deemed to possess potential to grow into a disruptor.

Inpatient Service

Our inpatient analysis consisted of three parts: beneficiaries and reimbursement rates, length of stay, and technological factors. In terms of beneficiaries and reimbursement rates, we discovered that due to a general shift from inpatient services to outpatient services as well as a variety of other factors, the Company can actually expect a small but steady decline of approximately 0.5% per year in payments for inpatient services.

In our length of stay (LOS) and cost of stay analysis, we used a collection of research reports, news articles, medical journals, and case studies to evaluate the forces that drove LOS to increase or decrease as well as its error ranges and used simulation models to the average scenario. Then, we combined this with an analysis of hospital stay costs, and determined that together, total costs going into inpatient stays could be expected to steadily increase to an aggregate of roughly 20% in the next five years.

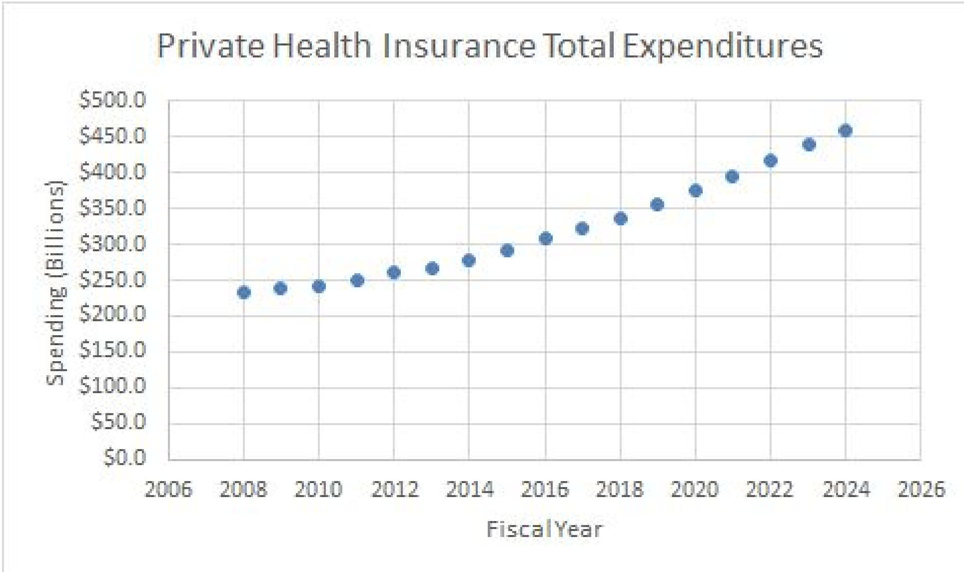
Finally, our analysis of technology through case studies and medical journals led us the conclusion that the appearance of new tech in the medical community would not pose as a disruptor. Rather, recent technology appeared to decrease inpatient service costs by driving them towards outpatient services.

PURPOSE AND BACKGROUND

Sitting at the intersection between public, private, and government service, the healthcare industry is constantly changing. As such, an accurate evaluation of disruptors must consider changes that affect the four main corners – pharmaceuticals, physician fees, inpatient services, and outpatient services. Furthermore, the evaluation must also consider disruptor forces that manifest in a plethora of forms. These include factors directly related to health care, such as physician payment legislation and drug companies, as well as factors that indirectly influence health care, such as macroeconomic indexes. The list of potential disruptors extends onwards, some of which produce an isolated effect while others can intertwine and impact multiple finances at once. On the next level, disruptors divide into numerical data (e.g. drug price hikes), human factors (e.g. behavioral shifts and law), and even something in between. Ultimately, it is clear that healthcare disruptors and their financial impacts cannot be inspected on a large scale. Rather, the complexity of healthcare disruptors demands that each of the four benefit costs be individually and thoroughly analyzed, which this report serves to do.

Existing literature and data unanimously point to increases in all departments. Regarding pharmaceuticals, the CMS drug spending dashboard indicates that a large quantity of drugs have either steadily increased or hiked in price within the recent year. On top of this, the advent of expensive drugs like Hep-C drug Sovaldi called for massive amounts of spending. This price hike trend also stacks on top of increasing prevalence rate for diseases like diabetes and certain cancers, according to the CDC. The dual increase of beneficiaries and price is a well known potent disruptor, and thus will be thoroughly investigated. It was also clear from research that a lot drug companies are merging and consolidating, which leads to high potentials of price hikes, so this report will also examine the industry and drugs vulnerable to change.

With regards to physician fees, research indicated that private insurance generally operates by paying a markup of Medicare payments to physicians, which therefore acts as the baseline for change. Shown on the next page is a graph of CMS projections made in 2014 for private health insurance.



(Source: CMS 2014 Projections of Private Health Insurance Expenditure)

It became clear from reading that physician fees are expected to increase for many reasons, from baby boomers to inflationary causes. Traditionally Medicare physician fees are dictated by a formula which involves the Sustainable Growth Rate (SGR) algorithm. This was true until the middle of 2015, when the SGR method of determining physician fees was fully repealed by legislation and physician payment systems was overhauled in place of MACRA legislation. Therefore, physician fees require an updated analysis that accounts for recent legislation as well as disruptor factors from before.

As for inpatient and outpatient services. The primary concern appeared to be from baby boomers, who are expected to require much more care as they age, especially in certain departments such as clinical visits. However, inpatient services also featured other concerns, such as the recent trend of inpatient services shifting towards outpatient services, the length of stay in a hospital factor, and also the increase of recent technology, all of which could drive costs in unpredictable manners. Ultimately, these services lie within blurry lines as to how they can affect the Company's financials, thus it deserves a thorough inspection of the potential disruptors.

Current models we've come across in our research mostly rely on the use of regression, where trend lines are used to project future rates. However, this is typically performed in the context of purely healthcare related statistics, such as number of beneficiaries, and does thus does not reflect a financial impact. Moreover, when the source does translate data into financials, it fails to account for how it translates into private insurance, since most of the research goes into Medicare. Even so, most of the time projection models don't exist at all, especially with regards to very discrete data such as legislative and behavioral changes.

This report aims to overcome these problems and improve them by taking a holistic approach towards each benefit cost and using a variety of mathematical and statistical techniques. We use traditional methods such as linear regressions to project single variables that demonstrate robust trends. To handle more chaotic and unpredictable data (which could derive from human factors, lack of history, large ranges, etc.), we utilize various simulation methods with Excel to project future rates. In doing so, we ensure that we deeply research the topic to determine fluctuation bounds and validate simulation results. We then combine these non-financial variables with results from healthcare databases, legislation, news reports, economic and medical case studies, healthcare society polls, and medical journals to determine the error bounds as well as how they translate into finances by deriving custom formulas featuring weighted variables and probabilistic models. During this process, we paid rigorous attention to identifying and justifying our assumptions by reasoning with research evidence and mathematical formulas.

The essence of our report is to demonstrate projected changes in spending for each sector. Since we lack information on the fine details of our insurance program and our client demographic, we present our findings in terms of formula output or simulated percentage increase. In other words, our formulas will sometimes require input variable(s), and then scale or add the relevant disruptors to those variables and output a financial result. The advantage to this is that the formulas can be adjusted to fit specific categories as well as reworked to function for future reference. When a financial bottom line is produced as a percentage increase, it is done through Monte Carlo simulation performed through Excel, sometimes with assumptions made on the input variable (e.g. let the number of beneficiaries be 10,000) to demonstrate a possible outcome.

We would also like to note that because of the large sizes of the charts and data sets, we opted to refrain from showing the full chart, but rather show excerpts or refer to them by appendix code. Finally, we make use of the following term very commonly, and therefore would like to define it.

- Financially conservative/conservative measurement: Since a lot of our data derives from Medicare data, which caters to the older population that tends to require higher maintenance on every end (drugs, physicians, hospital services), we assume that by treating the entire insured population as having the same medical requirements as older people, we are overestimating our costs and encouraging extra preparation, thus being financially conservative or “safe.”

DISRUPTOR ANALYSIS

PART I: PHARMACEUTICAL DISRUPTORS

Section 1.1 Data Collection and Exploration

To quantify the effect of drugs that are pharmaceutical disruptors, we will analyze drug spending and beneficiary count. By accounting for these factors and associated disruptors, we can combine them to produce an impact of the financial bottom line. We established that the information we extracted from CMS, the CDC, the GAO, and the United States Census Bureau are valid and reliable databases.

Our first step was to examine the drugs that are likely to contribute to the increase in healthcare spending. More specifically, we gathered data from the Medicare Drug Spending Dashboard released by the Centers for Medicare & Medicaid Services (CMS). The CMS has released information of Medicare's prescription drugs to the public for Part B and Part D plans. With information accumulated from 2011-2014, the spending dashboard consists of 80 drugs that have a high spending on a per user basis. The spending dashboard specifically includes the drugs that have a high spending per user or a high overall spending, thus drugs with these characteristics would be more likely to impact benefit costs. We choose to focus on Medicare drugs and Medicare data as the information is thoroughly detailed and publicly available. Therefore, we decided to use this database and assume that this Medicare Drug Spending Dashboard displays all the relevant drugs that could contribute to increases in spending. Another assumption is that the average spending per user is uniform for all age groups, despite Medicare catering to the older population. Treating the other age groups in the same way also acts as a financially conservative preparation. An excerpt from the Medicare Drug Spending Dashboard can be seen in Appendix A5.

From the CMS, we extracted data of the drugs within in the Medicare system which included figures such as the spending and beneficiaries of each drug from 2010-2014 as seen in the Dashboard. From this, we could determine various information such as the disease the drug treated and the manufacturers producing it. We then gathered the prevalence rates of various diseases from CMS's prevalence report which can be seen in Appendix A7. The CDC also provide refined prevalence rates for specific diseases sorted by age group. The disease prevalence rates for diabetes can be visited in Appendix A6.

After accumulating data on the drugs, the associated spending, respective disease, and the prevalence of these diseases, we wanted to gather information regarding the United States population to take into the account the number and demographics of beneficiaries. From The United States Census Bureau, the projected population from 2010 to 2060 can be seen in Appendix A7.

Section 1.2 Methodology and Analysis

We now can proceed to perform our analysis of the pharmaceutical spending disruptors with information for drugs that the CMS has categorized to be high spending, prevalence rates of the diseases that the drugs treat, and the projected population of the United States in 5 years.

To begin systematically quantifying the effect of a disruptor drug, we first developed a general pricing formula which can be applied to any drug a company wishes to analyze, given modest requirements for data. This establishes a base case for the expected effect that a drug will have on company costs. That is, it will gauge the potential impact a drug will have without the event of a price hike. Then, we estimate the probability of a price hike and multiply the increase onto the pricing formula. Finally, we account for the advent of new, high spending drugs. A more detailed exposition follows.

Section 1.3 Basic Pricing Formula

Our basic pricing methodology will take into account future prevalence rates, future population by age groups, average spending per user, and the number of beneficiaries to take a certain drug. We will first explain how we relate these factors and justify the assumptions in our model. Then we demonstrate an application of our methodology on the diabetes drugs Glucagen, Januvia, and Lantus for the years 2015-2020. We provide only a single application due to the vastness of available drugs and diseases, but the method can be applied to any drug the company wishes to analyze. Since we lack specific data on the company we represent, we decided that this flexible approach would be best.

Define:

λ_1 = Current number of people taking drug A aged 0-44

λ_2 = Current number of people taking drug A aged 45-64

λ_3 = Current number of people taking drug A aged 65-74

λ_4 = Current number of people taking drug A aged 75+

Ω = Population of age group i in year YYYY

φ = Disease rate of age group i in year YYYY

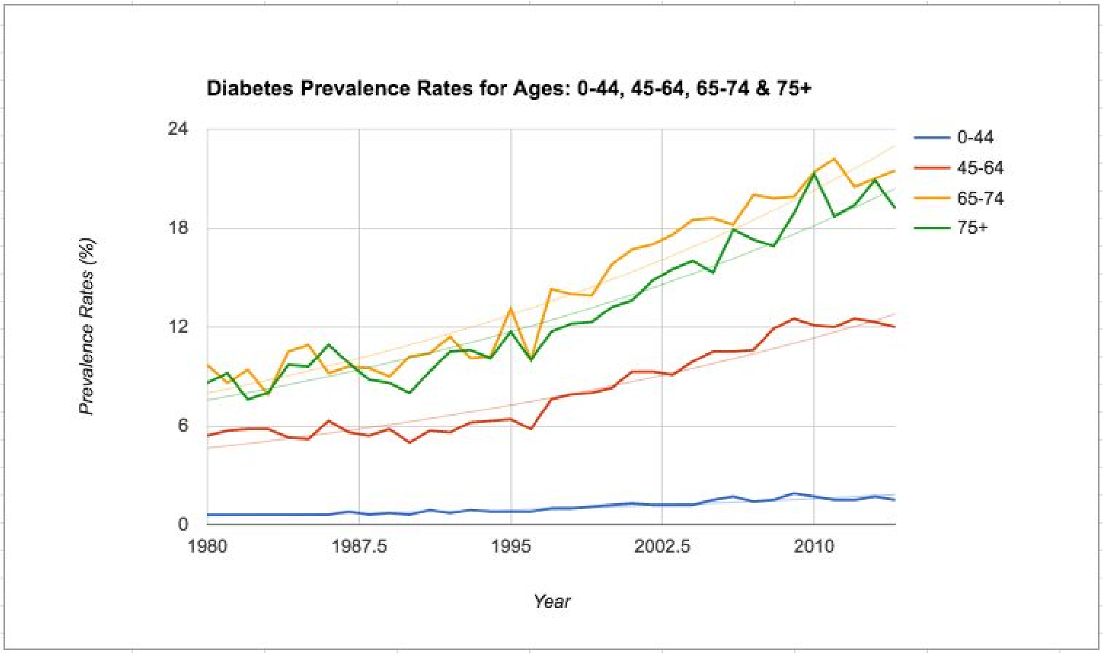
P = Average spending/user of age group i in year YYYY

$$\text{Spending in year YYYY} = \sum_{i=1}^{4} (\lambda_i * P_0)\left(\frac{\Omega_i * \varphi_i - \Omega_0 * \varphi_0}{\Omega_0 * \varphi_0}\right)\left(\frac{P_i - P_0}{P_0}\right)$$

This method has a set of assumptions inherent to all calculations. First, we assume drug use increases uniformly with disease. For example, if diabetes prevalence rates increase, we assume all diabetes drugs will experience a similar increase. This simplifying assumption is necessary for both practical and ideological reasons. We lack the data necessary to determine if this assumption can be verified. In addition, this assumption will give a worst case scenario in terms of costs, so it makes the calculation more conservative. We also ignore all behavioral shifts such as doctor biases toward a certain prescription. The main reason this is negligible is because the Brand-Name Prescription Drug Pricing report by the GAO found that price hikes are typically caused by a lack of competition among certain drugs as opposed to minute factors like favoritism. In addition, there have been crackdowns on doctors who specifically prescribe more expensive drugs due to a variety of reasons (Medicare Part B Drugs 2015). Because of this, we can reasonably neglect any behavioral trends in our method.

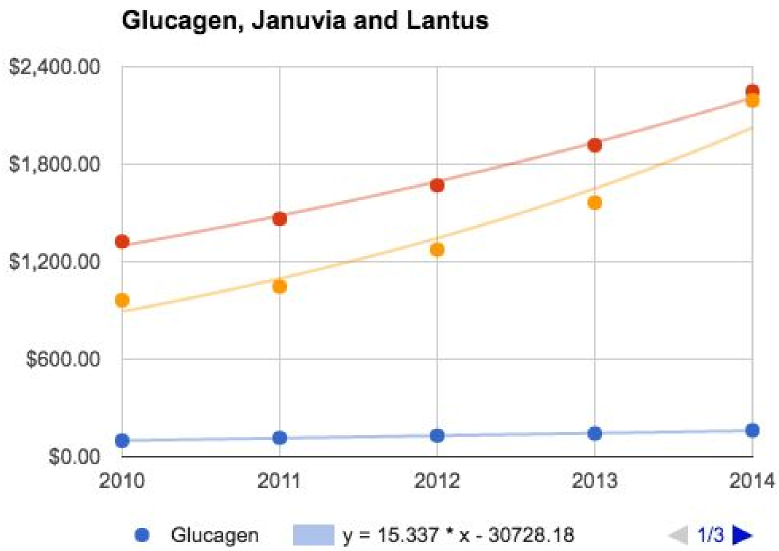
The following assumptions are specific to our demonstration of the method on diabetes drugs. First, we assume population grows linearly from 2015 to 2020. We have a breakdown of the population for 2015 and 2020 (Appendix A4). The data ranges from 2015 to 2060 and the population is supposed to grow exponentially. However, exponential models are locally linear and since we have only two data points over a short time period to interpolate, we decided a linear regression would be a better fit. Note that all numbers from drug prices and prevalence rates were obtained through regression models. This is only for convenience in the demonstration. More sophisticated projections could also be used if more information on prices and rates are readily available, but it would not affect the underlying formula. Lastly, assume that average spending per user is uniform across all age groups. This is simply a limitation of the CMS data set and the lack of public information regarding particluar usage per age group.

Here is a demonstration of our pricing methodology applied to diabetes drugs which are disruptors. To establish our model, we must find the projected figures for the diabetes prevalence rates, the total spending per user for the diabetes drugs are are disruptors, and the increase in population to conclude the projected spending per user for diabetes. From the yearly data of diabetes prevalence rates, we can model exponential and linear regression lines that best fit the historical trend.



Similarly, we extracted the drugs from the Medicare Drug Spending Dashboard, which has already categorized these drugs as high spending, that are used to treat diabetes. A regression model is then conducted to project the annual spending per user for each of these drugs for the next 5 years.

Total Annual Spending Per User			
	Glucagen	Januvia	Lantus
2010	$98.84	$1,324.48	$962.92
2011	$115.93	$1,463.65	$1,046.66
2012	$129.79	$1,669.74	$1,274.74
2013	$142.54	$1,917.26	$1,563.82
2014	$162.22	$2,247.40	$2,192.06



Linear Regression Models:

Let $x = year$

Glucagen: $y = 15.336x - 30726$

Januvia: $y = 1.71346 \times 10^{-113} \times exp(0.132748x)$

Lantus: $y = 1.91209 \times 10^{-176} exp(.204677x)$

Thus, with the predicted diabetes prevalence rates and the projected population of the United States, we are able to project the change in the diseased population. With the projected disease population and the projected average spending per user. Finally, we are able to predict the change in average spending per user for each drug for the next 5 years. The results are summarized in the table below. We disregard the age group: 0-44 years old because we are concerned with our current beneficiaries lapsing into other age groups, and it is not feasible to lapse into the 0-44 age group.

Projected Increase in Average Spending/User for Diabetes Drugs						
	45-64	2016	2017	2018	2019	2020
	% change in diseased population	2.97%	6.01%	9.22%	12.43%	15.80%
Glucagen	% change in avg spending/user	11.94%	24.48%	37.77%	51.61%	66.25%
Januvia	% change in avg spending/user	17.58%	38.25%	62.66%	91.20%	124.90%
Lantus	% change in avg spending/user	26.35%	59.64%	101.83%	154.95%	222.24%
	65-74	2016	2017	2018	2019	2020
	% change in diseased population	5.95%	12.06%	18.31%	24.72%	31.27%
Glucagen	% change in avg spending/user	8.71%	17.42%	26.14%	34.85%	43.56%
Januvia	% change in avg spending/user	14.20%	30.41%	48.92%	70.06%	94.20%
Lantus	% change in avg spending/user	22.71%	50.58%	84.79%	126.76%	178.26%
	75+	2016	2017	2018	2019	2020
	% change in diseased population	6.15%	6.05%	5.96%	5.88%	5.80%
Glucagen	% change in avg spending/user for	15.40%	14.55%	13.83%	13.19%	12.63%
Januvia	% change in avg spending/user for	21.22%	21.11%	21.01%	20.91%	20.82%
Lantus	% change in avg spending/user for	30.26%	30.14%	30.03%	29.93%	29.83%

Section 1.4 Inclusion of Price Hiking

Of the 80 drugs on the CMS dashboard that we analyzed, we have identified 6 drugs that experienced a price hike. We defined a price hike as an increase in prices of over 100%, and of the aforementioned drugs, the range of increase was from 100% - 300%. This finding is consistent with historical data, according to a GAO report from 2009 (Brand-Name Prescription Drug Pricing 2009). This range is a valid boundary because we want to determine drugs that will continue to affect costs, not just peek for a single year.

From this, we estimate that the probability for drug price hikes is 6/80. We recognize that this is a crude estimation for several reasons. Generic drugs tend not to experience price hikes because of the availability of viable alternatives. Typically, price hikes occur when a single distributor obtains a monopoly over a niche market or for whatever reason there is a lack of competition. In addition, there might be some interdependence between the prices of certain drugs. However, our estimate makes the simplifying assumption that the probability of a listed drug experiencing a price hike is uniformly distributed. Therefore, this probability is meant to be used as a rough estimate. To follow our approach of analyzing disruptors, this number could easily be substituted out for another probability obtained through more sophisticated techniques.

With this probability, we analyze best and worst case scenarios of a price hike by considering the range boundaries.

Financial impact of price hike

Best case = P(price hike) * 100%

Worst case = P(price hike) * 300%

These terms are to be multiplied onto our results from the previous pricing method. Thus, if Y is the expected cost of a drug, then Y*(Best case) and Y*(Worst case) will give the impact of a price hike on a certain drug. Note that these scenarios should only be applied to brand name drugs, since they are the only ones that can experience a price hike.

Section 1.5 Accounting for New Drugs

Due to the unpredictable nature of this potential disruptor, we decide to perform a worst case analysis. First, we examine historical data from the Drug Spending Dashboard and identified the drugs that recently emerged in 2014 and were of abnormally high spending (> 10,000 per user). Then, we established that on average 30 new drugs are approved by the FDA every year (Novel Drugs Summary 2015). From this we estimate the probability of a new drug coming out with a significant financial impact and determine the magnitude of said impact.

High spending new drugs tend to follow certain patterns. First, they treat specific conditions which are relatively not widespread. Second, it tends to be that intense research and development goes into chronic diseases of high mortality rates. In the case of 2014, the high spending drugs treated hepatitis C and various cancers, both of which are chronic and have a prevalence rate of < 5%. In our data, there were only 5 drugs out of the 30 new ones released which were of high spending.

From this we estimate that there is a 5/30 probability that a new drug comes out in any given year which will significantly affect costs. Based on the prevalence rates from Appendix A2 and our hypothesis that new drugs come out for rare and deadly diseases, we estimate that for some disease matching those characteristics, about 3% of the population will be affected. The average spending per user of such drugs is about $65,000, based on our available data. The total financial impact is then thereby determined with the following formula:

$$Financial\ impact\ of\ new\ drug\ =\ P(new\ drug) * \ \$65,000\ *\ (0.03 * \sum_{i=1}^{4} \lambda_i)$$

Section 1.6 Aggregation of Effects and Financial Evaluation

In conclusion, to analyze potential pharmaceutical disruptors we recommend first picking a certain disease to focus on. Then, using our pricing methodology, determine the expected financial impact. Multiply onto this result estimates which account for the probability of a price hike. Then add on the dummy variable that accounts for potential new drugs. In summary, if X disruptor effects of a certain disease and you want the worst case scenario:

$$X = (3)P(price\ hike)[\sum_{i=1}^{4}(\lambda_i * P_0)(\frac{\Omega_i * \varphi_i - \Omega_0 * \varphi_0}{\Omega_0 * \varphi_0})(\frac{P_i - P_0}{P_0})] + P(new\ drug) * \$65,000 * (0.03 * \sum_{i=1}^{4}\lambda_i)$$

The best case scenario is similar.

