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ORIGINAL RESEARCH

Modeling the Risk Assessment of COVID-19 Pandemic in Bingham University of Nigeria

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Abstract

COVID-19 virus has spread everywhere in Africa and to the 36 states of Nigeria, including the Federal Capital Territory (FCT), Abuja. The outbreak of COVID-19 in Lagos, since February 27, 2020 has generated 158,506 confirmed cases, including 1,969 deaths, as of 8 March 2021. In most cases, community transmission is the prime factor in which the viruses are fast spreading. Fortunately, there has never been a reported incidence of COVID-19 infection on any of the Nigerian university campuses. We assess the risk of sustained transmission at the Bingham University of Nigeria whenever the Coronavirus arrives on our university campus. Risk assessment is achieved through data describing the interaction amongst human-to-human and used facilities on the campus. The data analysis involves a fitted combination of 11 statistical models including inter alia logistic model presented by equation (12). Parameter estimation shows the probability of incidence rates and percentage for coefficient of determination at each level of individual interactions. The cubic regression model of Zankli visitors, Zankli Staff and the inverse regression model of Security Staff yield the highest coefficient of determination with the percentages of 82%, 79% and 74% respectively. This emphasizes the probability that an imported case through the Zankli visitors, Zankli Staff and Security Staff may cause COVID-19 outbreak on the University campus if the Coronavirus protocols are not properly maintained. Under the assumptions that the imported case is a threshold of an index number in the University community, and that the Coronavirus spread through human-to-human and facilities interaction. However, we found that strict compliance to Coronavirus prevention guidelines, which includes regular washing of hands with soap and water, cleaning of hands with alcohol-based hand rub, maintaining of at least 1 metre distance when coughing or sneezing, practicing of physical distancing by avoiding unnecessary travel, staying away from large groups of people, refrain from smoking and other activities that weaken the lungs, staying home whenever you feel unwell and avoid frequent touching of your face are tips for non-pharmaceutical preventive measures.

Keywords

COVID-19, Coronavirus, Pandemic, Bingham University (BHU), Risk assessment, Statistics models

Introduction

Bingham University is located in Karu, 25 kilometers from the Federal Capital city of Nigeria Abuja. The University was established in 2005 by the Evangelical Church of West Africa (ECWA) as a conventional University in line with the ethics of public universities in Nigeria. Its founding father's visionaries within the

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various Executive Councils, as well academics of ECWA extraction, looked back to the golden age of mission education, with its focus purposefulness, and high quality it was the desire to meet the soaring need for not only quality, secular education, but education that recognizes and integrates the moral and spiritual values on which the Christian faith is founded, which fueled its establishment. Recognizing the importance of the technological revolution of the 19th and 20th centuries, BHU determined to build a technology-driven institution of the 21st century.

In line with the vision of the University, risk assessment of the COVID-19 pandemic in BHU sought to create awareness and identify contingency factors that are sensitive in the disease dynamics. Risk awareness is the best way to prevent and slow down both the community and local transmission of the COVID-19 pandemic. [1] opined that risk awareness is achieved through the communication of risk assessment. Effective risk communication is an important measure to control the pandemic. Most risk assessment tools focus on either tracking the affected patients or diagnosing a probable health condition through symptoms [2,3]. RIKA India introduced an innovative Risk Assessment Tool that goes beyond symptom detection and patient tracking. It includes 4 factors in the assessment of risk: Health, Behavior, Exposure, and Social policy. Each of these four factors has sub-factors that help to assess the overall risk more comprehensively and also present it to the user in a simplified way [4].

Preliminaries

We will first recall some basic notions in modeling of the COVID-19 pandemic in BHU.

Risk assessment model

Risk Assessment is one of the important steps in understanding the dynamics of an epidemic where it enhances the understanding of risk and allows information to decide on adequate preventive and mitigation measures. Very importantly, the epidemiological risk assessment includes an index case exposure, and hazard and vulnerability assessment. Risk assessment is also widely used in the context of health, safety, and the environment. It involves the evaluation of existing conditions of vulnerable individuals who are newly infected and the impending hazard, existing exposure, and carrying health capacities for prevention. Risk Models specify the factors which are needed to assess risk and the relationship among those factors, producing a sort of guidelines for risk assessors to use in their assessments. Health risk assessment tools have been developed to assess individuals' risk for particular diseases.

Coronavirus disease in 2019

COVID-19 also known as novel coronavirus or 2019-nCoV, is a severe acute respiratory syndrome infectious disease caused by SARS-CoV-2. According to [5-8], the common symptoms of an infected person are fever, cough, dyspnea, shortness of breath, and breathing difficulties. In more severe cases, the infection can cause pneumonia, kidney failure, and even death.

Pandemic

A pandemic is described as an epidemic outbreak that affects worldwide or over a very wide geographical area by crossing international boundaries and usually affecting a large number of people. COVID-19 can be described as a pandemic. This is due to the rapid increasing number of cases on the daily basis from 31 December 2019 in Wuhan of People's Republic of China to the moment of this study.

Statistical model

Statistical Models are equations in a simplified way to approximate reality. In Statistics, models are either deterministic or probabilistic. In the former case, outcomes are precisely defined, whereas, in the latter, they involve variability due to unknown random factors. Models with a probabilistic component are called statistical models [9]. A statistical model is usually specified as a mathematical relationship between one or more random variables and other non-random variables. This is a mathematical model embodies a set of statistical assumptions concerning the sample data of a system, process, or relationship in numerical form in which equations are used to simulate the behavior of the system or process under study.

Risk assessment and estimation

Risk is defined as the probability that an individual develops a specified disease over a specified interval of time, given that the individual is alive and disease-free at the start of the period. As with the incidence rate, the risk is time-dependent and depends on both the starting point and the length of the interval. In a longitudinal follow-up study as described below. The proportion of new occurrences d_j among n_j disease-free individuals still under observation at the time t_j,

$$\hat{P}(t_j) = \frac{d_j}{n_j},$$

is an estimate of the risk or probability of disease occurrence in the j^{th} time interval. Incidence rates and risks are related via the general formula, risk = rate × time. For the longitudinal follow-up study estimates defined above, the relationship is manifest by the equation

$$\hat{P}(t_j) = \lambda(t_j)L_j.$$

Incidence Rate Measure

Incidence Rate, a common measure of disease occurrence used in COVID-19 epidemiology is the incidence rate. Incidence refers to new cases of disease occurring among previously unaffected individuals. The population incidence rate is the number of new cases of the disease occurring in the population in a specified time interval divided by the sum of observation times, in that interval, on all individuals who were disease-free at the beginning of the time interval. Generally, the incidence rate is time-dependent and depends on both the starting point and the length of the interval. With data from studies in which subjects are followed over time, incidence rates can be estimated by partitioning the following period into intervals of lengths L_j having midpoints t_j for $j = 1,\ldots,J$, and estimating a rate for each interval. Let n_j denote the number of individuals who are disease-free and still under observation at time t_j and d_j the number of new diagnoses during the j^{th} interval. An estimate of the incidence rate at the time t_j is obtained by dividing d_j by the product of n_j and L_j:

$$\hat{\lambda}(t_j) = \frac{d_j}{n_j L_j}.$$

The denominator in $\hat{\lambda}(t_j)$ is an approximation to the sum of observation times on the n_j population members in the j^{th} interval and in practice is usually replaced by the actual observation time, which accounts for the fact that the d_j diagnoses of disease did not occur exactly at time t_j.

