

# **Predictive Model on the Progression of COVID-19 Symptoms for Patients with Underlying Diseases Lean Manufacturing, Operations Management and Six Sigma Applications**

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## **Abstract**

Coronavirus Disease 2019 (COVID-19) is affecting life all over the world with an increasing number of infected individuals and fatality. Certain individuals are at a higher risk for severe illness if they become infected. This study aims to identify the risk of progression of COVID-19 symptoms for patients with underlying diseases residing in the National Capital Region, Philippines. The longer the patient stays in the hospital, the higher the risk that the symptoms will progress from mild to severe illness. Descriptive statistics were used to categorize quantitative data, Correlation to identify significant relationships between variables, ANOVA to determine the significant difference among all the factors, a Tukey test was conducted to identify which of the specific pairs are statistically significant, and multiple linear regression to obtain significant factors that could affect the number of days that a patient with underlying diseases experiences mild to severe symptoms, as well as the number of days that a patient with severe symptoms to be transferred to the medical ward. Lastly, Risk assessment with the use of Kepner Tregoe (KT) Analysis was utilized. Findings reveal that factors age, blood type group, gender, vitamin intake, sleeping hours, and smoking have a significant difference between the duration of Mild and Severe infection. The length of having symptoms is directly proportional to the whole duration of the infection. Furthermore, Comorbidity Cancer with Chronic Kidney Disease and Type II Diabetes has the longest duration of severe infection among all the underlying disease and comorbidity.

## **Keywords**

Covid-19, Underlying Disease, National Capital Region, Predictive Model, Pandemic

## **1. Introduction**

Health is the state of a human's body and the extent to which it is illness-free or could be able to resist an illness. Collins dictionary (n.d) Investing in healthcare is an important priority to the community especially to each of the individuals. The Coronavirus (COVID-19) was first reported as a mystery illness that no one knows where it came from and the next thing we knew, it has already spread around the world. The outbreak started with the increasing number of pneumonia that originated from Wuhan China around December 2019. A 38-year-old woman who arrived from Wuhan China was the first case of Covid-19 in the Philippines and it was confirmed last January 30, 2020. Dancel, R. (2020). A person who develops Covid-19 starts noticing the symptoms like Fever, Dry Cough, Fatigue, Loss of taste or smell, Sore Throat, Headache, Diarrhea, Nasal Congestion within 2 to 14 days after being exposed to the novel coronavirus. The study according to Zaki, N. (2020), tackled that the severity of COVID-19 illness with people who have diabetes, hypertension, kidney disease, cancer, stroke, and high cholesterol should be carefully interpreted because there is a lot of factors that can be associated with the COVID-19 patient, including their age, history of smoking or other clinical conditions. It was found through the disease variables, evidenced by the increased risk of COVID-19 severity including the following: hypertension, diabetes, and cholesterol level imbalance.

The overall case-fatality rate (CFR) in China was raised for patients with comorbidities, 10.5% with cardiovascular disease, 7.3% with diabetes, 6.3% with chronic respiratory disease, and 5.6% with cancer dying of COVID-related illness. Wu, Z. (2020). The possible significant variables that could affect the patients such as the number of days that would take a patient with mild symptoms reaching the severe level, as well as the number that takes for the patient with severe symptoms to be transferred in the medical ward until its recovery will also be a part of this

research and would focus on the COVID-19 cases in the National Capital Region (NCR), Philippines.

### **1.1 Objectives**

The main objective of this study is to identify the risk of progression of COVID-19 symptoms for patients with Underlying diseases residing in the National Capital Region, Philippines. The researchers assess the medical condition by gathering the records of patients with the underlying disease who got infected by COVID-19 infection since the virus started. Cai, J. (2020). There are 1,099 hospitalized patients, 44% of the patients experienced fever but eventually, there are 89% of patients experiencing an on and off fever during their hospitalization. Guan, W. (2020). The higher the number of days that a patient stays in the hospital, the higher the risk that the symptoms will progress from mild to severe. The study according to Rees, E.M (2020), is about the length of stay in the hospital of a COVID-19 patient. They identified 52 studies, the majority from China. There was a visible difference in discharge status with patients -- who were discharged alive -- that had a longer duration of stay in the hospital than those people who died with a short duration of stay in the hospital. Furthermore, the researchers aim to provide alternative solutions and contingency plans that could aid both the medical staff and patients as they deal with this illness based on the significant factors that will be determined by the predictive model.