For diabetes, using the formula above, the financial impact of new drug can be calculated to be:

Financial Impact of New Drug					
Year	2016	2017	2018	2019	2020
$	$6,874,955	$7,181,263	$7,499,046	$7,824,465	$8,162,332

Then taking into account the financial impact of new drugs as well as the projected spending per year for each drug, the worst case scenario when taking into account the effect of a disruptor:

Spending per year:	2016	2017	2018	2019	2020
Glucagen	$4,048,321.64	$4,567,446.14	$5,123,641.82	$5,715,134.61	$6,347,138.67
Januvia	$60,972,900.85	$72,729,196.47	$98,524,495.27	$109,756,292.44	$123,110,356.64
Lantua	$68,607,738.62	$82,628,711.26	$105,887,628.29	$135,574,633.09	$173,552,903.03

Expected Financial Impact of Disruptor Drugs for Diabetes					
	2016	2017	2018	2019	2020
Glucagen	$910,872	$1,027,675	$1,152,819	$1,285,905	$1,428,106
Januvia	$13,718,903	$16,364,069	$22,168,011	$24,695,166	$27,699,830
Lantua	$15,436,741	$18,591,460	$23,824,716	$30,504,292	$39,049,403

This method takes accounts for the projected spending of the drugs have been concluded to be disruptors for a certain disease, the likelihood of new drugs and price hikes to project the financial impact of disruptors on their respective disease.

Section 1.7 Accuracy Evaluation

In our demonstration, we recognize that our projections within each variable for future years might be incorrect. These projections are used for convenience of the demonstration as our purpose is to present a complete methodology and explain the way different variables relate to each other. However, because the input variables, such as population and prevalence rates, can vary by large margins depending on which drug the formula is applied to, a general error cannot be derived. Rather, by referring to the code and reproduction section, the method to generating Monte Carlo simulations can be applied to this formula to assess variation and error.

PART II: PHYSICIAN FEE DISRUPTORS

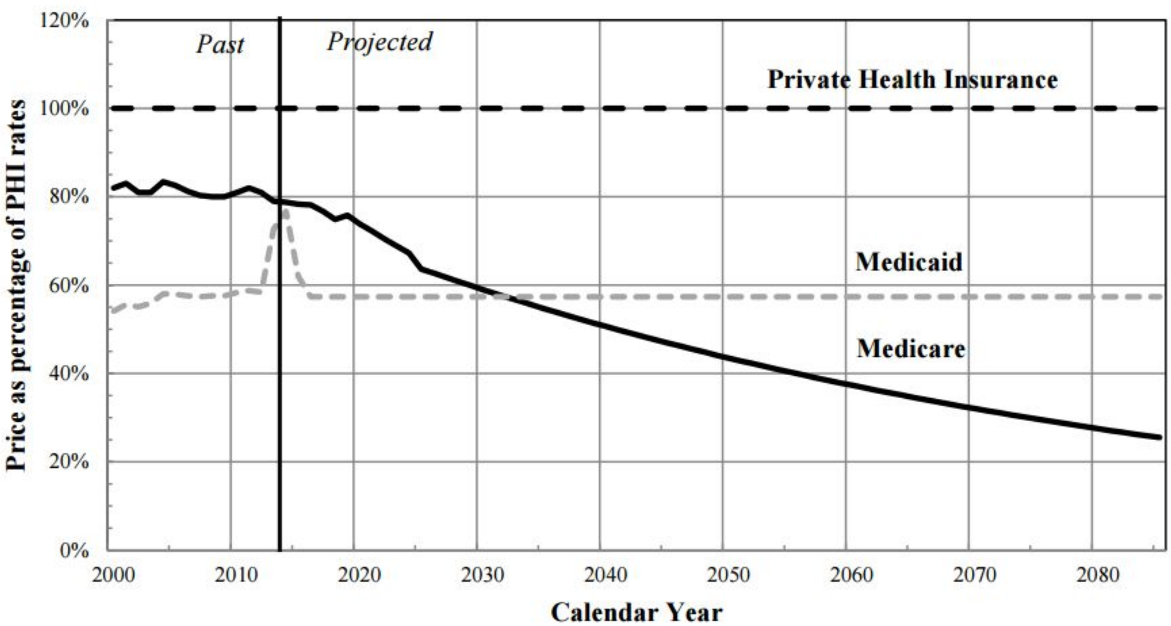
Section 2.1 Data Exploration and Collection

In regards to physician fees, we determined that most of the relevant disruptors involved legislation as opposed to trends in data. This is a direct consequence of the 2015 legislation which repealed the SGR and replaced the physician fee updates with a more systematic approach. As such, the numbers and estimates used in the projections derives from CMS actuary reports, CMS published legislation, MedPAC reports, and one independent case study.

To validate our data, we considered any report from government sources such as CMS and MedPAC to be inherently reliable. The case study used in our physician fee analysis was also deemed valid as it was written by UCSD economics professors and published in the National Bureau of Economic Research. Furthermore, the sources we used are appropriately recent and were published in 2013 latest.

Since our company acts as a private entity and the data on private insurance physician fees are extremely limited while a plethora of data and literature existed for Medicare physician fees, data exploration began with the search for a link between private insurance fees and Medicare fees, which led us to the 2013 case study "How Medicare Shapes the US Health Sector" (Clemens, 2013). In brief, the paper investigated the "cost-following" nature of private insurance physician fees, explaining that the typical fee is set through negotiation between physicians and insurers, resulting in a markup with the Medicare Physician Fee Schedule as the baseline. While the magnitude of the markup depends on minute characteristics such as local availability of insurance, specific physician procedure, etc., the overarching relationship between the two can ultimately be generalized. As of 2013, the paper concluded that across “various regional and economic and demographic characteristics,” for every increase of $1 in Medicare fees, there is a consequential increase of $1.2 in private insurance physician spending. The findings of this article are consistent to the 2016 MedPAC report on physician fee updates, which also stated that the ratio of fees between Medicare fees and private insurance fees has historically been approximately 0.8. However, we considered the possibility that this ratio could act as a disruptor, and examined its potential to change in the future and affect finances. This led us to the 2015 CMS actuary report (Shatto 2015), which suggests that the ratio will gradually decrease with time. That is, within the next five years (and after), every dollar spent on physicians in Medicare will result in an increasing amount spent in private insurance, as shown in the graph below. In particular, our estimates of the future ratio based on this graph are presented in a chart below.

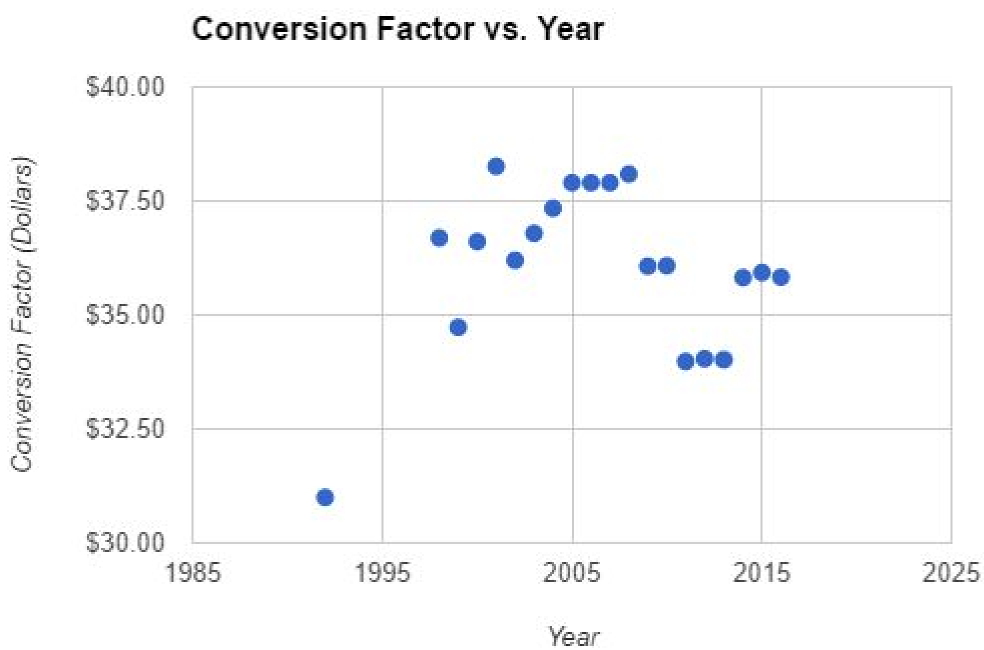
Figure 2. Illustrative comparison of relative Medicare, Medicaid, and private health insurance prices for physician services under current law



(Source: Projected Medicare Expenditures under an Illustrative Scenario with Alternative Payment Updates to Medicare Providers. J. Shatto)

Year	2015	2016	2017	2018	2019	2020	2021
Medicare : Private Insurance Ratio	79%	79%	78%	76%	75%	75%	73%

Having established the connection between private insurance fees and Medicare fees, we sought to investigate financial factors in the Medicare Physician Fee schedule. By determining the Medicare Physician Fee and its disruptors, we can translate the financial impacts of Medicare disruptors to fit our company. In summary, the Medicare physician fees are traditionally dictated by two elements, the Relative Value Units (RVU) and a conversion factor (CF). The RVU's can be thought of as the weight of the physician procedure, while the CF converts the weight into an actual payment. Due to the nature of RVU's, which have to do with mostly consistent factors like work schedule and malpractice, we have deemed that it is not a disruptor and therefore not worthy of further investigation. Thus we continue to examine disruptors in the CF. Below is a graph of the historical conversion factors



(chart in Appendix B.1. Source: History of Medicare Conversion Factors AAAP)

Traditionally, the CF was primarily determined through a mathematical formula which utilized the Sustainable Growth Rate (SGR) amongst other factors, but recently, the Medicare Access & CHIP Reauthorization Act of 2015 (MACRA) legislation completely overhauled the CF calculation method as it repealed the SGR. Furthermore, other old payment modifiers such as Value-Based payment scalar have also been replaced, leaving the CF to be determined by systematic methods such as the Merit-Based Incentive Payment System (MIPS) and Alternative Payment Methods (APM) payment structures (explained below). As such, we deemed that drawing upon past data and using trends mathematically to project the CF's calculation through components such as SGR was mostly futile, and turned to evaluating the new ways that the CF is to be determined. Because this legislation was instated in 2015, data mostly does not yet exist, which forced us to take a more qualitative route to determining disruptors by reading and evaluating the impact of CF scalars proposed in MACRA legislation. We found that specifically, the CF for 2016 was determined by four factors that could affect our financial bottom line.

1) Last year's CF. This is well established and determined to be $35.7547

2) Budget Neutrality. Medicare has a target spending range and budget neutrality exists to scale spending downwards by lowering the CF until it is within bounds.

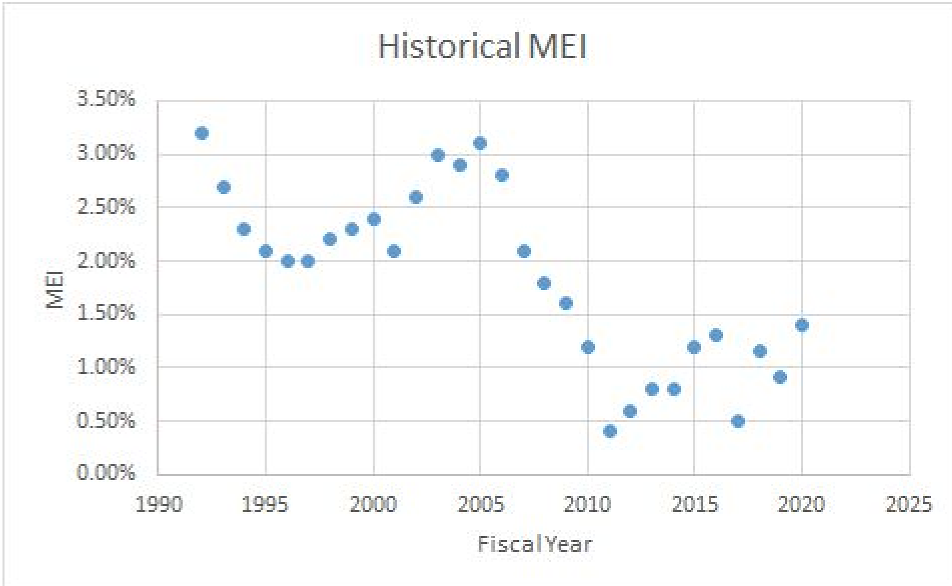
3) Misvalued Codes. Medicare has identified a total of 118 "high expenditure" medical practices estimated to be overpriced. Misvalued codes thus exists to bring spending on those codes down by a target of 1%

4) MACRA Legislation. This component of CF is split into two *mutually exclusive* parts. Both involve bonuses (or penalties) towards physician payments. Physicians under Medicare have a choice of which program to enroll in.

   a) MIPS: Provides payment bonuses of 0.5% for the next 3 years, and then changes to a bonus/penalty system based on performance and adherence to MIPS standards, which involve quality of care and resourceful usage.

   b) APM: Provides payment bonuses of 0.75% for the next 3 years, and then changes to lump sum percentage bonuses based on adherence to APM standards, which involve performing more complicated treatments.

On top of these figures, there remained two factors outside of the CF that we suspected could impact our financial standings. The Medicare Economic Index (MEI), which represents inflationary medical expenses relative to GDP, and the patient volume, which refers to the increasing utilization of physicians. To find data on these two factors, we used past data on MEI, presented in the graph on the next page



(Chart in Appendix B.2.)

In terms of physician use volume, we used the 2016 Physician MedPAC report, which accounted for physician services in terms of volume and intensity by examining physician RVU's across various practices. The conclusion suggested that overall, in 2013-2014, physician services increased by 0.3% in terms of units of service per beneficiary, and increased by 0.4% in terms of volume per beneficiary (that is, the increase in both number of beneficiaries and the intensity of the practice). The magnitude of this recent change is relatively consistent with the same measurements' historical changes. Previous MedPAC reports (MedPAC 2013 Physician report), which estimated a -0.1% change in units of service and -0.2% change in volume.

Section 2.2 Methods, Analysis, and Models

The issue was determining precisely what factors would have a substantial financial impact on the Medicare physician expenditures and how they will change in the upcoming 5 years. We first assumed that Medicare physician payments will continue to share a relationship with private insurance payments as outlined in the 2013 case study "How Medicare Shapes the US Health Sector" mentioned earlier. Considering the history of this relationship and the studies done, we felt this was a robust assumption, especially on a local range of 0-5 years. Therefore, we accounted for this as a dummy variable for when the ratio changes. If it goes up, then physician fees are scaled up; if it remains constant, then no scaling is applied.

We also assumed that the estimations given by CMS (Spitalnic 2015) and the National Business Group on Health (Emerman 2016) that 55% of physicians participated in an alternative payment model (APM) in 2015 that 100% of physicians will participate by 2038 are accurate. Using these figures, we used a linear model to project the percentage of physicians who will participate in APM. We felt a linear model was appropriate because we determined that no apparent forces would cause it to grow in any other way.

Finally, we assumed that physician fees could be generalized for all physicians. In reality, specific RVUs fluctuate, sometimes wildly at increases or decreases of approximately 10% (APTA 2013). However, due to the lack of information on which of the hundreds of codes that could change and the lack of consistency with magnitude as well as direction, we could not adequately perform an analysis that included these variables. Thus, we looked into intensity of physician procedures as an aggregate, and assumed that the volume and frequency scalar (explained below) would introduce a significant impact that accounts for the change in RVU codes.

Section 2.3 Expected Disruptors and Quantitative Evaluation

Key disruptors were selected based on whether we found them to have a substantial financial impact on physician payments over the next 5 years. To begin, we ruled out two pieces of CF calculation-budget neutrality and MIPS. Budget neutrality was ruled out because it technically should not affect payments in the first place since it refers to budget planning errors on the government's part. Furthermore, even if it exists, it represents a negligibly small magnitude (0.02% in 2015) and can only scale the CF downwards. Thus ignoring it acts as a conservative estimate. MIPS was also excluded from our list of disruptors. This is because it has a low incentive, it is expected to lose out participation to its alternative APM, and because it is a zero-sum mechanism. That is, for every dollar that a physician receives as bonus, another physician loses one dollar as penalty.

Participation in alternative payment models was selected as a disruptor, as it is a new feature in MACRA and is expected to grow relatively quickly in popularity over the next two decades due to its high bonus incentive, which would also heavily impact costs[1]. Accordingly, we assume that 100% of the physicians in APM will receive the 5% bonus due to its high incentive.

Adjustments to misvalued codes were determined as a disruptor because of their impacts on the conversion factor used in calculating physician payments. In 2016, the low savings resulting from this

[1] Specifically, the large bonuses it plans to give physicians (.75% from 2016 to 2018 and 5% from 2019 to 2021 if requirements are fulfilled), makes it a significant factor that will increase costs substantially

factor caused a .77% decrease in the conversion factor, causing physician payments to decrease instead of increase for that year (CMS Revisions to Payment Policy 2016). Misvalued Codes still poses as a relevant disruptor as it continues to change (from 103 codes in 2015 to 118 in 2016). As such, we deemed that its effect should be accounted for in the calculation of physician payments in 2016-2021 when these reductions will still be in effect. Because of the extremely unpredictable nature of this factor given its recent inception, we opted to treat this factor as a bounded random value with uniform probability which will be assigned to the savings that result from the adjustments to misvalued codes for the years 2017 and 2018. We assume this will be in the range [0%, 0.5%] because we can reasonably expect that the savings will not exceed the target 0.5% target expenditure reductions that Congress has set for Medicare's physician payments ("2016 Proposed Medicare Physician Fee Schedule Analysis", 2016), as its value for 2016 was only .23%.

As for MEI, we will also consider this scaling factor as a bounded random variable. This is because MEI represents a macroeconomic measurement which accounts for inflationary factors involving GDP and as such is incredibly difficult to project. Furthermore, as demonstrated in the graph above, a consistent trend line does not fit the data, therefore regression is insufficient. A CMS actuarial report (Spitalnic 2015) uses an estimate of 1.2% for the upcoming years to account for the factor. We will therefore use 1.2% as a baseline, and based on its historical fluctuations in the last 5 years, treat it as a random variable with bell curve behavior, assuming a mean of 1.2% and standard deviation of .1%. The assumption made is that MEI will not behave abnormally relative to its history, which is reasonable since MEI tends to refrain from exhibiting dramatic behavior on a 5 year scale [2].

The variable that is most open to fluctuation is the volume/intensity factor. Although we have very strong reason to assume a strict increase due to baby boomers, this factor is the most inconsistent overall. Fortunately, these factors change within small margins, so again, a weighted probability simulation will be used. According to the 2016 March Physician MedPAC report, the average change from 2011-2013 in units/beneficiary was 1.4% while the change in volume was about 2%. Then from 2011- 2013 it has been about -0.1% for units/beneficiary and 0.2% for volume. In 2013-2014, both rates became positive, with units/beneficiary at 0.3% and volume at 0.4%. This means that we can expect our base rate to be 1.004 * 1.003 = 1.007012 = 0.7012%. Then based off its historical behavior, we concluded that a fair estimate would reside in the range of ±0.5% as this bound has been consistent in the local 5 year time frame. However, to account the emergence of retiring baby boomers who have greater needs for physician needs in all departments (e.g. imaging, surgery, bone and joint repair/replacement), we also

[2] The only time MEI behaved dramatically was during the 2008 economic crisis, and has since stabilized. Thus, it is unlikely to change within the next five years assuming no economic turmoils.

concluded that the fluctuations would be much more likely skewed towards positive increases. To simulate this while accounting for baby boomers, we weighed a positive increase as 80% more likely to occur, and if a negative error occurs, then we expect its magnitude to be no more than 0.3% due to the offset that would be caused by the aging population and disease prevalence rates increasing,

Section 2.4 Model Construction and Financial Evaluation

We denote all of the factors given above as the following: percent participation in APMs (τ), APM bonus set in given year (APM), target reduction in physician expenditures in given year - savings from adjustments to misvalued codes (Γ) , ratio of private insurance payments to Medicare payments in given year (δ), MEI scalar (MEI), and physician volume/intensity/frequency factor ($\Lambda = (1.04) * (1.03$). Given all of the factors outlined above, the expected percentage change in the Company's is modeled by the following equation, which weighs each factor according to how it affects overall payments:

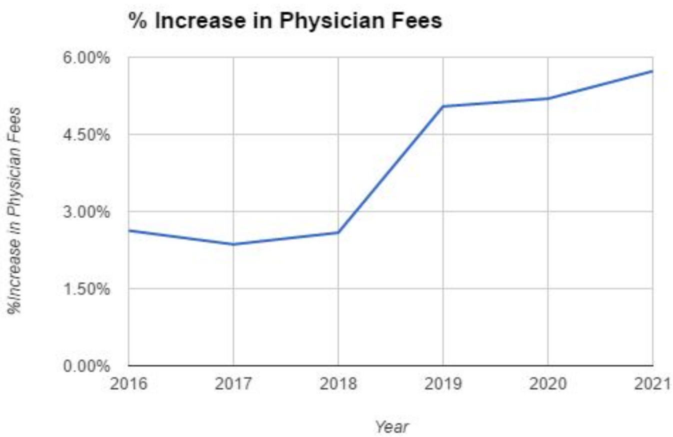
$$\%\Delta = (1 + [(\tau * APM) * (1 - \Gamma)]) * \delta * (1 + MEI) * \Lambda$$

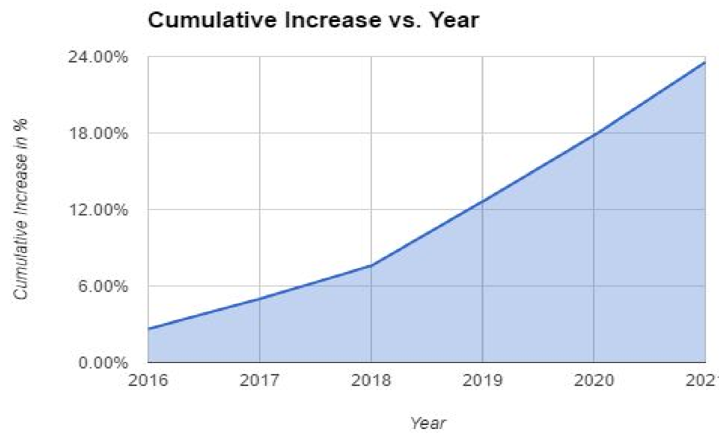
Year	2015	2016	2017	2018	2019	2020	2021
τ	0.55964	0.57921	0.59878	0.61835	0.63792	0.65749	0.67706
APM	0.50%	0.50%	0.50%	0.50%	5%	5%	5%
Γ	0.77%	0.41%	0.10%	0.11%	0.11%	0.44%	0.20%
δ	1.00000	1.000000	1.012821	1.026316	1.013333	1.000000	1.027397
MEI	1.20%	1.58%	1.20%	1.39%	1.18%	0.93%	1.42%
Λ	1.007012	1.007412	1.008412	1.008612	1.005712	1.009212	1.007512

Note: Gamma, lambda, and MEI are random bounded variables, and can be made more specific as time passes and more information is revealed regarding the two scalars. The volume conversion factor will also become more apparent as recent trends stabilize.

This percent change is used by plugging in the variables multiplying the previous year's spending on physician payments to calculate the current year's expected spending. A sample calculation is demonstrated below; using the formula and the above numbers obtained from simulations, the percentage change is calculated for each year.