COVID-19 Pandemic in Nigeria Universities and the necessity for Risk Assessment in BHU

According to [10], all continents reported confirmed cases of COVID-19 while Africa confirmed its first case in Egypt on Feb 14, 2020. China is Africa's leading commercial partner; thus, there are large travel volumes through which severe acute respiratory syndrome coronavirus 2 could reach the continent. Several measures have already been implemented to prevent and control possible case importations from China and countries that are the epicenter for the disease. However, the ability to limit and control local transmission after importation depends on the application and execution of strict measures of detection, prevention, and control. These measures include heightened surveillance and rapid identification of suspected cases, followed by patient transfer and isolation, rapid diagnosis, tracing, and follow up of potential contacts [7,8].

Nigeria is one of the countries in Africa with over 200 million citizens and the country's major cities are on lockdown since the index case. A report from [2] ascertained that the first confirmed COVID-19 case in Nigeria was February 27, 2020, when an Italian citizen in Lagos tested positive for the virus. As of April 29, 2020, data from the Nigerian Centre for Disease Control (NCDC) website shows that Nigeria has recorded 1,278 confirmed cases and 51 deaths. The data showed that Lagos State currently has 718 active cases and recorded 21 deaths, and the new epicenter, Kano State, has 136 reported cases and 3 residents of the state have died of COVID-19 [10]. BHU is one of the private institutions located in the outskirt of Abuja metropolitan city in Karu, Nasarawa State, where 0.85% burden of the COVID-19 infected cases in Nigeria is found. University campuses in Nigeria are struggling with the decision of how to reopen school when the Federal Government would announce the resumption date in the fall, given the COVID-19 pandemic. This decision has identified epidemic models as one of the tools been applied to understand testing and campus risk mitigation policies which could enable BHU to detect outbreaks early and reduce the risk of transmission in the densely connected campus networks. Virus spread depends not only on the reported number of cases but also on the number of individuals who never tested but carry the virus.

According to [11] epidemiological models are been used to gain a realistic insight into the transmission dynamics and control of emerging and re-emerging infectious diseases of public health interest. This dates back to the pioneering works of the likes of Sir Ronald Ross, a British surgeon and a polymath, who, in addition to elucidating the full lifecycle of the malaria parasite in birds and in humans in Freetown, Sierra Leone, in the 1890s, introduced the the notion of threshold analysis in the control of infectious diseases. He showed, using a simple mathematical model involving two differential equations for the temporal dynamics of the the population of infected mosquitoes and infected humans, which we do not need to kill all mosquitoes to effectively control malaria. All that was needed was to reduce the mosquito population below a certain threshold and malaria will be effectively controlled or even eliminated from the community. This was what was done to eliminate malaria from Western Europe. He won the 1902 Nobel Prize in Physiology or Medicine. In the 1920s, distinguished Scottish scientists (biochemist, William O. Kermack and Lt. Col. Anderson G. McKendrick, military physician, and epidemiologist) formulated the much-celebrated mathematical framework for modeling infectious diseases. Their modeling assumptions were based on stratifying the total human population into mutually-exclusive compartments based on infection status. The resulting mathematical models typically take the form of deterministic systems of nonlinear differential equations, involving many state variables i.e. humans' compartments and model parameters. The resulting dynamic models are built based on incorporating all the pertinent epidemiological, ecological, immunological, and demographic features of the disease, as well as making realistic assumptions on the key aspects associated with the disease transmission process e.g. mixing patterns, distribution of waiting times in epidemiological compartments, etc. That's why the models are dynamic in nature. In other words, the transmission dynamics and control of the disease is now modeled using a collection of mathematical equations, which typically take the form of differential equations i.e. equations that measure the rate at which some epidemiological state variable of the model, such as the number of infected or hospitalized individuals, changes with time. By using rigorous mathematical analysis, coupled with data analytics to parameterize the models which can be used to first reproduce the observed trajectory of the disease i.e. the model can be validated by showing that it reasonably mimics the observed data, the initial number of cases, hospitalizations and the disease-induced death. Consequently, be used to make predictions on the likely course of the disease. We can then predict the expected number of cases, hospitalizations, ICU admissions, and mortality in the near or distant future. Thus, either mathematical or statistical modeling is inherently multidisciplinary. It entails the coming together of various disciplines, notably mathematics, statistical data analytics, epidemiology, ecology, immunology, public health, computation, and even the social sciences, including disciplines such as communications and behavioral analysis needed to determine effective ways to communicate the disease control strategies obtained from modeling to the general public.

Risk assessment has become an essential tool during times of serious health challenge as reported in [12,13]. The outbreak and evolution of the COVID-19 pandemic have been analyzed from different perspectives. For example, [14] fitted country-wise quadratic regressions to estimate the peak periods. [15,16] analyzed the impact of the pandemic on China's economy and risk management of COVID-19 by universities in China. [17] proposed solutions and recommendations related to early warning, identification, and monitoring of risks. [18] surmised the Chinese experience and its implications for other countries. [19] presented a chart for sustainable travel, tourism, and hospitality industry for the time after COVID-19. [20] critically evaluate the Global Health Security Index (2019), which provides data before the discovery of COVID-19 and makes it possible to evaluate how countries might have been prepared for a pandemic and acted accordingly. Further research analyzing the containment strategies of individual countries and global risk analysis of the COVID-19 situation includes [21-24].

While COVID-19 pandemic as an emergency public health challenge in the 21st Century, this has brought into limelight a need for interdisciplinary research. It has brought into the picture the need for a trans-disciplinary view of the current crisis through various angles of global governance, technology, and risk assessment [12]. While world health organizations and governments advised many preventive measures like social distancing and personal hygiene, one of the foremost strategies on the campuses of learning remains risk assessment and communication to break the chain of spread [25]. Risk assessment and understanding of a disease dynamic at the community level goes a long way to enhancing prevention.

Objectives of the study

Amidst the risk management team in BHU, Karu and response to the COVID-19 pandemic, this paper has six specific objectives as follows:

i. Heightened surveillance and rapid identification of suspected cases.

ii. Evaluation of the University health capacity in preparedness.

iii. Screening, testing and isolation, rapid diagnosis, tracing, and follow-up of potential contacts.

iv. Contextualized and simulates the vulnerability of BHU based on the available data of the University.

v. Assess the probability of epidemic outbreak in BHU

vi. Observation of government guidelines advised and world health organization emergency framework.

Aim

The main aim of this paper is to assess the risk of the COVID-19 pandemic at BHU as investigated.

Materials and Methods

The theory of risk assessment, modeling, estimation and the computational software for deriving statistically sound parameter estimates from data, provide a powerful set of tools for calculating risk estimates. Risk models provide the general form of the dependence of risk on the available incidences as shown in Table 1. Specific risk estimates are obtained by fitting the models to data. The role of data in the process of risk estimation cannot be overemphasized. Theory, models, or model fitting software can overcome limitations in the data from which risk estimates are derived. In human epidemiologic studies of infectious diseases, both the quality and the quantity of the data available for risk modeling are limiting factors in the estimation of COVID-19 risk. The quality of data, or lack thereof, and its impact on risk modeling are discussed below. There are several approaches for the numerical calculations of likelihood analysis. Estimation based on grouped data using a Poisson form of the likelihood as reviewed in [26] has been used for the analyses of atomic bomb survivors and other major epidemiologic studies of radiation health risks. This analysis is facilitated by forming a table so that individuals contributing information to each cell of the table have equal, or approximately equal, background rates. In particular, the table is formed by the cross classification of individuals into categories of exposure, period, importation, available incidence rates, and all other variables that appear in the model.