### **1.2 Significance of the Study**

The findings of this study may support the progress of preventive and clinical interventions leading to reduced severe outcomes in COVID-19 patients with underlying conditions. Results of this study may also assist in the Inter-Agency Task Force for the management of emerging infectious disease resolutions. In addition, this study would help medical staff and patients to identify significant factors that affect the patients' vulnerability in COVID-19.

### **1.3 Scope and Limitations**

The study will concentrate on 212 living patients with underlying diseases that experienced COVID-19 symptoms from mild to severe transfer to a quarantine ward residing in the National Capital Region, Philippines without age limit provided that they have pre-existing comorbidity(s) that are proven causes that increase the severity of the COVID-19 infection. The findings of this study may support the progress of preventive and clinical interventions leading to reduced severe outcomes in COVID-19 patients with underlying conditions. Results of this study may also assist in the Inter-Agency Task Force for the management of emerging infectious disease resolutions. In addition, this study would help medical staff and patients to identify significant factors that affect the patients' vulnerability in COVID-19.

## **2. Literature Review**

According to WHO (2020) A person who develops Covid-19 starts noticing the symptoms like Fever, Dry Cough, Fatigue, Loss of taste or smell, Sore Throat, Headache, Diarrhea, Nasal Congestion within 2 to 14 days after being exposed to the novel coronavirus. Furthermore, people with chronic medical conditions or commonly known as underlying diseases - including diabetes, cardiovascular disease, obesity, cancer, and kidney disease are at higher risk of developing severe respiratory and low oxygen levels and pneumonia. Elderly patients are also at higher risk of severe illness.

The study according to Callender, B. (2020), it is about the generality of individuals who have preceding comorbidities and COVID-19 at the same time. Screening and data extraction were done to perform this study with the use of a Meta-analysis (PRISMA) methodological framework and systematic review. Based on their findings, the most common comorbidity diseases that a COVID-19 patient has are hypertension, diabetes, and cardiovascular diseases. They have a high risk of dying because immune dysfunction can affect the severity of the disease. There is also an increase in fatality due to complications of the illness.

The higher the number of days that a patient stays in the hospital, the higher the risk that the symptoms will progress from mild to severe. The study according to Rees, E.M (2020), is about the length of stay in the hospital of a COVID-19 patient. They identified 52 studies, the majority from China. There was a visible difference in discharge status with patients -- who were discharged alive that had a longer duration of stay in the hospital than those people who died with a short duration of stay in the hospital. Also, to identify the significant factors that could affect the number of days for a patient with underlying diseases experiencing mild to severe COVID-19 symptoms, as well as the duration of the patient's treatment inside the hospital to the time that the patient is transferred to the medical ward.

### 3. Methods

#### 3.1 Conceptual Framework

In Figure 1, The conceptual framework was used to determine the research study. It consists of several factors that affect the number of days that a patient with underlying diseases experiences mild to severe symptoms, and the number of days that a patient with severe symptoms to be transferred to a medical ward.

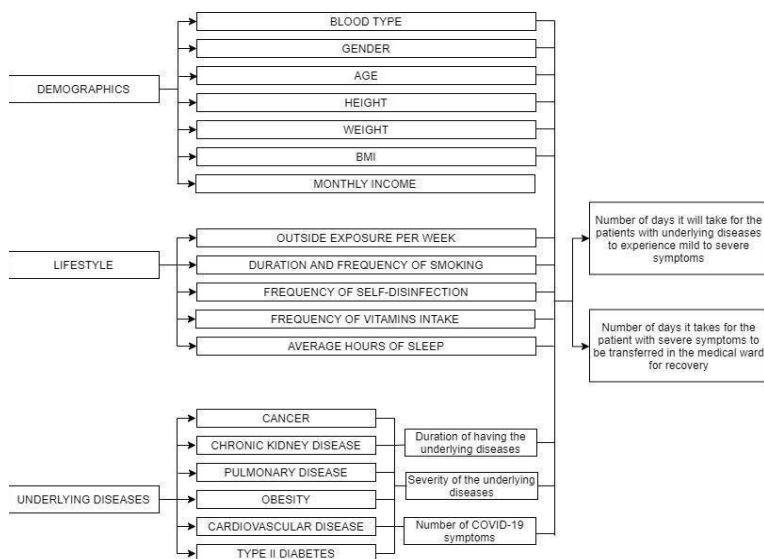


Figure 1. Conceptual Framework

#### 3.2 Research Design

The researchers established three separate phases of this study that will determine the most significant factors that affect the number of days that a patient with underlying diseases experiences mild to severe symptoms, as well as the number of days that a patient with severe symptoms will be transferred to the medical ward. The researchers developed a strategy to satisfy the objectives below:

**Phase 1:** Assessment of patients with underlying diseases infected with COVID-19 condition

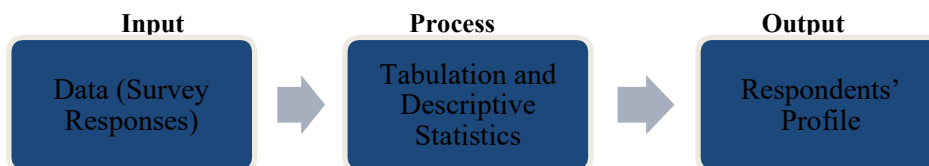


Figure 2. Data Analysis Procedure for cluster analysis of operating data

Figure 2 shows that patients with underlying diseases' historical and present data who got COVID-19 symptoms were tabulated and utilized Descriptive statistics to categorize quantitative data. As an outcome, the researchers were able to attain the respondent's profile that was used for the data analysis.

**Phase 2:** Identifying the significant factors that affect the number of days that a patient with underlying diseases experiences mild to severe symptoms, and the number of days that a patient with severe symptoms will be transferred to the medical ward.

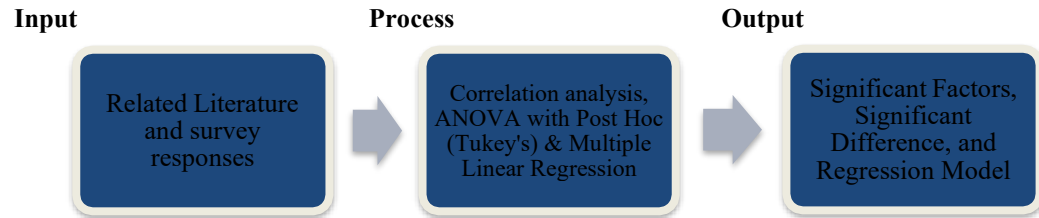
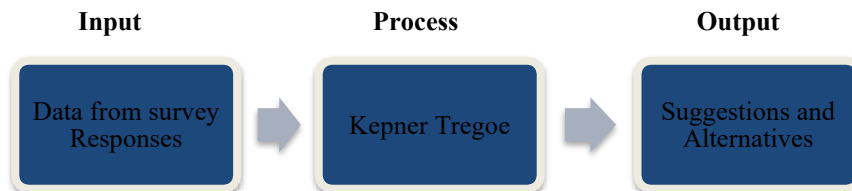


Figure 3 shows the Data Analysis Procedure per Correlation Analysis, Anova and MLR. The researchers reviewed previous studies on the infectious disease COVID-19 to determine the factors from the responses to undergo differential statistical test like correlation to identify significant relationships between variables, the one-way analysis of variance to determine the significant difference among the different levels or attributes per variable, a Tukey test were conducted to identify which of the specific pairs that are statistically significant, and multiple linear regression to obtain significant factors that could affect the number of days that a patient with underlying diseases experiences mild to severe symptoms, as well as the number of days that a patient with severe symptoms to be transferred to the medical ward. A regression model will be created to interpret the data that will be used as the study progresses to phase 3.

**Phase 3:** Constructing possible solutions and contingency plans those hospitals can utilize in aiding their patients and creating an awareness of precautionary measures to the patients with underlying diseases.



**Figure 4.** Using Kepner Tregoe analysis to provide suggestions and

In Figure 4, after the predictive model was established, the Kepner Tregoe (KT) Analysis was applied by the researchers based on the factor with the most significant impact on the two response variables in this study. The purpose of executing this analysis is to conclude certain evaluations and contingency plans to avoid the chances of being infected.

#### 4. Data Collection

The researchers contacted the hospital, doctors, nurses, and medical staff within the National Capital Region via electronic mail to acquire the necessary information needed for this research. The research only focuses on patients with underlying disease. When all the documents have been acquired, survey questions will be sent out via Google forms. Furthermore, the researchers also utilized the social media platforms such as Facebook, Instagram, Twitter, and Tiktok to gather respondents. Thereafter, results were analyzed using statistical methods to achieve the results.