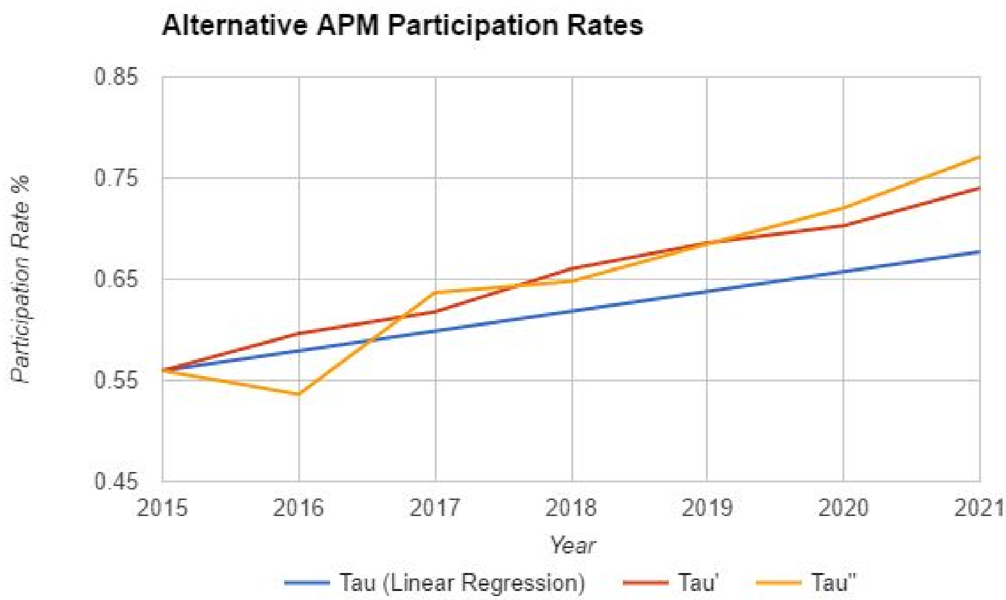
Year	2016	2017	2018	2019	2020	2021
%Increase in Physician Fees	2.63%	2.36%	2.59%	5.04%	5.19%	5.73%





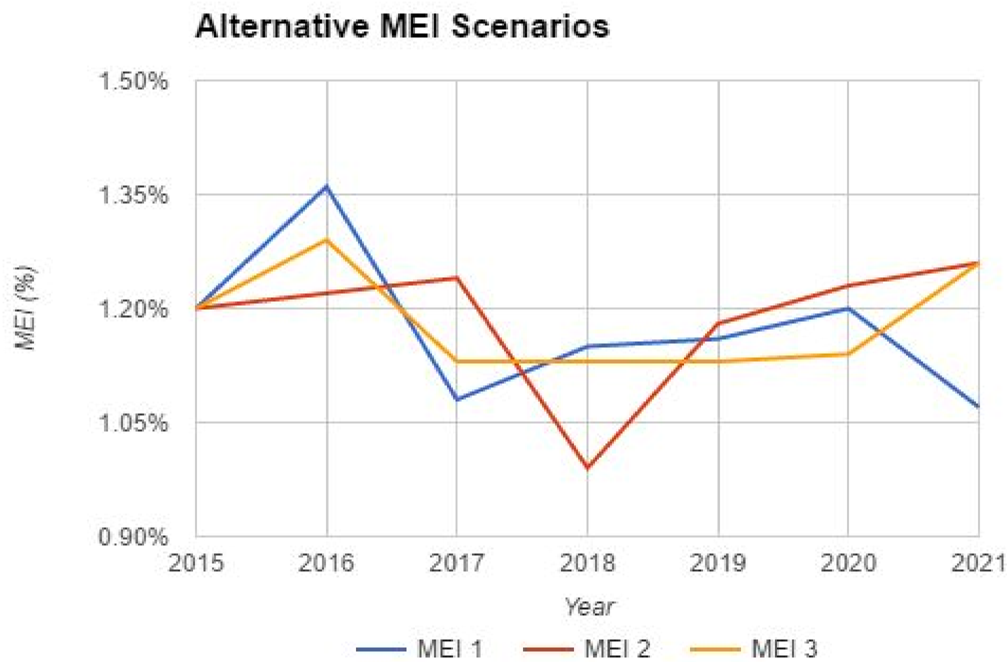
Section 2.5 Accuracy Evaluation

Most of the error in the presented equation derives from the inclusion of dummy variables and bounded random variables. This section will evaluate the possible variance brought by the relevant variables. To begin, the percent participation in junction with the APM legislation bonuses could pose as a very wide miss. Due to the newness of MACRA legislation and lack of polling doctors regarding APM vs. MIPS participation, the percentage could vary somewhat greatly under two possible scenarios. That is, it could either increase quicker than we expect or participation rates could drop and thus an error of 10% each year would not be unreasonable. However, because of the high incentives towards the APM program, we reason that it is more likely that an increase will occur. Thus, the error is weighted in favor of the positive increase by 50% (i.e. our simulation, it is 50% more likely that the error will be positive). Furthermore, we assume that once participation rates have increased, they will not drop (assuming doctors are consistent with their choices) Below is a demonstration of three scenarios. The red line indicates the scenario where participation increases faster than expectation and the yellow line represents an initial drop in participation (perhaps due to unfamiliarity with APM ruling) and then a gradual pick up.



Because of the savings resulting from adjustments to misvalued codes will be uniformly randomly generated between 0% and 0.5% of total physician payments, this figure will have margin of error that covers the entire range of possible values. Thus, Γ may be off by a maximum of 0.5%. However, given its small magnitude to begin with, it should not affect the bottom line very dramatically. Note that the best case is that Medicare indeed determines that some physician services are overvalued, and the payment towards those procedures decrease.

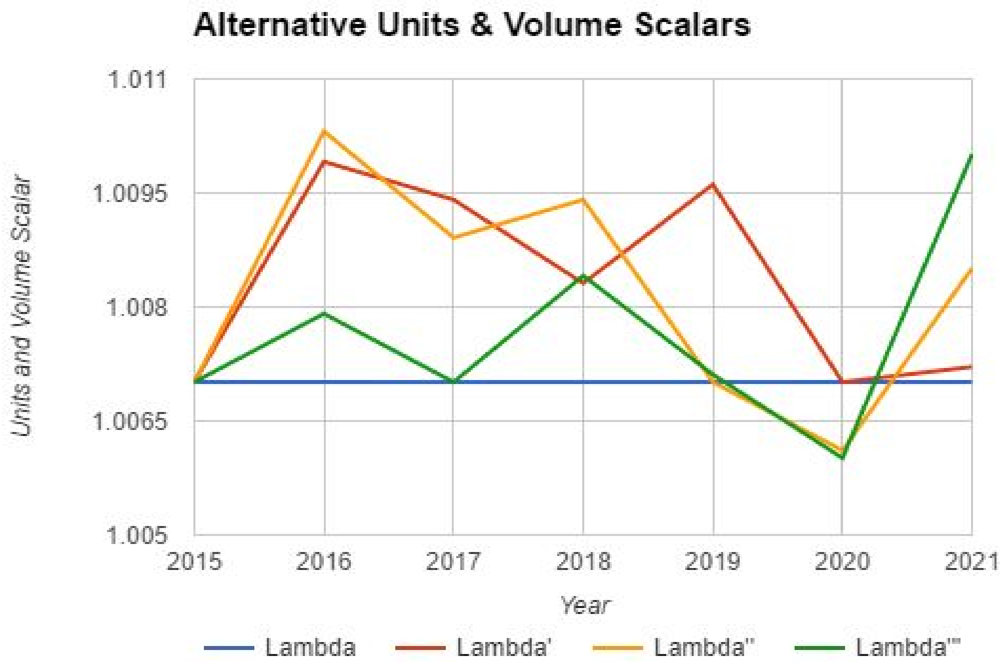
Extending this argument to MEI percentages, the margin of error is also expected to potentially be off by a maximum of 0.4% according to recent historical fluctuations with a standard deviation of approximately 0.1%. The best case would be a slow increase or a reversal in trends. The graph on the next page demonstrates some possible scenarios for future MEI rates.



For the Medicare to private insurance physician fee payment ratio, we reason that if this dummy variable is off, it will again only be marginally so. We base this claim off the MedPAC's 2016 Physician report which concluded that historically, this ratio has been stably hovering at around 0.8, and has only very recently started to decrease due to recent legislature which complicated the SGR payment method. Some instability is to be expected, but we estimate that due to historical data, the error will be bounded between [-1%,1%]. The best case is that it remains close to 0.8%, however, a favorable increase in the ratio is highly unlikely. The aforementioned case study (Clemens 2013) suggests that this ratio has to do primarily with bargaining power; it found that areas with large physician groups tended to hold higher payments and vice versa. At the same time, the recent trend is that physicians are clearly moving away from private practice and aggregating into hospitals and large clinics (Francis 2015). If the negotiation mechanism remains consistent, then physician negotiation power can be expected to rise. Thus the possible error should be expected to act as a strictly downward force on the trends.

Lastly, the accuracy of the units/beneficiary and volume is considered to be the most unstable. Again, while it is much more likely that we observe these traits increase, it is still possible that they drop due to a myriad of factors such as better drugs/home diagnosis technology/better health trends. Nevertheless, because both factors have not changed by 0.5% in aggregate over the last ten years

(MedPAC 2016 Physician Report), it is a safe error bound. A few scenarios are presented in the graph below.



PART III: OUTPATIENT SERVICES DISRUPTORS

Section 3.1 Data Exploration and Collection

When it came to outpatient data, we needed quantitative data on the spending towards outpatient services as well as the beneficiaries. To this end, we used CMS as our primary data source, which we considered strongly reliable. After drawing and observing trends from the data, we sought methods to explain them through recent medical journals and news reports. In doing so, we endeavored to use only sources we considered reliable.

We began our data collection for outpatient services keeping in mind that we could observe vastly different trends across the myriad of outpatient services. We expected that procedures related to increasingly prevalent diseases and/or the aging population would exhibit signs of increasing beneficiaries. But we also considered the possibility of cost increase, which could be attributed to technology or new surgical procedures. Thus, we focused on unveiling trends in beneficiaries and cost for specific procedures. First, we utilized CMS data on plan B procedures in terms of allowed general procedures and spending. This allowed us to form an overall sense of which departments to inspect closely. Below is an excerpt of the data.

Allowed Services per Year				
0 indicates non-existent/irrelevant data	2009	2010	2011	2012
General Practice	14843414	13209720	11238436	10175022
General Surgery	14830137	14299776	14141904	13790616
Allergy/Immunology	13282567	13651740	14196389	14917397
Otolaryngology	14608548	14561364	14855648	15239295
Anesthesiology	18178946	17214642	16337046	16912123
Cardiology	114323919	108376913	99097940	92995136
Dermatology	41110432	41713006	42536090	43737439
Family Practice	130541579	132463569	132174323	139684602
Interventional Pain Management	9152173	9188758	9072684	9476776
Gastroenterology	16739083	16867272	17407207	17489030

Chart in Appendix C1

However, after searching extensively for data on specific hospital outpatient services, we deemed that due to the limitations of recent and publicly available quantitative data, we would have to use only CMS data describing outpatient procedure data in terms of costs and number of beneficiaries over the released years (2011-2013). The obvious limitation of using CMS as a source is that the data would refer to Medicare beneficiaries, which means that we have assume that it is valid to generalize the data to the entire age population. Another issue we tried to account for qualitatively is whether increases in beneficiaries are due to recent legislation like ACA which simply allows more access to health care or rather due to actual demand for such services. On the flip side, the advantage is that the baby boomer effect would be more apparent and emphasized in both number of beneficiaries and cost, which means that the the Company can make conservative preparations. Below is an excerpt of the data

Total Payments	2011	2012	2013	Average % Change
0012 - Level I Debridement & Destruction	$20,478,235.40	$22,593,689.44	$25,629,428.99	11.8832%
0013 - Level II Debridement & Destruction	$85,276,276.02	$97,037,388.14	$106,312,468.00	11.6750%
0015 - Level III Debridement & Destruction	$166,376,564.00	$190,840,157.19	$216,856,780.65	14.1682%
0019 - Level I Excision/ Biopsy	$56,087,194.80	$59,867,569.24	$63,262,377.66	6.2054%
0020 - Level II Excision/ Biopsy	$128,488,057.32	$141,503,856.12	$148,213,926.63	7.4360%
0073 - Level III Endoscopy Upper Airway	$8,178,779.84	$9,996,042.74	$10,697,860.70	14.6201%
0074 - Level IV Endoscopy Upper Airway	$117,871,067.84	$127,386,099.28	$101,005,153.20	-6.3185%
0078 - Level III Pulmonary Treatment	$124,905,865.20	$140,578,536.00	$144,235,559.16	7.5745%
0096 - Level II Noninvasive Physiologic Studies	$165,194,229.85	$156,557,299.62	$147,848,980.30	-5.3954%
0203 - Level IV Nerve Injections	$25,024,553.12	$32,721,280.00	$34,617,963.52	18.2766%
0204 - Level I Nerve Injections	$201,874,689.00	$237,626,184.96	$288,366,961.25	19.5315%
0206 - Level II Nerve Injections	$52,146,220.86	$61,060,025.88	$68,223,787.14	14.4131%
0207 - Level III Nerve Injections	$1,164,320,281.80	$1,225,191,018.24	$1,258,664,656.55	3.9801%

Chart in Appendix C.2

Ultimately, we collected and sorted data on these specific hospital procedures and separated them into beneficiaries, average cost/procedure, and total cost, and used this to decide which procedures were relevant, if they had a common factor, and whether we could designate those factors as disruptors.

Section 3.2 Methods, Models, and Analysis

Upon gathering our data, we computed the total cost per year and the associated average change in cost. From inspection, we designated a threshold change of +10.00% as significant enough to warrant consideration as a potential disruptor. Thus, we gathered a list of procedures which fit that trait and invested the two outlets which contributed to the price change - cost of procedure and number of beneficiaries. Our analysis yielded a list of 6 procedures of varying levels which could be disruptors.

0012 - Level I Debridement & Destruction

0013 - Level II Debridement & Destruction

0015 - Level III Debridement & Destruction

0073 - Level III Endoscopy Upper Airway

0203 - Level IV Nerve Injections

0204 - Level I Nerve Injections

0206 - Level II Nerve Injections

0269 - Level II Echocardiogram Without Contrast

0270 - Level III Echocardiogram Without Contrast

0369 - Level III Pulmonary Tests

0604 - Level 1 Hospital Clinic Visits

0605 - Level 2 Hospital Clinic Visits

0606 - Level 3 Hospital Clinic Visits

0607 - Level 4 Hospital Clinic Visits

0690 - Level I Electronic Analysis of Devices

0692 - Level II Electronic Analysis of Devices

Thus, we decided to analyze each hospital procedure separately and consider three factors as potential disruptors.

1) Beneficiaries: We needed to consider how demographic shifts would increase demand for certain procedures
2) Cost of procedure: Anything that could bring an increase to procedures
    a) Technology/Legislature/Behavioral shifts: We considered emergence of new and expensive technology or material, legislature that demanded changes in treatment, and behavioral pressures from the public and/or medical community regarding specific procedures that affected cost.

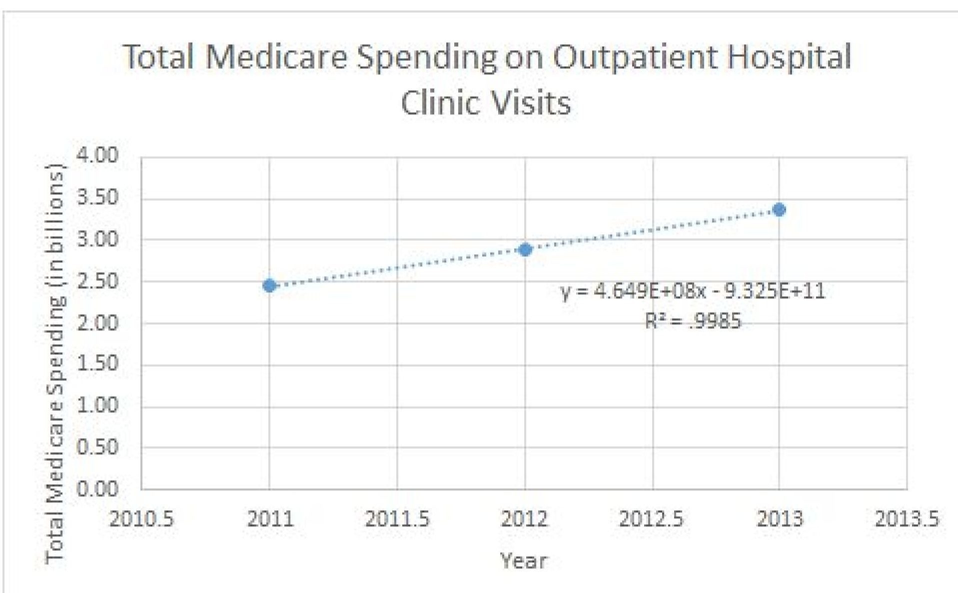
Section 3.3 Debridement and Destruction

Debridement refers to the removal of dead tissue from a wound and is distinguished into 3 categories. The price of the procedure is contingent on two factors – the length of time and frequency. According to the data, debridement mostly appears to be decreasing in costs, with an average decrease of 3.43% for level 1 and 1.61% for level 2. This makes sense since debridement is a very well established category where there exist a variety of methods to treat common issues. For example, on top of surgical debridement, chemical, mechanical, and autolytic debridement are other well-known methods. Furthermore, there is no immediate demand nor external factors that would point towards research into advanced debridement techniques/technology. Level 3 procedures have increased in cost, but our research found no recent evidence of this trend continuing past 2013, nor did we find a clear reason for the increase either. Therefore, we concluded no apparent disruptors should affect the price end.

On the beneficiary's end of debridement, increases were apparent in every level. However, upon further examination of evidence of news reports and medical journals from 2011-2015 regarding debridement services and prevalence rates of related conditions, the increase in beneficiaries could not be attributed to any factors aside from increasing access to health care. As such, we concluded that debridement would not pose as a disruptor on any end.

Section 3.4 Level I-IV Hospital Clinic Visits

Based on the CMS charge data, total Medicare payments on levels I-IV hospital clinic visits increased at very significant percentage rates ranging from 13.57% to 21.44% per year. Upon investigating the cause behind this growth in spending, we discovered that average issued charges were decreasing at rates between 3.59% and 5.07% for levels II-IV and increasing at a modest rate of only 1.70% for level I. However, the number of outpatient services for hospital visits rose at significantly higher rates from 11.69% to 28.09% per year. Clearly, CMS's data reveals the rising number of outpatient beneficiaries to be the primary factor driving Medicare spending to increase. Thus, baby boomers were determined to be a significant disruptor, as shifts in populations demographics towards the elderly, who are more likely to suffer from health problems that will cause them to visit the hospital, was the most likely cause behind these increases in outpatient services.



As can be seen in the graph above , total spending on hospital clinic visits rose in a very linear fashion from 2011 to 2013 as pictured above. Since changes in spending should be similar for the Company, we can project their spending from 2016 to 2020 using a linear model with a rate of change scaled to their spending levels. Using linear regression, we can project Medicare's spending on hospital clinic visits to be $4.2735 billion at 2015. We can then take the Company's spending for this procedure at 2015 and scale it[3] to find the appropriate rate of change for the Company. The resulting linear equation would be as follows:

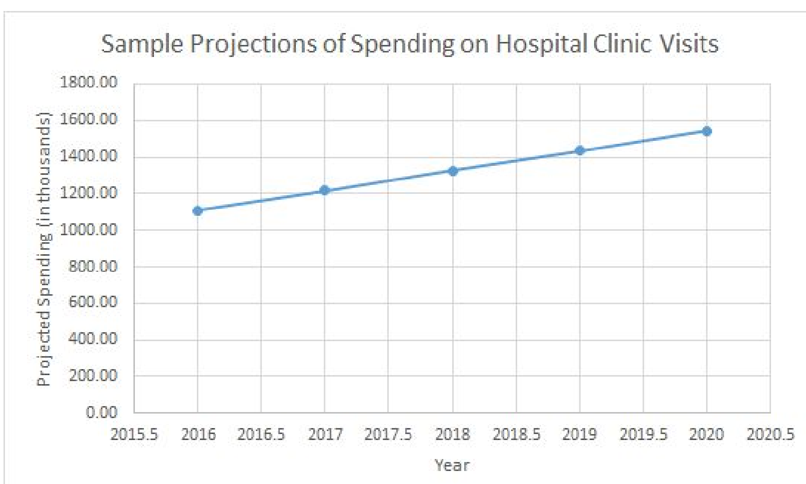
y = 4.64920E+08*x - 9.32515E+11

X = year of interest

Y = Company's projected spending for that year in clinic outpatient visits

A sample demonstration is shown below, where the Company's spending for 2015 is assumed to be $1,000,000. The rate of change for the Company would be (1,000,000 / 4,273,500,000) * 464,920,000 = $108,791.39 per year. Using a linear model, the projections for the years 2016 to 2020 would be as follows:

Year	2016	2017	2018	2019	2020
Projected Spending	$1,108,791.39	$1,217,582.78	$1,326,374.17	$1,435,165.56	1,543,956.94



[3] That is, divide it by $430 million, and multiply by $465 million (the rate of change for Medicare spending)

Based on these sample calculations, we can see that spending should rise at a constant rate of 10.88% of the Company's spending level in 2015.

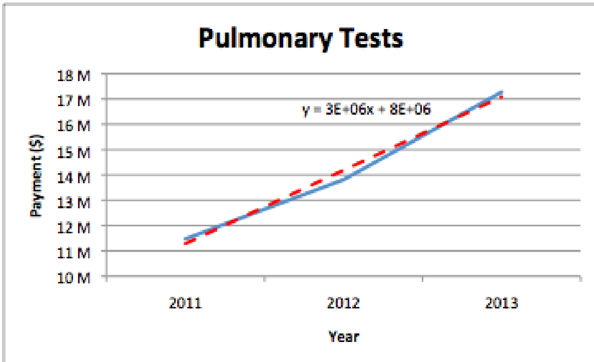
Any error in the projections made from this model would originate from the linear regression used to fit the data for total spending during the years 2011 to 2013. To precisely determine the margin of error in the Company's projections, we will use the standard error[4]. This gives a value of $14,955,958.03 based on the data shown in the graph above. Dividing this by the most recent spending level in 2013 yields a percent error margin of 0.44%, which can be applied to the Company's projections of their own spending hospital clinic visits. This is a very minute margin that suggests high accuracy in the projections the Company makes with this model.

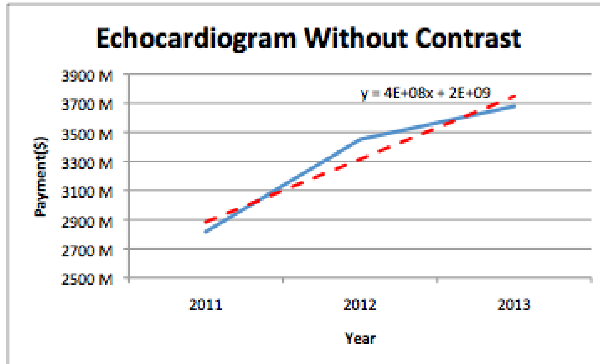
Section 3.5 Echocardiograms Without Contrast, Pulmonary Tests

The total payments for Echocardiogram Without Contrast as well as Pulmonary Tests increased significantly from 2011 to 2013. Again, research suggested that the change in spending in both of these services is likely to be attributed to baby boomers, as, based on the CMS charge data, the total number of outpatient beneficiaries rose 8.97% on average. Although the average issued charges of echocardiograms increased by about 4% each year, there is a relatively low cost of machines (under $300,000) (Goozner 2014). For echocardiograms without contrast, the cost of equipment has not only dropped considerably despite the expensive machines when it first came into practice. The stable technology has not changed in decades and has become easily accessible. With financial disruptors ruled out, the increase in spending is more likely to be a result of the generation of baby boomers, especially with the usage per person rising with age until age 85 where it plateaus (Virnig 2014). Furthermore, there is an increase in beneficiaries, causing an increase in spending, as many baby boomers develop issues with the lung and the heart. The American Heart Association state, of baby boomers, of the 60 to 79-year-old age group, 70.2% of men and 70.9% of women have Cardiovascular Disease and many others have coronary heart disease.

Similarly, for pulmonary tests, the average issued charges increased by only 1.44% on average while beneficiaries rose at a rate of 14.71% on average from 2011 to 2013. Further research revealed chronic hepatitis C, which more than 2 million baby boomers are infected with may trigger inflammation in the lungs and could lead to the development of Chronic Obstructive Pulmonary Disease (O'Shea 2014). The increase in number of beneficiaries is thus due to the baby boomers are they are most likely to develop pulmonary and cardiac diseases.