Table 1: Interaction between BHU facilities and community.

	Students	Parents	Academic Staff	Non-Academic Staff	Health Workers	Zankli Staff	Zankli Visitors	General Visitors	Health Centre	Visitors to Health Centre	Foods Vendor Staff	Provision Staff	Chapel	Class Rooms	Staff Offices	Labs	Sport Complex	Halls	Hostel Rooms	University Buses	Private Vehicles	Okada Riders	Security Staff
Students	2500	1200	1800	1400	800	400	200	500	300	220	3000	2000	2790	3500	2100	450	80	1100	4400	30	1700	15	150
Parents	1200	600	2750	1560	230	25	50	900	200	315	135	116	20	5	210	30	4	1	6	2	100	5	1000
Academic Staff	1800	2750	700	500	400	100	40	340	150	95	800	35	450	900	800	10	16	4	2	6	650	211	65
Non Academic Staff	1400	1560	500	750	320	100	65	1340	490	272	1470	230	850	60	258	5	35	10	20	118	114	111	75
Health Workers	800	230	400	320	217	110	88	77	135	245	190	105	140	15	20	76	25	2	5	4	100	6	23
Zankli Staff	400	25	100	100	110	120	100	95	125	140	130	22	70	2	30	26	5	1	2	5	25	8	16
Zankli Visitors	200	50	40	65	88	100	97	85	45	55	19	12	10	1	6	1	2	1	2	5	10	16	20
General Visitors	500	900	340	1340	77	95	85	2000	670	750	800	400	200	4	1100	2	5	3	4	9	215	36	236
Health Centre	300	200	150	490	135	125	45	670	150	290	100	50	145	14	24	5	6	3	2	7	55	15	38
Visitors to Health Centre	220	315	95	272	245	140	55	750	290	450	250	100	50	5	95	3	4	2	1	4	215	10	76
Food Vendor Staff	3000	135	800	1470	190	130	19	800	100	250	500	200	300	10	85	2	11	3	4	6	21	22	40
Provision Staff	200	116	35	230	105	22	12	400	50	100	200	75	60	3	8	1	5	2	1	7	14	16	20
Chapel	2790	20	450	850	140	70	10	200	145	50	300	60	50	10	6	1	5	2	4	5	8	3	5
Class Rooms	3500	5	900	60	15	2	1	4	14	5	10	3	10	185	890	13	5	2	3	5	10	8	35
Staff Offices	2100	210	800	258	20	30	6	1100	24	95	85	8	6	890	400	30	10	2	1	5	45	20	50
Laboratories	450	30	10	5	76	26	1	2	5	3	2	1	1	13	30	8	1	1	1	3	6	3	10
Sport Complex	80	4	16	35	25	5	2	5	6	4	11	5	5	5	10	1	75	25	60	2	7	5	3
Halls	1100	1	4	10	2	1	1	3	3	2	3	2	2	2	2	1	25	4	10	1	4	2	5
Hostel Rooms	4400	6	2	20	5	2	2	4	2	1	4	1	4	3	1	1	60	10	3000	5	55	25	40
University Buses	30	2	6	118	4	5	5	9	7	4	6	7	5	5	5	3	2	1	5	7	5	3	6
Private Vehicles	1700	100	650	114	100	25	10	215	55	215	21	14	8	10	45	6	7	4	55	5	390	10	17
Okada Riders	15	5	211	111	6	8	16	36	15	10	22	16	3	8	20	3	5	2	25	3	10	148	70
Security Staff	150	1000	65	75	23	16	20	236	38	76	40	20	5	35	50	10	3	5	40	6	17	70	85

Source: BHU.

Data generating mechanisms and models

In statistical modeling, we are interested in discovering what we can learn about systematic patterns from empirical data containing a random component. We suppose that some complex data generating mechanism has produced the observations and wish to describe it by some simpler, but the still realistic, model that highlights the specific aspects of interest. Thus, by definition, models are estimated prototypes to mimic a real-life situation.

Often, in a model, researchers distinguish between systematic and random variability, where the former describes the patterns of the phenomenon in which we are particularly interested. Thus, the distinction between the two depends on the particular questions being asked. Random variability can be described by a probability distribution, perhaps multivariate, whereas the systematic part generally involves a regression model, most often, but not necessarily [27], a function of the mean parameter. The analysis and interpretation of past data provide the basis for more accurate decisions and predictions. However, in this study, we explore the data available in BHU, Karu, and hypothetical observations on the two campuses of the same institution. Consequently, the full likelihood or probability of causation outbreak of COVID-19 in BHU is the product of available incidence rates. In general, infection rates vary considerably as functions of importation, and there is strong evidence indicating that community transmission risks associated with lack of social-distancing, facemask, and regular washing of hands after exposure. This study is a useful analysis that includes the extrapolation of risks effects on data available in Table 1 and Table 2. On the other hand, our tabulation of data involves a method of summarizing data in columns and rows to make it more comprehensive and meaningful. The primary data was collected using the interaction between the university facilities and community. The data was collected hourly then converted into daily as shown in Table 1 and was collected between February to December 2020. The data collected was subjected to regression models of equations 1-11 and the results obtained are shown in equations 13-35.

Table 2: Model description.

Model Name		MOD-1
Dependent Variable	1	Students
	2	Parents
	3	Academic Staff
	4	Non Academic Staff
	5	Health Worker
	6	Zankli Staff
	7	Zankli Visitors
	8	General Visitors
	9	Health Center
	10	Visitor to Health Center
	11	Staff Food Vendor
	12	Provision Staff
	13	Chapel
	14	Classroom
	15	Staff Office
	16	Lab
	17	Sport Complex
	18	Halls
	19	Hostel Room
	20	University Buses
	21	Private Vehicles
	22	Okada Riders
	23	Security Staff

Statistical Model Formulation

We begin our model formulation by introducing the followings, which are the general forms of regression models:

Linear Regression Model is

$$Y_1 = b_0 + b_1 x \quad (1)$$

Logarithmic Regression Model

$$Y_2 = b_0 + b_1 \ln x \quad (2)$$

Inverse Regression Model

$$Y_3 = b_0 + \frac{b_1}{x} \quad (3)$$

Quadratic Regression Model

$$Y_4 = b_2 x^2 + b_1 x + b_0 \quad (4)$$

Cubic Regression Model

$$Y_5 = b_3 x^3 + b_2 x^2 + b_1 x \quad (5)$$

Power Regression Model

$$Y_6 = x^{b_1} + b_0 \quad (6)$$

Compound Regression Model

$$Y_7 = b_0 (b_1^{x}) \quad (7)$$

S-curve

$$Y_8 = e^{\left(b_0 + \frac{b_1}{x}\right)} \quad (8)$$

Exponential Regression Model

$$Y_9 = b_0 (e^{b_1 x}) \quad (9)$$

Growth Regression Model

$$Y_{10} = e^{(b_0 + b_1 x)} \quad (10)$$

Logistic Regression Model

$$Y_{11} = \frac{1}{\left(\frac{1}{u} + (b_0 (b_1^{x}))\right)} \quad (11)$$

From equations (1-11), b_1, b_2 and b_3 are coefficients of x_1, x_2 and x_3 respectively and b_0 is a constant. Where y is dependent variable and the X's are the independent variables.