### 5. Results and Discussion

#### 5.1 Descriptive Statistics

The responses obtained were used in statistical analysis to interpret them. Frequency and percentage count were created to have a breakdown of the results for the demographic factor from the survey. The researchers gathered a total of 212 individuals consisting of 87 females and 125 males. 25.00% of the respondents live in Quezon City which was the highest count in the survey. According to ABS-CBN news (2021), Quezon City continues to lead the highest count of COVID-19 cases in the National Capital Region, followed by the City of Makati. Most of the respondents are coming from the age group of 50 – 59 years old, blood type A, with a BMI of 18.5 – 25, and coming from the family with 23,381 – 46,760 and 46,761 - 81,831 income.

## 5.2 Analysis of Variance

The one-way ANOVA was used to identify factors that have significant differences to the infected duration. For the demographics factors- age, blood type group, and gender have a significant difference between the mild and severe duration. For the lifestyle factors, vitamin intake, average hours of sleep, and vices have significant differences also between the mild and severe duration. Based on the numerical data calculated from Tukey's test, all of the variables P-value is <0.05. For the symptoms, fever, dry cough, tiredness, aches & pain, sore throat, and headache have significant differences between the whole infected duration with a p-value of 0.00,0.00,0.00,0.013, 0.03 and 0.00 respectively. Tukey's test for the symptoms showed that the longer the duration of the symptoms, the longer the whole duration of infection. And lastly, there is also a significant difference between Underlying disease, Comorbidities, and Severe Duration. Patients with Cancer, Chronic Kidney, and Diabetes comorbidities have the highest mean which is 69.00 among all the underlying diseases and comorbidity and a p-value of 0.00. The results obtained explain that people who have Comorbidity of Cancer with Chronic Kidney Disease, and Type II Diabetes experience a longer duration of severe infection among all the Underlying disease and Comorbidity.

## 5.3 Correlation

The researchers have identified the significant relationships of each factor. Mild duration resulted of having a significant relationship with the factors: number of cigarettes sticks per day, average hours of sleep, use of alcohol, washing of hands, use of hand sanitizer, and disinfection of footwear, disinfection of gadgets, vitamin intake before COVID-19, and vitamin intake during COVID-19. The number of cigarettes sticks per day has a moderate positive correlation and the average hours of sleep have a moderate negative correlation with the mild duration. Meanwhile, the correlation between mild duration and disinfection of gadgets has shown strong positive relationships with each other. The factors washing your hands, use of sanitizer, and disinfection of footwear have shown a weak negative correlation to the mild duration. The factors vitamin intake before and during COVID-19 has shown a very weak positive correlation to the mild duration. Taking a bath has no significant relationship at all. And as for the severe duration, it resulted in Severe Duration having a significant relationship with these factors: number of comorbidities, number of cigarettes sticks per day, average hours of sleep, disinfection of gadgets, vitamin intake before COVID-19, and vitamin intake during COVID-19. However, the correlation between the number of comorbidities has a moderate positive correlation to the severe duration, the number of cigarettes sticks per day vitamin intake before COVID-19 and vitamin intake during COVID-19 have shown a very weak positive correlation to the severe duration. While average hours of sleep have shown a weak negative correlation and in contrast with the disinfection of gadgets with a weak positive correlation to the severe duration. The factors of taking a bath, use of alcohol, washing of hands, use of sanitizer, use of wet wipes, and disinfection of footwear have no significant relationship at all. It is concluded that there is a significant difference but low weak negative correlation between mild and severe duration which means that there are instances that a patient with mild symptoms has a longer number of days experiencing the infection and only experienced severe symptoms for a shorter duration or vice versa.

## 5.4 Regression Model

This statistical treatment was established to calculate the equation of the linear regression line and come up with a predictive model. A predictive model is a tool used in predictive analytics and refers to the mathematical and computational method to develop a predictive model that examines datasets and calculates the probability of an outcome. According to Ringle, C. (2015), the maximum acceptable level of VIF must be less than 5. All the data that have been tested closely follows the line and resembles a bell-shaped and or known as a normal distribution, the regression and assumptions for the multiple regression method are met. The study has three dependent variables, the number of days it takes for the patient to experience mild to severe COVID-19 symptoms, the number of days it takes for the patient to experience severe to recovery COVID-19 symptoms in a quarantine facility, and the whole duration of COVID-19 infection, the researchers established three separate regression analyses.

