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Analysis of the Costs of Treatment for Schizophrenia and Bipolar Disorder, and the Potential Damage of Misdiagnoses

Natalie Irizarry

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Analysis of the Costs of Treatment for Schizophrenia and Bipolar Disorder, and the Potential Damage of Misdiagnoses

A thesis submitted to the Faculty of Barry University
in partial fulfillment of the requirements
for the completion of the Honor's Program

By

Natalie Irizarry

May, 2016

Analysis of the Costs of Treatment for Schizophrenia and Bipolar Disorder, and the Potential Damage of Misdiagnoses
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Barry University
Honors Program

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The primary purpose of this study is to analyze the costs of diagnosing mental disorders, mainly schizophrenia and bipolar disorder, to express the estimations of how much money is being spent per individual and how this factor plays a role in exposing the potential errors that can lead to misdiagnosis. As populations in countries age and as migration changes population compositions in the United States as well as internationally, the diagnosis and treatment of mental disorders has become more complicated with respect to the cost of healthcare expenditures. In order to compare costs over many years, a calculation of inflation rate should be used. The prevalence (number of cases at a point in time) and incidence (number of cases over an interval of time) rates of mental illnesses should be compared over long periods of time. Through the analysis of research articles and the use of comparative data, this thesis seeks to test the hypothesis that medical diagnoses for heart disease, bipolar disorder, and schizophrenia are the same and that the costs of treatment are the same.

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This thesis would not have been revised and completed without the help, support and dedication that Dr. Jeremy Montague put forth as my Thesis Advisor. Dr. Montague suggested and researched many applicable scientific research papers, which helped to provide this thesis with accurate content. Dr. Montague also guided me step by step through the revising process of my thesis and made sure to make himself available and scheduled meetings to ensure that I was on the right track. Dr. Pawena Sirimangkala played an immense role in the completion of this thesis, initially helping me narrow down my topic and to make sense of some of the research conducted. I would also like to thank the committee for all of the support given throughout this thesis, Dr. Laura Mudd, Dr. John Goehl and Dr. Michael Bill. The input of the committee helped me to further revise my thesis accordingly. Also, my parents were a great support and backbone for helping me research and overall being a part of my college career.

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Natalie Irizarry

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INTRODUCTION

The purpose of this study is to compare three medical disorders in terms of their rates of occurrence and their costs of treatment. I have chosen a common and well understood disorder (heart disease) to compare with two lesser known and lesser understood disorders, the mental illnesses of schizophrenia and bipolar disorder.

Schizophrenia is a chronic disease associated with a significant and long-lasting health, social, and financial burden, not only for patients but also for families. Bipolar disorder is characterized by manic-depressive illness and mania. According to the authoritative Diagnostic and Statistical Manual of Mental Disorders (DSM-5, 2013)[i] there are five domains for schizophrenia pertaining to abnormalities: delusions, hallucinations, disorganized thinking (speech), and grossly disorganized or abnormal motor behavior (including catatonia). Some of these conditions are similar to those of bipolar disorders that include manic episodes and catatonic and abnormal behavior. This condition also impairs the social skills of an individual (DSM-5, 2013).[ii] Due to the complicated symptoms of schizophrenia and bipolar disorder, these illnesses can be misdiagnosed.

The delusions feature is defined as fixed beliefs that are not amenable to change in light of conflicting evidence; delusions are further broken down into five different types. Persecutory delusions are delusions where the individual believes that he/she is going to be harmed or harassed. Referential delusions are the belief that certain gestures, comments, or environmental cues are directed at oneself. Grandiose delusions are the belief that the individual has exceptional abilities, wealth, or fame. Erotomanic delusions occur when the individual believes falsely that another individual is in love with him/her.

Nihilistic delusions involve the conviction that a major catastrophe will occur, and somatic delusions are mainly preoccupations regarding health and organ function. As for hallucinations, these are perception-like experiences that are vivid and clear, but not under voluntary control, occurring without external stimulus. As for disorganized thinking, this refers to events when the individual moves from one topic to another unrelated topic. Their speech may be disorganized, which impairs direct and effective communication with other individuals. Grossly disorganized or abnormal motor behavior refers to a combination of an adult individual experiencing child-like behavior as well as a decrease in reactivity to the environment (catatonic behavior). These behaviors include inappropriate posture, resistance to instruction, and lack of completion of verbal and motor responses, such as mutism, which is defined as the loss of speech due to functional or organic causes; the catatonic subtype is a branch of mutism which includes episodes of violent and aggressive behavior, social withdrawal, and disturbed biological functions and movements (Pingali, 2013).[iii]

One component to consider in schizophrenia is the negative symptom (DSM-5, 5th edition, 2013).[i] Negative symptoms include diminished emotional expression, decrease in self-motivation, decrease in the ability to experience positive stimuli from the environment, and lack of interest in social interactions.

There is potential for confusing diagnoses for schizophrenia and bipolar disorder. According to (Kilbourne, 2008)[iv]: “American patients with bipolar disorder are more likely to receive diagnoses of mutually exclusive conditions such as schizophrenia and thus appear to have an elevated risk of their illnesses being under-recognized or

misdiagnosed and receiving inappropriate treatment." In other words, the patient can be treated for a disorder that he/she does not have. This is what is meant by misdiagnosis.

Several outdated sources report that black manic-depressive patients are frequently misdiagnosed as being chronic undifferentiated schizophrenics (Bell et al., 1980)[v], (Neighbors, 2003),[vi] and (Knapp et al., 2004).[vii] According to Bell et al. (1980)[v], "While there have been several attempts to demonstrate that diagnostic differences tend to reflect the subtle form of institutionalized racism . . . frequent misdiagnosis of Black manic depressive patients is still prevalent." Although it is possible that there are racial differences in rates of misdiagnoses, I have been unable to find any source that documents any such differences.

