I. BACKGROUND AND SIGNIFICANCE OF THE PROJECT

My capstone project is about the lack of access to quality healthcare in the Philippines. I pick this topic because I experienced it before. I have a heart problem and I had been admitted in ICU (Intensive Care Unit) twice in a year in a hospital. Unfortunately, the hospital doesn't have a specialist in the heart or a cardiologist. The hospital is also lacking important medical equipment for diagnosing heart-related issues, such as 2D echocardiograms and cardiac MRI scans, as well as angiography. So, I and my family had to transfer to another hospital that are more capable but a bit expensive. Fortunately, I survived. I do believe that it doesn't happened to me only. I live in a highly urbanized city and yet experienced something like that. What about the other cities, municipalities and rural areas in the country? How will they be able to survive if there is no available quality healthcare system in the area?

To be able to access quality healthcare is a fundamental right of not just the people of the Philippines but to all human. Not having quality healthcare can cause illnesses that could have been prevented, make people suffer, and even cause people to die earlier. It also makes it harder for some groups of people, like those who are already struggling, to get the healthcare they need. Fixing this problem is important for making sure everyone gets the same chance at good healthcare.

Not having access to quality healthcare also costs a lot of money in the long run. When people can't get the right care, their health problems can get worse and may spend more in expensive treatments and hospital stays. This puts a big burden on the healthcare system and makes the differences in healthcare even bigger. And also, if the healthcare system is expensive, how will the less fortunate Filipinos can afford it?

Also, not having quality healthcare affects public health crises. The COVID-19 pandemic showed how important it is for every Filipino to be able to get the care they need. If some people can't get the right care, diseases can spread faster, and this can be a big problem for everyone, not just the people who are sick. Additionally, how well will the Philippines fare in the face of future pandemics?

In short, fixing the problem of not being able to get quality healthcare is not just about making every Filipinos healthier. It's also about creating equality in society, reducing the money problems with healthcare, and being ready for public health emergencies. This is a big problem that needs big solutions to make Philippine society better for everyone.

II. MOTIVATION AND PROBLEM STATEMENT

What are the key factors contributing to the lack of access to quality healthcare in the Philippines, and how does this issue impact individuals and communities in the country?

The lack of access to quality healthcare is affecting every individual and communities in the Philippines. This problem statement highlights the ongoing unequal access to healthcare in many places. Motivated by my own experience and by the fundamental principle that healthcare is a fundamental human right, addressing this problem is a must. Many Filipinos, especially those in areas with not enough healthcare services, have a hard time getting the healthcare they require. This can be because they can't afford it, there aren't enough hospitals or doctors, and so on. This creates many problems like delayed diagnoses, illnesses that could have been avoided, and people suffering needlessly. Fixing this

problem is a big challenge for healthcare systems and governments. It means coming up with new ideas and rules to make sure that every Filipino, no matter where they live or how much money they have, can get the healthcare they need.

III. METHODOLOGY

In order to address the problem of lack on access to quality healthcare, we need to utilize the 4 types of analysis namely descriptive analysis, diagnostic analysis, predictive analysis and prescriptive analysis.

First, we need to gather data related to lack of access to quality healthcare.

Then, we use descriptive analysis on the data to understand the problem and realize the current state of healthcare infrastructure in the Philippines. We will be using moving averages and other fundamental statistics to analyze the data.

Also, we apply diagnostic analysis on the data to examine the root causes behind the lack of access to quality healthcare. In this phase, we will use correlation to examine the data and draw insights from it.

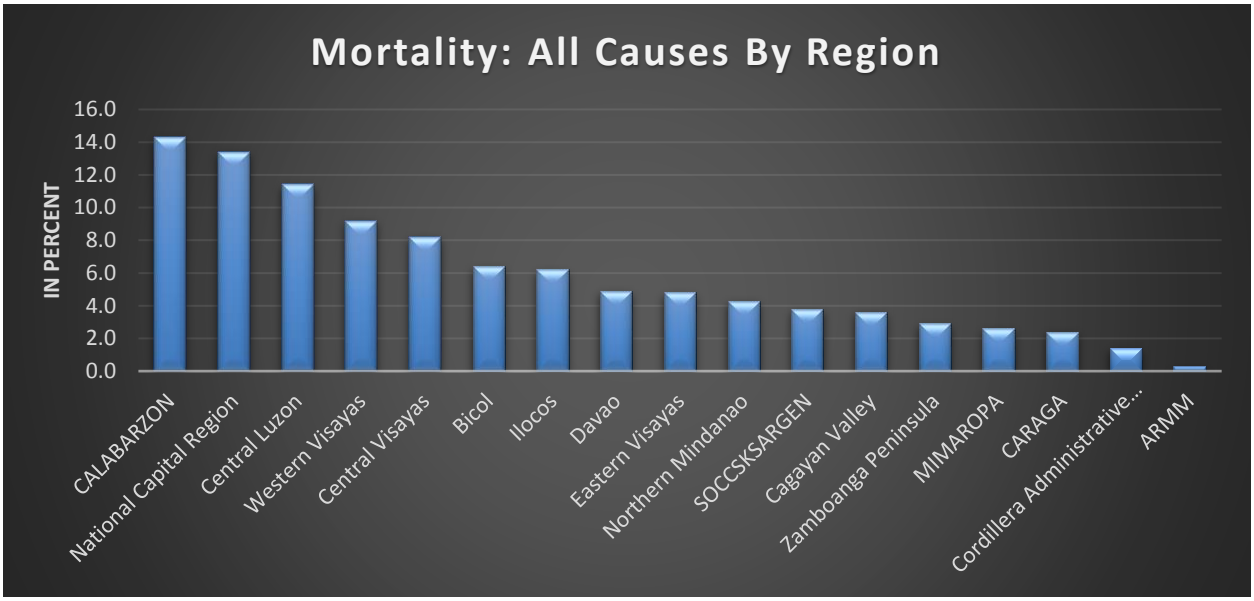
The next step involves using the data collected to create predictive models. These models can forecast how the lack of access to quality healthcare is likely to evolve in the future. At this stage, we will be using predictive analysis specifically regression and classification methods.