[4] Technicality of the formula and computation method is explained in the code section on page __





From the yearly increase in total payment between 2011-2013, for both echocardiograms and pulmonary tests, there is a linear trend in the increase in spending. By using a linear regression model, the projected spending for echocardiograms with contrast is model by the function

$$y = 4.319 \times 10^{8} x - 8.657 \times 10^{11}$$

X = Year of interest

Y = Projected spending on echocardiograms

and the projected spending for pulmonary tests is modeled by

$$y = 2.898 \times 10^{6} x - 5.816 \times 10^{9} .$$

X = Year of interest

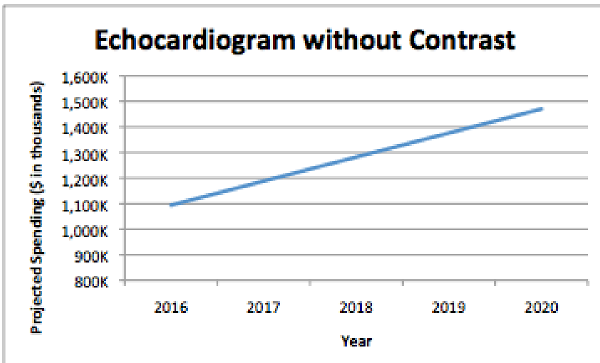
Y = Projected spending on pulmonary tests

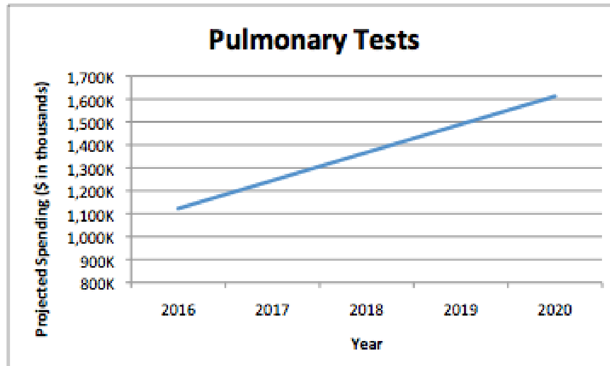
With the regression line, the projected spending for echocardiograms in 2015 is $4,588,650,000. The Company's spending for 2015 is again assumed to be $1,000,000. Then the rate of change for the Company would be (1,000,000 /4,588,650,000) * 431,900,000 = $94,123 per year. Using a linear model, the projections for the years 2016 to 2020 would be as follows:

Echocardiogram without Contrast					
Year	2016	2017	2018	2019	2020
Projected Spending	$1,094,123	$1,188,246	$1,282,369	$1,376,492	$1,470,615

Similarly, the projected spending for pulmonary tests in 2015 is $23,683,590. The rate of change for the Company would be (1,000,000 /23,683,590) * 2,898,000 = $122,363 per year.

Pulmonary Tests					
Year	2016	2017	2018	2019	2020
Projected Spending	$1,122,363	$1,244,726	$1,367,089	$1,489,452	$1,611,815





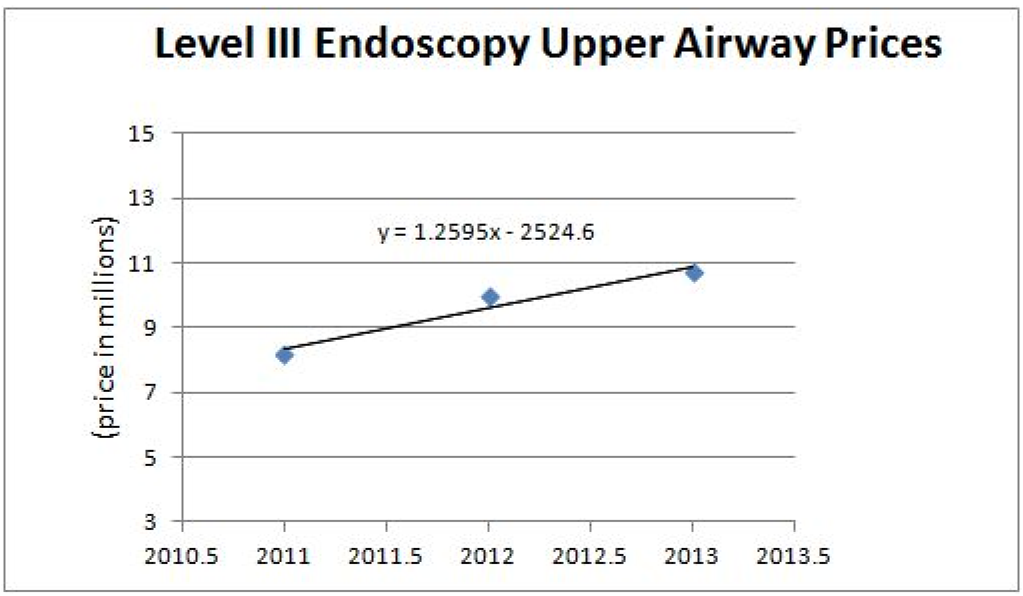
From the sample calculations, the Company's spending levels should increase at a rate of 9.41% and 12.24% of the Company's total spending in 2015 for echocardiograms and pulmonary tests, respectively.

To evaluate the accuracy for echocardiogram and pulmonary tests projections, we calculated the standard error to be $258,343,743.5 and $1,683,584.793 respectively based from the data. From this, there is percent margin of error of 7% for echocardiogram and 9% for pulmonary tests which is still an acceptable margin of error as they are both less than 10%.

Section 3.6 Level III Endoscopy and Nerve Injections

In 2016, reimbursements for colonoscopies were cut up to 19% because of the Misvalued Code Initiative. This is extremely significant because the colonoscopy code is the "highest volume code family". (CMS Proposes Cuts" 1). As a result, this procedure will become more expensive for beneficiaries. This leaves room for private insurance companies to make up the difference. Thus, this legislation can increase costs to private insurance over the next few years. The Misvalued Code Initiative will continue to inspect all endoscopy procedures in the coming years. Since reimbursements fell for colonoscopy rates, we assume this will also affect endoscopy in a similar way because the procedures are similar and our analysis will be more conservative. In addition, there is an increased use of sedation among GI procedures (Basil 1). Increased sedation will result in more complicated procedures so we assume this trend will cause a continued rise in prices. These articles talk specifically about lower endoscopy procedures. But due to lack of data, we assume that these trends can be generalized toward all endoscopy procedures since the treatments are related. The sedation practices represent a general trend toward an initiative to make endoscopy tests less scary to the public. Therefore, endoscopy procedures as a whole should be affected by the trend. These stated changes in behavior and legislation mean that this procedure will be a disruptor in the future due to rising costs.

We assume that payments will continue to rise linearly for several reasons. The procedure will continue to become more expensive due to continuing trends sedation practices and the Misvalued Code initiative will continue to drive up prices. In addition, these procedures tend to apply more to older generations, meaning that baby boomers will continue to drive up beneficiaries. Due to lack of data, we used a linear model. The main takeaway is that Endoscopy Upper Airway procedures will continue to significantly affect costs in the future and that the prices will rise linearly in the near future.



Our formula for the projected spending in millions of the procedure is

$$y = 1.2595x - 2524.6$$

X = year of interest

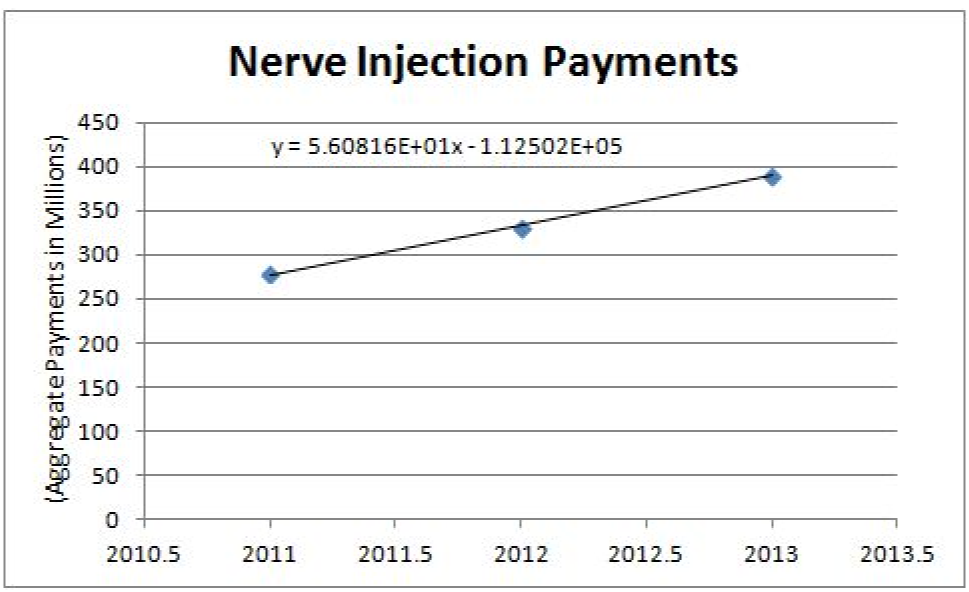
Y = spending in the Endoscopy procedure

Again we follow the above methodology to scale and project for company spending. So if we assume the company spends $1,000,000 in 2015, the spending is scaled as follows:

Level III Endoscopy Upper Airway					
Year	2016	2017	2018	2019	2020
Projected Spending	$1,094,752.68	$1,189,505.36	$1,284,258.04	$1,379,010.72	$1,473,763.40

We use the standard error formula to gauge the accuracy of our regression with respect to our data points. Calculation shows that the sum of squares error is $285,084.81. This is only about 2.66% of our 2013 cost, so it is a good gauge of future prices.

Nerve injections also witnessed an increase in payments. We hypothesize that this derives from procedural mistakes. Recent studies in 2014 find that sedating a patient before a nerve block increases both costs and risk ("Sedation before Nerve Block" 1). The increase in our data is therefore perhaps a result of these malpractices. The article states that such procedures can also result in false positive results, which prolong diagnosis procedures and result in increased costs. Although such practices should stop, it is unclear if they can be since no systematic effort has been started for corrections. Thus, costs is likely to force this to remain a disruptor for the near future.



From the above projection formulas, if we follow again the previous scaling methodology we get the following prices for private insurance:

Nerve Injection Scaled Spending					
year	2016	2017	2018	2019	2020
projected spending	$1,111,179.48	$1,222,358.96	$1,333,538.44	$1,444,717.92	$1,555,897.40

As can be observed, spending should increase at a constant rate of 11.12% of the company's spending level in 2015. Again, accuracy on a local scale can be measured using the standard error formula. Calculation shows the sum of squares error for nerve injections yields $1,777,578.21. This is only 0.0045% of the 2013 spending so this is a good approximation for the near future.

PART IV: INPATIENT SERVICE DISRUPTORS

Section 4.1 Data Exploration and Collection

All data on inpatient fees/costs were provided on the CMS website. They are specifically charge data, showing the total discharges, average covered charges, and average Medicare payments for each of 3,000 hospitals that are part of the Inpatient Prospective Payment System (IPPS) on the 100 most frequently billed procedures/services for the fiscal years of 2011 to 2013. Data was also gathered from CMS on the ratio of Medicare, Medicaid, and private health insurance prices for inpatient hospital services. As with physician fees, we determined such data from CMS to be reliable and accurate. Moreover, when we felt that CMS data was inadequate or failed to provide information on potential disruptors, we turned to other sources such as MedPAC, the Kaiser Family Foundation database, various medical journals, case studies, and news reports. In doing so, we endeavored to use sources from well established societies and reliable news outlets.

Considering the similarities between the inherent nature of outpatient and inpatient services, we decided to collect similar data on inpatient services in order to perform an analysis that would be consistent with our approach to outpatient services and therefore would allow for comparative investigation. Hence, we decided that primary factors that would influence payments on inpatient services would include increasing discharges due to a burgeoning elderly population and possibly increasing/decreasing costs. However, we also considered the exclusive factor that is length of stay (abbreviated as LOS), and conjectured that technology would play a larger role here, which led us on an investigation down three paths.

1) Disruptors in number of admissions/discharges and associated costs of procedures
2) Disruptors in average LOS and cost of stay
3) Disruptors as a result of dramatic technological development or behavioral changes regarding technology.

To this end, we first decided to look into CMS's charge data on inpatient services. Although data was limited to a relatively short time period 2011 to 2013, we were unable to find any other database that provided as much detail and information as CMS's charge data, and therefore felt it was best to perform our analysis on this particular set of data. This data set provided us with three variables

1) Discharges per procedure
2) Covered costs per procedure
3) Medicare payments per procedure

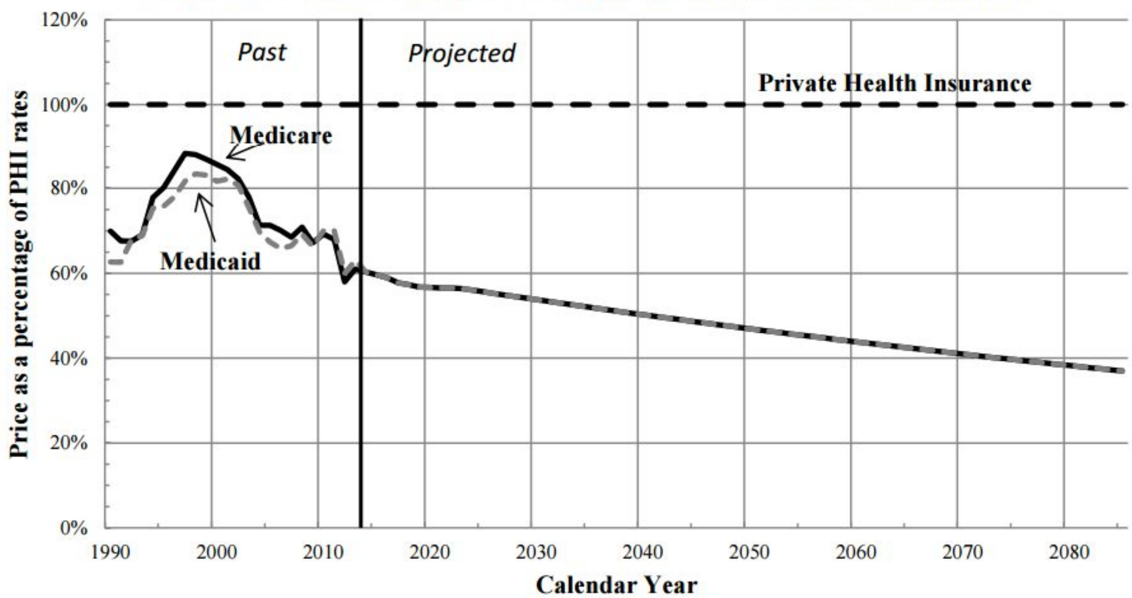
A sample of the collected and sorted data is pictured below[5]

Total Discharges				
Inpatient Procedure	2011	2012	2013	Average Change
039 - EXTRACRANIAL PROCEDURES W/O CC/MCC Total	33,606	31,341	28,553	-7.82%
057 - DEGENERATIVE NERVOUS SYSTEM DISORDERS W/O MCC Total	30,212	26,591	22,390	-13.89%
064 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W MCC Total	62,093	63,439	66,379	3.40%
065 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W CC OR TPA IN 24 HRS Total	106,414	103,849	103,200	-1.52%
066 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W/O CC/MCC Total	55,849	55,060	52,907	-2.66%
069 - TRANSIENT ISCHEMIA Total	79,590	75,570	68,011	-7.53%
074 - CRANIAL & PERIPHERAL NERVE DISORDERS W/O MCC Total	21,659	19,380	16,474	-12.76%
101 - SEIZURES W/O MCC Total	48,854	45,972	42,845	-6.35%

[5] Due to the size of the data, we only show an excerpt now, although the full data set can be found in Appendix A.2

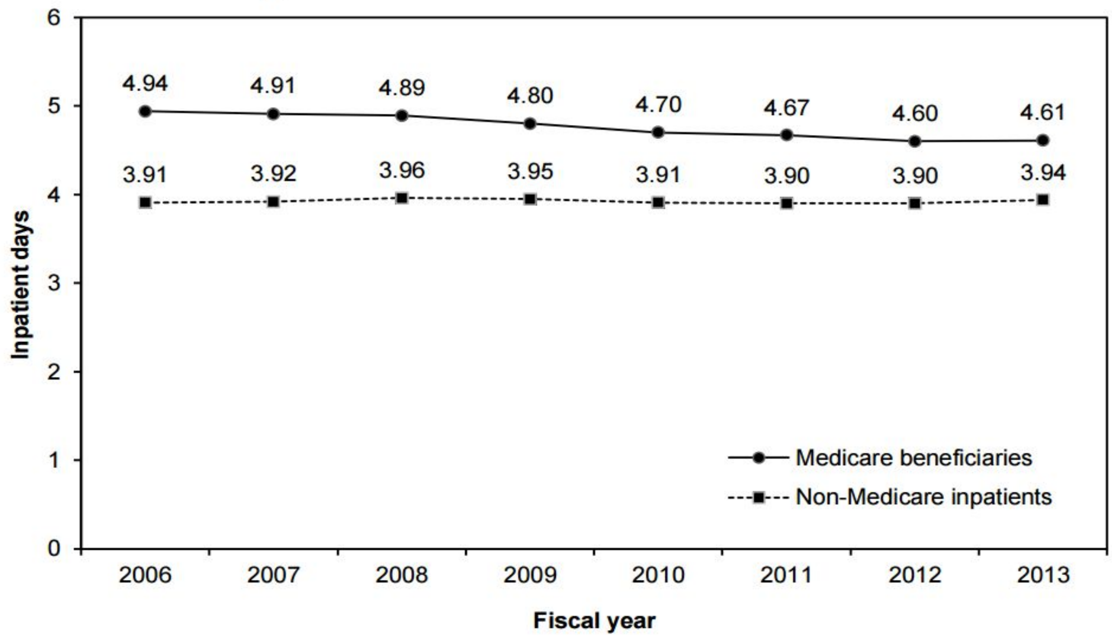
The immediately apparent issue was that the data was limited to Medicare payments and therefore would not be completely reflective of private insurance costs. However, similar to our physician fee analysis, we were able to correct for this limitation by consulting data provided by an actuary report from CMS on the projected ratio between Medicare, Medicaid, and private health insurance prices for inpatient services, as pictured below. This will again forge a link between Medicare and private insurance payments that will give us a rough estimate of how total payments may change for the Company over the next 5 years.

Figure 1. Illustrative comparison of relative Medicare, Medicaid, and private health insurance prices for inpatient hospital services under current law

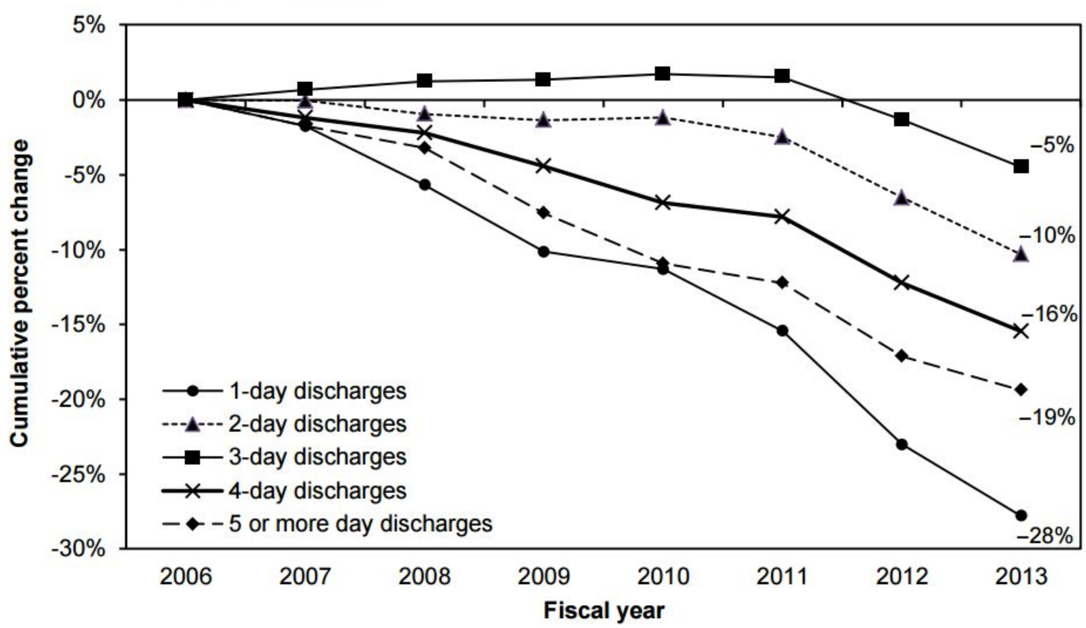


To research LOS, we utilized a MedPAC report and data from the Kaiser Family Foundation, which provided information from 2006 to 2013 about average LOS and rates of various lengths of stay. Both graphs are displayed on the next page. (MedPAC "Acute Inpatient Services", 2015)

Trends in Medicare and non-Medicare inpatient length of stay, 2006–2013



Cumulative change in Medicare inpatient discharges per FFS beneficiary by length of stay, 2006–2013

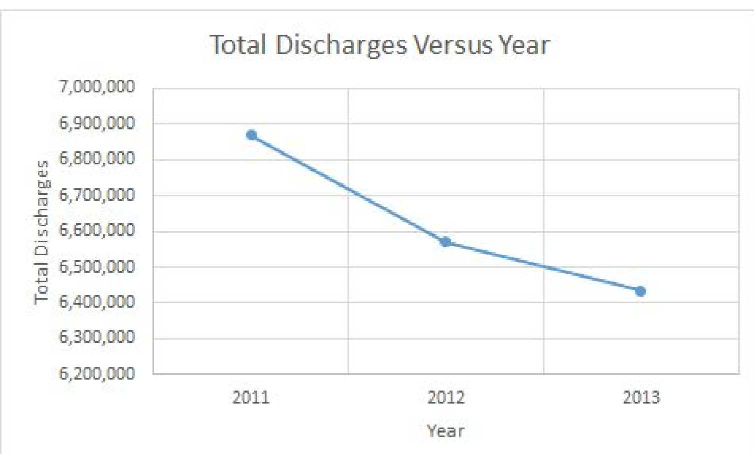


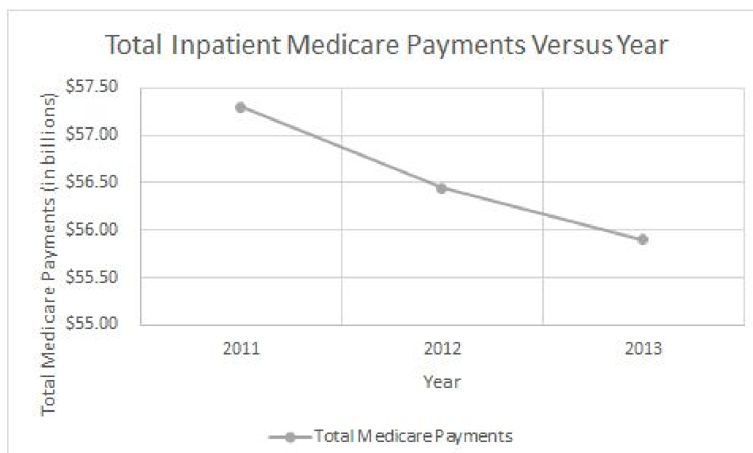
To further examine whether these trends would continue, we consulted various sources which will be referenced when disruptors are considered. Similarly, due to the lack of data from any database website regarding technology, most of the information was pulled from case studies.

Section 4.2 Methods, Models, and Analysis

To analyze potential disruptors in the Company's spending on inpatient services, we decided to first look into average Medicare payments and total discharges from 2011 to 2013. From this data, we aimed to link any projections we could make for Medicare payments to private insurance payments using the projected ratios of Medicare to private insurance payment rates from Figure 1 for the next 5 years. We are assuming that the Company's insurance policies regarding payments on inpatient services will adhere to the aforementioned ratios.

In observing CMS's inpatient charge data (See A4 in the appendix), we noticed that many of the procedures were decreasing in average Medicare payments from 2011 to 2013 . Upon further investigation, it seemed that the primary factor causing these drops was declining total discharges. Indeed, both total payments and discharges seemed to decrease in a similar fashion, as can be observed in the following two graphs showing total Medicare payments and total discharges versus year.