Now, we present our model as given in equation (12) below:

$$T = Y_1 + Y_2 + . . . + Y_n \quad (12)$$

Where, n = 11 and $Y_1, Y_2, . . . ,Y_n$ are given as defined in equation (1-11) respectively. Equation (12) is the summation of equation (1-11) and is being considered as a logistic model to predict the worst case scenario whenever there is an imported case of COVID-19 on the campus. The model requires all non-missing values to be positive. We, first, present the table for the model description as shown below.

Comparative Analysis of Regression Models

Subjecting the data in Table 1 into equations (1) to (11) and using each of the variables as a dependent variable against the remaining ones, the following regression models that fitted the data best, their summary tables and graphs are as shown in equations (13-35), Table 3, Table 4, Table 5, Table 6, Table 7, Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14, Table 15, Table 16, Table 17, Table 18, Table 19, Table 20, Table 21, Table 22, Table 23, Table 24, Table 25, Table 26, Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, Figure 18, Figure 19, Figure 20, Figure 21, Figure 22 and Figure 23.

Table 3: Summary result for cubic regression model on students.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.419	0.176	0.038	1239.081		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	5885061.409	3	1961687.136	1.278	0.312
Residual	27635771.546	18	1535320.641		
Total	33520832.955	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Serial No	-598.448	466.092	-3.076	-1.284	0.215
Serial No ** 2	73.613	46.542	8.961	1.582	0.131
Serial No ** 3	-2.322	1.332	-6.073	-1.743	0.098
(Constant)	2135.878	1265.893		1.687	0.109

Table 4: Summary result for quadratic regression model on parents.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.671	0.450	0.392	520.029		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	4206102.800	2	2103051.400	7.777	0.003
Residual	5138176.291	19	270430.331		
Total	9344279.091	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
SerialNo	-252.253	73.171	-2.456	-3.447	0.003
SerialNo ** 2	8.929	3.089	2.059	2.890	0.009
(Constant)	1736.338	365.321		4.753	0.000

Table 5: Summary result for inverse regression model on academic staff.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.820	0.673	0.656	354.694		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	5168975.940	1	5168975.940	41.086	0.000
Residual	2516151.333	20	125807.567		
Total	7685127.273	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 / Serial No	2295.086	358.055	0.820	6.410	0.000
(Constant)	25.148	96.575		.260	0.797

Table 6: Summary result for power regression model on non-academic staff.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.575	0.331	0.298	1.357		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	18.224	1	18.224	9.903	0.005
Residual	36.805	20	1.840		
Total	55.029	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
In (Serial No)	-1.133	0.360	-0.575	-3.147	0.005
(Constant)	1792.066	1513.158		1.184	0.250
The dependent variable is In (Non-Academic Staff)					

Table 7: Summary result for quadratic regression model on health worker.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.812	0.659	0.623	68.222		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	170702.245	2	85351.123	18.338	0.000
Residual	88430.346	19	4654.229		
Total	259132.591	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-29.357	9.599	-1.716	-3.058	0.006
Serial No ** 2	0.698	0.405	0.966	1.721	0.101
(Constant)	332.403	47.926		6.936	0.000

Table 8: Summary result for cubic regression model on Zankli staff.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.891	0.794	0.760	24.935		
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	43226.583	3	14408.861	23.174	0.000
Residual	11192.008	18	621.778		
Total	54418.591	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	42.020	9.380	5.360	4.480	0.000
Serial No ** 2	-4.680	0.937	-14.141	-4.997	0.000
Serial No ** 3	0.128	0.027	8.319	4.780	0.000
(Constant)	8.459	25.475		0.332	0.744

Table 9: Summary result for cubic regression model on Zankli visitors.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.907	0.823	0.793	15.680		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	20537.903	3	6845.968	27.846	0.000
Residual	4425.370	18	245.854		
Total	24963.273	21			
The independent variable is Serial No.					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	20.479	5.898	3.857	3.472	0.003
Serial No ** 2	-2.802	0.589	-12.500	-4.758	0.000
Serial No ** 3	0.085	0.017	8.185	5.065	0.000
(Constant)	32.623	16.019		2.036	0.057

Table 10: Summary result for compound regression model on general visitors.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.520	0.271	0.234	1.982		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	29.152	1	29.152	7.419	.013
Residual	78.591	20	3.930		
Total	107.743	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
SerialNo	.834	.056	0.594	15.011	0.000
(Constant)	818.782	716.372		1.143	0.267
The dependent variable is ln (General Visitors)					

Table 11: Summary result for compound regression model on health center.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.720	0.519	0.495	1.184		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Regression	30.241	1	30.241	21.581	0.000
Residual	28.026	20	1.401		
Total	58.267	21			
The independent variable is Serial No.					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	0.831	0.033	0.487	25.138	0.000
(Constant)	381.819	199.491		1.914	0.070
The dependent variable is ln (Health center)					

Table 12: Summary result for compound regression model on visitor to health center.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.615	0.378	0.347	1.631		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	32.323	1	32.323	12.153	0.002
Residual	53.195	20	2.660		
Total	85.519	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	0.826	0.045	0.541	18.246	0.000
(Constant)	439.207	316.149		1.389	0.180
The dependent variable is ln (visitor to Health center)					

Table 13: Summary result for compound regression model on staff food vendor.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
.688	0.473	0.446	1.453		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	37.845	1	37.845	17.934	0.000
Residual	42.204	20	2.110		
Total	80.049	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	0.813	0.040	0.503	20.485	0.000
(Constant)	641.704	411.432		1.560	0.135
The dependent variable is ln (staff food vendor)					

Table 14: Summary result for regression models on provision staff.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.615	0.378	0.347	1.408		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	24.098	1	24.098	12.160	0.002
Residual	39.635	20	1.982		
Total	63.734	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	0.848	0.040	0.541	21.138	0.000
(Constant)	146.846	91.241		1.609	0.123
The dependent variable is ln (provision staff)					
Serial No	-0.165	0.047	-0.615	-3.487	0.002
(Constant)	146.846	91.241		1.609	0.123
The dependent variable is ln (provision staff)					
Serial No	1.179	0.056	1.849	21.138	0.000
(Constant)	0.007	0.004		1.609	0.123
The dependent variable is ln (1/provision staff)					

Table 15: Summary Result of Exponential Regression Models on Chapel

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.759	0.576	0.555	1.282		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	44.621	1	44.621	27.164	0.000
Residual	32.853	20	1.643		
Total	77.474	21			
The independent variable is Serial No.					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-0.224	0.043	-0.759	-5.212	0.000
(Constant)	310.126	175.434		1.768	0.092
The dependent variable is ln (Chapel)					

Cubic regression model of students

$$Y = -598.448x^3 + 73.613x^2 - 2.322x + 2135.878 \quad (13)$$

With the p-value of 1.284, 1.582, 1.743 and 1.687 respectively and with a coefficient of determination (R^2): 0.176

Quadratic regression model of parents

$$Y = -252.253x^2 + 8.929x + 1736.338 \quad (14)$$

With the p-value of 3.447, 2.890, and 4.753 respectively and with a coefficient of determination (R^2): 0.45

Inverse regression model of academic staff

$$Y = 25.148 + \frac{2295.086}{x} \quad (15)$$

With the p-value of 6.410 and 0.260 respectively and with a coefficient of determination (R^2): 0.673.