Lastly, prescriptive analysis will focuses on developing strategies and solutions to address the identified problems. Drawing from the insights gained through descriptive, diagnostic, and predictive analysis, this phase involves the formulation of evidence-based policies, resource allocation plans, and healthcare interventions. It may involve strategies like expanding healthcare infrastructure in underserved areas, increasing funding for healthcare programs, improving health education, and optimizing healthcare delivery models.

IV. RESULTS AND FINDINGS

The lack of access to quality healthcare is a pressing issue that has significant repercussions for individuals and communities. These problems manifest in higher rates of preventable diseases, increased morbidity and mortality, and decreased life expectancy among those with limited access to quality healthcare.

Figure 1. Mortality: All Causes by Region



In Figure 1, the data reveals the mortality rates in various regions of the Philippines. CALABARZON stands out with the highest rate at 14.3, followed closely by the National Capital Region (NCR).

Figure 2. Mortality by Attendance and Region

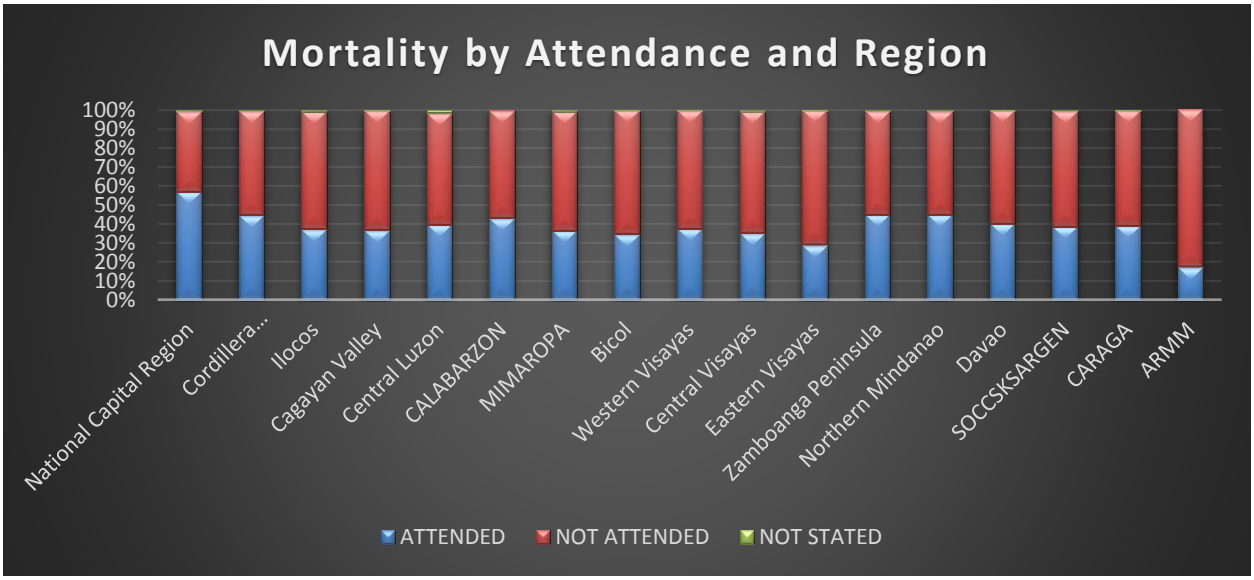
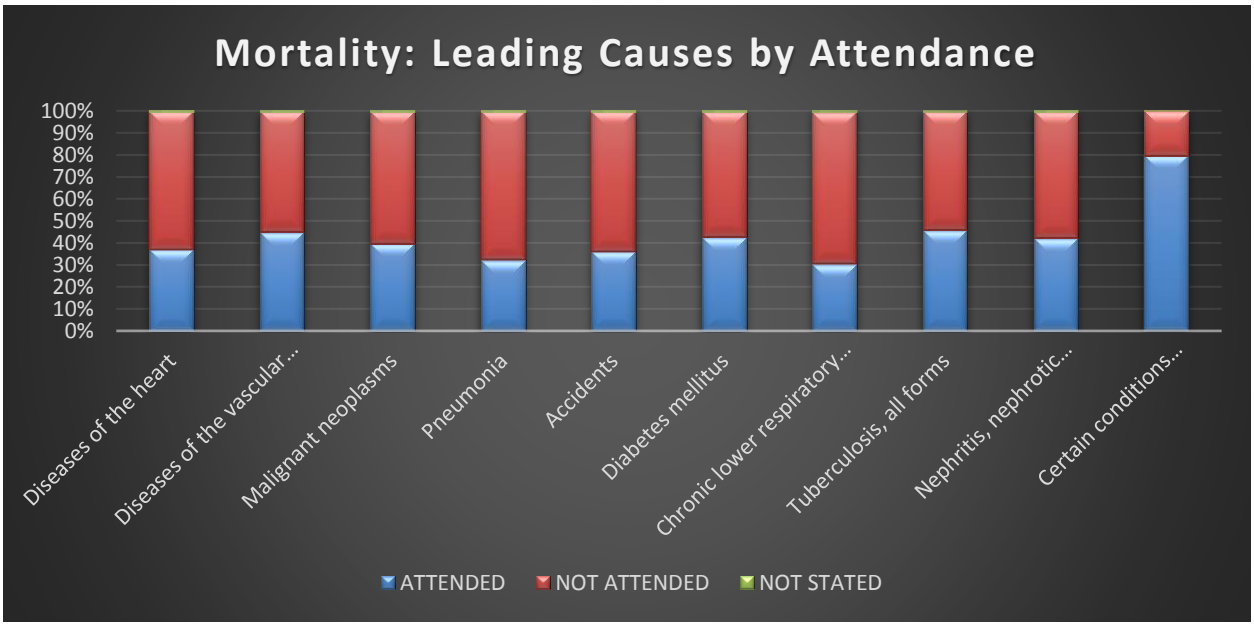