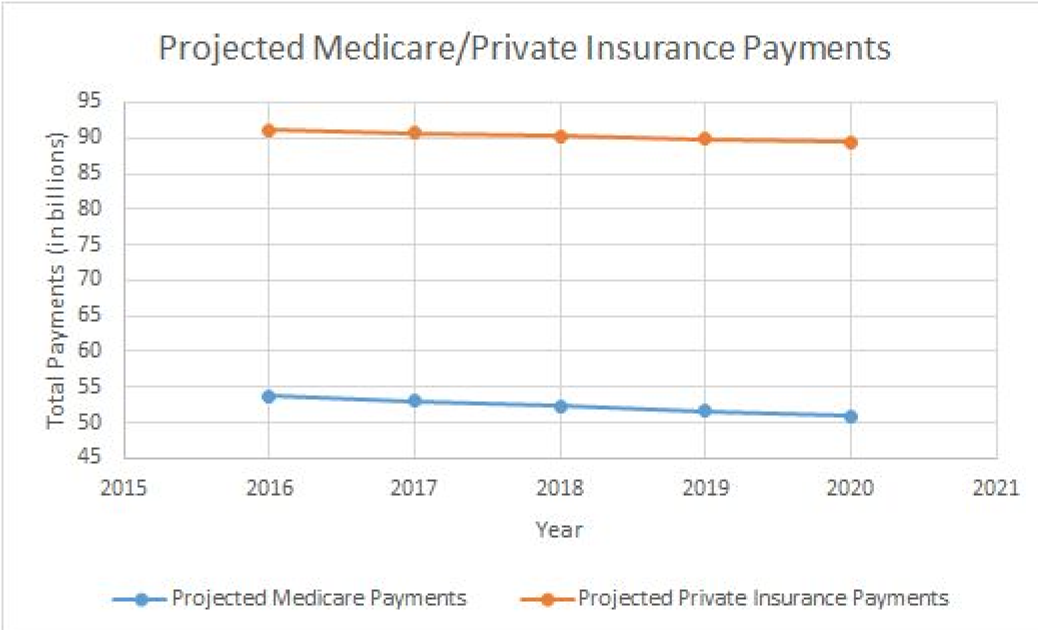
As demonstrated, total Medicare payments were declining from 2011 to 2013, most likely as a result of the declining total discharges during this period. After further investigation into this matter, we discovered more information about the causes behind this pattern. According to Modern Healthcare, inpatient admissions are dropping all across the nation, a trend that started during the Great Recession in 2009 and will probably continue due to various factors such as “the slow U.S. economic rebound; the continued rise of high-deductible insurance plans that constrain medical use; the growth in the number of patients who are held for observation instead of being admitted; and the reforms of payment and delivery models to better coordinate care, improve outcomes and lower costs” (Kutscher, 2013). MedPAC provides further justification of this from 2013 to 2014, noting that inpatient discharges dropped 3.6% for each Medicare beneficiary and that the volume of inpatient services also decreased 2 to 7 percent for all age groups (“Hospital Inpatient and Outpatient Services”, 2016).

Modern Healthcare also relates this decline to the rising prominence of outpatient services, noting that “as more care shifts from inpatient to ambulatory settings, Sg2 projects 17% growth in outpatient services” (Kutscher, 2013). This is consistent with our findings on outpatient services, where total Medicare payments increased substantially for many services like hospital clinic visits, echocardiograms, pulmonary tests, debridement services, etc. Thus, we determined that inpatient admissions are likely to decline during the next 5 years and therefore may not be a source of disruptors that could adversely impact the Company.

However, the ratio of Medicare to private insurance payment rates are projected to decrease from 2016 to 2020 by CMS. This suggests that private insurance payments will increase relative to Medicare spending. Thus, even as Medicare payments are decreasing due to lowering total discharges, private insurance payments may still increase over the next 5 years, which would signify a potential disruptor. To analyze the combined effects of these factors, we decided to make projections on total Medicare payments, taking into account the data we gathered on CMS as well as the ratio of Medicare to private insurance payment rates. Below is a chart of the projected ratio values for the years 2016 to 2020 based on the graph provided by a 2015 CMS actuarial report (Shatto, 2015).

Year:	2016	2017	2018	2019	2020
Ratio:	59%	58.5%	58%	57.5%	57%

We created a linear equation to fit the existing data from 2011 to 2013, yielding the equation y = -7.013E+08x + 1.468E+12. Using this equation, we made projections of total Medicare payments for the years 2016 to 2020, then divided each value by the corresponding ratio, resulting in the following graph:



Year	2016	2017	2018	2019	2020
Projected Medicare Payments (in billions)	53.75	53.05	52.34	51.64	50.94
Projected Private Insurance Payments (in billions)	91.10	90.68	90.25	89.81	89.37
Percentage Decrease	0.000%	-0.461%	-0.474%	-0.488%	-0.490%

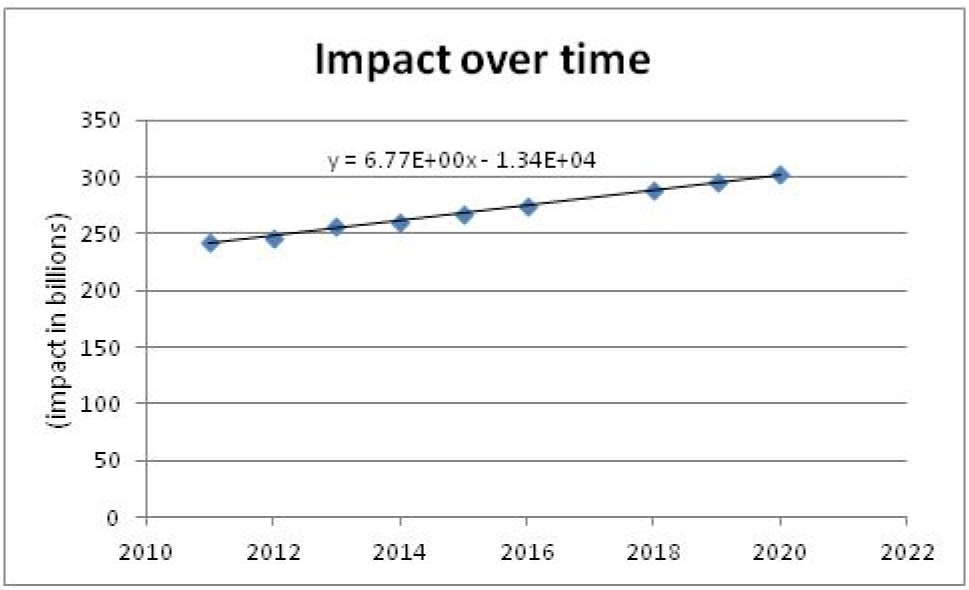
This shows that private insurance payments should marginally decrease over the 5 year period, therefore suggesting that if Medicare payments decrease at the rate it has been decreasing from 2011 to 2013, private insurance payments should similarly go down despite a growing gap between the two payment rates. Ultimately, this implies a low likelihood that there exists a potential disruptor relating to total discharges and the ratio between Medicare and private insurance payment rates which could significantly impact the Company.

Any error in the projections made for inpatient payments stems from the usage of linear regression to fit the data gathered from CMS on Medicare payments. This error can be measured in the form of the standard error of the estimate, which gives a value of $73,285,778.06 for the three aggregate Medicare payment values calculated for the years 2011, 2012, and 2013. This is only 0.131% of aggregate spending in 2013, which shows these projections to be highly accurate.

Section 4.3 Average Covered Charges

We recognize that private insurance companies are not strictly bound to any ratio. In the case where a company diverges from our previous analysis, we can consider the actual cost of the treatments. These can be used as a lower bound on what it would cause a company to diverge, since it must always be marked up from Medicare rates.

We follow a similar analysis. First, we multiply discharge patients with average covered charges for each treatment (see Appendix D1 and D2). We denote this as the total payment per procedures. Then we sum all such numbers obtained for each year and project the aggregates into 2020. We refer to these aggregates as "impacts". From this, we analyze the average change in impact in each year in relation to the previous year. If it tends to rise, then we know it will be more expensive to follow such a strategy. Below are the projected impacts, interpolated to 2020 using linear regression.



The average percent change in impact from year to year is calculated to be 0.0294%, which is substantial given that the units are in billions. Therefore, it is not beneficial to deviate far from the Medicare ratios. The error in this projection is considered from the three original data points from 2011-2013. It is calculated to be $3,392,383,432, which is 1.32% of our last known data point. Thus it is an acceptable measure for future behavior.

Section 4.4 Length and Cost of Inpatient Stay

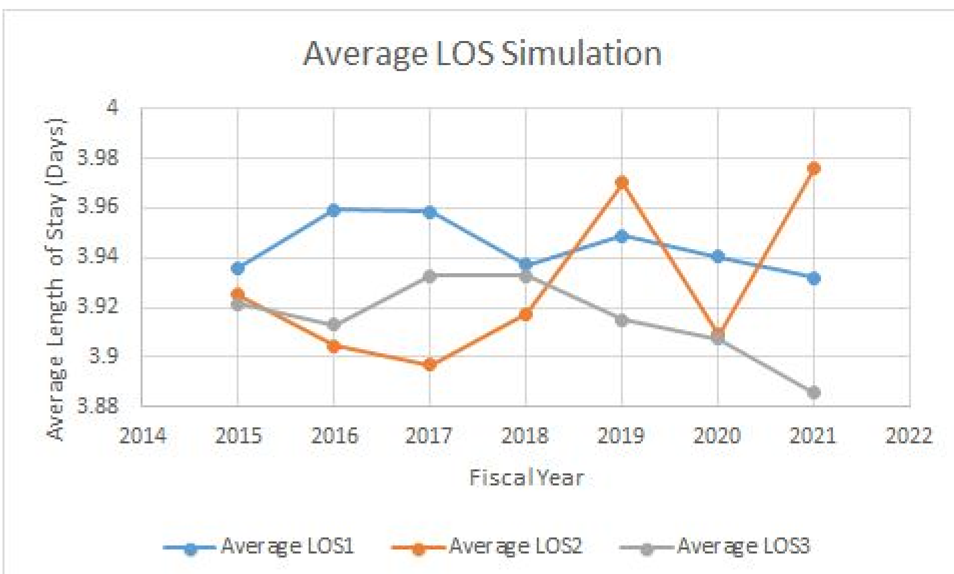
Average length of stay data did not exist for 2014 and 2015, thus we will evaluate the trends present in data from 2006 - 2013 and endeavor to justify a generalization based on recent literature. That is, we will investigate forces that could increase or decrease LOS and try to determine the net magnitude of those forces.

On one hand, there are two main factors that currently influence the increase of average LOS. First, there are financial incentives on the hospital end due to the Hospital Readmission Reduction Program (HRRP). In brief, the legislation imposes a penalty on Medicare reimbursements to hospitals that have readmissions of patients within a 30-day period. Thus, hospitals are incentivized to make sure patients are safe to leave, even if it demands a longer LOS. A study published in PubMed (Carey 2014) suggested that an increase of LOS by merely one day could improve readmission rates by 7-18% in heart attack patients; although this type of study has not been repeated nor generalized for other conditions, it certainly raises the possibility that hospitals will shift towards increasing LOS as preventive measures against readmissions. Financial factors aside, it is an evident fact that certain diseases or conditions, such as the aforementioned heart attacks (Okunji 2012), demand longer LOS's than others. The important detail is that certain conditions with extended LOS are increasing in prevalence rates, which raises the possibility of being a disruptor. For instance, a 2015 study (Punke 2015) on *Clostridium difficile* infections, which has increased by 200% in hospitalization rates in 15 years, concluded that patients with the condition had LOS 55% higher than average. Similar conclusions can be found with other diseases, such as diabetes (Flanagan 2008) and mental diseases (Colorado Hospital Association 2013), indicating that disease prevalence rates could instigate longer LOS.

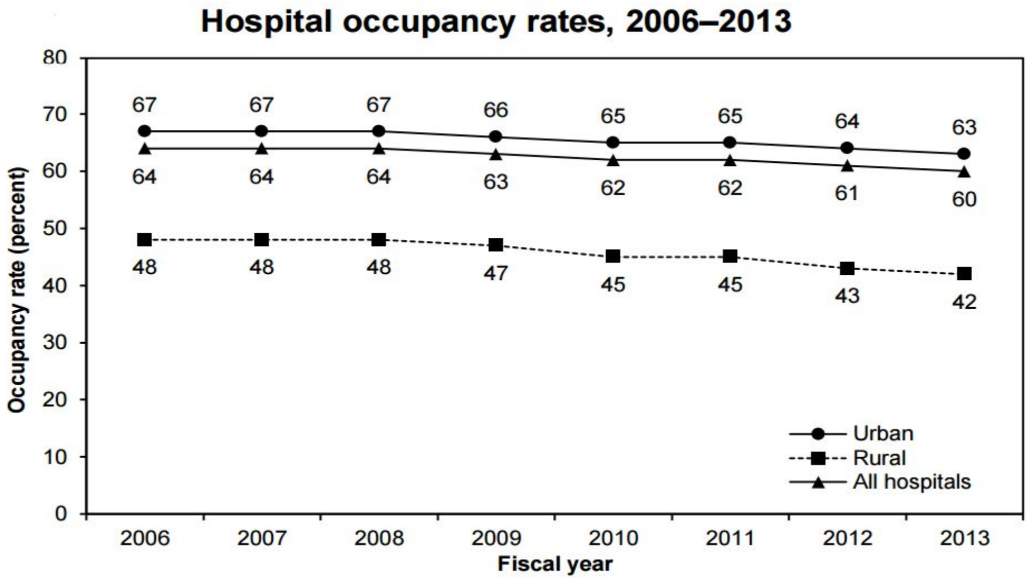
Interestingly, there are also various counter forces that operate against LOS increase. To begin, data and case studies on the association of longer LOS and readmission rates have been inconsistent. For example, a study done in 2011 (Hansen 2011) suggests that discharge planning did not have any association to 30-day readmission rates.Furthermore, one very noteworthy trend is the general desire to run hospitals more efficiently and thereby decrease LOS. This is evident in publications as well as the density of related information online. For example, a three year case study in NYU (Iorio 2016) was able to decrease LOS by 0.62 days and readmission rates by 2% simultaneously. Another publication (Cowel, 2014) supports this result, stating that LOS could decrease by up to 1.48 days through efficient management. These findings are not isolated, and together suggest that LOS could be more related to behavior and management than to disruptors like age and disease.

Between disease rates, specific procedures, financial incentives, and hospital behavioral shifts, we ultimately decided that the net magnitude of the counteracting forces was indeterminate. However, the myriad of data consistently demonstrates that the LOS *can* fluctuate more so than it has historically. Furthermore, we are personally convinced by the reports that a decrease is slightly (assume 5%) more likely. Therefore, we will use a skewed normal distribution with a widened standard deviation to model this disruptor.

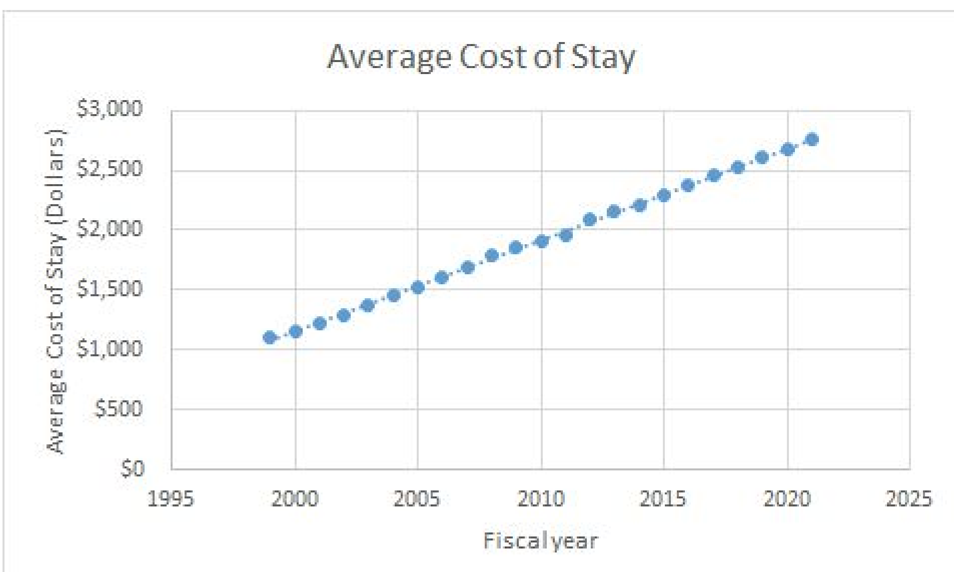
The LOS data from 2006-2013 has a mean of 3.9237 days and a standard deviation of 0.02175, which we will broaden by 20% to 0.02610. We will assume that the 2015 average LOS is approximately equal to the LOS of 2013 and use that as the base case. Below are some sample simulation results. LOS1 could represent a situation where disease rates strongly influence LOS increases. LOS2 could represent a case where hospitals become more efficient, but a pandemic in 2017 leads to a steep increase of average LOS. LOS3 could represent a situation where hospitals generally become more efficient. As more publications are established, or legislation to decrease LOS is passed, we will know for greater certainty which event is more likely.



Lastly, one point that can strengthen the generalization of this data is that inpatient hospital stays are not affected by location, as demonstrated by this graph from a 2015 MedPAC report



It remains to translate this data into a financial impact by combining LOS with average cost of stay. From the Kaiser Family Foundation, we found data describing average cost from 1999-2014 (Appendix D.3). By computing a linear regression $y = 76.547x - 151{,}943.424$, $R^2 = 0.998$, we projected future rates.

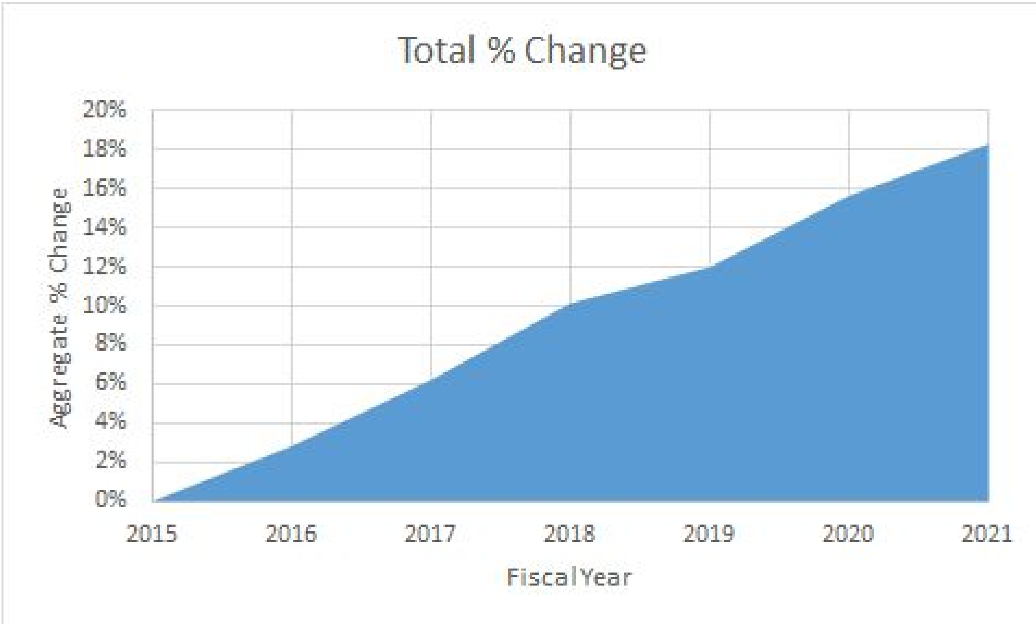


(Source: Kaiser Family Foundation - Hospital Adjusted Expenses Per Inpatient Stay)

Cost of Stay per (Projections)						
2015	2016	2017	2018	2019	2020	2021
$2,298.78	$2,375.33	$2,451.88	$2,528.42	$2,604.97	$2,681.52	$2,758.06

To justify the use of linear regression in this case, we rely the fact that the high R-squared value from the least squares regression indicated that historical growth was consistently linear and thus could fairly predict future rates as well. The source of this increase is primarily due to rising costs for specific diseases (Pfuntner 2013) and the increasing behavior is expected to remain steady. Technically, cost of stay here refers to how much it costs the hospital, but in determining financial impact for the Company, we assume that an increase in the hospital's costs will reflect a proportional increase in the inpatient bill. Thus, we will multiply the cost of stay with projected LOS to derive projections for % increase of expenses going towards staying costs. Below is a graph of a simulation when increasing costs of stay are combined with shifting average LOS. After many simulations, it is certain that the increase in costs will overtake the LOS. Thus, LOS will not pose as a relevant disruptor, leaving the only concern as the increase in hospital costs.

After many simulations, the expected increase in total payment/inpatient is summarized in the graph below.



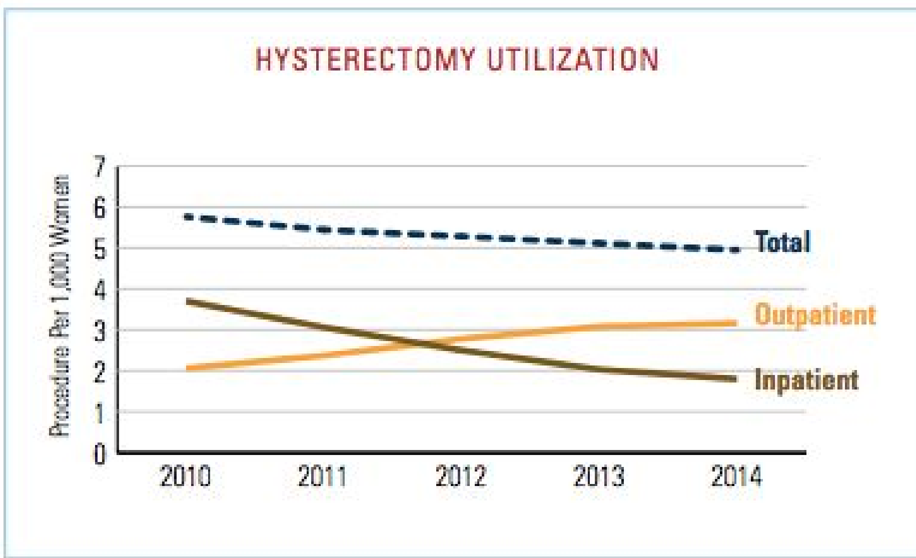
Projected Aggregate Increase in Total Costs/Inpatient							
Year	2015	2016	2017	2018	2019	2020	2021
Total % Change	0.00%	2.82%	6.21%	10.14%	11.99%	15.64%	18.29%

Because the standard error of the regression is $13.04794, which is .56760% of the 2015 rate, we believe the error from the regression is negligible. This leaves the LOS metric. However, even with the increased standard deviation, the average case still suggests that the difference LOS makes on the total spending per inpatient is still minimal. Specifically, after 100 random simulations, the average came out to be approximately 0.671% of a difference between two simultaneous discrete simulations.

Section 4.5 Analysis of Technological Disruptors

With respect to technology, inpatient care spending is not expected to dramatically increase and thus technology should not be considered a disruptor. When new technology is implemented, there is an insignificant increase in spending and rather it drives a shift from inpatient to outpatient care. The new technology add-on payment (NTAP) program is a compensation program by Medicare to hospitals for using new technology that Medicare does not already reimburse. Medicare then pays this add-on payment to offset the cost of new technology for these hospitals. However, it is difficult to meet the strict criteria of the CMS for an add-on payment. As a result, few new technologies are recognized for their costs. Since the program started in 2001, only 19 out of 53 applicants have been approved for the new technology add-on program (Kirkner 2015). Thus, with the lack of technology that qualify for the add-on payment, the new technology add-on payment program is unlikely to increase spending.