Table 1, below, contains estimates for the rates of selected mental disorders, including schizophrenia and bipolar disorder. The table compares percentages for Caucasians vs. non-Caucasians. Of particular interest is the comparison for the rates of schizophrenia in (Kunen, 2005)[viii] compared with (Neighbors, 2003).[vi] They are at least two magnitudes apart. The reason for this disparity is that Neighbors expresses these statistics in order to compare Caucasians with African-Americans in diagnosing schizophrenia, while Kunen expresses the statistics for diagnosing schizophrenia to compare Caucasians with non-Caucasians, which includes a broad range of racial backgrounds.

Table 1: Percentage of Diagnosis in Diseases (in the U.S. Population)

Condition	Caucasian	Non-Caucasian	Source
Mood disorders	1.30%	0.53%	Kunen (2005)[viii]
Anxiety disorders	1.98%	0.79%	Kunen (2005)[viii]
Psychosis (psychotic disorder) diagnosis	1.49%	0.71%	Kunen (2005)[viii]
Mood disorders	4-7%	0.70% (African American)	Kunen (2005)[viii]
Anxiety disorders	11-16%	1.19% (African American)	Kunen (2005)[viii]
Substance use disorders (mental)	7%	2.05% (African American)	Kunen (2005)[viii]
Organic Psychosis	0.85%	0.28%	Kunen (2005)[viii]
Schizophrenia	0.32%	1.30%	Kunen (2005)[viii]
Schizophrenia	30.6%	42.4% (African American)	Neighbors (2003)[vi]
Bipolar disorder	13.7%	5.2%	Neighbors (2003)[vi]
Schizoaffective	16.10%	13.2% (African American)	Neighbors (2003)
Depression	24.20%	25.9% (African American)	Neighbors (2003)

The causes of medical misdiagnoses are poorly understood. Although advanced technology has helped further scientific research, digital medical records might also lead to misdiagnosis because of the lack of knowledge of how to use these digital navigation aids. “Most respondents or their colleagues considered even highly regarded, industry-leading electronic medical recording to be challenging to use because of the multiplicity of screens, options, and navigational aids” (Miller et al., 2004).[ix] Problems with electronic medical record usability have been ongoing, especially when it comes to primary healthcare physicians having to document progress notes, which caused them to

spend extra work time to learn effective ways to diagnose patients using such systems (Chrones, 2015).[x]

Implementation of electronic medical records (EMR) falls into two categories: hardware support and software support. Software support needs to go beyond a lesson, a thick pamphlet of which key combinations to punch, and intricate wall maps of where all the information is to go (Miller et al., 2004).[ix] Unfortunately, too many implementation teams think that this is all they need to provide. They fail to realize, especially in rural or remote communities, where clerical staff can be almost computer illiterate, that long-term on-site support is needed to develop understanding and proper use of the EMR. Funding agencies fail to realize that extra staff members are needed for implementation, especially in rural areas.

According to (Frazier, 2012),[xi] many longitudinal studies suggest that roughly a third of all depressions have a bipolar course when followed over time. There is no good evidence that it is more common in some demographic groups than others, although ethnic minorities with bipolar disorder are likely to be misdiagnosed with schizophrenia, conduct disorder, or antisocial behavior instead (Frazier, 2012).[xi] This suggests a possible origin for misdiagnosis of bipolar disorder and schizophrenia. The diagnosis of bipolar disorder can often be confused with schizophrenia because of similar symptoms, such as delirium, catatonia, and anxiety, as well as negative symptoms.

Medical computer imaging is another potential source of misdiagnosis (Scarborough, 2008).[xviii] Diagnosis is continuously advancing, and medical imaging is one of the cornerstones. Radiologists and the imaging interpretations they provide are critical factors in medical misdiagnosis, and an error in image interpretation can result in

an undesirable series of events, leading to medical misadventure. Studies have indicated that medical errors have occurred where there was a failure to detect abnormalities where disease was present and incorrectly diagnosed (Scarborough, 2008).[xviii]

It is possible that misdiagnoses of medical conditions are related to discrimination based on race, gender, or sexual orientation (Corrigan et al., 2003).[xii] An outdated article (Bonham & Brock, 1985)[xiii] having to do with diabetes, sex, and obesity illustrates the potential for misdiagnosis based on discrimination. In this study, the prevalence of non-insulin diabetes was misdiagnosed for black, obese females at a higher rate than for white females. It is unknown if such discrepancies in misdiagnosis exist for mental disorders.

Racial discrimination in diagnoses might exist. According to the article, "Race and Mental Illness: An Epidemiologic Update," the hypothesis suggests that racial factors play an important etiologic role in accounting for perceived racial differences in the rates of mental illness (Warheit et al., 1975).[xiv] "It was not until the 1930 census, when counts of the mentally ill were restricted to those in state hospitals, that blacks had higher rates of reported insanity than whites; nonwhite rates of admission and treatment in public facilities have remained higher than those for whites since then" (Warheit et al., 1975).[xiv] This shows that racial discrimination alone had once played a role in its relationship to mental illness. It is not known if this remains the case today.

Treatment policies and procedures may be related to race (Bailey et al., 2009).[xv] According to one study, major issues for African-Americans include access to treatment, treatment disparities, low acceptance of antidepressants, possible medical comorbidities (the existence of more than one disease in the same person) (Center for Disease Control and Prevention, 2015),[xvi] and drug metabolism, which are just some of the many issues

that arise. (Bailey et al., 2009)[xv] addressed the complications of medical treatment and race. In terms of treatment disparities, African-Americans were found to be less likely than Caucasians to receive appropriate care for mental illness, and were less likely to receive medication such as antidepressants upon first diagnosis, when compared with Caucasians. As for comorbidities, African-Americans have been shown to suffer more from an alternative disease such as diabetes or hypertension, and have been shown to suffer higher rates of chemical dependency, placing patients at greater risk of poor physical health and general disease. According to researchers' findings, Caucasians and African-Americans show a great difference in drug metabolism, and this is due to the cytochrome enzyme, specifically CYP2D6 (Bailey et al., 2009).[xv] This difference resulted in African-Americans responding more quickly to this type of drug metabolism, which can lead to a higher risk of side effects and result in nonfunctional and reduced function of certain alleles. Recommendations for treatment, management, improvement, and coping include a basis for strategies to improve diagnosis overall among different ethnic groups (refer to discussion section for further implications).