Table 16: Summary result for logistic regression model on Chapel.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.759	0.576	0.555	1.282		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	44.621	1	44.621	27.164	0.000
Residual	32.853	20	1.643		
Total	77.474	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	1.252	0.054	2.136	23.218	0.000
(Constant)	0.003	0.002		1.768	0.092
The dependent variable is ln (1/Chapel)					

Table 17: Summary result for cubic regression models on classroom.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.329	0.109	-0.040	265.678		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	154711.944	3	51570.648	0.731	0.547
Residual	1270524.829	18	70584.713		
Total	1425236.773	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-130.438	99.937	-3.251	-1.305	0.208
Serial No ** 2	12.544	9.979	7.405	1.257	0.225
Serial No ** 3	-0.352	0.286	-4.464	-1.232	0.234
(Constant)	459.366	271.427		1.692	0.108

Table 18: Summary result for power regression models on staff office model summary.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.449	0.201	0.161	1.815		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	16.599	1	16.599	5.041	0.036
Residual	65.863	20	3.293		
Total	82.462	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
ln(SerialNo)	-1.081	0.482	-0.449	-2.245	0.036
(Constant)	417.250	471.296		0.885	0.387
The dependent variable is ln (staff office).					

Table 19: Summary result for cubic regression models on laboratories.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.437	0.191	0.056	16.744		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	1190.891	3	396.964	1.416	0.271
Residual	5046.381	18	280.355		
Total	6237.273	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-3.941	6.298	-1.485	-0.626	0.539
Serial No ** 2	0.164	0.629	1.465	0.261	0.797
Serial No ** 3	-0.002	0.018	-0.343	-0.099	0.922
(Constant)	33.014	17.106		1.930	0.070

Table 20: Summary result for cubic regression models on the sport complex.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.390	0.152	0.011	19.317		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	1206.392	3	402.131	1.078	0.384
Residual	6716.699	18	373.150		
Total	7923.091	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-11.339	7.266	-3.791	-1.560	0.136
Serial No ** 2	1.242	0.726	9.837	1.712	0.104
Serial No ** 3	-0.036	0.021	-6.145	-1.739	0.099
(Constant)	35.542	19.735		1.801	0.088

Table 21: Summary result for compound regression models on hostel room model summary.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.462	0.214	0.174	1.714		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	15.971	1	15.971	5.437	0.030
Residual	58.746	20	2.937		
Total	74.717	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	1.144	0.066	1.588	17.363	0.000
(Constant)	1.398	1.058		1.322	0.201
The dependent variable is ln (hostel room)					

Table 22: Summary result for quadratic regression models on university buses model summary.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.351	0.123	0.031	23.819		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	1514.008	2	757.004	1.334	0.287
Residual	10779.992	19	567.368		
Total	12294.000	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-3.862	3.352	-1.037	-1.152	0.263
Serial No ** 2	0.119	0.142	0.758	0.842	0.410
(Constant)	33.851	16.733		2.023	0.057

Table 23: Summary result for cubic regression model on university buses.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.353	0.125	-0.021	24.450		
The independent variable is Serial No.					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	1533.788	3	511.263	0.855	0.482
Residual	10760.212	18	597.790		
Total	12294.000	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-2.311	9.197	-0.620	-0.251	0.804
Serial No ** 2	-0.046	0.918	-0.291	-0.050	0.961
Serial No ** 3	0.005	0.026	0.653	0.182	0.858
(Constant)	30.552	24.979		1.223	0.237

Table 24: Summary result for power regression models on private vehicles model summary.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.530	0.281	0.245	1.309		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	13.384	1	13.384	7.806	0.011
Residual	34.290	20	1.714		
Total	47.674	21			
The independent variable is Serial No.					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Ln (Serial No)	-0.971	0.348	-0.530	-2.794	0.011
(Constant)	273.820	223.165		1.227	0.234
The dependent variable is ln (private vehicles)					

Table 25: Summary result for cubic regression models on Okada riders model summary.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.572	0.327	0.214	48.106		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	20204.549	3	6734.850	2.910	0.063
Residual	41655.314	18	2314.184		
Total	61859.864	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Serial No	-10.059	18.096	-1.204	-0.556	0.585
Serial No ** 2	-0.210	1.807	-0.596	-0.116	0.909
Serial No ** 3	0.029	0.052	1.795	0.570	0.576
(Constant)	100.409	49.147		2.043	0.056

Table 26: Summary result for inverse regression models on security staff model summary.

Model Summary					
R	R Square	Adjusted R Square	Std. Error of the Estimate		
0.857	0.735	0.722	110.602		
The independent variable is Serial No					
ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Regression	679036.759	1	679036.759	55.509	0.000
Residual	244656.196	20	12232.810		
Total	923692.955	21			
The independent variable is Serial No					
Coefficients					
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 / Serial No	831.847	111.650	0.857	7.450	0.000
(Constant)	-51.600	30.115		-1.713	0.102

Power regression model of non-academic staff

$$y = x^{-1.133} + 1792.066 \quad (16)$$

With the p-value of 3.147 and 1.184 respectively and with a coefficient of determination (R^2): 0.331.

Quadratic regression model of health worker

$$Y = -29.357x^2 + 0.698x + 332.403 \quad (17)$$

With a p-value of 3.058, 1.721, and 6.936 respectively, and with a coefficient of determination (R^2): 0.659.

Cubic regression model of Zankli staff

$$Y = 42.020x^3 - 4.680x^2 + 0.128x + 8.459 \quad (18)$$

With the p-value of 4.480, 4.997, 4.780, and 0.332 respectively and with a coefficient of determination (R^2): 0.794

Cubic regression model of Zankli visitors

$$Y = 20.479x^3 - 2.802x^2 + 0.085x + 32.623 \quad (19)$$

With the p-value of 3.472, 4.758, 5.065, and 2.036 respectively and with a coefficient of determination (R^2): 0.823

Compound regression model of general visitors

$$Y = 818.782\ (0.834^x) \quad (20)$$

With the p-value of 15.011 and 1.143 respectively and with a coefficient of determination (R^2): 0.271

Compound regression model of health center

$$Y = 381.819\ (0.831^x) \quad (21)$$

With the p-value of 25.138 and 1.914 respectively and with a coefficient of determination (R^2): 0.519

Compound regression model of visitor to health center

$$Y = 439.207\ (0.826^x) \quad (22)$$

With the p-value of 18.246 and 1.389 respectively and with a coefficient of determination (R^2): 0.378

Compound regression model of staff food vendor

$$Y = 641.704\ (0.831^{x}) \tag{23}$$

With the p-value of 20.485 and 1.560 respectively and with a coefficient of determination (R^2): 0.473

Compound regression model of provision staff

$$Y = 146.846\ (0.848^{x}) \tag{24}$$

With the p-value of 21.138 and 1.609 respectively and with a coefficient of determination (R^2): 0.378

Exponential regression model of Chapel

$$Y = 310.126\ (e^{-0.224x}) \tag{25}$$

With the p-value of 5.212 and 1.768 respectively and with a coefficient of determination (R^2): 0.576