Moreover, technological advances also cause a shift from inpatient to outpatient care. A report conducted by the Blue Cross Blue Shield, The Health of American Report in 2016 compares the number outpatient and inpatient services for certain procedures with respect to time. More specifically, the report compares the " 'shoppable' procedures that can be performed in either inpatient or outpatient settings" which are hysterectomy, spine surgery, angioplasty and gallbladder removal (The Health of America Report 2016). The cost savings of each procedure also increased most likely due to the "Core reimbursement structures are the primary driver of the cost difference between inpatient and outpatient procedures." (The Health of America Report 2016). Specifically for hysterectomies, outpatient share increased by 28% from 36% to 64% (The Health of America Report 2016). As seen in the graph below, there is a significant increase in outpatient services and a decrease in inpatient services.



(Source: Blue Cross Blue Shield- Hysterectomy Utilization)

During this time, some hysterectomies have been able to use newer laparoscopic and robotic-assisted laparoscopic approaches (The Health of America Report 2016). This technological advance is believed to cause this decrease in inpatient care. Similarly, will gallbladder removal procedures, there has been innovation of laparoscopic instruments and new minimally invasive techniques. As a result, it cannot be concluded that technology is a disruptor because as seen through the lack of implementation of the new technology add-on payment program and the decrease in procedures within inpatient care with the advancement of technology.

PART 5: CODE AND REPRODUCTION

Ultimately, all the equations published above were produced by hand. Only data points that were extracted from regression models and simulations were produced using technology.

All of the calculations - regressions and simulations, were done by using Microsoft Excel 2013. For regression, We plotted the data in a scatter plot against years and added a trendline. We limited our regression choices to the traditional predictive models - linear, exponential, and logarithmic, depending on three factors - inspection of fitness (how well we thought the trendline matched the points), qualitative reasoning (based on readings of case studies and reports), and the R^2 value (which acted as the deciding factor in borderline cases). Upon producing an equation, we would then plug in years to predict behavior in 2016-2021. To assess the potential error that resulted from linear regression models when an error bound could not be determined from inspection, reading, or historical variation (e.g. in the case of limited size), we used the following equation, known as the standard error.

$$\sigma = \sqrt{\frac{\Sigma(Y - Y')^2}{N}}$$

Errors that could be reasonably bounded by inspection or historical variation were then bounded and estimated by simulation. The functions used for the simulations are listed below.

1) $RANDBETWEEN(\,)$
2) $IF(\,)$
3) $NORMINV(\,)$
4) MIN( )
    a) Excel uses the following probability density function

$$f(x, \mu, \sigma) = \frac{1}{\sqrt{2\Pi\sigma}} e^{-(\frac{(x-\mu)^2}{2\sigma^2})}$$

To produce a uniform probability simulation as performed to obtain the Misvalue Codes for 2016-2021, we used RANDBETWEEN( ) using 0 and our desired bound (using negative when bounds are double sided), and then divided the number appropriately.

To produce a random distribution behaving as a bell curve as performed to obtain MEI projections, we used NORMINV( ), with the probability as RANDBETWEEN( ) and standard deviation as equal to the max error divided by four. To skew the normal distribution, weight can be added to one side by adding a constant to RANDBETWEEN( ) and including an MIN( ) statement to prevent a probability of > 1.

To produce a weighted probability as performed to obtain errors in physician volume shifts, we used RANDBETWEEN( ) and then used IF( ) in junction with the produced number (e.g. if RANDBETWEEN( ) <= 0.75, then positive shift, else negative shift) in order to weight one result or error direction as more likely. Note that this procedure could be layered multiple times to simulate Monte Carlo projections with Markov chains (that is, the probability of one event is contingent on the probability of its previous event occurring).

Finally, all charts and graphs were produced by Google Docs and Sheets and Excel.

CONCLUSION AND FINAL EVALUATION

Conclusion: Pharmaceutical Disruptors

We determined that drug hikes and new drugs are the disruptors that increase pharmaceutical spending.To quantify the effect, we begin by writing a pricing formula which can be applied to any drug under consideration. Then we estimate the probability of a price hike of any drug and the bounds on the percent markup of a drug. This will allow for a best and worst case scenario considerations. Next, we estimate the probability of a new drug being approved which could have a significant impact.

We considered drug price hikes, new drugs, and change in population. We defined a price hike as an increase in prices of over 100% with a probability of 6/80 and the probability that a new drug will be approved that also will significantly affect costs to be 5/30. Taking into account these factors, we are able to estimate the financial impact of these disruptors by using our formula that projects the financial impact of these disruptors.

As seen in the demonstration calculations with diabetes, there is bound to be a significant increase in spending. More specifically, the spending projections for Glucagen, Januvia, Lantus increase by 56.78%, 101.91%, 152.96% respectively from 2016 to 2020. Our sample calculations demonstrate that a 22.5% increase in yearly spending for diabetes can be expected for 2016-2020. Though we only demonstrate the impacts for one drug, our methodology can easily be generalized for any drug with information on prevalence rates. Furthermore, the overarching trend in the pharmaceutical world suggests that the Company must prepare for the worst as we witness a multitude of drug prices behave spastically as new drugs and price hikes emerge on the horizon.

Conclusion: Physician Fee Disruptors

Physician fee projections were investigated to account for the 2015 MACRA legislation which revamped the structure of physician payments. With limited data on private insurance physicians, we opted to first find the connection between their fees and Medicare physician fees, which is ripe with data. After using MedPAC reports and case studies to establish a quantitative link between the two, we examined the various legislative, behavioral, and metric factors that could act as disruptors in Medicare physician fees. Ultimately, our projections identified and accounted for the following disruptors based on their impact on payment and volume rates: changes in the private to Medicare physician payment ratio, APM participation and financial bonus rates, misvalued codes, the Medicare Economic Index, and finally volume/intensity of physician services. After thoroughly researching historical rates, medical journals, and case studies to numerically gauge the potential for each variable to change and their respective uncertainty bounds, we ran several simulations involving various types of probabilistic models to find an average case for each disruptor factor. Culminating the average projections of each variable into our physician fee formula, we found that physician fees are expected to increase by approximately 2.5% for 2016-2019, and then by marginally more than 5% for 2019-2021, resulting in a total increase in spending of an estimated 24%. With small error bounds in our formula and safe assumptions, we can trust that the accuracy of this projection is fairly robust. Considering physicians will consistently play a large role in any health insurance program, we recommend strong preparations with regards to physician fees, especially for 2019 as new legislation and behavioral trends point to physicians gaining higher pays and more bargaining power against insurance companies.

Conclusion: Outpatient Service Disruptors

We looked into outpatient services to determine how baby boomers and hospital costs would impact spending levels. To this end, we decided to utilize CMS's charge data on outpatient services from 2011 to 2013, which provide a plethora of information about the issued charges, number of outpatient services or beneficiaries, and total payments for 30 popular outpatient procedures covered by Medicare. While this data is limited to Medicare, which primarily covers the elderly and therefore would not be a totally accurate reflection of private insurance payment rates, we reasoned that it would present a suitable worst-case scenario. This is because Medicare would be more heavily impacted by baby boomers than private insurance companies. From this data, we singled out 6 procedures where total payments increased at a large enough rate to indicate the presence of a disruptor: debridement and destruction services, levels I-IV hospital clinic visits, echocardiograms without contrast, pulmonary tests, level III endoscopies, and nerve injections. After further investigation, we noticed that average issued charges for each of these procedures increased relatively slowly compared to the number of outpatient services. Thus we determined that the primary factor driving total payments to increase was a rising number of beneficiaries. This was consistent with our suspicions that baby boomers would significantly increase total payments, as the elderly are more likely to suffer from health problems that will cause them to visit the hospital. Additional research into the financial circumstances of these outpatient services led us to decided that baby boomers was indeed a significant disruptor for every one of these procedures except for debridement. Furthermore, complications involving sedation practices, malpractice lawsuits, and misvalued codes revealed costs to be a possible disruptor for endoscopies and nerve injections.

In quantifying the impact of these disruptors on the Company's spending levels, we used linear regression on Medicare payments to find an approximate rate of change that could then be scaled to the Company's total payments on each procedure. Ultimately, after performing sample calculations, this yielded the following linear rates of change for each procedure: 10.88% of the Company's spending in 2015 per year for hospital visits, 9.41% for echocardiograms without contrast, 12.24% for pulmonary tests, 9.48% for endoscopies, and 11.12% for nerve injections, while other procedures can be expected to either decrease or only rise negligibly. Due to the relatively small error bounds calculated using the standard error of the estimate, we can be confident in the accuracy of these projections of the Company's worst-case spending levels over the next 5 years.

Conclusion: Inpatient Services Disruptors

Inpatient services were investigated to analyze how various factors such as total discharges, average covered charges, length of stay, and technological advancements could affect spending levels. In regards to total discharges and average coverage charges, we had to allow for two separate scenarios in which the Company would either follow projected trends in the ratio of Medicare to private insurance spending, or deviate from this path in setting their payment rates for inpatient services.

Under the former assumption we decided average covered charges would be irrelevant to how spending would change, a direct link could already be formed between Medicare and private insurance spending levels. In our research, we discovered that total discharges have been declining, but that the ratio of Medicare to private insurance payments have been declining, suggest that private insurance spending would be increasing relative to Medicare spending. After our analysis, we discovered that the combined effects of these two factors would cause private insurance to decrease from $91.1 billion to $89.37 or in order by 2% from 2016 to 2020. With an extremely small margin of error, we are confident that these projections are representative of how spending will change. Thus, we determined that there would be no significant disruptor relating to total discharges and the ratio between Medicare and private insurance payment rates..Under the latter assumption that the Company does not follow the projected ratio, we concluded that rising average covered charges would become a disruptor.Although there is a projected shrinkage in beneficiaries the overall rise in total costs driven by covered charges would make large deviations from the ratio unadvisable.

We next considered the inpatient length of stay as a potential disruptor as we conjectured that it could shift under the influence of demographics and disease. After thoroughly researching influential factors, we concluded that the main forces, which acted in opposing directions, were: financial incentives from readmission, increasing prevalence rates of certain diseases, and hospital management efficiency/hospital behavior. However, when we combined these variables, we could not determine a definite direction of increase or decrease of LOS. Rather, we concluded that LOS would be more open to fluctuation in the next five years, with a greater tendency towards decreasing. We then determined the nature of increase for hospital stay costs and through simulation models, and ultimately established that regardless of how LOS fluctuates, the total cost/inpatient is bound to increase linearly due to rising average stay costs by a significant aggregate of 20% by the end of 2021. With a very strong regression model and miniscule error bounds, we recommend advanced preparation of costs quickly increasing every year.

Finally, we looked into technological advancements as a possible source of disruptors. After extensive research, we discovered that new technologies are rather infrequently compensated for by Medicare via the NTAP program and thus are unlikely to have a significant impact on spending. Furthermore, we found that technological developments have been causing the healthcare industry to generally shift from inpatient to outpatient care, causing inpatients to go down. With this in mind, we determined that technology was not a disruptor for spending on inpatient services.

OUTSTANDING ISSUES AND FURTHER QUESTIONS

Throughout this report, we have exercised rigorous attention to detail and evaluating the validity of assumptions we made. However, there were certain factors that continuously posed as problems; these issues could mainly be distinguished into two categories - lack of data on miniscule disruptors, or on the other hand, massively large disruptors.

In every analysis, we endeavored to work all the possible disruptors into our projections, but often times, it proved impossible when it came down to questions of very fine details. For instance, we considered investigating bacterial resistance in our drug analysis, but the massive variation between each drug/disease and the lack of data regarding resistance rates made it far too difficult. To account for such intricate disruptors, it would be necessary to analyze research papers (which may or may not exist) studying long term effects of each drug and disease. Another example of interference with details is behavioral shifts. By nature of certain diseases such as diabetes, the general lifestyle habits of society can have a dramatic impact on prevalence rates. In fact, since the disease is not contagious, it is entirely behavior dictates the contraction rates. Behavior plays an integrated role in other diseases too, such as STD's and atherosclerosis. However, behavioral shifts are ultimately too difficult to quantify and also, it varies too greatly case by case. Yet, it certainly influences other disruptors; for instance, paranoia of diseases due to pandemics can sharply drive up physician visits and/or outpatient test procedures. As mentioned before, hospital behavior could also affect length of stay. Existence of tangled details also complicated the way various disruptors fit together. When we wrote our formulas for drug analysis and physician fees, we weighed all the variables equally; but demographics could, in reality, deliver a much greater impact than prevalence rates, or the model could work only on a limited population size. In terms of technology, it would sometimes be clear that financials are affected for specific procedures, but in the bigger picture (that is, the aggregate of hospitals performing the procedure) it was futile to try and generalize or fit technology into the analysis, simply because we lack detail on the its prominence in the medical community. These intricacies could not be exactly addressed in our analysis; rather at best, we qualitatively evaluate behavioral trends and work them into our calculations as error bounds or convince us that one direction of error was more probable.

Next, our analysis struggled with regards to low frequency-high impact events, which represent the very large scale disruptors such as legislation, pandemics, and technological change. Throughout our report, we repeatedly utilized regression to project future data, however, this could not be done for the aforementioned events. Each large scale disruptor is inherently different from one another; for instance, it is invalid to predict the course of a modern pandemic with pandemics of the past. Since a canon of factors change between pandemics, such as time, behavior, technology, etc. comparison is simply not a valid technique and as such there are massive limitations on prediction methodologies. This is particularly true for legislation in physician fees, as previously mentioned. Large scale disruptors also describe potential changes in other macro conditions like economic conditions, since the financial well-being of the country as a whole is deeply rooted to the general supply and demand of insurance. As such, to account for these techniques we resorted to using qualitative data and debated possible scenarios to determine which ones are most likely.

In the end, all the disruptors, regardless of whether this report quantifies it or not, proves one absolute fact - the healthcare industry has been and will continue to be a living and breathing entity. It starts at the microscopic level, where a battle between pharmaceutical drugs and bacteria or viruses elevates to an interaction of behavior and exchange between physicians and people. Taking a step back, we witness the advent of hospitals, businesses, and research companies, which all link to the government and society to create a web of infinite complexity. As a whole, it is certain the healthcare industry cannot be quantified to exact details, but there are some factors to question and observe in the upcoming decade that can dramatically refine or distort these details.

1) How will technology advance the actuarial field?

Clearly, as society relentlessly weaves together with technology, data collection and consolidation will reach new levels of precision, thereby allowing actuaries to minimize their errors. Technology could also open new fields of quantitative investigation or link existing ones, such the interaction between human behavior like exercise and bacterial drug resistance. Beyond the research into healthcare, we must also ask: what research needs to be done into data science, programming, and electronic recording?

2) Will health care soon be revolutionized by technology?

We may not see robotic surgeons in the next five years, but it is evident that technology has been wiring itself into the industry on all fronts. From nanoscale instruments to novel biologic drugs, it is possible at any moment that a single piece of technology completely transforms healthcare. Perhaps someday nanorobotics will eradicate diseases like hepatitis C and the need for a cure. This would set off a chain reaction of events extending from the shutdown of drug companies to new insurance policies. However, because this is a historical event that has not occurred, it begs the question: Are we bound to witness a complete transformation of the way healthcare itself operates?

3) What can we expect from competitors in the business?

Beyond adjusting for the healthcare industry, the Company must also consider the inner dynamics between the insurers. This becomes a matter of customer demand and how attitudes toward healthcare as a whole changes. In this regard, we must maintain pacing with the Company's competitors and research the forces that push customers towards one side. As new frontiers and disruptors swiftly open up in the industry, we must consider: What research can be done into the market itself?

4) Will the dynamic between private insurance and public healthcare change?

In this report, we discover again and again that private insurance is inextricably connected to its public counterpart. We established that there exist mechanisms that cause the two to both converge and diverge. However, sometimes it happens in favorable ways and in other instances not, but the vital question is: what can be done to achieve a tighter gauge of the ties relationship between the two so that private insurance can control their distance from public healthcare?

5) How will changes in politics and legislation impact the healthcare industry?

In our analyses of potential disruptors, we found that changes in legislation could have a significant impact on spending levels and coverage. Particularly, we see this with the establishment of MACRA legislation, which ended the use of the SGR and revolutionized how physicians were compensated. With the upcoming presidential election and the huge political controversy revolving around the Affordable Care Act, it is not hard to imagine that the healthcare industry will continue to experience changes in the foreseeable future as a result of new legislation. Whether the government will attempt to further control and consolidate the healthcare industry or push for less regulation, these changes will undoubtedly have a substantial financial impact on any private insurance company. This leads to an important question: what can be done to prepare for such developments in order to remain profitable in this ever-changing political landscape?

APPENDIX

A1: Medicare Drug Spending Dashboard

Medicare Drug Spending 2014

Program Spending List	Spending Per User List	Unit Cost List	Brand Name	Generic Name	Coverage Type	Total Spending	Beneficiary Count	Unit Count	Beneficiary Cost Share	Total Annual Spending Per User	Avg Cost Per Unit	Average Annual Beneficiary Cost Share	Claim Count
Y			Abilify	Aripiprazole	Part D	$2,527,319,031.60	405,161	88,198,691	$49,598,419.68	$6,237.83	$28.65	*	2,964,075
	Y		Abraxane	Paclitaxel Protein-Bound	Part B	$276,345,661.22	17,733	29,216,874	$55,960,035.18	$15,583.69	$9.46	$3,155.70	124,144
		Y	Activase; Cathflo Activase	Alteplase	Part B	$38,263,515.60	56,521	631,241	$7,062,091.26	$676.98	$60.62	$124.95	85,617
Y			Advair Diskus	Fluticasone/Salmeterol	Part D	$2,276,374,748.70	1,420,748	460,372,139	$211,936,509.12	$1,602.24	$4.94	*	6,094,244
Y			Alimta	Pemetrexed Disodium	Part B	$559,204,732.70	22,993	9,462,662	$106,180,684.54	$24,320.65	$59.10	$4,617.96	100,741
Y			Aranesp	Darbepoetin Alfa In Albumn Sol; Darbepoetin Alfa In Polysorbat	Part B	$286,631,627.79	63,252	78,439,196	$58,890,146.84	$4,531.58	$3.65	$931.04	350,311
	Y		Atripla	Efavirenz/Emtricitab/Tenofovir	Part D	$577,030,155.94	29,484	8,400,201	$9,441,611.05	$19,570.96	$68.69	*	264,074
Y			Avastin	Bevacizumab	Part B	$1,063,835,621.50	216,357	16,421,928	$201,495,178.87	$4,917.04	$64.78	$931.31	885,129
	Y		Azacitidine; Vidaza	Azacitidine	Part B	$194,446,522.59	8,821	41,906,803	$39,577,789.73	$22,043.59	$4.64	$4,486.77	188,122
		Y	Brovana	Arformoterol Tartrate	Part B	$148,844,291.83	68,086	24,183,512	$31,735,714.83	$2,186.12	$6.15	$466.11	409,675
	Y		Capecitabine; Xeloda	Capecitabine	Part B	$274,454,628.60	27,052	8,737,998	$56,050,968.50	$10,145.45	$31.41	$2,071.97	114,953
		Y	Captopril	Captopril	Part D	$37,263,265.91	82,827	44,776,539	$2,869,016.64	$449.89	$0.83	*	458,345
		Y	Clobetasol Propionate	Clobetasol Propionate	Part D	$167,415,145.68	998,143	111,203,886	$17,805,093.26	$167.73	$1.51	*	1,954,141
		Y	Clomipramine Hcl	Clomipramine HCL	Part D	$79,334,397.90	17,991	9,892,402	$2,277,563.80	$4,409.67	$8.02	*	135,792
Y			Copaxone	Glatiramer Acetate	Part D	$1,221,108,238.27	26,851	2,098,371	$46,550,783.63	$45,477.20	$581.93	*	226,053
Y			Crestor	Rosuvastatin Calcium	Part D	$2,543,786,425.72	1,752,704	419,224,451	$370,196,109.42	$1,451.35	$6.07	*	9,073,952
		Y	Cubicin	Daptomycin	Part B	$91,580,070.34	15,926	142,106,378	$18,617,769.77	$5,750.35	$0.64	$1,169.02	127,456
		Y	Cyanocobalamin Injection	Cyanocobalamin (Vitamin B-12)	Part B	$4,822,427.48	583,190	2,334,618	$1,286,268.93	$8.27	$2.07	$2.21	2,322,568
		Y	Cyclophosphamide	Cyclophosphamide	Part B	$91,168,573.76	33,812	1,632,441	$18,141,631.65	$2,696.34	$55.85	$536.54	131,804
		Y	Digoxin; Digox	Digoxin	Part D	$217,958,706.40	916,472	232,082,170	$38,977,521.11	$237.82	$0.94	*	5,024,757
		Y	Divalproex Sodium ER	Divalproex Sodium	Part D	$357,176,774.84	275,739	147,563,209	$10,773,299.14	$1,295.34	$2.42	*	1,986,710
		Y	Doxazosin Mesylate	Doxazosin Mesylate	Part D	$102,415,256.03	599,375	181,545,024	$23,522,590.16	$170.87	$0.56	*	3,125,479
Y			Duloxetine HCl	Duloxetine HCl	Part D	$1,426,877,758.40	1,161,079	316,724,503	$142,168,816.11	$1,228.92	$4.51	*	7,047,482
	Y		Enbrel	Etanercept	Part D	$1,198,397,787.78	53,459	1,849,495	$45,299,112.47	$22,417.14	$647.96	*	375,300
Y			Epogen; Procrit	Epoetin Alfa	Part B	$303,550,323.94	95,774	26,951,893	$62,873,741.65	$3,169.44	$11.26	$656.48	731,690
	Y		Erbitux	Cetuximab	Part B	$257,845,777.54	9,474	4,957,519	$52,265,908.32	$27,216.15	$52.01	$5,516.77	78,911
Y			Eylea	Aflibercept	Part B	$1,295,189,434.49	132,511	1,345,094	$263,976,678.53	$9,774.20	$962.90	$1,992.11	625,239
	Y		Faslodex	Fulvestrant	Part B	$172,864,427.14	14,554	1,938,944	$35,224,736.96	$11,877.45	$89.15	$2,420.28	99,107
	Y		Gammagard Liquid	Immune Globulin,gamma(IGG)	Part B	$253,466,882.70	12,135	6,373,808	$50,872,805.96	$20,887.26	$39.77	$4,192.24	80,988
	Y		Gammaked; Gamunex; Gamunex-C	Immune Glob,gam Caprylate(IGG)	Part B	$245,937,276.29	9,579	6,246,629	$48,964,621.02	$25,674.63	$39.37	$5,111.66	69,669
	Y		Gleevec	Imatinib Mesylate	Part D	$995,836,211.55	14,388	5,534,594	$37,726,863.34	$69,212.97	$179.93	*	118,319
		Y	Glucagen; Glucagon Emergency Kit	Glucagon,human Recombinant	Part B	$8,624,803.36	53,168	63,725	$1,787,240.11	$162.22	$135.34	$33.61	56,496
	Y		Harvoni	Ledipasvir/Sofosbuvir	Part D	$699,892,572.27	11,718	612,518	$16,288,447.13	$59,727.99	$1,142.65	*	21,799
Y			Herceptin	Trastuzumab	Part B	$560,661,666.26	18,476	6,994,748	$110,327,234.34	$30,345.40	$80.15	$5,971.38	175,613
	Y		Hizentra	Immune Globulin,gamma(IGG)	Part B	$162,035,365.66	2,964	11,483,983	$32,961,851.25	$54,667.80	$14.11	$11,120.73	32,058
Y			Humira	Adalimumab	Part D	$1,239,853,884.21	51,557	931,166	$34,774,570.43	$24,048.22	$1,331.51	*	362,301
	Y		Invega Sustenna	Paliperidone Palmitate	Part D	$540,403,968.98	43,399	424,436	$2,519,703.54	$12,451.99	$1,273.23	*	360,049