It should be noted, however, that evidence of past discriminatory practices does not indicate that current practices are discriminatory in the same ways.

This thesis looks at the costs of treatment and diagnosis of selected diseases. A study on the examination of major depressive disorder in the African-American population stated that "Nearly one-fourth of African-Americans are uninsured in the United States, which is 1.5 times more than Caucasians. The rate of employer-based covered health insurance for African-Americans is 53% vs. 73% in Caucasians" (Bailey et al., 2009).[xv] The article also mentioned that the economic burden of manic-depressive disorder was

estimated at $83 billion in the year 2000, and has increased to the current time. A National Study of American Life, the largest study conducted on mental illness, studied 6083 patients; 3570 were African-American, and the rest were Caucasian. A sample size of 10.4% accounted for the prevalence of depression in African-Americans (Bailey et al., 2009).[xv] The availability of healthcare is a very important aspect to consider with regard to primary care, emergency, and hospital care. "Many researchers have shown that African-Americans have lower rates of seeking psychiatric care than Caucasians . . . African-Americans are more likely to receive healthcare in outpatient hospital and emergency departments and their mental health services are also characterized by high rates of emergency care" (Bailey et al., 2009).[xv] This shows that African-Americans are more likely to receive care from hospitals, while Caucasians are more likely to receive a diagnosis from their primary care physicians. This leads to the possibility of misdiagnosis. In terms of health insurance, low-income families work for employers who are less likely to offer coverage, while high-income families will most likely have medical coverage.

Economic status can also be a source of confusion and misdiagnoses. "Recently it has been shown that prevalence of distress among low-income blacks is distinctly different from the prevalence among low-income whites; but among the upper classes, blacks and whites display essentially similar rates of psychological distress" (Kessler & Neighbors, 1986).[xvii] The economy, in general, plays a major role in that the costs of diagnosing diseases can be substantial, so misdiagnoses play a part in increasing medical costs.

Bailey et al. (2009)[xv] discussed the National Mental Health Association in 1996, when they commissioned a survey that revealed that approximately 63% of African-Americans

see depression as a personal weakness, and of the 63%, 31% believed that depression is a health problem (Bailey et al., 2009).[xv] Only one-third of African-Americans would accept medication for depression prescribed by a doctor, and close to two-thirds of the African-Americans believed that prayer and faith alone would heal them. The attitudes and beliefs of individuals also have to be taken into consideration, because these individuals are misdiagnosed due to lack of knowledge of the individual, or lack of wanting to receive medical diagnosis or treatment for a mental illness. It is important to note that this comparison was among African-Americans; it did not compare attitudes and beliefs of Caucasian populations, and it is unknown if the Caucasian population follows the same pattern.

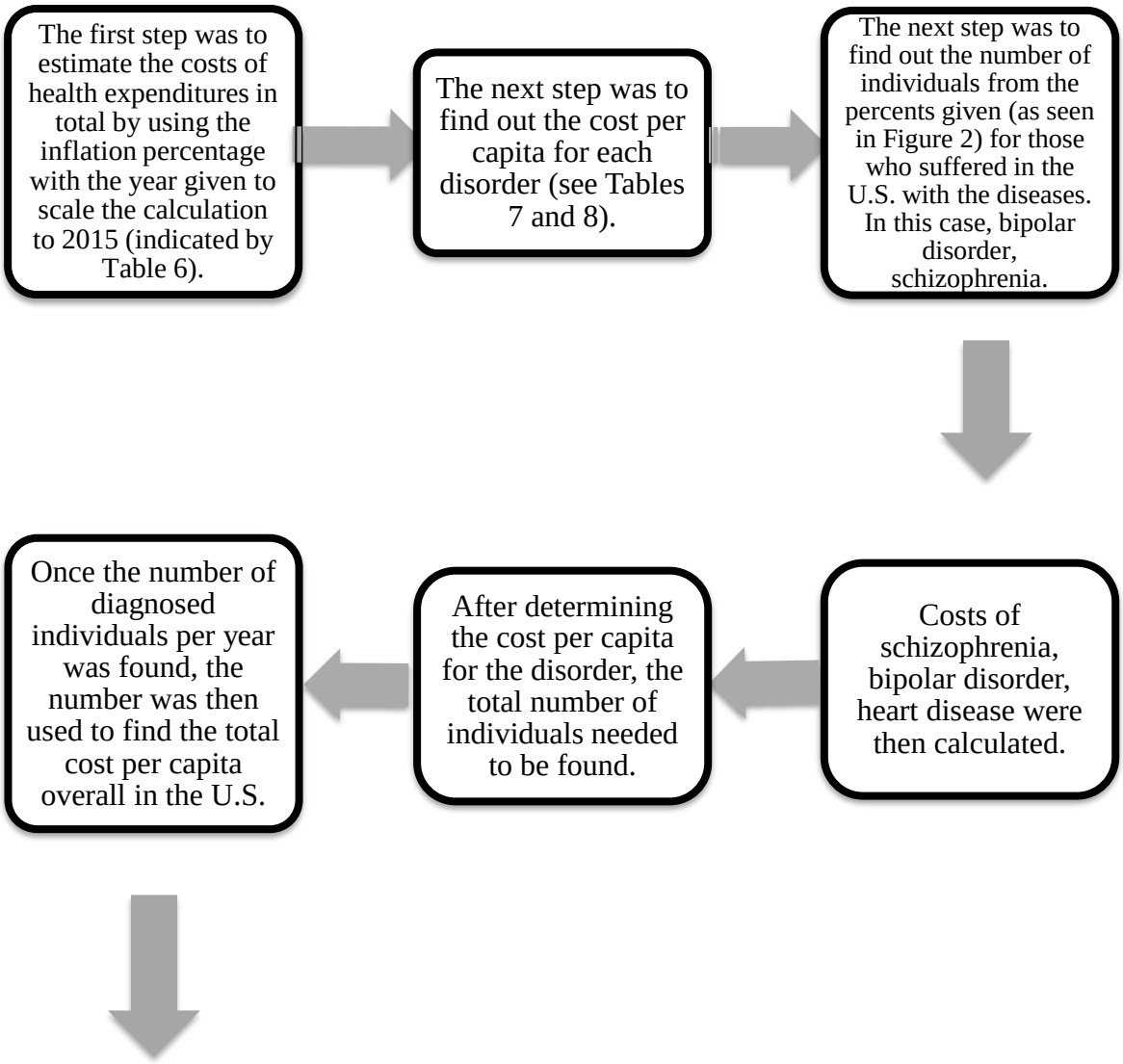
Serious medical errors can occur in physicians' offices, outpatient surgical centers, imaging centers, nursing homes, and retail pharmacies. (Scarborough, 2008)[xviii] estimated that approximately 44,000-98,000 Americans die annually as a result of medical errors. Medical errors are also very costly. The national costs of medical errors resulting in injury are estimated between $17 billion and $29 billion annually (Scarborough, 2008).[xviii] Thus, there are considerable costs to misdiagnoses.