Cubic regression model of classroom

$$Y = -130.438x^3 + 12.544x^2 - 0.352x + 459.366 \tag{26}$$

With the p-value of 1.305, 1.257, 1.232, and 1.692 respectively and with a coefficient of determination (R^2): 0.329

Power regression model of staff office

$$y = x^{-1.081} + 417.250 \tag{27}$$

With the p-value of 2.245 and 0.885 respectively and with a coefficient of determination (R^2): 0.201

Cubic regression model of laboratories

$$Y = -3.941x^3 + 0.164x^2 - 0.002x + 33.014 \tag{28}$$

With the p-value of 0.626, 0.261, 0.099, and 1.930 respectively and with a coefficient of determination (R^2): 0.191

Cubic regression model of sport complex

$$Y = -11.339x^3 + 1.242x^2 - 0.036x + 35.542 \tag{29}$$

With the p-value of 1.560, 1.712, 1.739, and 1.801 respectively and with a coefficient of determination (R^2): 0.152

Cubic regression model of halls

$$Y = -2.014x^3 + 0.\ .228x^2 - 0.007x + 7.043 \tag{30}$$

With the p-value of 0.984, 1.116, 1.125, and 1.267 respectively and with a coefficient of determination (R^2): 0.096

Compound regression model of hostel room

$$Y = 1.398\ (1.144^{x}) \tag{31}$$

With the p-value of 25.138 and 1.914 respectively and with a coefficient of determination (R^2): 0.214

Quadratic regression model of university buses

$$Y = -3.862x^2 - 0.119x + 33.851 \tag{32}$$

With the p-value of 1.152, 0.842, 1.739, and 2.023 respectively and with a coefficient of determination (R^2): 0.123

Power regression model of private vehicles

$$y = x^{-0.971} + 273.820 \tag{33}$$

With the p-value of 2,794 and 1.227 respectively and with a coefficient of determination (R^2): 0.281

Cubic regression model of Okada riders

$$Y = -10.059x^3 - 0.210x^2 + 0.029x + 100.409 \tag{34}$$

With the p-value of 0.556, 0.116, 0.570, and 2.043 respectively and with a coefficient of determination (R^2): 0.327

Inverse regression model of security staff

$$Y = -51.6 + \frac{831.847}{x} \tag{35}$$

With the p-value of 7.450 and 1.713 respectively and with a coefficient of determination (R^2): 0.735

Discussion

The Students, Parents, Academic Staff, Non-Academic Staff, Health Workers, Zanki Staff, Zanki Visitors, General Visitors, Health Centre, Visitors to Health Centre, Food Vendors, Provision Staff, Chapel, Classrooms, Staff Offices, Laboratories, Sport Complex, Hall, Hostel Rooms, University Buses, Private Vehicles, Okada Riders and Security Staff and their interactions were used as variables to predict the spread of Covid-19 in BHU. From the foregoing, the analysis and results obtained, linear regression did not past all the six assumptions required (i) there need to be a linear relationship between the two variables; (ii) there should be no significant outliers; (iii) data needs to be homoscedasticity except: (i) two variable should be measured the continuous level; (ii) independency of observations; (iii) the residuals of the regression line are approximately normally distributed as all the six assumptions required are depicted in Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, Figure 18, Figure 19, Figure 20, Figure 21, Figure 22 and Figure 23. The regression models are usually used to: test hypothesis, select variables for prediction models or generate prediction models. Regression models are particularly suited to assess the correlation among variables and to establish the dependence of one variable upon others, the regression models can be used effectively by clinician to make a diagnosis or assess prognosis. Calculation of the value of predictor variables singly or in combination might be of greater interest to the medical investigation more concerned with the assessment of the pathophysiology of disease or to the therapist attempting to improve survival by modulating risk factors. This research briefly examines the interpretation and use of regression models, particularly with regard to estimating and evaluating the dependence relationships. The selections of variables

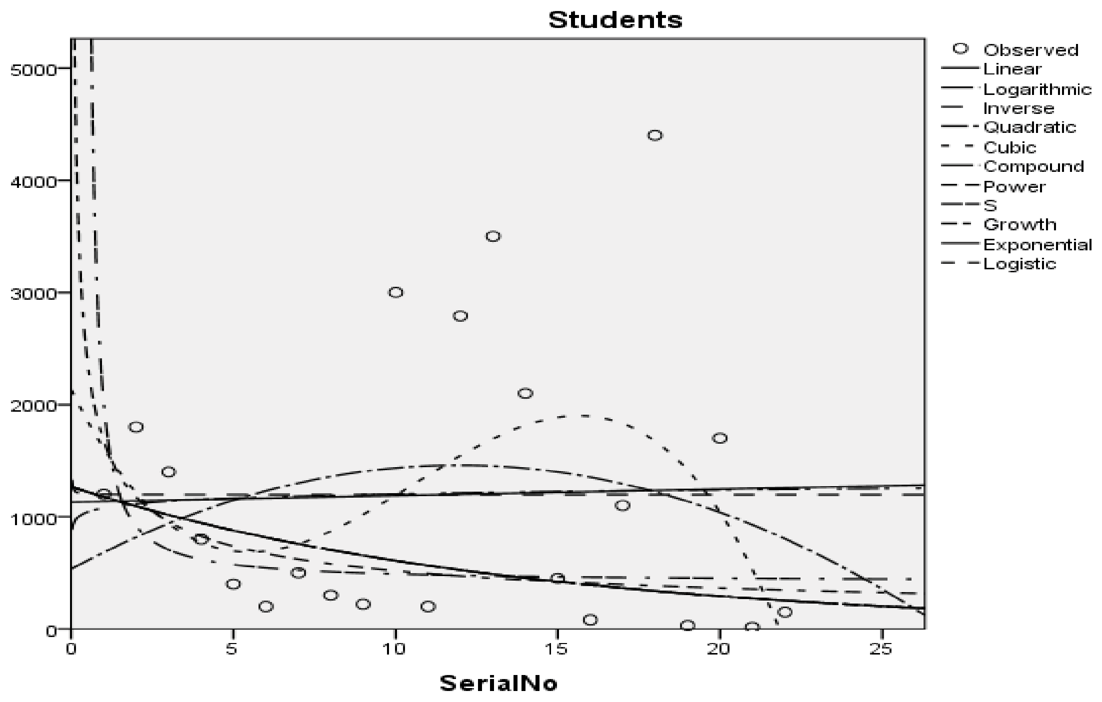

Figure 1: Graphical representation of regression models of students.