Table 1. Mild Duration Model Summary

S	R-Sq	R-sq (adj)	R-sq (pred)
5.09973	70.96%	70.11%	69.08%

### Mild Regression Equation

$$Y_1 = 24.91 - 3.84 (M_1) + 3.804 (M_2) + 0.784 (M_3) - 0.582 (M_4) - 2.911 (M_5) - 4.075 (M_6) + \varepsilon \sim (0, 5.1)$$

The regression summary and equation for mild duration are shown above.  $Y_1$  denotes the response variable number of days it takes for the patient to experience mild to severe COVID-19 symptoms. There are total of 6 significant factors for the independent variables,  $M_1$  denotes the Blood Type (Group),  $M_2$  for Smoker & Non-Smoker,  $M_3$  for the Use of Alcohol,  $M_4$  for the Disinfection of Footwear,  $M_5$  for the Disinfection of Gadgets and  $M_6$  for Vitamin Intake.

Table 1 shows that S is 5.09973 which tells us that the average distance of the data points from the fitted line is about 5.1% mild duration. 70.96% of the variation in the number of days for mild symptoms is explained by variation in the identified factors to have a significant difference because the factors obtain a less than 0.05 p-value in the ANOVA.

Table 2. Severe Duration Model Summary

S	R-Sq	R-sq (adj)	R-sq (pred)
11.2537	43.64%	41.99%	39.24%

### Whole Regression Equation

$$Y_3 = 39.24 - 6.39(W_1) + 8.11(W_2) - 0.000019 (W_3) - 3.949(W_4) + 7.08 (W_5) + \varepsilon \sim N(0, 10.92)$$

The regression summary and equation for severe duration are shown above.  $Y_2$  denotes the response variable number of days it takes for the patient to experience severe COVID-19 symptoms.  $Y_1$  denotes the response variable number of days it takes for the patient to experience severe to recovery COVID-19 symptoms in a quarantine facility.  $S_1$  denotes the Smoker & Non-Smoker,  $S_2$  is the Family Average Income,  $S_3$  is the Average Sleeping Hours,  $S_4$  is the Disinfection of Gadget,  $S_5$  for the Vitamin Intake and  $S_6$  for the Number of Comorbidity.

In Table 2, S is 11.2536 which tells us that the average distance of the data points from the fitted line is about 11.2% severe duration. 43.64% of the variation in the identified factors to have a significant difference because the factors obtain a less than 0.05 p-value in the ANOVA.

Table 3. Whole Duration Model Summary

S	R-Sq	R-sq (adj)	R-sq (pred)
10.9203	52.67%	51.53%	49.53%

Table 3 represents the Whole Duration Model Summary.  $Y_3$  denotes the response variable of the whole duration it takes for the patient to experience COVID-19 symptoms.  $W_1$  is the Blood Type Group,  $W_2$  for the Smoker & Non-Smoker,  $W_3$  for the Family Average Income,  $W_4$  for the Average Sleeping Hours and  $W_5$  for the Number of Comorbidity. R is 10.9203 which tells us that the average distance of the data points from the fitted line is about 10.9% the whole duration. 52.67 % of the variations in the identified factors have a significant difference because the factors obtain a less than 0.05 p-value in the ANOVA.

### 5.5 Kepner Tregoe

The Kepner Tregoe (KT) Analysis (Table 4 – Table 7) was based on the result of the predictive model using the identified factors that affect the number of days that a patient with underlying diseases experiences mild to severe symptoms, the number of days that a patient with severe symptoms will be transferred to the medical ward, and the whole duration of the Covid-19 infection in ANOVA and multiple linear regression. The purpose of the Risk

Assessment is to conclude certain evaluations and contingency plans to avoid the chances of experiencing a severe infection. The contingency plans were mostly based on the guidelines and preventive measures released by the Department of Health, and the protocols of the Inter-Agency Taskforce (IATF) that the Philippine Government organized to respond to the emerging infectious diseases.