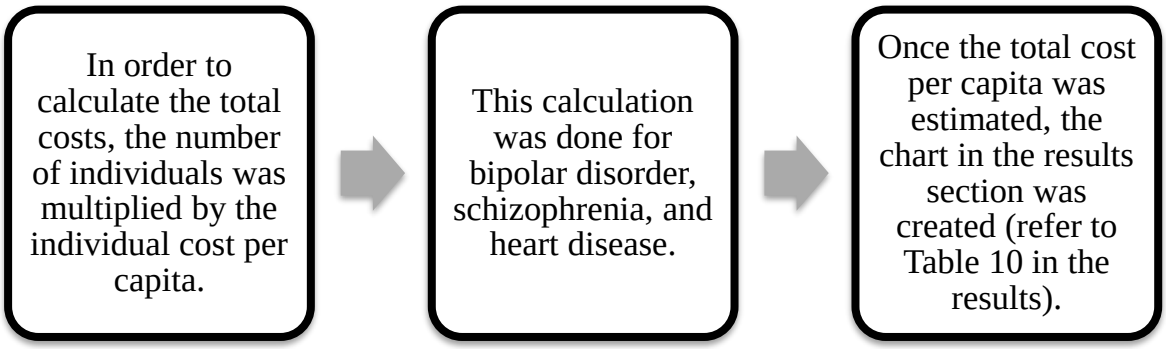
Swigart et al. (2008)[xix] detailed evidence suggesting medical errors were present after identifying patients and diagnosing their diseases. In this study, delirium was examined. This is a disorder of brain functioning that involves a disturbance of consciousness with reduced capacity to focus or sustain attention. This disorder is a basis for both bipolar disorder and schizophrenia. Even though it is seen as a common disorder, it is frequently not recognized by treating physicians and nursing staff.

In summary, I propose the hypothesis that per capita costs of diagnoses and medical treatment for: (1) heart disease, (2) schizophrenia, and (3) bipolar disorder are equal. To test this hypothesis, I must first find and calculate appropriate measures for rates of the disease of each condition, as well as economic estimates for treatment. Following this, I will estimate potential costs due to misdiagnosis of these conditions.

METHODS

Figure 1: Flowchart of the methods used to derive the total costs and costs per capita of U.S. spending on treatment for heart disease, bipolar disorder and schizophrenia.





The figure above expresses the estimates in total costs and costs per capita of U.S. spending on treatment for the three types of disorders/diseases. The values are expressed in the results section (refer to Table 12). The values for Table 11 were the calculated values due to inflation rates from 2014-2016 (estimates) with the use of national health care expenditure statistics (refer to Table 10). The estimates in Table 11 were based on inflation rate percentages; 7.5% in 2013, 4.5% in 2014, 4.8% in 2015, and 6.5% in 2016 (U.S. Healthcare).[xx] The same inflation rate was used for the scaling of costs per capita and total U.S. costs for the disorders/diseases in Table 12. The cost per capita of diagnosing heart disease was $5,693 in 1996 (Tarride et al., 2009)[xxi]. Due to inflation rate percentages (Historical Inflation Rates 2008),[xxii] after calculating the percent increase for each year from 1996 to 2015, the cost per capita for 2015 was $9,253. After determining the cost per capita, the number was then multiplied by the number of individuals who were diagnosed with heart disease in 2013, 85,600,000 individuals in the U.S. The number given was then multiplied by the inflation rate increase for 2015, which was 4.8%, and this calculated value was then added to the initial number. The same method was used for schizophrenia and bipolar disorder.

The estimated cost per capita for the resources spent on care for people with schizophrenia in 2006 was $2,306 (Blomqvist, 2006).[xxiii] The estimated cost per capita of bipolar disorder ranged from $8,000 to $14,000 (Kleine-Budde, 2014).[xxiv] The estimate

per capita for all individuals diagnosed with schizophrenia was calculated by dividing the total cost, 2,306 million dollars, by 3,250,500 (the number of individuals diagnosed with schizophrenia), to arrive at a total of $7,495,653,000 in 2013. In 2015, scaling with the percent inflation increase is 4.8%, the total cost of treatment per capita for individuals with schizophrenia is $7,855,444,344. A sample equation for this calculation can be expressed as;

$$A_{(i+1)}=A_{(i)} + A_{(i)}X_{(i)}$$

Where $A_{(i+1)}$ stands for the result calculation of total cost per capita times the percentage of inflation increase, $A_{(i)}$ stands for the initial cost per capita for the prior year, and $X_{(i)}$ stands for the percentage of inflation increase for that year. The same method of calculation was used for bipolar disorder and heart disease.

Cost-of illness studies, in general, take either a prevalence or incidence analytic approach, and estimate the direct and indirect costs associated with a certain disease. The incidence approach typically deals with the patients diagnosed with the specific disease during a specific year. The prevalence approach typically estimates all direct and indirect costs associated with the group of patients with the targeted diagnosis for a specific year. These two factors are examined in this research paper in association with bipolar disorder and schizophrenia disorders.