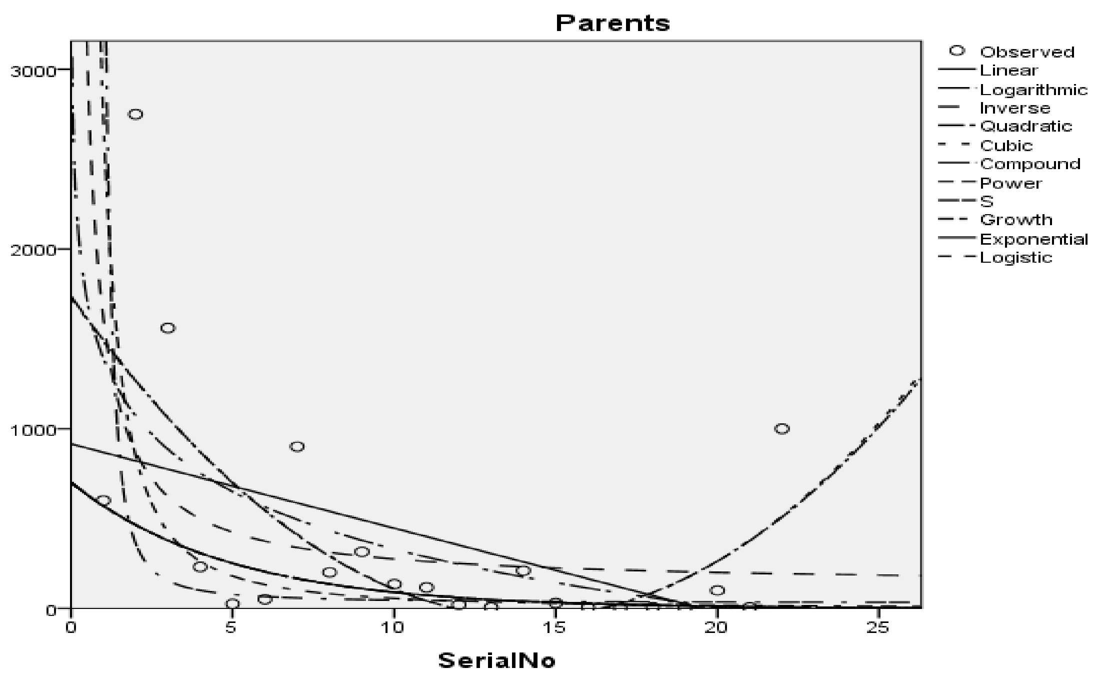

Figure 2: Graphical representation of regression models of parents.

for prediction models are dealt with only as it pertains to the use of regression models. The use of regression for hypothesis testing is ignored. While each variable with its interactions to other variables is predicted with the following models: Cubic regression model of students with the p-value of 1.284, 1.582, 1.743 and 1.687 respectively and with a coefficient of determination (R^2): 0.176.Quadratic regression model of parents with the p-value of 3.447, 2.890, and 4.753 respectively and with a coefficient of determination (R^2): 0.450.Inverse regression model of academic staff with the p-value of 6.410 and 0.260 respectively and with a coefficient of determination (R^2): 0.673.Power regression model of non-academic staff with the p-value of 3.147 and 1.184 respectively and with a coefficient of determination (R^2): 0.331. Quadratic regression model of health workers with a p-value of 3.058, 1.721, and 6.936 respectively, and with a coefficient of determination (R^2): 0.659. Cubic regression model of Zankli staff with the p-value of 4.480, 4.997, 4.780, and 0.332 respectively and

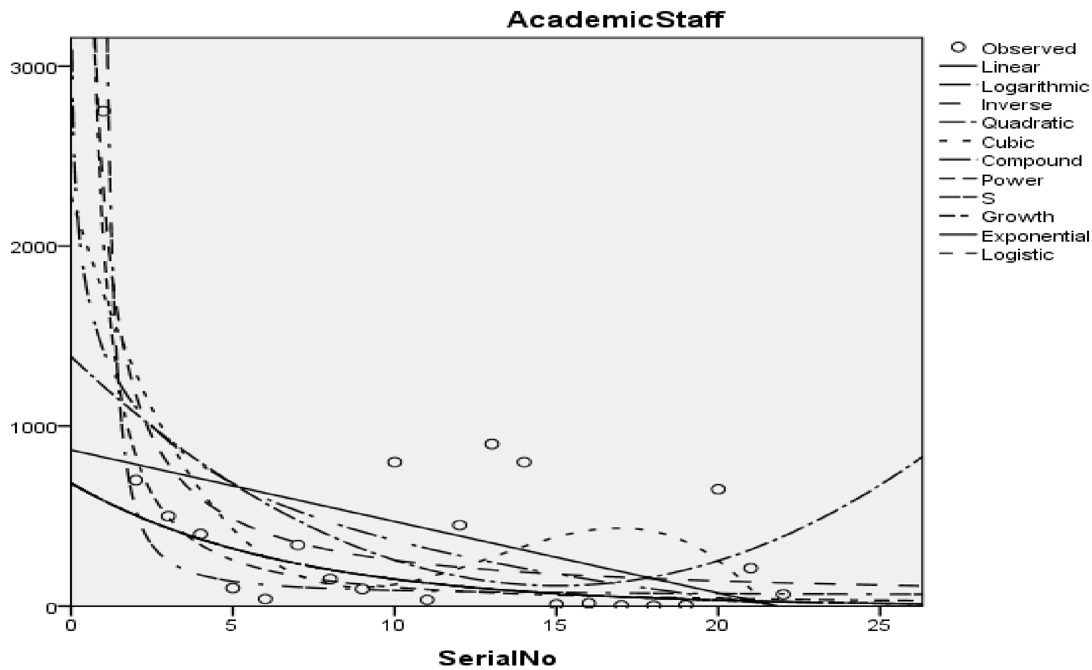

Figure 3: Graphical representation of regression models of academic staff.

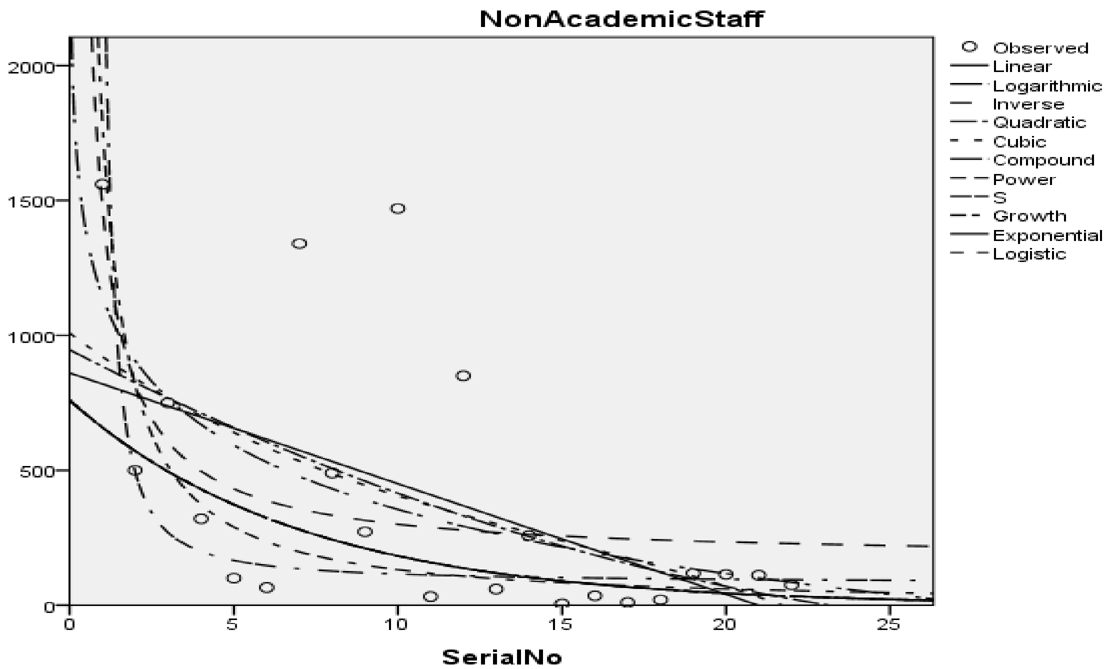

Figure 4: Graphical representation of regression models of non-academic staff.