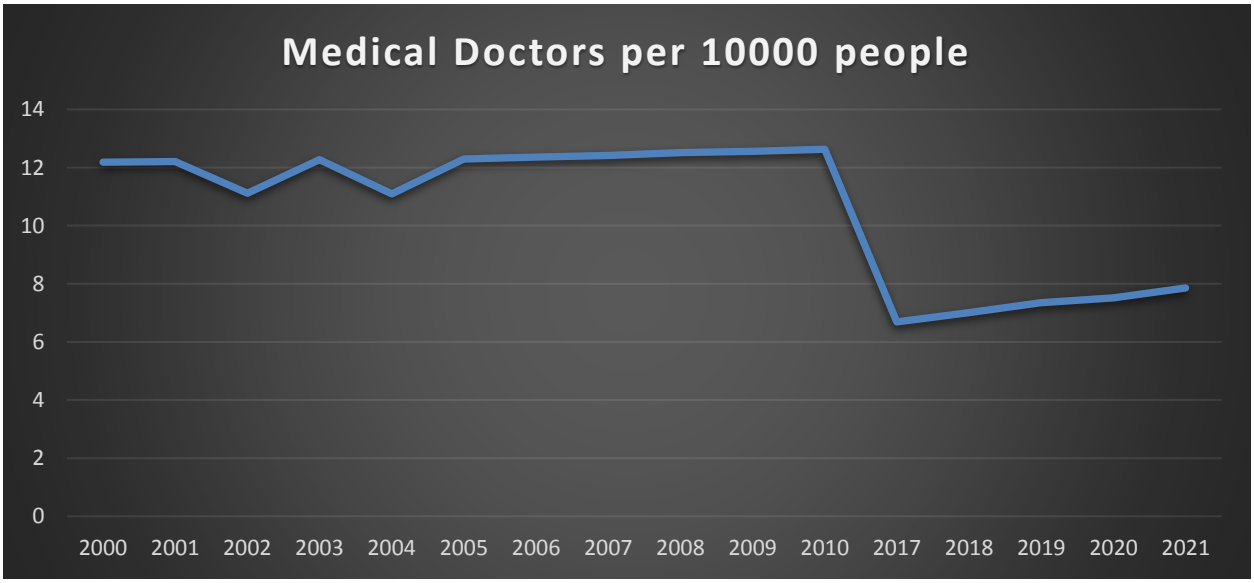
Figure 2 presents regional mortality rates, distinguishing between cases where individuals received medical attention from a doctor and those where they did not. The data clearly indicates that the majority of these deaths, averaging around 61%, occurred without the involvement of a medical doctor. The highest incidence of such occurrences is observed in the BARMM region, where a staggering 83% of the local population passed away without the benefit of medical consultation.

Figure 3. Mortality: Leading Causes by Attendance



In Figure 3, it is evident that heart-related issues are the primary cause of mortality, with a substantial portion of individuals passing away without undergoing a medical examination by a doctor.