Prevalence is a product of incidence and length of illness. Length of illness is determined by various factors, including variation in the life expectancies of the populations studied, excess mortality after disease onset, and varying proportions of symptom-free cases due to differences in treatment, so that comparisons of prevalence rates across studies are difficult (Hafner, 1997).[xxv] Prevalence rates are primarily used as

an indicator of the morbidity of a given population and its need for care. Prevalence is calculated by the information of the characteristics of the population as a whole and estimated from those samples of the population who have the specific mental illness.

Incidence rates refer to the number of new cases per population at risk in a given time period. When the denominator is the sum of the person-time of the at risk population, it is also known as the incidence density rate or person-time incidence rate. Incidence rates are the key indicator of morbidity risk. Their distribution patterns across geographic, cultural, and social units, family membership, age, and sex also provide some external criteria for testing the validity of a diagnosis and for formulating etiological and pathogenetic hypotheses (Hafner, 1997).[xxv]

One way to express the prevalence of schizophrenia at any given time is the number of individuals affected per 1,000 in a total population. In the United States that figure is 7.2 per 1,000 (Schizophrenia facts and statistics 1996-2010).[xxvi] This means that a city of 3 million people will have over 21,000 individuals suffering from schizophrenia. Incidence: The number of people who will be diagnosed as having schizophrenia in a year is about one in 4,000. So about 1.5 million people will be diagnosed with schizophrenia this year, worldwide. About 100,000 people in the United States will be diagnosed with schizophrenia this year.

In order to reach conclusions based on research, there needed to be a method(s) of diagnoses in bipolar and schizophrenia disorders. This was done by using estimations through calculations of the economic costs regarding healthcare expenditures for all treatments and diseases. The tables listed are statistical values for costs, treatment,

diagnosing, incidence, and prevalence rates for the mental disorders. The U.S. statistics were also compared with those of other countries to evaluate the actual differences in costs.

Table 2: Percentage of Prevalence of Schizophrenia Internationally per Year (Hafner, 1997)[xxv]

Country	Prevalence per 1000 population (worldwide)
USA	0.41%
UK	0.75%
Botswana	0.53%
China	0.19-0.47%
Sweden	0.60%
Tonga	0.09-0.13%
Italy	0.13%

Table 3: Prevalence Rate for Schizophrenia Internationally (Schizophrenia Statistics)[xxvi]

Country	Prevalence rate
China	12 million individuals
India	8.7 million individuals
USA	2.2 million individuals
Australia	285,000 individuals

Table 4: Bipolar Prevalence Rates Internationally per 1000 Total Population (Messias, 2007)[xxvii]

Prevalence rate= rate/total number per population

Country	Year	Prevalence	Incidence
Denmark	1977 1972	0.27%	 0.012%
Baltimore, Maryland, USA	1963	0.07%	0.07%
Camberwell, England	1963 1971	0.44%	 0.011%
Ireland	1973 1986	0.83%	 0.022%
Portogruaro, Italy	1982 1989	0.27%	 0.019%

Hampstead, England	1991-1995	0.51%	0.021%

Table 5: Bipolar Disorder Incidence Rate

Year	Incidence rate	Source
1997-2007	0.69/10000 (112 of 649 patients) (originally diagnosed with manic depression)	(Kroon 2013)[xxviii]

Table 6: Percentage of Incidence of Schizophrenia Internationally, Clinical Diagnosis (Hafner, 1997)[xxv]

Country	Incidence per 1000 population per year
USA	0.94%
Canada	0.10%
UK	0.09-0.16%
Germany	0.48%
Sweden	0.24%
Denmark	0.07-0.18%
India	0.09-0.35%
USSR	0.08-0.23%
Japan	0.10-0.21%
Ireland	0.09-0.22%
Australia	0.18%
Denmark	0.07-0.11%
China	0.11%

A more recent estimate of the cost of bipolar disorder and other serious mental illnesses (2004) was that federal costs for the care of seriously mentally ill individuals now total $41 billion a year and are rocketing upward at a rate of $2.6 billion a year. The cost in the UK in the same year was 3.7 billion in pounds. This supports that bipolar disorder causes a substantial strain on mental healthcare and is a contributing factor to the cost of diagnosis of mental disorders.

Table 7: NIH Research Expenditures for Bipolar Disorder and Schizophrenia in 1999 (US Government Spending)

Totals for Bipolar and Schizophrenia (out of 2.2 million people in the U.S)

Disease	Federal research expenditures	Prevalence of individuals with disease	NIH research dollars per person affected	Source
Bipolar disorder	$196,515,000	2,632,396	$74.65	(Schizophrenia Statistics)[xxvi]
Schizophrenia	$57,805,000	2,227,412	$25.95	(Schizophrenia Statistics)[xxvi]
Bipolar disorder	$196,515,000	2,632,396	$74.65	(Bipolar disorder-Facts and Statistics)[xxix]
Schizophrenia	$57,805,000	2,227,412	$25.95	(Bipolar disorder-Facts and Statistics)[xxix]

Table 8: Direct Cost of Schizophrenia in the U.S. (Knapp, 2004)[xxx]

Year	Cost
1975	$11.6-19.5 billion
1985	$22.8 billion
1990	$32.5 billion

Table 9: Total Costs per Patient per Year of Schizophrenia (Knapp, 2004)[xxx]

Year	Cost
1975	$13,700
1990 (Hu et al., 1996)	$13,015
1990 (Rice & Miller 1996)	$2,543 (only direct costs)

Table 10: National Health Expenditures in the U.S. (National Health Statistics 2015) [xxxi]

Year	Amount, in billions
1960	$27.4
1970	$74.9
1980	$255.8
1990	$724.3
2000	$1,378.0
2009	$2,505.8
2012	$2,817.3
2013	$2,919.1

Table 10 expresses the total amount in billions of health expenditures, which are statistics retrieved from the National Health Statistics in the U.S. from 1960-2013.