A2: Diabetes Prevalence Rates

Year	Age							
	0–44		45–64		65–74		75+	
	Rate(%)	Standard Error	Rate	Standard Error	Rate	Standard Error	Rate	Standard Error
1980	0.6	0.05	5.4	0.31	9.7	0.56	8.6	0.79
1981	0.6	0.04	5.7	0.3	8.6	0.63	9.2	0.79
1982	0.6	0.1	5.8	0.47	9.4	0.89	7.6	0.87
1983	0.6	0.08	5.8	0.43	7.9	0.92	8	1.1
1984	0.6	0.08	5.3	0.41	10.5	0.95	9.7	1.06
1985	0.6	0.07	5.2	0.43	10.9	0.93	9.6	0.94
1986	0.6	0.11	6.3	0.59	9.2	1.36	10.9	1.69
1987	0.8	0.09	5.6	0.41	9.6	0.92	9.8	0.98
1988	0.6	0.07	5.4	0.4	9.5	0.87	8.8	0.91
1989	0.7	0.07	5.8	0.43	9	0.76	8.6	1.02
1990	0.6	0.07	5	0.39	10.2	0.81	8	0.91
1991	0.9	0.1	5.7	0.4	10.4	0.77	9.3	1.02
1992	0.7	0.08	5.6	0.44	11.4	0.95	10.5	1
1993	0.9	0.08	6.2	0.45	10.1	0.94	10.6	1.23
1994	0.8	0.08	6.3	0.41	10.2	0.82	10.1	0.99
1995	0.8	0.09	6.4	0.44	13.1	0.99	11.7	1.21
1996	0.8	0.11	5.8	0.52	10	1.16	10	1.34
1997	1	0.06	7.6	0.31	14.3	0.73	11.7	0.65
1998	1	0.07	7.9	0.33	14	0.69	12.2	0.74
1999	1.1	0.07	8	0.33	13.9	0.67	12.3	0.66
2000	1.2	0.08	8.3	0.32	15.8	0.75	13.2	0.72
2001	1.3	0.07	9.3	0.37	16.7	0.71	13.6	0.7
2002	1.2	0.08	9.3	0.34	17	0.75	14.8	0.78
2003	1.2	0.08	9.1	0.34	17.6	0.87	15.5	0.82
2004	1.2	0.07	9.9	0.34	18.5	0.85	16	0.77
2005	1.5	0.1	10.5	0.34	18.6	0.8	15.3	0.75
2006	1.7	0.12	10.5	0.44	18.2	0.94	17.9	1.02
2007	1.4	0.11	10.6	0.4	20	0.89	17.3	0.99
2008	1.5	0.11	11.9	0.47	19.8	0.94	16.9	0.94
2009	1.9	0.12	12.5	0.48	19.9	0.92	18.9	1
2010	1.7	0.11	12.1	0.39	21.4	0.92	21.3	0.93

2011	1.5	0.09	12	0.39	22.2	0.72	18.7	0.83
2012	1.5	0.1	12.5	0.39	20.5	0.79	19.4	0.84
2013	1.7	0.1	12.3	0.38	21	0.76	20.9	0.9
2014	1.5	0.1	12	0.38	21.5	0.72	19.2	0.89

A3: Disease Prevalence Rates

Disease Prevalence Rates for 65 Years Old & Over								
Disease	2007	2008	2009	2010	2011	2012	2013	2014
Alzheimer's Disease/Dementia	11.86%	12.04%	12.19%	12.28%	12.20%	12.10%	11.89%	11.53%
Arthritis	27.78%	28.32%	29.09%	29.56%	30.06%	30.48%	30.65%	30.69%
Asthma	3.72%	3.88%	3.97%	4.05%	4.24%	4.31%	4.44%	4.48%
Atrial Fibrillation	8.62%	8.59%	8.80%	9.01%	9.14%	9.19%	9.25%	9.30%
Autism Spectrum Disorders	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
COPD	11.45%	11.48%	11.43%	11.39%	11.55%	11.36%	11.25%	11.00%
Cancer	8.86%	8.90%	8.89%	8.84%	9.21%	9.09%	9.00%	8.87%
Chronic Kidney Disease	11.63%	12.57%	13.64%	14.67%	15.56%	16.22%	16.78%	17.29%
Depression	9.83%	10.39%	10.88%	11.32%	12.29%	12.75%	13.14%	13.56%
Diabetes	25.53%	26.16%	26.74%	27.15%	27.43%	27.47%	27.33%	27.06%
HIV/AIDS	0.09%	0.08%	0.06%	0.07%	0.08%	0.08%	0.08%	0.09%
Heart Failure	17.74%	17.33%	17.02%	16.69%	16.29%	15.68%	15.11%	14.59%
Hepatitis (Chronic Viral B & C)	0.24%	0.24%	0.25%	0.27%	0.29%	0.32%	0.34%	0.37%
Hyperlipidemia	42.80%	44.35%	45.89%	46.96%	47.98%	48.13%	48.30%	47.89%
Hypertension	56.87%	57.98%	59.01%	59.52%	59.41%	59.18%	59.05%	58.40%
Ischemic Heart Disease	33.50%	33.34%	33.15%	32.67%	31.99%	31.17%	30.23%	29.30%
Osteoporosis	7.12%	7.57%	7.77%	7.75%	7.76%	7.26%	6.92%	6.73%
Schizophrenia/Other Psychotic Dis	2.33%	2.34%	2.37%	2.39%	2.52%	2.59%	2.59%	2.59%
Stroke	4.57%	4.50%	4.42%	4.35%	4.22%	4.12%	4.03%	3.99%

Disease Prevalence rates for under 65 Years Old								
Disease	2007	2008	2009	2010	2011	2012	2013	2014
Alzheimer's Disease/Dementia	3.01%	3.06%	3.12%	3.13%	3.13%	3.15%	3.14%	3.09%
Alzheimer's Disease/Dementia	3.01%	3.06%	3.12%	3.13%	3.13%	3.15%	3.14%	3.09%
Arthritis	18.48%	19.17%	20.12%	20.88%	21.67%	22.44%	22.92%	23.30%
Asthma	6.34%	6.55%	6.89%	7.01%	7.31%	7.44%	7.56%	7.59%
Atrial Fibrillation	1.75%	1.72%	1.79%	1.85%	1.91%	1.96%	2.01%	2.07%
Autism Spectrum Disorders	0.41%	0.45%	0.50%	0.54%	0.59%	0.67%	0.75%	0.85%
COPD	10.20%	10.29%	10.61%	10.64%	10.96%	11.08%	11.10%	11.15%
Cancer	2.48%	2.50%	2.55%	2.58%	2.70%	2.71%	2.73%	2.75%
Chronic Kidney Disease	10.01%	10.50%	11.12%	11.61%	12.04%	12.41%	12.81%	13.21%
Depression	23.50%	24.10%	25.16%	25.98%	27.19%	27.77%	28.19%	28.60%
Diabetes	23.99%	24.39%	24.83%	25.12%	25.32%	25.33%	25.26%	25.14%
HIV/AIDS	1.74%	1.71%	1.70%	1.70%	1.69%	1.65%	1.64%	1.59%
Heart Failure	10.48%	10.25%	10.19%	10.08%	9.96%	9.75%	9.58%	9.49%
Hepatitis (Chronic Viral B & C)	2.15%	2.16%	2.21%	2.25%	2.33%	2.40%	2.40%	2.37%
Hyperlipidemia	26.81%	27.58%	28.83%	29.46%	30.16%	30.19%	30.21%	29.83%
Hypertension	36.24%	37.14%	38.38%	38.99%	39.35%	39.61%	39.79%	39.66%
Ischemic Heart Disease	18.48%	18.23%	18.12%	17.84%	17.52%	17.14%	16.70%	16.34%
Osteoporosis	2.16%	2.30%	2.42%	2.45%	2.55%	2.42%	2.34%	2.31%
Schizophrenia/Other Psychotic Dis	9.58%	9.49%	9.45%	9.40%	9.38%	9.44%	9.42%	9.22%
Stroke	2.53%	2.54%	2.57%	2.58%	2.51%	2.51%	2.51%	2.53%

A4: Projection of US Population

Table 3. Projections of the Population by Sex and Selected Age Groups for the United States: 2015 to 2060

Sex and age	(Resident population as of July 1. Numbers in thousands)									
	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
BOTH SEXES	321,369	334,503	347,335	359,402	370,338	380,219	389,394	398,328	407,412	416,795
Under 18 years	73,635	74,128	75,015	76,273	77,446	78,185	78,910	79,888	81,087	82,309
Under 5 years	19,965	20,568	21,010	21,178	21,268	21,471	21,775	22,147	22,499	22,778
5 to 13 years	36,874	36,824	37,316	38,322	38,848	39,087	39,389	39,887	40,527	41,193
14 to 17 years	16,796	16,737	16,689	16,773	17,330	17,627	17,746	17,854	18,061	18,338
18 to 64 years	199,903	203,934	206,400	209,022	213,659	219,690	225,772	230,444	233,856	236,322
18 to 24 years	31,214	30,555	30,736	30,794	30,890	31,815	32,440	32,717	32,937	33,300
25 to 44 years	84,657	89,518	93,429	95,795	96,981	96,854	98,034	99,653	101,228	103,010
45 to 64 years	84,032	83,861	82,235	82,434	85,788	91,021	95,298	98,074	99,691	100,013
65 years and over	47,830	56,441	65,920	74,107	79,233	82,344	84,712	87,996	92,470	98,164
85 years and over	6,304	6,727	7,482	9,132	11,909	14,634	17,259	18,972	19,454	19,724
100 years and over	72	89	119	138	154	193	267	387	493	604

B1: Historical Conversion Factors

Year	Conversion Factor
1992	$31.00
1993	N/A
1994	N/A
1995	N/A
1996	N/A
1997	N/A
1998	$36.69
1999	$34.73
2000	$36.61
2001	$38.26
2002	$36.20
2003	$36.79
2004	$37.34

Year	Conversion Factor
2005	$37.90
2006	$37.90
2007	$37.90
2008	$38.09
2009	$36.07
2010	$36.08
2011	$33.98
2012	$34.04
2013	$34.02
2014	$35.82
2015	$35.93
2016	$35.83

B1: Historical Medicare Economic Index

Year	MEI
1992	3.20%

Year	MEI
2004	2.90%

1993	2.70%		2005	3.10%
1994	2.30%		2006	2.80%
1995	2.10%		2007	2.10%
1996	2.00%		2008	1.80%
1997	2.00%		2009	1.60%
1998	2.20%		2010	1.20%
1999	2.30%		2011	0.40%
2000	2.40%		2012	0.60%
2001	2.10%		2013	0.80%
2002	2.60%		2014	0.80%
2003	3.00%		2015	1.20%

C1: Outpatient Services (2009-2012)

Allowed Services per Year				
0 indicates non-existent/irrelevant data	2,009	2,010	2,011	2,012
General Practice	14,843,414	13,209,720	11,238,436	10,175,022
General Surgery	14,830,137	14,299,776	14,141,904	13,790,616
Allergy/Immunology	13,282,567	13,651,740	14,196,389	14,917,397
Otolaryngology	14,608,548	14,561,364	14,855,648	15,239,295
Anesthesiology	18,178,946	17,214,642	16,337,046	16,912,123
Cardiology	114,323,919	108,376,913	99,097,940	92,995,136
Dermatology	41,110,432	41,713,006	42,536,090	43,737,439
Family Practice	130,541,579	132,463,569	132,174,323	139,684,602
Interventional Pain Management	9,152,173	9,188,758	9,072,684	9,476,776
Gastroenterology	16,739,083	16,867,272	17,407,207	17,489,030
Internal Medicine	224,599,557	224,713,262	221,791,677	218,889,393
Osteopathic Manipulative Medicine	1,140,465	1,110,518	999,672	1,051,904
Neurology	33,433,016	34,687,532	37,073,960	39,979,148
Neurosurgery	3,397,978	3,270,760	3,035,857	3,032,843

Speech Language Pathologists	25,460	160,265	278,058	331,515
Obstetrics/Gynecology	8,544,830	8,290,969	8,398,781	8,770,582
Hospice and Palliative Care	5,071	69,500	123,632	157,247
Ophthalmology	54,141,502	55,838,658	55,169,826	56,285,995
Oral Surgery (dentists only)	203,632	200,172	200,735	211,071
Orthopedic Surgery	37,523,304	44,494,792	45,539,179	46,566,366
Cardiac Electrophysiology	0	0	1,554,446	3,632,604
Pathology	24,768,217	25,929,471	27,324,080	28,168,820
Sports Medicine	1,898,120	2,044,860	174,987	474,374
Plastic and Reconstructive Surgery	0	0	2,213,025	2,212,963
Physical Medicine and Rehabilitation	21,183,514	22,269,503	22,942,461	23,467,742
Psychiatry	18,421,673	18,147,516	17,855,625	17,278,816
Geriatric Psychiatry	0	0	77,544	139,379
Colorectal Surgery (formerly proctology)	786,743	814,310	829,738	849,766
Pulmonary Disease	24,757,890	24,276,275	24,180,696	23,062,302
Diagnostic Radiology	172,231,285	167,526,649	165,660,716	164,126,342
Anesthesiologist Assistant	113,354	122,106	141,063	164,132
Thoracic Surgery	1,535,842	1,390,074	1,249,633	1,189,046
Urology	34,809,031	35,580,661	36,761,589	39,116,975
Chiropractic	22,841,766	22,793,870	22,360,635	21,787,254
Nuclear Medicine	1,378,047	1,161,093	1,079,092	1,095,094
Pediatric Medicine	2,611,034	2,323,785	1,839,505	1,844,523
Geriatric Medicine	2,749,951	2,939,243	3,053,769	3,162,251
Nephrology	54,757,047	55,444,672	48,162,506	42,163,009
Hand Surgery	1,197,147	1,289,561	1,561,741	1,795,635
Optometry	12,367,567	12,711,263	12,502,506	12,877,054
Certified Nurse Midwife (effective July)	40,711	41,298	51,514	59,098
Certified Registered Nurse Anesthetist (CRNA)	5,575,132	5,906,403	6,219,536	6,680,612
Infectious Disease	39,771,999	43,288,966	44,378,187	48,511,009
Mammography Screening Center	45,850	43,159	42,207	42,609
Endocrinology	9,220,658	9,389,664	9,697,357	10,458,993
Independent Diagnostic Testing Facility (IDTF)	20,521,850	18,212,198	17,426,653	16,314,432
Podiatry	37,538,080	38,370,556	37,980,648	37,982,805

Ambulatory Surgical Center	8,229,876	7,963,629	7,419,731	7,389,662
Nurse Practitioner	28,193,018	31,334,965	33,586,046	38,459,563
Medical supply company w/ orthotic pers	6,853,768	8,487,014	7,974,912	6,932,205
Medical supply company w/ prosthetic pers	1,392,008	1,291,793	1,222,640	1,324,719
Medical supply company w/ prosthetic/orthotic pers	2,561,204	2,655,894	2,482,905	2,281,379
MEDICARE PART B PHYSICIAN/SUPPLIER NATIONAL DATA - CALENDAR YEAR	5,153	429,204,554	2,011	0
EXPENDITURES AND SERVICES BY SPECIALTY Medical supply company not in -	0	2,010	482,540,873	499,815,540
Individual orthotic personnel certified	0	4,235,934	3,660,860	3,513,870
Individual prosthetic personnel certified	0	1,242,818	1,273,100	1,284,677
Individual prosthetic/ort	0	262,141	244,277	210,527
Medical Supply Company with registered pharmacist	0	522,603	968,237	1,852,262
Ambulance Service Supplier	0	156,870,036	159,286,278	159,462,239
Public Health or Welfare Agencies	0	661,902	435,713	317,203
Clinical Psychologist (Billing Independently)	0	143,056	161,916	176,798
Portable X-Ray Supplier (Billing Independently)	0	6,651,053	6,823,920	6,881,245
Audiologist (Billing Independently)	0	1,694,321	1,780,132	1,819,034
Physical Therapist in Private Practice	74,944,156	77,385,687	83,046,043	84,909,804
Rheumatology	29,459,053	33,393,673	45,362,875	55,832,569
Occupational Therapist in Private Practice	0	5,375,649	5,918,996	6,174,164
Clinical Psychologist	0	7,204,432	7,515,532	7,790,816
Clinical Laboratory (Billing Independently)	0	350,552,453	343,790,689	365,023,460
Single or Multispecialty Clinic or Group Practice	0	920,470	758,413	3,771,742
Registered Dietician/Nutrition Professional	0	411,413	448,535	483,313
Pain Management	0	2,843,411	3,469,748	3,845,789
Mass Immunization Roster Biller	0	11,680,071	11,737,496	11,644,447
Radiation Therapy Centers	0	410,346	425,131	440,855
Slide Preparation Facilities	0	219,031	222,481	206,756
Peripheral Vascular Disease	0	532,568	263,760	239,912
Vascular Surgery	5,310,067	5,706,418	5,795,085	5,940,862
Cardiac Surgery	1,367,788	1,352,007	1,274,519	1,187,980
Addiction Medicine	55,884	69,393	57,019	87,228

Licensed Clinical Social Worker	0	4,994,819	5,294,238	5,499,162
Critical Care (Intensivists)	0	2,956,146	2,886,311	2,757,749
Hematology	15,276,593	13,722,927	12,484,367	13,224,406
Hematology/Oncology	300,909,831	313,668,262	316,959,360	312,063,089
Preventive Medicine	0	257,639	236,561	263,979
Maxillofacial Surgery	0	132,787	149,847	158,276
Neuropsychiatry	0	170,843	188,109	193,524
All other suppliers e.g. Drug Stores	0	3,079,480	4,808,486	0
Unknown Supplier/Provider	0	84,428	33,528	39,892
Certified Clinical Nurse Specialist	0	1,124,482	1,044,715	1,060,493
Medical Oncology	100,523,854	94,723,884	89,452,375	89,661,873
Surgical Oncology	436,699	422,340	432,850	428,770
Radiation Oncology	14,241,346	14,337,350	14,880,501	14,521,713
Emergency Medicine	26,178,822	27,804,675	29,178,901	30,093,335
Interventional Radiology	0	5,076,151	4,608,524	4,683,287
Optician	0	288,213	258,182	236,555
Physician Assistant	16,738,243	19,207,413	21,699,173	24,409,498
Gynecological/Oncology	0	3,611,905	3,846,888	3,519,190
Unknown Physician Specialty Code	0	44,538,973	13,620,552	5,556,696
Hospital	0	385,175	451,085	424,206
Skilled Nursing Facility	0	8,156,107	6,461,281	7,282,734
Intermediate Care Nursing Facility	0	457,283	439,794	351,990
Nursing Facility Other	0	2,037,201	1,477,427	680,217
Home Health Agency	0	408,746	337,462	276,595
Pharmacy	1,268,806,801	1,249,402,953	1,198,284,727	1,183,679,679
Medical Supply Company with Respiratory Therapist	0	46,637,200	52,044,352	57,166,293
Department Store	0	22,690	22,797	22,454
Grocery Store	0	331,888	46	18
Supplier Of Oxygen Or Oxygen Related Equipment	0	21,212	815,449	1,257,356
Pedorthic Personnel	0	372,056	47,852	76,093
Medical Supply Company with Pedorthic Personnel	0	0	340,779	726,775
Ocularist	0	0	203	4,239

C2: Total Payments on Outpatient Services

Total Payments	2011	2012	2013	Average % Change
0012 - Level I Debridement & Destruction	$20,478,235.40	$22,593,689.44	$25,629,428.99	11.88%
0013 - Level II Debridement & Destruction	$85,276,276.02	$97,037,388.14	$106,312,468.00	11.68%
0015 - Level III Debridement & Destruction	$166,376,564.00	$190,840,157.19	$216,856,780.65	14.17%
0019 - Level I Excision/ Biopsy	$56,087,194.80	$59,867,569.24	$63,262,377.66	6.21%
0020 - Level II Excision/ Biopsy	$128,488,057.32	$141,503,856.12	$148,213,926.63	7.44%
0073 - Level III Endoscopy Upper Airway	$8,178,779.84	$9,996,042.74	$10,697,860.70	14.62%
0074 - Level IV Endoscopy Upper Airway	$117,871,067.84	$127,386,099.28	$101,005,153.20	-6.32%
0078 - Level III Pulmonary Treatment	$124,905,865.20	$140,578,536.00	$144,235,559.16	7.57%
0096 - Level II Noninvasive Physiologic Studies	$165,194,229.85	$156,557,299.62	$147,848,980.30	-5.40%
0203 - Level IV Nerve Injections	$25,024,553.12	$32,721,280.00	$34,617,963.52	18.28%
0204 - Level I Nerve Injections	$201,874,689.00	$237,626,184.96	$288,366,961.25	19.53%
0206 - Level II Nerve Injections	$52,146,220.86	$61,060,025.88	$68,223,787.14	14.41%
0207 - Level III Nerve Injections	$1,164,320,281.80	$1,225,191,018.24	$1,258,664,656.55	3.98%
0209 - Level II Extended EEG, Sleep, and Cardiovascular Studies	$1,238,621,449.80	$1,379,708,288.49	$1,408,988,631.12	6.76%
0265 - Level I Diagnostic and Screening Ultrasound	$260,126,863.50	$285,610,475.85	$309,510,976.54	9.08%
0267 - Level III Diagnostic and Screening Ultrasound	$1,319,954,725.34	$1,467,321,206.64	$1,516,261,444.60	7.25%
0269 - Level II Echocardiogram Without Contrast	$2,613,791,167.44	$3,186,267,380.28	$3,392,734,430.32	14.19%
0270 - Level III Echocardiogram Without Contrast	$202,009,822.88	$263,917,612.45	$286,922,178.75	19.68%
0336 - Magnetic Resonance Imaging and Magnetic Resonance Angiography without Contrast	$2,963,925,361.80	$3,320,524,675.17	$3,457,263,239.04	8.07%
0368 - Level II Pulmonary Tests	$201,231,458.78	$93,970,704.55	$144,689,725.44	0.34%
0369 - Level III Pulmonary Tests	$11,478,205.00	$13,814,198.64	$17,274,103.08	22.70%
0377 - Level II Cardiac Imaging	$2,921,346,643.38	$3,388,734,219.50	$3,368,603,430.00	7.70%
0604 - Level 1 Hospital Clinic Visits	$451,066,128.71	$505,891,858.80	$581,732,618.91	13.57%
0605 - Level 2 Hospital Clinic Visits	$1,203,809,097.18	$1,425,608,933.10	$1,674,117,391.80	17.93%
0606 - Level 3 Hospital Clinic Visits	$575,391,780.90	$705,900,866.30	$848,528,397.78	21.44%
0607 - Level 4 Hospital Clinic Visits	$191,825,255.30	$217,044,484.72	$247,935,511.56	13.69%

0608 - Level 5 Hospital Clinic Visits	$27,871,603.20	$28,716,757.92	$27,490,403.70	-0.62%
0690 - Level I Electronic Analysis of Devices	$106,691,214.40	$123,639,679.03	$133,206,990.28	11.81%
0692 - Level II Electronic Analysis of Devices	$22,136,930.70	$24,592,061.61	$27,167,455.04	10.78%
0698 - Level II Eye Tests & Treatments	$33,383,220.45	$26,726,017.29	$31,133,236.80	-1.73%