Figure 4. Medical Doctors per 10000



According to data from the World Health Organization (WHO), Figure 4 illustrates a notable decrease in the ratio of Filipino medical doctors per 10,000 people, particularly in the latter part of the graph. It decline to around 8 doctors per 10,000 people in the Philippines, which is lower than the recommended ratio of 10 doctors per 10,000 population (WHO, 2018).

Now, let's take a look the health facility and health service capability in the Philippines.

Figure 5. ASEAN Hospital Beds per 1000 people

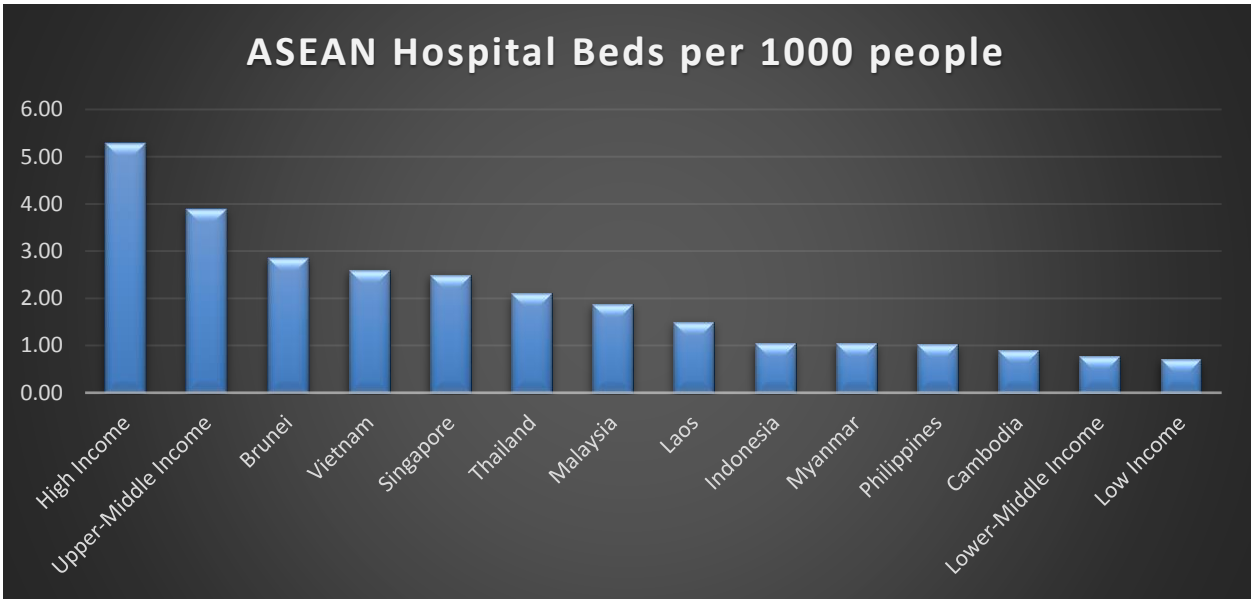


Figure 6. Philippine Hospital Beds per 1000 Filipinos

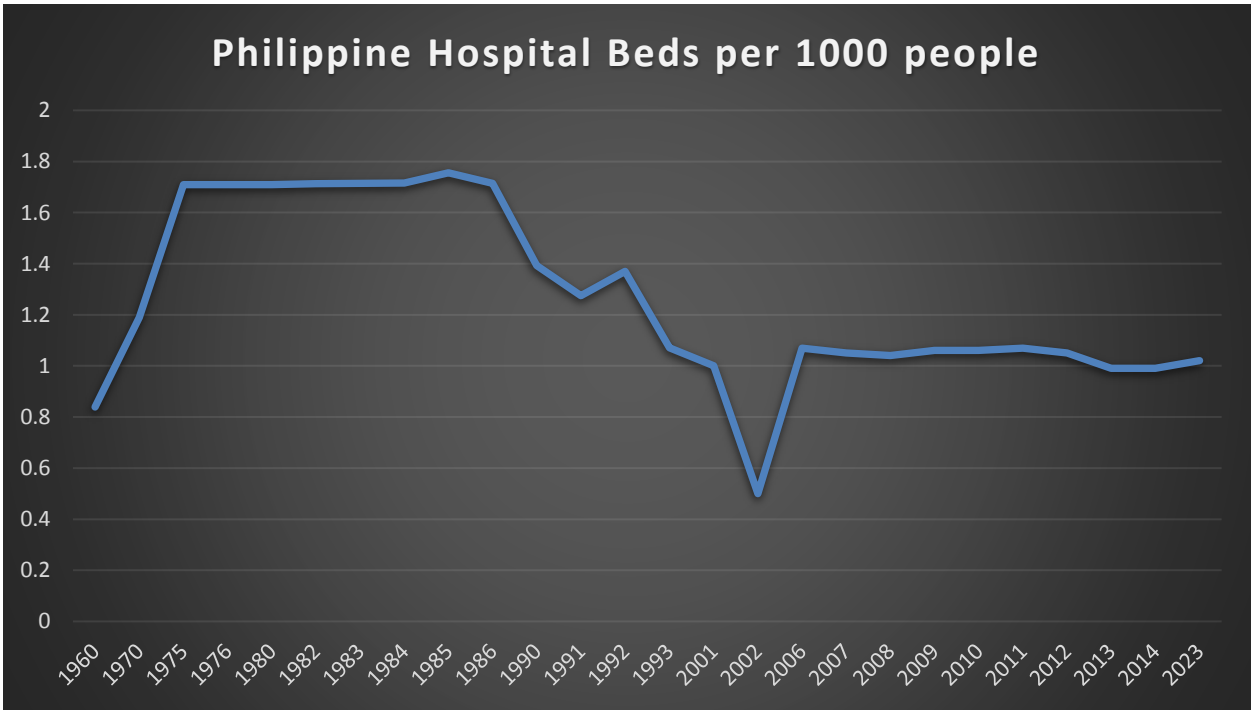
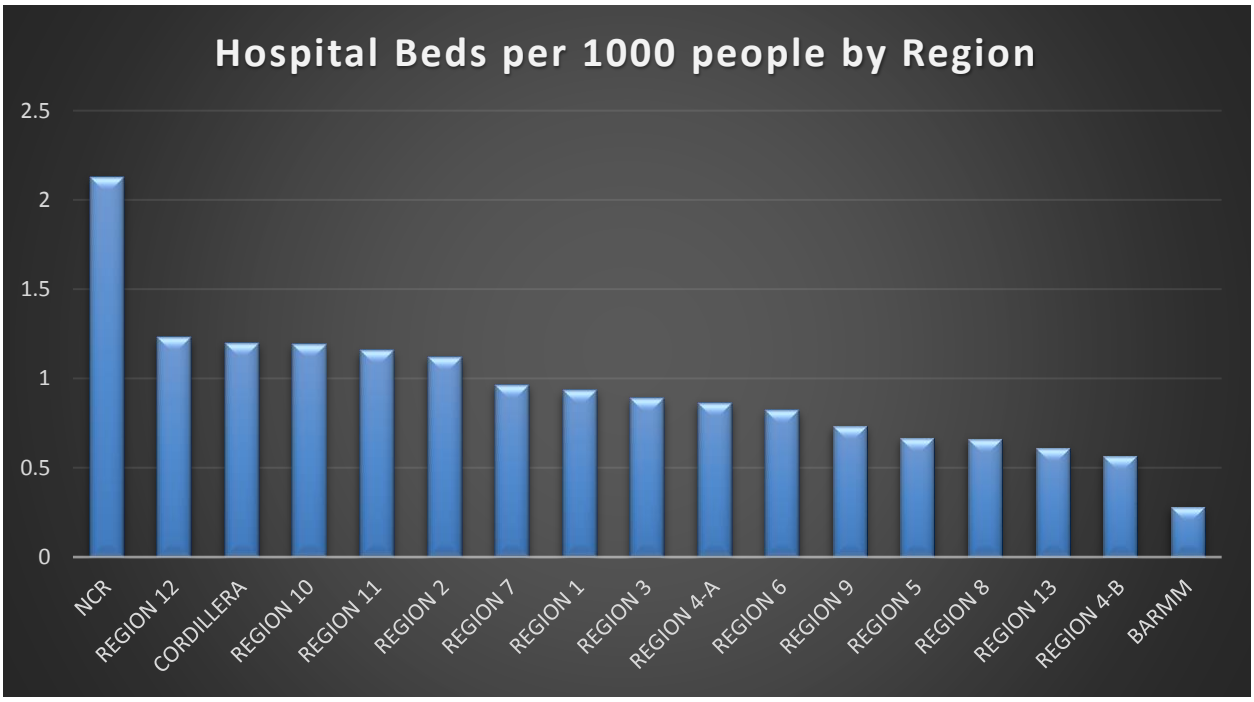


Figure 5 depicts a comparative analysis of ASEAN countries concerning the availability of hospital beds per 1000 people. The data underscores that the Philippines ranks at the bottom of this group, with statistics that are nearly on par with those found in low-income nations.