Table 11: Estimated Healthcare Expenditures in the U.S. from 2013-2016.

i	Year	$A_{(i)}$ (in billions)	$X_{(i)}$
1	2013	$2,919.1	7.5%
2	2014	$3,050.5	4.5%
3	2015	$3,196.9	4.8%
4	2016	$3,404.7	6.5%

In order to calculate the estimated years of inflation rate, the total cost of health expenditure for that year was multiplied by the percent inflation rate for the year being estimated. The result is then added to the cost of the year prior to the one being estimated. This can be deduced from the replica of the equation used for the costs per capita; $A_{(i+1)}=A_{(i)} + A_{(i)}X_{(i)}$.The national health care expenditure estimates for 2014 through 2016 have been listed above in Table 11.

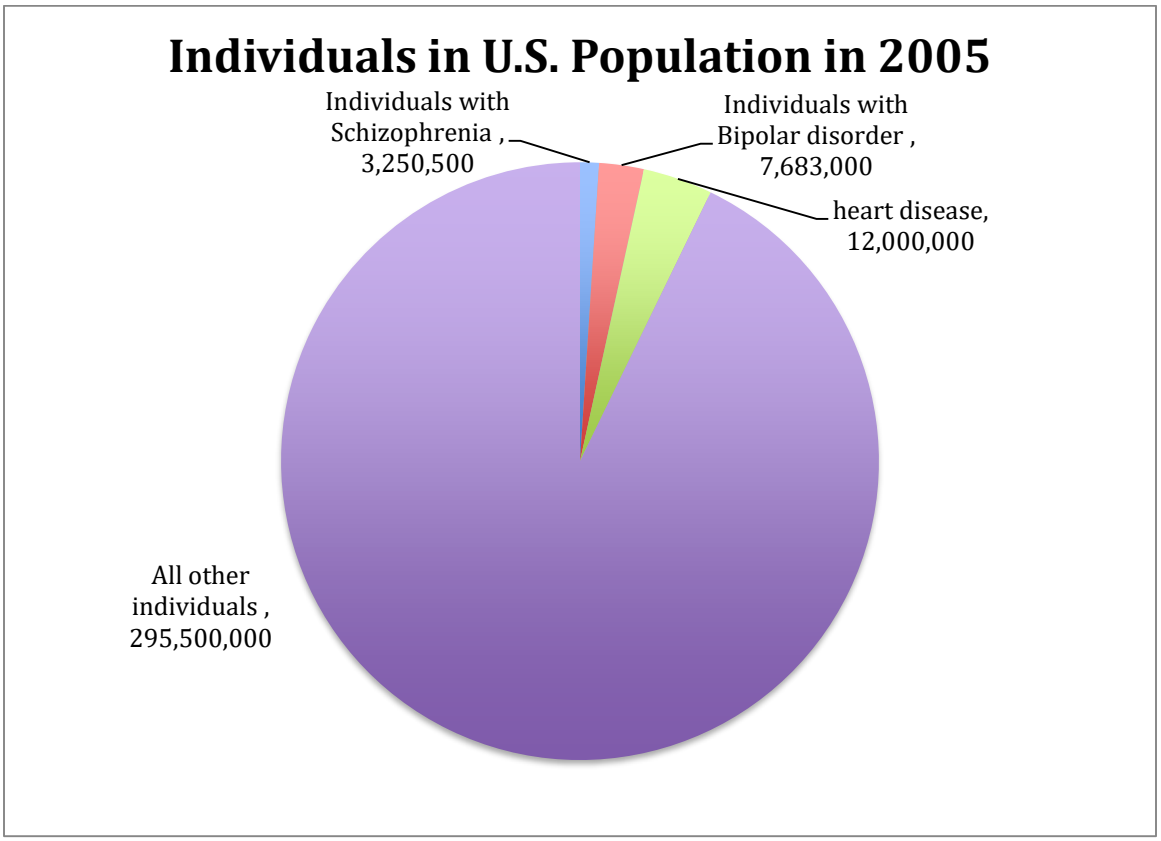
RESULTS

Table 12: Total Cost per Capita for Treatment of Disorders in 2015 (scaled by inflation percentage using the equation: $A_{(i+1)}=A_{(i)} + A_{(i)}X_{(i)}$)

	Total U.S.	Per capita U.S.
Heart disease	$8,300,755,264	$9,253
Schizophrenia	$7,855,444,344	$2,306
Bipolar Disorder	$6,441,427,200-$11,272,497,600	$8,000-$14,000

Table 12 indicates the primary results in direct costs of treatment per capita of each disorder/disease. The methodology behind this table reveals the actual calculations in reference to these disorders/diseases. According to thesis findings, it can be inferred that these mental illnesses have a substantial impact on costs of health expenditures overall.

Figure 2: Estimated Number of Individuals in the U.S. population in 2005 vs. the Estimated Number of Individuals with Bipolar Disorder and Schizophrenia Using the Equation $A_{(i+1)}=A_{(i)} + A_{(i)}X_{(i)}$ (Duckworth, 2013)[xxxii]



According to Figure 3, the diagnosis rate of schizophrenia is 1.1 percent (DSM-5, 5th edition, 2013)[i] and is 2.6 percent for bipolar disorder in the U.S. (DSM-5, 2013).[ii] The number of individuals diagnosed with heart disease per year was 12 million individuals (Heart Disease, 2016)[xxxiii] The number of individuals in the U.S. with bipolar disorder, schizophrenia, and heart disease was calculated by using the total number of individuals in the U.S. to get the actual number of individuals with each disorder.