D1: Inpatient Services: Total Discharges

Total Discharges				
Inpatient Procedure	2011	2012	2013	Average Change
039 - EXTRACRANIAL PROCEDURES W/O CC/MCC Total	33,606	31,341	28,553	-7.82%
057 - DEGENERATIVE NERVOUS SYSTEM DISORDERS W/O MCC Total	30,212	26,591	22,390	-13.89%
064 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W MCC Total	62,093	63,439	66,379	3.40%
065 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W CC OR TPA IN 24 HRS Total	106,414	103,849	103,200	-1.52%
066 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W/O CC/MCC Total	55,849	55,060	52,907	-2.66%
069 - TRANSIENT ISCHEMIA Total	79,590	75,570	68,011	-7.53%
074 - CRANIAL & PERIPHERAL NERVE DISORDERS W/O MCC Total	21,659	19,380	16,474	-12.76%
101 - SEIZURES W/O MCC Total	48,854	45,972	42,845	-6.35%
176 - PULMONARY EMBOLISM W/O MCC Total	32,042	32,971	31,338	-1.03%
177 - RESPIRATORY INFECTIONS & INFLAMMATIONS W MCC Total	66,660	64,515	67,660	0.83%
178 - RESPIRATORY INFECTIONS & INFLAMMATIONS W CC Total	56,100	49,512	45,796	-9.62%
189 - PULMONARY EDEMA & RESPIRATORY FAILURE Total	95,099	98,498	110,034	7.64%
190 - CHRONIC OBSTRUCTIVE PULMONARY DISEASE W MCC Total	149,677	140,495	150,332	0.43%
191 - CHRONIC OBSTRUCTIVE PULMONARY DISEASE W CC Total	148,491	135,081	133,597	-5.06%
192 - CHRONIC OBSTRUCTIVE PULMONARY DISEASE W/O CC/MCC Total	114,790	95,987	86,871	-12.94%
193 - SIMPLE PNEUMONIA & PLEURISY W MCC Total	127,989	127,832	142,245	5.58%
194 - SIMPLE PNEUMONIA & PLEURISY W CC Total	198,390	180,262	181,006	-4.36%
195 - SIMPLE PNEUMONIA & PLEURISY W/O CC/MCC Total	79,873	68,709	66,272	-8.76%
202 - BRONCHITIS & ASTHMA W CC/MCC Total	32,086	28,449	32,658	1.73%
207 - RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT 96+ HOURS Total	26,412	23,202	24,124	-4.09%
208 - RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT <96 HOURS Total	68,080	65,104	66,500	-1.11%
238 - MAJOR CARDIOVASC PROCEDURES W/O MCC Total	34,669	32,174	32,222	-3.52%
243 - PERMANENT CARDIAC PACEMAKER IMPLANT W CC Total	29,646	26,554	24,023	-9.98%

244 - PERMANENT CARDIAC PACEMAKER IMPLANT W/O CC/MCC Total	27,951	22,251	17,968	-19.82%
246 - PERC CARDIOVASC PROC W DRUG-ELUTING STENT W MCC OR 4+ VESSELS/STENTS Total	27,104	27,175	29,065	3.61%
247 - PERC CARDIOVASC PROC W DRUG-ELUTING STENT W/O MCC Total	108,272	101,093	99,648	-4.03%
251 - PERC CARDIOVASC PROC W/O CORONARY ARTERY STENT W/O MCC Total	28,583	24,716	24,277	-7.65%
252 - OTHER VASCULAR PROCEDURES W MCC Total	34,222	31,494	28,984	-7.97%
253 - OTHER VASCULAR PROCEDURES W CC Total	36,434	35,328	33,193	-4.54%
254 - OTHER VASCULAR PROCEDURES W/O CC/MCC Total	26,385	22,959	19,524	-13.97%
280 - ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W MCC Total	63,934	61,558	63,447	-0.32%
281 - ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W CC Total	40,836	40,427	39,405	-1.76%
282 - ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W/O CC/MCC Total	21,596	19,948	18,952	-6.31%
286 - CIRCULATORY DISORDERS EXCEPT AMI, W CARD CATH W MCC Total	21,820	22,605	23,002	2.68%
287 - CIRCULATORY DISORDERS EXCEPT AMI, W CARD CATH W/O MCC Total	115,920	106,673	90,241	-11.69%
291 - HEART FAILURE & SHOCK W MCC Total	185,599	182,445	192,040	1.78%
292 - HEART FAILURE & SHOCK W CC Total	222,038	204,069	196,318	-5.95%
293 - HEART FAILURE & SHOCK W/O CC/MCC Total	89,217	75,040	66,748	-13.47%
300 - PERIPHERAL VASCULAR DISORDERS W CC Total	38,458	36,260	31,817	-8.98%
303 - ATHEROSCLEROSIS W/O MCC Total	30,184	23,961	16,689	-25.48%
305 - HYPERTENSION W/O MCC Total	25,205	24,530	20,485	-9.58%
308 - CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W MCC Total	61,060	62,424	65,669	3.72%
309 - CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W CC Total	102,484	103,312	100,114	-1.14%
310 - CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W/O CC/MCC Total	113,454	107,474	96,270	-7.85%
312 - SYNCOPE & COLLAPSE Total	141,918	118,431	98,485	-16.70%
313 - CHEST PAIN Total	131,079	102,497	77,486	-23.10%
314 - OTHER CIRCULATORY SYSTEM DIAGNOSES W MCC Total	51,079	47,885	43,444	-7.76%
315 - OTHER CIRCULATORY SYSTEM DIAGNOSES W CC Total	17,478	16,796	15,770	-5.01%
329 - MAJOR SMALL & LARGE BOWEL PROCEDURES W MCC Total	37,250	35,229	33,841	-4.68%
330 - MAJOR SMALL & LARGE BOWEL PROCEDURES W CC Total	50,766	49,343	47,797	-2.97%
372 - MAJOR GASTROINTESTINAL DISORDERS & PERITONEAL INFECTIONS W CC Total	28,509	29,300	27,085	-2.39%
377 - G.I. HEMORRHAGE W MCC Total	48,398	49,590	51,031	2.68%
378 - G.I. HEMORRHAGE W CC Total	138,678	138,921	138,190	-0.18%
379 - G.I. HEMORRHAGE W/O CC/MCC Total	33,393	27,592	23,790	-15.58%

389 - G.I. OBSTRUCTION W CC Total	46,860	47,491	46,839	-0.01%
390 - G.I. OBSTRUCTION W/O CC/MCC Total	31,249	30,226	29,649	-2.59%
391 - ESOPHAGITIS, GASTROENT & MISC DIGEST DISORDERS W MCC Total	43,026	42,084	40,718	-2.72%
392 - ESOPHAGITIS, GASTROENT & MISC DIGEST DISORDERS W/O MCC Total	244,854	215,483	197,086	-10.27%
394 - OTHER DIGESTIVE SYSTEM DIAGNOSES W CC Total	41,346	40,667	39,212	-2.61%
418 - LAPAROSCOPIC CHOLECYSTECTOMY W/O C.D.E. W CC Total	18,227	17,799	16,266	-5.48%
439 - DISORDERS OF PANCREAS EXCEPT MALIGNANCY W CC Total	17,948	18,153	17,540	-1.12%
460 - SPINAL FUSION EXCEPT CERVICAL W/O MCC Total	65,997	68,494	70,715	3.51%
469 - MAJOR JOINT REPLACEMENT OR REATTACHMENT OF LOWER EXTREMITY W MCC Total	18,714	18,666	18,608	-0.28%
470 - MAJOR JOINT REPLACEMENT OR REATTACHMENT OF LOWER EXTREMITY W/O MCC Total	427,207	430,717	444,816	2.05%
473 - CERVICAL SPINAL FUSION W/O CC/MCC Total	23,834	24,668	25,067	2.56%
480 - HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W MCC Total	17,851	17,546	18,489	1.83%
481 - HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W CC Total	77,525	77,210	77,819	0.19%
482 - HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W/O CC/MCC Total	20,739	18,025	17,638	-7.62%
491 - BACK & NECK PROC EXC SPINAL FUSION W/O CC/MCC Total	34,579	27,581	22,897	-18.61%
536 - FRACTURES OF HIP & PELVIS W/O MCC Total	22,728	20,204	17,080	-13.28%
552 - MEDICAL BACK PROBLEMS W/O MCC Total	63,116	53,669	47,625	-13.11%
563 - FX, SPRN, STRN & DISL EXCEPT FEMUR, HIP, PELVIS & THIGH W/O MCC Total	20,278	18,884	15,688	-11.90%
602 - CELLULITIS W MCC Total	17,714	18,106	18,203	1.37%
603 - CELLULITIS W/O MCC Total	140,894	140,038	131,207	-3.46%
638 - DIABETES W CC Total	48,025	45,788	44,849	-3.35%
640 - MISC DISORDERS OF NUTRITION,METABOLISM,FLUIDS/ELECTROLYTES W MCC Total	56,816	55,428	58,351	1.42%
641 - MISC DISORDERS OF NUTRITION,METABOLISM,FLUIDS/ELECTROLYTES W/O MCC Total	153,660	132,997	118,938	-12.01%
682 - RENAL FAILURE W MCC Total	101,029	104,492	107,204	3.01%
683 - RENAL FAILURE W CC Total	150,444	153,170	150,966	0.19%
684 - RENAL FAILURE W/O CC/MCC Total	19,540	19,457	18,451	-2.80%
689 - KIDNEY & URINARY TRACT INFECTIONS W MCC Total	66,583	68,813	68,757	1.63%
690 - KIDNEY & URINARY TRACT INFECTIONS W/O MCC Total	206,695	195,346	173,271	-8.40%
698 - OTHER KIDNEY & URINARY TRACT DIAGNOSES W MCC Total	22,085	24,713	27,021	10.62%
699 - OTHER KIDNEY & URINARY TRACT DIAGNOSES W CC Total	23,755	23,849	23,914	0.33%

811 - RED BLOOD CELL DISORDERS W MCC Total	24,148	24,452	23,760	-0.79%
812 - RED BLOOD CELL DISORDERS W/O MCC Total	92,851	86,432	77,631	-8.55%
853 - INFECTIOUS & PARASITIC DISEASES W O.R. PROCEDURE W MCC Total	39,482	42,769	47,717	9.95%
870 - SEPTICEMIA OR SEVERE SEPSIS W MV 96+ HOURS Total	22,624	23,862	26,995	9.30%
871 - SEPTICEMIA OR SEVERE SEPSIS W/O MV 96+ HOURS W MCC Total	319,072	345,343	396,451	11.52%
872 - SEPTICEMIA OR SEVERE SEPSIS W/O MV 96+ HOURS W/O MCC Total	112,430	119,380	124,603	5.28%
885 - PSYCHOSES Total	89,733	93,466	89,707	0.07%
897 - ALCOHOL/DRUG ABUSE OR DEPENDENCE W/O REHABILITATION THERAPY W/O MCC Total	31,935	32,714	32,053	0.21%
917 - POISONING & TOXIC EFFECTS OF DRUGS W MCC Total	16,952	19,024	20,458	9.88%
918 - POISONING & TOXIC EFFECTS OF DRUGS W/O MCC Total	29,225	26,726	23,672	-9.99%
948 - SIGNS & SYMPTOMS W/O MCC Total	50,411	45,583	39,741	-11.20%

D2: Inpatient Services: Average Medicare Payments

Average Medicare Payments				
Procedure	2011	2012	2013	Average % Change
039 - EXTRACRANIAL PROCEDURES W/O CC/MCC Total	$5,459.87	$5,591.24	$5,603.83	1.32%
057 - DEGENERATIVE NERVOUS SYSTEM DISORDERS W/O MCC Total	$5,936.91	$6,234.69	$6,172.52	2.01%
064 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W MCC Total	$12,554.69	$12,544.43	$12,182.15	-1.48%
065 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W CC OR TPA IN 24 HRS Total	$6,864.22	$6,845.04	$6,593.02	-1.98%
066 - INTRACRANIAL HEMORRHAGE OR CEREBRAL INFARCTION W/O CC/MCC Total	$4,512.87	$4,475.00	$4,404.29	-1.21%
069 - TRANSIENT ISCHEMIA Total	$3,962.34	$3,988.02	$4,003.75	0.52%
074 - CRANIAL & PERIPHERAL NERVE DISORDERS W/O MCC Total	$5,322.94	$5,459.79	$5,455.84	1.25%
101 - SEIZURES W/O MCC Total	4,707.47	4,835.40	$4,608.53	-0.99%

176 - PULMONARY EMBOLISM W/O MCC Total	$6,140.99	$6,064.71	$5,826.49	-2.59%
177 - RESPIRATORY INFECTIONS & INFLAMMATIONS W MCC Total	$12,866.18	$13,010.53	$12,738.03	-0.49%
178 - RESPIRATORY INFECTIONS & INFLAMMATIONS W CC Total	$8,987.10	$9,014.29	$8,668.79	-1.77%
189 - PULMONARY EDEMA & RESPIRATORY FAILURE Total	$7,841.42	$7,851.93	$7,729.24	-0.71%
190 - CHRONIC OBSTRUCTIVE PULMONARY DISEASE W MCC Total	$7,083.97	$6,965.49	$6,983.75	-0.71%
191 - CHRONIC OBSTRUCTIVE PULMONARY DISEASE W CC Total	$5,627.42	$5,631.79	$5,455.90	-1.52%
192 - CHRONIC OBSTRUCTIVE PULMONARY DISEASE W/O CC/MCC Total	$3,879.52	$3,825.22	$3,741.18	-1.80%
193 - SIMPLE PNEUMONIA & PLEURISY W MCC Total	$8,942.11	$9,084.89	$8,926.15	-0.08%
194 - SIMPLE PNEUMONIA & PLEURISY W CC Total	5,872.24	$5,863.03	$5,728.34	-1.23%
195 - SIMPLE PNEUMONIA & PLEURISY W/O CC/MCC Total	$3,712.29	$3,686.19	$3,655.06	-0.77%
202 - BRONCHITIS & ASTHMA W CC/MCC Total	$4,920.42	$5,066.71	$4,983.38	0.66%
207 - RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT 96+ HOURS Total	$36,451.73	$37,165.94	$37,216.34	1.05%
208 - RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT <96 HOURS Total	15,081.80	$15,344.37	$15,319.13	0.79%
238 - MAJOR CARDIOVASC PROCEDURES W/O MCC Total	$19,925.64	$20,186.06	$21,175.36	3.10%
243 - PERMANENT CARDIAC PACEMAKER IMPLANT W CC Total	16,758.50	$16,976.26	$16,931.16	0.52%
244 - PERMANENT CARDIAC PACEMAKER IMPLANT W/O CC/MCC Total	$12,496.64	$12,618.95	$12,904.50	1.62%
246 - PERC CARDIOVASC PROC W DRUG-ELUTING STENT W MCC OR 4+ VESSELS/STENTS Total	21,091.23	$21,372.58	$21,460.95	0.87%
247 - PERC CARDIOVASC PROC W DRUG-ELUTING STENT W/O MCC Total	$11,818.66	$12,010.10	$12,162.87	1.45%
251 - PERC CARDIOVASC PROC W/O CORONARY ARTERY STENT W/O MCC Total	11,874.05	$12,464.09	$12,874.34	4.13%
252 - OTHER VASCULAR PROCEDURES W MCC Total	21,883.58	$22,412.74	$22,666.60	1.78%
253 - OTHER VASCULAR PROCEDURES W CC Total	$16,068.28	$16,655.07	$16,776.41	2.19%
254 - OTHER VASCULAR PROCEDURES W/O CC/MCC Total	$9,987.49	$10,406.91	$10,331.43	1.74%
280 - ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W MCC Total	$11,639.39	$11,418.28	$11,367.76	-1.17%
281 - ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W CC Total	$7,051.64	$6,860.44	$6,424.63	-4.53%
282 - ACUTE MYOCARDIAL INFARCTION, DISCHARGED ALIVE W/O CC/MCC Total	4,405.44	$4,322.61	$4,166.96	-2.74%
286 - CIRCULATORY DISORDERS EXCEPT AMI, W CARD CATH W MCC Total	$13,949.88	$14,711.67	$14,279.52	1.26%
287 - CIRCULATORY DISORDERS EXCEPT AMI, W CARD CATH W/O MCC Total	6,304.70	$6,291.57	$6,183.67	-0.96%
291 - HEART FAILURE & SHOCK W MCC Total	9,524.57	$9,691.91	$9,597.65	0.39%
292 - HEART FAILURE & SHOCK W CC Total	6,250.98	$6,294.84	$5,987.66	-2.09%
293 - HEART FAILURE & SHOCK W/O CC/MCC Total	$3,880.35	$3,847.52	$3,741.31	-1.80%
300 - PERIPHERAL VASCULAR DISORDERS W CC Total	$5,949.30	$6,032.72	$5,817.52	-1.08%

303 - ATHEROSCLEROSIS W/O MCC Total	$3,223.46	$3,206.30	$3,203.80	-0.31%
305 - HYPERTENSION W/O MCC Total	3,393.38	$3,397.84	$3,290.14	-1.52%
308 - CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W MCC Total	$7,765.30	$7,808.68	$7,647.39	-0.75%
309 - CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W CC Total	4,860.59	$4,751.33	$4,586.61	-2.86%
310 - CARDIAC ARRHYTHMIA & CONDUCTION DISORDERS W/O CC/MCC Total	$2,843.34	$2,784.55	$2,658.69	-3.29%
312 - SYNCOPE & COLLAPSE Total	$4,122.77	$4,187.23	$4,219.89	1.17%
313 - CHEST PAIN Total	$2,983.88	$2,959.81	$3,041.04	0.97%
314 - OTHER CIRCULATORY SYSTEM DIAGNOSES W MCC Total	12,590.09	$12,927.60	$12,813.20	0.90%
315 - OTHER CIRCULATORY SYSTEM DIAGNOSES W CC Total	6,209.54	$6,324.40	$6,049.10	-1.25%
329 - MAJOR SMALL & LARGE BOWEL PROCEDURES W MCC Total	$35,824.35	$36,350.13	$35,529.45	-0.40%
330 - MAJOR SMALL & LARGE BOWEL PROCEDURES W CC Total	$16,259.98	$16,565.13	$16,079.33	-0.53%
372 - MAJOR GASTROINTESTINAL DISORDERS & PERITONEAL INFECTIONS W CC Total	$8,086.06	$8,105.93	$7,518.41	-3.50%
377 - G.I. HEMORRHAGE W MCC Total	$11,730.83	$11,886.84	$11,792.06	0.27%
378 - G.I. HEMORRHAGE W CC Total	$6,064.88	$6,104.38	$5,941.27	-1.01%
379 - G.I. HEMORRHAGE W/O CC/MCC Total	$3,927.56	$3,941.79	$3,816.62	-1.41%
389 - G.I. OBSTRUCTION W CC Total	$5,454.60	$5,518.17	$5,270.39	-1.66%
390 - G.I. OBSTRUCTION W/O CC/MCC Total	$3,302.99	$3,352.38	$3,214.50	-1.31%
391 - ESOPHAGITIS, GASTROENT & MISC DIGEST DISORDERS W MCC Total	$7,577.74	$7,887.90	$7,705.48	0.89%
392 - ESOPHAGITIS, GASTROENT & MISC DIGEST DISORDERS W/O MCC Total	$4,012.55	$4,124.66	$4,074.61	0.79%
394 - OTHER DIGESTIVE SYSTEM DIAGNOSES W CC Total	6,189.30	$6,241.32	$6,013.83	-1.40%
418 - LAPAROSCOPIC CHOLECYSTECTOMY W/O C.D.E. W CC Total	9,881.58	9,975.23	$9,959.09	0.39%
439 - DISORDERS OF PANCREAS EXCEPT MALIGNANCY W CC Total	6,166.73	$6,047.42	$5,710.90	-3.75%
460 - SPINAL FUSION EXCEPT CERVICAL W/O MCC Total	23,612.22	$23,911.83	$24,280.36	1.41%
469 - MAJOR JOINT REPLACEMENT OR REATTACHMENT OF LOWER EXTREMITY W MCC Total	20,661.78	$20,791.58	$20,582.21	-0.19%
470 - MAJOR JOINT REPLACEMENT OR REATTACHMENT OF LOWER EXTREMITY W/O MCC Total	$12,053.00	$12,052.02	$12,080.91	0.12%
473 - CERVICAL SPINAL FUSION W/O CC/MCC Total	$11,873.77	$12,030.11	$12,379.04	2.11%
480 - HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W MCC Total	19,609.11	$19,828.86	$19,580.81	-0.07%
481 - HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W CC Total	11,377.46	11,697.51	$11,800.55	1.85%
482 - HIP & FEMUR PROCEDURES EXCEPT MAJOR JOINT W/O CC/MCC Total	9,111.84	$9,309.50	$9,363.76	1.38%
491 - BACK & NECK PROC EXC SPINAL FUSION W/O CC/MCC Total	5,433.44	$5,653.40	$5,835.27	3.63%
536 - FRACTURES OF HIP & PELVIS W/O MCC Total	$3,792.56	$3,919.88	$3,765.37	-0.29%

552 - MEDICAL BACK PROBLEMS W/O MCC Total	$4,646.18	$4,889.35	$4,841.39	2.13%
563 - FX, SPRN, STRN & DISL EXCEPT FEMUR, HIP, PELVIS & THIGH W/O MCC Total	4,016.60	$4,274.15	$4,182.17	2.13%
602 - CELLULITIS W MCC Total	9,402.54	$9,409.41	$9,348.05	-0.29%
603 - CELLULITIS W/O MCC Total	$4,744.43	4,837.49	$4,673.14	-0.72%
638 - DIABETES W CC Total	5,069.64	$5,045.69	$4,891.48	-1.76%
640 - MISC DISORDERS OF NUTRITION,METABOLISM,FLUIDS/ELECTROLYTES W MCC Total	$7,474.00	$7,430.07	$7,190.72	-1.90%
641 - MISC DISORDERS OF NUTRITION,METABOLISM,FLUIDS/ELECTROLYTES W/O MCC Total	$3,945.79	$4,064.40	$3,913.74	-0.35%
682 - RENAL FAILURE W MCC Total	$10,656.19	$10,714.49	$10,163.59	-2.30%
683 - RENAL FAILURE W CC Total	$6,139.78	$6,159.29	$5,828.35	-2.53%
684 - RENAL FAILURE W/O CC/MCC Total	$3,671.67	$3,516.98	$3,426.81	-3.39%
689 - KIDNEY & URINARY TRACT INFECTIONS W MCC Total	$7,341.58	$7,255.74	$6,958.26	-2.63%
690 - KIDNEY & URINARY TRACT INFECTIONS W/O MCC Total	4,486.80	$4,539.16	$4,392.19	-1.04%
698 - OTHER KIDNEY & URINARY TRACT DIAGNOSES W MCC Total	11,162.37	$11,213.66	$10,685.08	-2.13%
699 - OTHER KIDNEY & URINARY TRACT DIAGNOSES W CC Total	6,888.21	$7,047.10	$6,637.87	-1.75%
811 - RED BLOOD CELL DISORDERS W MCC Total	$8,466.70	$8,383.59	$8,317.06	-0.89%
812 - RED BLOOD CELL DISORDERS W/O MCC Total	$4,788.72	$4,829.18	$4,640.52	-1.53%
853 - INFECTIOUS & PARASITIC DISEASES W O.R. PROCEDURE W MCC Total	$38,666.86	$39,032.29	$37,810.12	-1.09%
870 - SEPTICEMIA OR SEVERE SEPSIS W MV 96+ HOURS Total	43,333.54	$43,833.07	$43,229.30	-0.11%
871 - SEPTICEMIA OR SEVERE SEPSIS W/O MV 96+ HOURS W MCC Total	$12,536.93	$12,721.99	$12,384.29	-0.59%
872 - SEPTICEMIA OR SEVERE SEPSIS W/O MV 96+ HOURS W/O MCC Total	$6,896.60	$6,873.00	$6,564.69	-2.41%
885 - PSYCHOSES Total	6,236.14	$6,330.87	$6,372.00	1.08%
897 - ALCOHOL/DRUG ABUSE OR DEPENDENCE W/O REHABILITATION THERAPY W/O MCC Total	$4,206.78	$4,401.16	$4,275.70	0.89%
917 - POISONING & TOXIC EFFECTS OF DRUGS W MCC Total	$9,633.97	$9,849.61	$9,351.58	-1.41%
918 - POISONING & TOXIC EFFECTS OF DRUGS W/O MCC Total	$3,617.65	$3,689.76	$3,633.49	0.23%
948 - SIGNS & SYMPTOMS W/O MCC Total	$4,024.64	$4,116.75	$4,045.14	0.27%

D3: Inpatient Services: Historical Costs of Stay

Cost of Stay (Historical)								
Year	1999	2000	2001	2002	2003	2004	2005	2006

Average Cost	$1,102	$1,148	$1,217	$1,290	$1,371	$1,450	$1,522	$1,612
Year	2007	2008	2009	2010	2011	2012	2013	2014
Average Cost	$1,696	$1,782	$1,853	$1,910	$1,960	$2,090	$2,157	$2,212

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