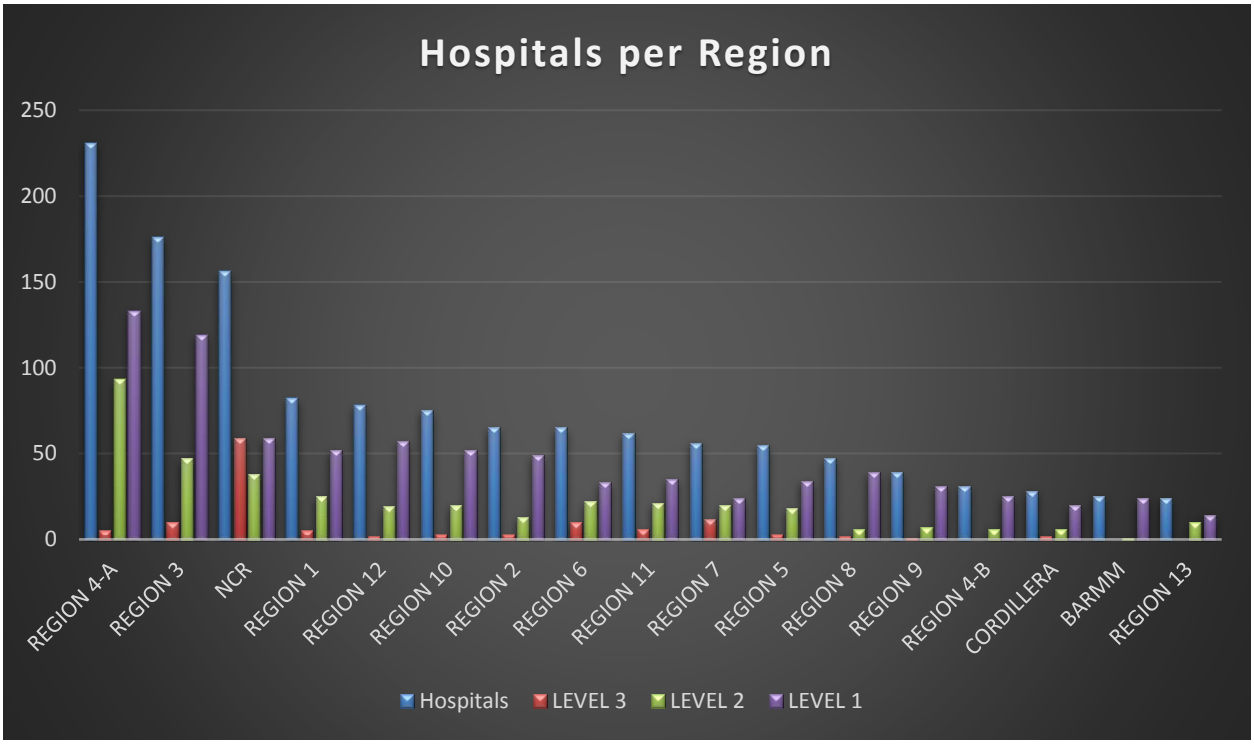
In Figure 6, there is a noticeable decline in the ratio of hospitals per 1000 people over the years, particularly evident in the latter portion of the graph. With the highest at 1.76 hospital beds per 1000 in 1985 and the lowest at 0.5 hospital beds in 2002.

Figure 7. Hospital Beds per 1000 People by Region



In Figure 7, the data reveals the hospital bed capacity per region. Notably, only six regions meet the WHO's recommended standard of 1:1000 hospital beds. The National Capital Region (NCR) boasts the highest bed capacity at 2.13 per 1000, while the BARMM region has the lowest, with only 0.28 hospital beds per 1000 residents.

Figure 8. Hospitals per Region



In Figure 8, we can observe the distribution of health facilities as indicated by the number of hospitals in each region. Region 4A stands out with the highest count, boasting 231 hospitals, while Region 13 holds the lowest position with just 24 hospitals. Notably, the National Capital Region (NCR) is abundant in Level 3 hospitals, with 59 in total, while three regions, namely CARAGA, BARMM, and MIMAROPA, do not have any Level 3 facilities. Excluding NCR from the calculation, the average number of Level 3 hospitals across all regions is a mere 4. These findings starkly illustrate the challenges within the country's healthcare system, reflecting a concerning state of affairs.