Table 4. Risk Assessment Demographics

FACTORS	MODE OF FAILURE	SOLUTION	RISK	CONTINGENCY PLAN
AGE	Older people are prone to getting the COVID-19 infection.	Vaccine and boost the immune system.	People in their 60s and above are at higher risk for severe illness than people in their 40s.	Avoid unnecessary travel and stay away from large groups. People in their 60's and above must stay at home.
GENDER	Behaviour lifestyle, men are more irresponsible of doing the preventive measure actions	Vaccine and boost the immune system.	The overall COVID-19 case-fatality ratio is approximately 2.4 times higher among men than among women	Practicing the preventive measures. Changing lifestyle and being more responsible.
BLOOD TYPE	N/A	Vaccine and boost the immune system.	Blood group A individuals had a higher risk for COVID-19 and blood group O was associated with a lower risk for the infection compared with non-O blood groups.	N/A
BMI	Nutrition and Fitness Combination: People will start exercising but neglect their nutrition.	Vaccine and boost the immune system.	The risk of severe COVID-19 illness increases sharply with elevated BMI. People who are overweight are at risk of the virus. Having obesity triples the risk of hospitalization due to the COVID-19 infection.	Healthy diet, limit unhealthy food in the household and exercise.
FAMILY INCOME	Not having a budget plan. Excessive/Frivolous Spending.	Learn how to budget the household income. Focus on the essentials.	People coming from the urban/poor family had a higher risk for the infection because they cannot provide the essential needs like foods, medicine and hospitalization	Government must take action and prioritize to help the people who are in need.

Table 5. Risk Assessment - Lifestyle

FACTORS	MODE OF FAILURE	SOLUTION	RISK	CONTINGENCY PLAN
Outside exposure per week	Contact of people with one another.	Vaccine and boost the immune system.	The risk of transmission outside because viruses that are released into the air can rapidly become diluted through the atmosphere.	Avoid unnecessary travel and stay away from large groups of people. Protect yourself by practicing preventive actions when you're outside.
Duration of smoking	Excessive use of cigarette	Make a list of reasons to quit. Change lifestyle	It weakens the immune system and prone to underlying diseases like lung cancer.	Find alternative habits. Make your hands and mouth busy.
Frequency of self-disinfection	Not following self-disinfect protocols	Washing of hands. Frequent disinfection of the places (home, shops and others), frequent use of alcohol and disinfect frequently touched objects and surfaces.	Risk of not having a proper disinfection especially with yourself can lead to infection within your environment and the same time, it also allows you to be infected.	Awareness and reminder to people on how to disinfect properly.
Frequency of vitamin intake	Not properly prescribed by the doctor and taking large doses of vitamins. Inconsistency of the human.	Consistent intake of vitamins that is prescribed by the doctor.	Vitamin deficiency anemia develops when the body has a shortage of the vitamins. It also weakens the immune system.	Healthy foods like fruits and vegetables.
Average hours of sleeping	Exposed to different kinds of distraction (internet, gaming etc.)	Stay away from the distractions. Go to sleep at the same time each night.	It weakens the immune system.	Avoid nap and limit caffeine intake



Table 6. Risk Assessment - Symptoms

Factors	Mode of Failure	Preventive Solution	Risk	Contingency Plan
<b>Fever</b>	Infection, Inflammation, Trauma	Limit exposure to infectious agents, Healthy Lifestyle, Proper Hygiene	A fever that occurs for an extended period can be dangerous. It can result in severe illness or fatality.	Seek immediate medical attention. Take Medication
<b>Dry Cough</b>	Excessive use of your voice, inhaled irritants such as dust or smoke (air pollution)	Drink the prescribed medicine and vitamins by the doctor, avoid close contact with a sick person. Rest and boost the immune system. Avoid irritants.	When a cough is severe, pulled chest muscles and even fractured ribs are a possible complication. Risk of developing pneumonia.	Separate yourself from all family members and pets. Seek immediate medical attention. Drinking plenty of warm liquids to keep hydrated .
<b>Tiredness</b>	Excessive work. Lack of sleep. Eating unhealthy meals. Poor lifestyle.	Changing lifestyle. Regular check-up. Rest and boost the immune system.	Weakens the immune system and a chance of getting chronic disease	Seek for medical attention. Rest and stay at home. Eat healthy meals. Be active.
<b>Aches and Pain</b>	Do not respond well to various therapies	Maintain a healthy lifestyle, drink vitamins	Pain that occurs for an extended period can be dangerous. It can result in severe illness.	Seek immediate medical attention. Take Medication
<b>Sore Throat</b>	Viral infection, inhaled irritants such as dust or smoke (air pollution)	Drink the prescribed medicine and vitamins by the doctor, avoid close contact with a sick person. Rest and boost the immune system. Avoid irritants.	Risk of cancers of the mouth, throat, voice box or developing pneumonia.	Separate yourself from all family members and pets. Seek immediate medical attention. Drinking plenty of warm liquids to keep hydrated .
<b>Headache</b>	Blood Clot	Get enough sleep and Exercise regularly	Lost sense of taste and smell	Seek immediate medical attention. Take Medication