Figure 3: Total Number of Individuals in the U.S. with Mental Disorders vs. Individuals Diagnosed with Bipolar Disorder, Schizophrenia, and Heart Disease Using the Equation: $A_{(i)}=A_{(i)}\ (1+X_{(i)})$ (Duckworth, 2013).[xxxii]

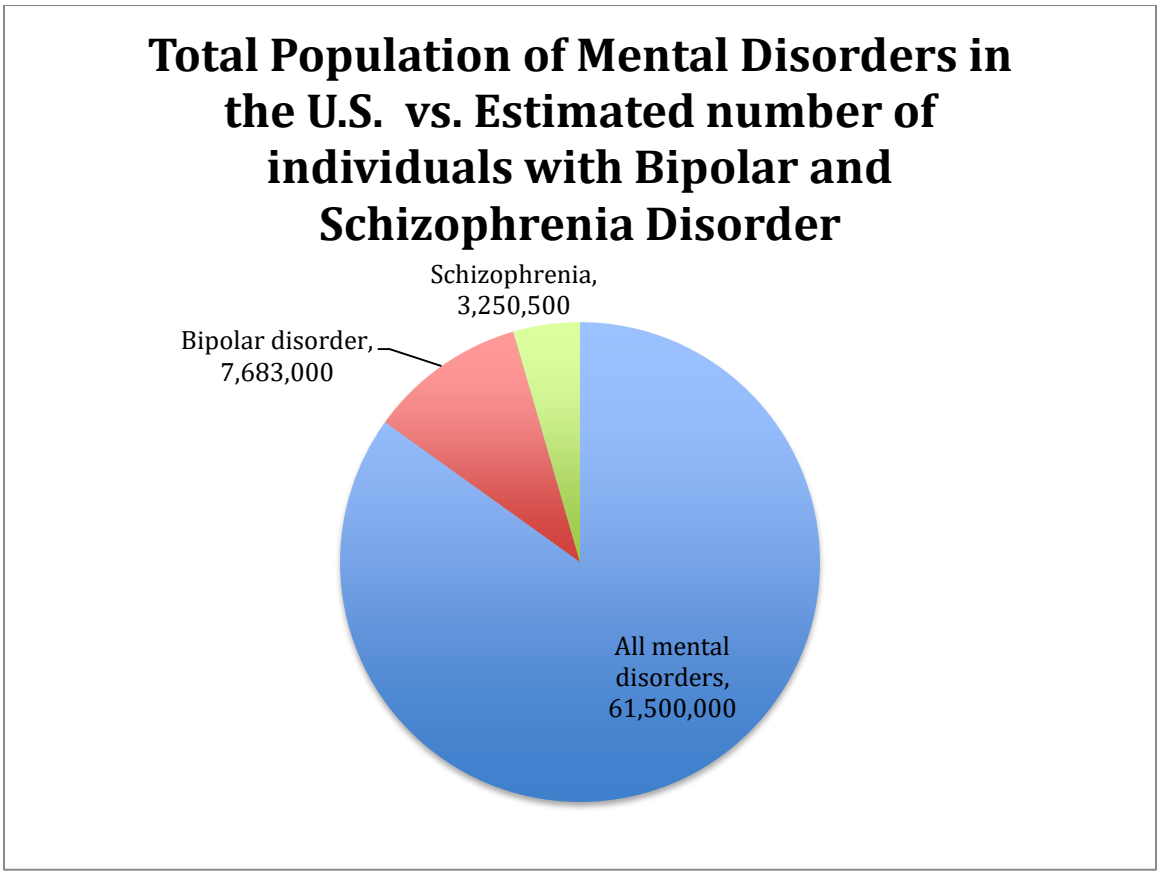


Figure 3 expresses the total population in the U.S. with mental health issues alone, and the impact schizophrenia and bipolar disorder have on mental illness as a whole. From these findings, it can be deduced that diagnosing bipolar disorder and schizophrenia are nearly equivalent in terms of the costs of each mental illness; these costs also include money being spent on medical errors, which has become a larger problem in the U.S.

DISCUSSION

Although no actual statistics were provided for rates of misdiagnoses, most of the papers included some form of medical error regarding schizophrenia and bipolar disorder. As a whole, society should be looking for ways to ameliorate medical diagnosis and attempt to decrease the costs of government spending on health expenditures.

A positive connotation, which reduces the cost of healthcare as well as the quality of patient care, is Premerus. Premerus is the industry's first and only diagnostic management company in 2008, representing a new healthcare paradigm: the coordinated focus of resources, expertise, and technology to improve the accuracy of diagnosis. It is a company dedicated to advancing clinical accuracy through diagnostic excellence (Scarborough, 2008).[xviii] Through the comparison of medical imaging interpretations of general radiologists to subspecialty radiologists, researchers found that the additional training and experience of the subspecialists in neuroradiology (brain and spine) and musculoskeletal imaging (bones and joints) and body imaging (neck, chest, abdomen, and pelvis tissues) that the subspecialists' reports are more definitive and less likely to recommend follow-up procedures (Scarborough, 2008).[xviii] Clinician reviews also indicate that the subspecialists' interpretations have greater accuracy in their preliminary results of data and greater efficiency when it comes to surgical biopsies and other invasive procedures, when compared to general radiologists. This is a great indication of enhancing healthcare practice in order to decrease false positive misdiagnoses.

Also, when screening for a mental disorder the different aspects that come along the way are false positives and false negatives, as expressed in Figure 4. Errors in diagnosis have serious impact on patients and the quality of care they receive. Patients

who receive a false positive diagnosis may endure unnecessary treatments or even surgery before discovering that they do not have the disease that was diagnosed (Scarborough, 2008).[xviii] Another case is when the patient receives a false negative diagnosis, where the undetected illness can cause the patient's condition to deteriorate to the point where more extensive intervention becomes necessary with the increased risk of a poor outcome. This is why additional testing is important, as well as implementing the use of more radiology subspecialists as opposed to regular physicians for diagnoses of disorders/diseases to gain more concise and accurate results, in order to reduce overall medical errors and costs of treatment and diagnosis in health expenditures.

Medical errors are very costly and can be seen in different ways. In the two cases expressed in Figure 2 deemed errors occurring, a person can either be misdiagnosed with a condition that is not present or they could not be diagnosed with a condition that is actually present. These are two errors that physicians sometimes subject their patients to. For example, if a person is misdiagnosed, money is being unnecessarily used and contributes to the costs of that specific condition; as a result, the patient is the one who gets hurt, because in the long run they did not need to go through the process of what the medical error made them go through. As for a person who actually has the condition but was not diagnosed with the treatment, this indeed may save money in healthcare expenditures. However, this is in turn hurting the patient, because they are not being treated for a condition that they ultimately do have. The medical consequences of errors can be directly correlated with a courtroom verdict.