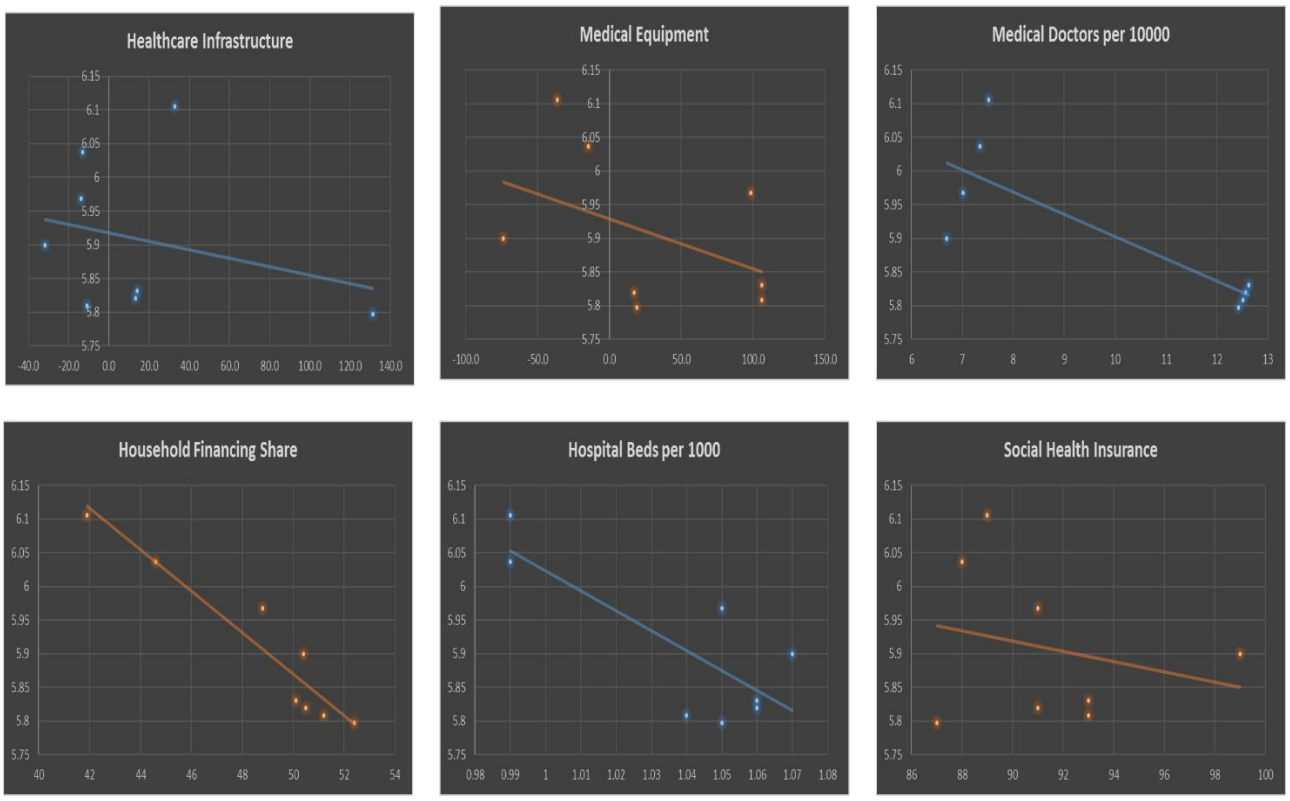
Figure 9. Correlation of Factors on Lack of Access to Quality Healthcare

	Social Health Insurance	*Medical Doctors per 10000*	*Hospital Beds per 1000*	*Household Financing Share*	*Healthcare Infrastructure*	*Medical Equipment*	*Mortality Rate*
Social Health Insurance	1						
Medical Doctors per 10000	-0.163280045	1					
Hospital Beds per 1000	0.595316482	0.399683193	1				
Household Financing Share	0.339578745	0.621672191	0.881757876	1			
Healthcare Infrastructure	-0.624159702	0.465618606	-0.004894462	0.212030934	1		
Medical Equipment	-0.114550702	0.534691963	0.278739938	0.39835215	-0.013135104	1	
Mortality Rate	-0.244942315	-0.818252754	-0.795797271	-0.952562252	-0.278983091	-0.440614658	1

In Figure 9, the data depicts the correlation among various potential factors contributing to the limited accessibility of quality healthcare. The primary measure of healthcare accessibility considered in this analysis is the mortality rate, as stated at the beginning of this report. It is presumed that superior healthcare services lead to lower mortality rates and higher life expectancy. For the purpose of this report, our focus remains solely on the mortality rate.

Furthermore, the figure illustrates a strong inverse relationship between the mortality rate and three key factors: the number of Medical Doctors per 10,000 people, the availability of Hospital Beds per 1,000 residents, and the Household Financing Share in healthcare.

Figure 10. Correlation of Each Possible Factor vs Mortality Rate



In Figure 10, we can observe the correlation between various individual factors and the mortality rate. Each of these factors exhibits a negative correlation with the mortality rate, as indicated by the downward trendline.

Figure 11. First Multiple Linear Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.995675
R Square	0.991369
Adjusted R Square	0.978422
Standard Error	0.01588
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	6	0.115855	0.019309	76.573	0.000442
Residual	4	0.001009	0.000252		
Total	10	0.116864			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	7.243822	0.528939	13.69501	0.000165	5.775253	8.712392	5.775253	8.712392
Social Health Insurance	0.036194	0.005026	7.201914	0.00197	0.022241	0.050147	0.022241	0.050147
Medical Doctors per 10000	-0.04822	0.003451	-13.9735	0.000152	-0.0578	-0.03864	-0.0578	-0.03864
Hospital Beds per 1000	-6.49165	1.121828	-5.78667	0.004432	-9.60634	-3.37696	-9.60634	-3.37696
Household Financing Share	0.052618	0.00939	5.603454	0.004981	0.026546	0.07869	0.026546	0.07869
Healthcare Infrastructure	0.001279	0.000236	5.425421	0.005597	0.000625	0.001934	0.000625	0.001934
Medical Equipment	7.43E-06	9.53E-05	0.078	0.941574	-0.00026	0.000272	-0.00026	0.000272

In Figure 11, our initial attempt at employing multiple linear regression to identify potential determinants of restricted access to quality healthcare and to assess the statistical significance of these factors is detailed. Additionally, our aim is to construct a predictive model. The findings indicate that our F-statistic for significance is impressively low, standing below 1% or 0.01, which is excellent. Furthermore, our R-squared value is at 0.991369, suggesting that the model is a strong fit for the data.