Table 7. Risk Assessment - Underlying Disease

Factors	Mode of Failure	Solution	Risk	Contingency Plan
<b>Cancer</b>	Smoking, radiation, viruses, cancer-causing chemicals, obesity, hormones, chronic inflammation and a lack of exercise that causes gene mutation	Maintain a healthy and active lifestyle, avoid risky behaviors, and get vaccinated	Blood-related cancers such as leukemia, lymphoma, or multiple myeloma, those undergoing chemotherapy treatment, individuals with more advanced disease, and those with cancer involving the lungs are at most risk for severe illness.	Develop awareness on how Cancer stigma may impact Covid-19 testing, and treatment.
<b>Chronic Kidney Disease</b>	Impaired kidney Functions	Maintain a healthy weight and lifestyle. Avoid Vice such as smoking and drinking	People with kidney disease have weaker immune systems, making it harder to fight infections and are at higher risk for more severe illness.	Dialysis, Healthy Diet, and get vaccinated
<b>Obesity</b>	Poor diet, lack of physical activity, and other medical conditions	Maintain a healthy and active lifestyle.	Increased risk of severe illness and are highly likely to require invasive respiratory support	Develop awareness on how obesity stigma may impact Covid-19 testing, and treatment.
<b>Cardiovascular Disease</b>	COVID-19 patients with pre-existing heart disease may suffer a heart attack or develop congestive heart failure.	Maintain a healthy weight and lifestyle. Avoid Vice such as smoking and drinking	Increased risk of severe illness and might have a higher risk of fatality.	Convalescent plasma
<b>Chronic Obstructive Pulmonary Disease</b>	Excessive exposure in tobacco	Maintain a healthy weight and lifestyle. Avoid Vice such as smoking and drinking	Higher risk of acquiring Covid-19 and are more likely to have severe illness.	Convalescent Plasma
<b>Type II Diabetes</b>	Insulin Resistance	Maintain a healthy weight and lifestyle. Avoid Vice such as smoking and drinking	Higher risk in acquiring Covid-19 and have complications with other underlying diseases	Convalescent plasma

The Contingency plan for the risk assessment is to avoid unnecessary travel and stay away from large groups of people and protect yourself by practicing preventive actions like wearing personal protective equipment when outside IATF (2020). On the other hand, vaccines and boosting the immune system are still the most effective ways that can help to protect the person's body from infection.WHO (2021). Furthermore, Seek Medical Attention and Take Medication only when prescribed by the doctors. According to CDC (n.d), if a person is experiencing trouble



in breathing, persistent pain, pressure in the chest, inability to stay awake, and discoloration they should seek emergency medical care immediately.

## 6. Conclusion

In conclusion, this research supports Bennett K. (2021) study entitled Underlying conditions and risk of hospitalization, ICU admission, and mortality among those with COVID-19 in Ireland: A national surveillance study. However, it is in the Philippines settings. The researchers assessed the medical condition by gathering the records of patients with the underlying disease to identify the risk of progression of COVID-19 symptoms. The study concentrated on the living patients that experienced symptoms from mild to severe residing in the National Capital Region without age limit. The survey determined the respondent's demographics, underlying diseases, lifestyle, and symptoms.

The researchers gathered a total of 212 individuals consisting of 87 females and 125 males. 25.00% of the respondents live in Quezon City which was the highest count in the survey. Most of the respondents are coming from the age group of 50 – 59 years old, blood type A, with a BMI of 18.5 – 25, and coming from the family with 23,381 – 46,760 and 46,761 - 81,831 income.