Figure 4: Courtroom Verdicts vs. Medical Errors and Potential Results in Costly Errors

	Person Truly Guilty	Person Truly Innocent
Jury Convicts	Correct Decision	Injustice
Jury Acquits	Injustice	Correct Decision

	Condition Present	Condition not Present
Condition Diagnosed	Correct Decision	False Positive
Condition not Diagnosed	False Negative	Correct Decision

Misdiagnosis occurs when a disease that does not exist in a patient is assumed to be present and when the failure to recognize the true existing disease leads to worsened patient prognosis (Kirch, 1996)[xxxiv] (see Figure 4). There are different terms commonly used when referring to misdiagnosis. A false negative diagnosis is defined as a disease discovered at autopsy that was clinically unrecognized and had no prognostic relevance. False positive diagnosis occurs when the disease does not exist but is thought to be present from the diagnostic procedure.

According to Figure 4, just as with medical errors, injustice can be brought upon defendants put on trial could face injustice that could hurt them and potentially ruin their lives. A person can be acquitted by a jury but be truly guilty, and this would be an injustice because a person who commits a criminal offense is being released and could pose a potential danger, just as if a medical condition is truly present in a person and they

are not diagnosed with the condition, they could be in potential danger if they are not treated. On the other hand, if a jury convicts a truly innocent person, this is an injustice and the person who is truly innocent is sentenced for a crime they did not commit, which could potentially ruin their life, just as if a person is diagnosed with a medical condition they do not have, this could potentially ruin their lives as well, considering they are being treated for a condition that is absent. According to a study done by the U.S. Department of Justice, approximately 7,500 persons arrested from index crimes out of 2.2 million were wrongfully convicted in the year 2000 (Huff, 2002).[xxxv] This fact alone shows that both medical and jury verdicts should be intently analyzed, because although the numbers of medical errors and court injustices are so low that they are insignificant within U.S. statistics, a person's life is very valuable and important, and neglecting to save these lives can lead to immense unwanted repercussions for the future.

Another aspect regarding false positives leading up to medical errors (refer to Figure 4), is the fact that they have more of a tendency to exist than false negatives. For many healthcare physicians, it can be assumed from a legal stance that in order to protect themselves from being legally liable for not diagnosing a patient who ultimately ends up having the condition, they diagnose and treat the patient that could potentially not have the condition at all. Doctors would rather diagnose and treat a patient with a condition if they show the slightest symptoms, rather than not diagnosing and treating the patient who turns out to actually have the condition. If primary care physicians were to lean more toward false negatives, they would in turn end up facing lawsuits for underdiagnosing their patients.

Another potential source for misdiagnosis is the U.S. healthcare system and how the importance in looking for and preventing medical errors has been put aside (Scarborough, 2008).[xviii] It is more common to pay close attention to improving and paying attention to safety rather than to healthcare. (Scarborough, 2008)[xviii] uses the example of the American Aviation Industry to compare the medical errors that exist due to the lack of attention being dedicated to a patient who is injured or dies due to a medical error, and would focus more on an airplane crash. A question that comes to mind is, is the life of an individual suffering from an airplane crash more important than a person whose life is in potential danger because of a medical error? Medical errors are commonly pushed aside because they are so small in number, and there are no statistics from my knowledge on the rate of misdiagnosis. Another ongoing issue is the idea that a misdiagnosis can come directly from a healthcare provider simply due to a mistake or lack of knowledge when diagnosing a patient. Are the numbers for misdiagnosis so small that they do not need to be accounted for?

Diagnoses that are missed, incorrect, or delayed are believed to affect 10 to 20 percent of cases, far exceeding drug errors and surgery on the wrong patient or body part (Boodman, 2013).[xxxvi] If we assume a 10% misdiagnosis rate, would the U.S. be spending a large amount of money in treating this error? Table 13 gives a theoretical estimation of how much it would cost if there were a 10% misdiagnosis rate.

Table 13: U.S. Cost per Capita in Estimating a 10% Possible Misdiagnosis Rate.

Disease/Mental Disorder	Cost per capita	Individuals diagnosed with disorder	Estimated cost of individuals per year	Estimation of possible cost for 10% of individuals being misdiagnosed
Heart Disease	$9,253	12,000,000	$110,360,000,000	$5,518,000,000
Schizophrenia	$2,306	3,250,500	$7,495,653,000	$347,782,650
Bipolar Disease	$8,000-$14,000	7,683,000	$61,464,000,000	$3,073,200,000 (using lowest cost per capita)

Although statistics regarding misdiagnosis are unknown, what about estimating costs per capita of the possibility of misdiagnosis? For example, if 10% of patients diagnosed with the disorder or disease were misdiagnosed, how much money is being accounted for the small number of patients? The calculations are shown above in Table 13. The results showed that a great deal of money is estimated to be very costly for misdiagnosing patients. This poses a great issue, because although when comparing heart disease, bipolar disorder, and schizophrenia, they were almost equivalent, potential for misdiagnosis still exists. The table shows that even with the smallest calculation, misdiagnosis can contribute to much healthcare spending, which is either wasting money to treat someone who is not sick or to save but kill someone by not diagnosing them with the illness and pass away as a result.

As stated before, although there are no actual statistics on misdiagnosis, the small outliers that are not being accounted for are individuals' lives at stake. (Suite et al., 2007)[xxxvii] discusses the misunderstanding and mistrust that goes beyond misdiagnosis. Although heart disease is the greatest leading factor of death, mental illness undertreated or untreated will be even more equivalent in 2020 (Suite et al., 2007).[xxxvii] This thesis

exposed the potential dangers of misdiagnosis in diseases. The healthcare expenditures and calculated estimates of the costs of diagnosis imply that even a small percentage of misdiagnosis can be extremely costly and if these costs are not given statistical value, this can pose a potential danger to the U.S. population on healthcare expenditures.

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