However, it's noteworthy that the variable "Medical Equipment" possesses a p-value of 0.941574 exceeding 0.01 as highlighted in red, implying that it lacks statistical significance and does not significantly influence the model. So, we have to remove the variable.

Figure 12. Second Multiple Linear Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.995668
R Square	0.991356
Adjusted R Square	0.982711
Standard Error	0.014214
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regression	5	0.115853	0.023171	114.6835	3.74E-05
Residual	5	0.00101	0.000202		
Total	10	0.116864			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	7.245815	0.472904	15.32195	2.15E-05	6.030177	8.461454	6.030177	8.461454
Social Health Insurance	0.0362	0.004498	8.048369	0.000479	0.024638	0.047762	0.024638	0.047762
Medical Doctors per 10000	-0.04829	0.00299	-16.149	1.66E-05	-0.05597	-0.0406	-0.05597	-0.0406
Hospital Beds per 1000	-6.49608	1.002865	-6.47752	0.001307	-9.07403	-3.91814	-9.07403	-3.91814
Household Financing Share	0.052675	0.00838	6.285655	0.001498	0.031133	0.074216	0.031133	0.074216
Healthcare Infrastructure	0.001283	0.000205	6.252089	0.001534	0.000756	0.001811	0.000756	0.001811

Figure 12 presents the results of our second multiple linear regression analysis, this time with the exclusion of the variable "Medical Equipment." Remarkably, the R-Square value remains unchanged at 0.991356 compared to our initial attempt. Additionally, the significance F-statistic continues to be below 0.01. Most notably, all the variables now exhibit p-values lower than 0.01, signifying that our model is statistically robust and well-founded. With these findings, we are now ready to formulate the final equation for our model.

Based on the data presented in Figure 12, we have derived the following formula:

$$MR = 7.245815 + 0.0362 * SHI - 0.04829 * MD - 6.49608 * HB + 0.052675 * HFS + 0.001283 * HI \quad (1)$$

Where:

MR – Mortality Rate per 1000
SHI – Social Health Insurance in Percent Population Coverage
MD – Medical Doctors per 10000
HB – Hospital Beds per 1000
HFS – Household Financing Share in Percent
HI – Health Infrastructure Expenditure in Growth Rate

In our pursuit to reduce the annual mortality rate by half for Filipinos, we aim to achieve a target mortality rate of 3. To facilitate this objective, we employ the derived formula (1) and leverage Excel's Solver tool. As a result, we obtain the following tabulated outcomes:

Figure 13. Prescriptive Analysis Result on Mortality Rate of 3

VARIABLES	LATEST	RECOMMEND
Healthcare Infrastructure	32.8	49.96
Household Financing Share	44.7	40
Social Health Insurance	92	100
Medical Doctors per 10000	7.86	12
Hospital Beds per 1000	1.02	1.46
Mortality rate	6.1	3

V. CONCLUSIONS AND RECOMMENDATIONS

In Figure 13, we present the results of our prescriptive analysis, aiming to achieve a target mortality rate of 3 by utilizing formula (1). Based on these findings, we recommend several critical measures:

1. **Healthcare Infrastructure Investment:** To enhance healthcare accessibility, it is recommended to increase healthcare infrastructure expenditure, with a growth rate of 49.96%. This should primarily focus on expanding hospital facilities, especially in remote areas.
2. **Household Health Financing Share:** The share of household financing for healthcare should be reduced to 40%, making healthcare services more affordable for the population.
3. **Universal Health Insurance:** Ensure that all Filipinos are covered by health insurance, ensuring that healthcare is accessible and affordable for everyone.
4. **Medical Workforce Enhancement:** To address the shortage of healthcare providers, hiring more doctors is crucial. The target is to have at least 12 doctors per 10,000 of the population in the Philippines.
5. **Hospital Bed Capacity:** Increase the number of hospital beds to 1.46 per 1,000 Filipinos to accommodate the healthcare needs of the population effectively.

These recommendations are essential steps to improve healthcare access and quality, ultimately working towards the goal of reducing the annual mortality rate in the Philippines.

On the data and analysis result:

An R-squared value of 0.99 is exceptionally high, and it signifies that approximately 99% of the variability in the dependent variable is accounted for by the independent variables in the model.

In real-world, an R-squared of 0.99 means that the model used is an extremely good fit for the data. It implies that the independent variables in the model are highly effective in explaining and predicting the variations in the dependent variable. However, it's important to exercise caution with very high R-squared values, as an extremely high value may also be an indication of overfitting, where the model fits the data too closely, and its performance might not generalize well to new or unseen data. It is recommended to assess model performance using other metrics and to consider the context of the analysis. Also, I recommended to check out other factors that are not considered in this report that may influence the model.

In conclusion, addressing the lack of access to quality healthcare is not only a matter of public health but also a vital economic and social concern. By implementing the recommended measures, we can strive for a future where all Filipinos have equal and improved access to quality healthcare, ultimately enhancing every Filipinos overall well-being and quality of life.