It was found that demographics factors - age, blood type group, and gender have a significant difference between the mild and severe duration. For the lifestyle factors, vitamin intake, average hours of sleep, and vices have significant differences also between the mild and severe duration. For the symptoms, fever, dry cough, tiredness, aches & pain, sore throat, and headache have significant differences between the whole infected duration. And lastly, there is also a significant difference between Underlying disease, Comorbidities, and Severe Duration. Patients with Cancer, Chronic Kidney, and Diabetes comorbidities have the highest mean among all the underlying diseases and comorbidity. The results obtained explain that people who have Comorbidity of Cancer with Chronic Kidney Disease, and Type II Diabetes experience a longer duration of severe infection among all the Underlying disease and Comorbidity.

It is concluded that there is a significant difference but low weak negative correlation between mild and severe duration which means that there are instances that a patient with mild symptoms has a longer number of days experiencing the infection and only experienced severe symptoms for a shorter duration or vice versa.

The researchers established three separate regression analyses. A multiple linear regression analysis was used to determine the most common significant factors with the most significant role in increasing the risk of acquiring the COVID-19 virus which is the smoker and non-smoker that became significant to all of the dependent variables. Disinfection of Gadget and Vitamin Intake resulted to be the significant factors for Mild and Severe Duration. Family Average Income and number of comorbidity resulted to be the significant factors for Severe and Whole Duration.

The researchers created a risk assessment with the use of Kepner Tregoe (KT) Analysis to conclude certain evaluations and contingency plans to avoid the chances of being infected. The researchers advised practicing preventive actions such as staying at home, avoiding unnecessary travel, staying away from large groups of people or people with symptoms, and wearing personal protective equipment inside and outside the area. Awareness and reminder to people on how to disinfect properly, how to take care of themselves, and ways to boost their immune system. And if the person starts to experience the symptoms the contingency plan is to isolate themselves from the other people and seek immediate medical attention. Get rest and drink plenty of liquid to avoid being dehydrated. Information that will be gathered in future references may expand this study and upsurge the knowledge of COVID-19 Symptoms for Patients with Underlying Diseases. Future researchers recommend gathering a wider sample size to produce more accurate data and to conduct the study outside NCR, to have more respondents. Also, adding more factors must be considered to have more variables for example are vices, other symptoms, and other kinds of underlying disease. The researchers recommend that the people who have fully recovered from the virus consider donating plasma since it contains high antibody levels that may reduce the severity and duration of COVID-19. Convalescent plasma is a therapy that uses blood from people who have recovered from an illness to help others. In addition, the national government and Inter-Agency Task Force (IATF) should develop a long-term solution that can immediately prevent the active cases from getting higher. As this study is a continuous work, it may support the progress of preventive and clinical interventions leading to reduced severe outcomes in COVID-19 patients with underlying conditions. This study will be a help to the medical staff and patients to identify significant factors that affect the patients' vulnerability in COVID-19.

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## Biographies

**Rianiña D. Borres** is an Assistant Professor at the School of Industrial Engineering and Engineering Management at Mapua University in Intramuros, Manila, Philippines. She has earned her B.S degree in Industrial Engineering (IE) and Masters of Engineering Program major in IE from Mapua University, Intramuros, Manila, Philippines. She is a Professional Industrial Engineer (PIE) with over 15 years of experience. She has taught courses in Probability and Statistics, Operations Research and Computer Integrated Manufacturing. She has done research projects in operations research, production, human factors and ergonomics. She is a member of Philippine Institute of Industrial Engineers (PIIE).

**Frances Mari Louise N. De Guzman** is a graduating student of B.S Industrial Engineering at Mapua University. She is a member of the Philippine Institute of Industrial Engineering (PIIE) Mapua Chapter and a Certified Lean Six Sigma Yellow Belt (CLSSYB). Her research interest includes Production, Operations Research, and Risk Management.

**Angelica Allei Dilay** graduated with a bachelor's degree in Industrial Engineering in Mapua University, Manila Philippines. As a college student, she has finished two research papers entitled Analyzation on the process of LTO that affect service quality and customer's satisfaction and Predictive Model on the Progression of COVID-19 Symptoms for Patients with Underlying Diseases. Aside from the academic experiences, she was very active with her extracurricular. Since her freshman year, she was already an officer in their organization named Philippine Institute of Industrial Engineering and was elected as the president in her senior year. She learned how to handle and communicate with the different levels of person inside and outside the organization and had exposure that helped her develop an attitude of being proactive and work under pressure with minimal supervision. It also enhanced her leadership, strategic planning and operations. She lives by her principle that once she is committed to something, she has to stay dedicated to it.