with a coefficient of determination (R^2): 0.794. Cubic regression model of Zankli visitors with the p-value of 3.472, 4.758, 5.065, and 2.036 respectively and with a coefficient of determination (R^2): 0.823. Compound regression model of general visitors with the p-value of 15.011 and 1.143 respectively and with a coefficient of determination (R^2): 0.271. Compound regression model of health center with the p-value of 25.138 and 1.914 respectively and with a coefficient of determination (R^2): 0.519. Compound regression model of visitor to health center with the p-value of 18.246 and 1.389 respectively and with a coefficient of determination (R^2): 0.378. Compound regression model of staff food vendor with the p-value of 20.485 and 1.560 respectively and with a coefficient of determination (R^2): 0.473. Compound regression model of provision staff with the p-value of 21.138 and 1.609 respectively and with a coefficient of determination (R^2): 0.378. Exponential regression model of chapel with the p-value of 5.212 and 1.768 respectively and with a coefficient of determination (R^2): 0.576. Cubic regression model of classroom with the p-value of 1.305, 1.257, 1.232, and 1.692 respectively

Figure 5: Graphical representation of regression models of health worker.

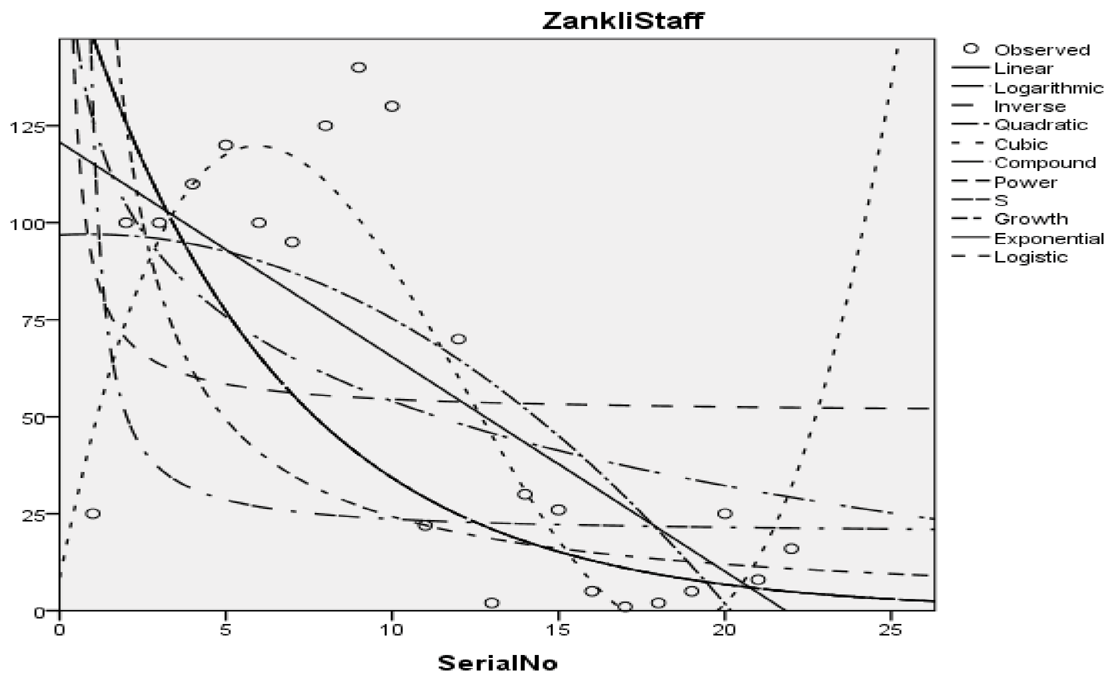

Figure 6: Graphical representation of regression models of Zankli staff.

and with a coefficient of determination (R^2): 0.329. Power regression model of staff office with the p-value of 2.245 and 0.885 respectively and with a coefficient of determination (R^2): 0.201. Cubic regression model of laboratories with the p-value of 0.626, 0.261, 0.099, and 1.930 respectively and with a coefficient of determination (R^2): 0.191. Cubic regression model of sport complex with the p-value of 1.560, 1.712, 1.739, and 1.801 respectively and with a coefficient of determination (R^2): 0.152. Cubic regression model of halls with the p-value of 0.984, 1.116, 1.125, and 1.267 respectively and with a coefficient of determination (R^2): 0.096. Compound regression model of hostel room with the p-value of 25.138 and 1.914 respectively and with a coefficient of determination (R^2): 0.214. Quadratic regression model of university buses with the p-value of 1.152, 0.842, 1.739, and 2.023 respectively and with a coefficient of determination (R^2): 0.123. Power regression model of private vehicles with the p-value of 2,794 and 1.227 respectively and with a coefficient of determination (R^2): 0.281. Cubic regression model of Okada riders with the p-value of 0.556, 0.116, 0.570, and 2.043 respectively and with a coefficient of determination: 32.7. Inverse regression model of security staff with the p-value of

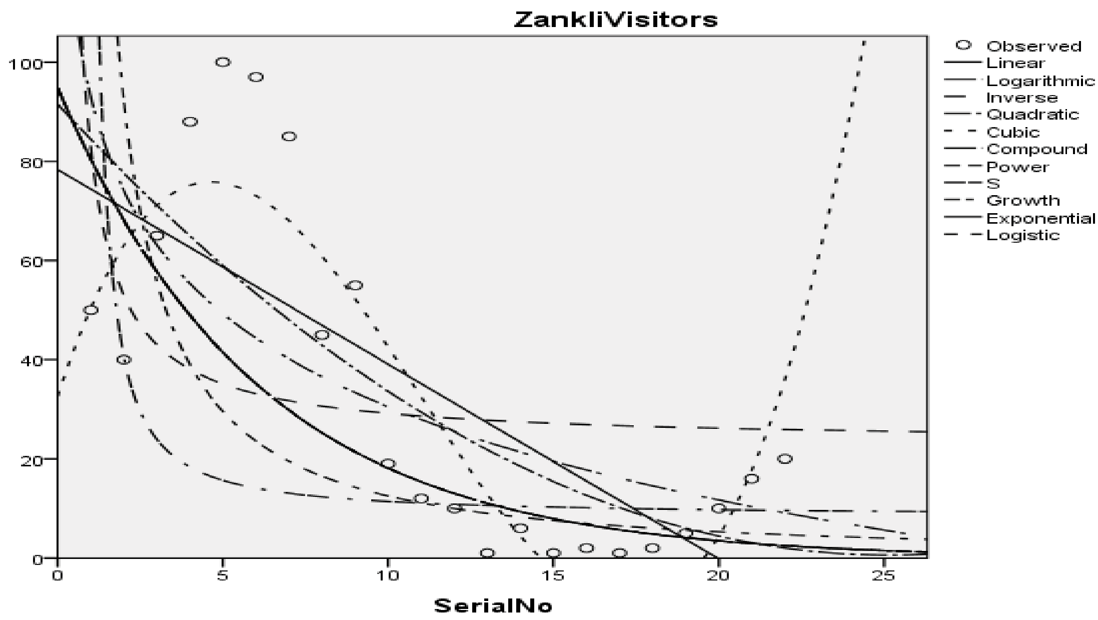

Figure 7: Graphical representation of regression models of Zankli visitors.

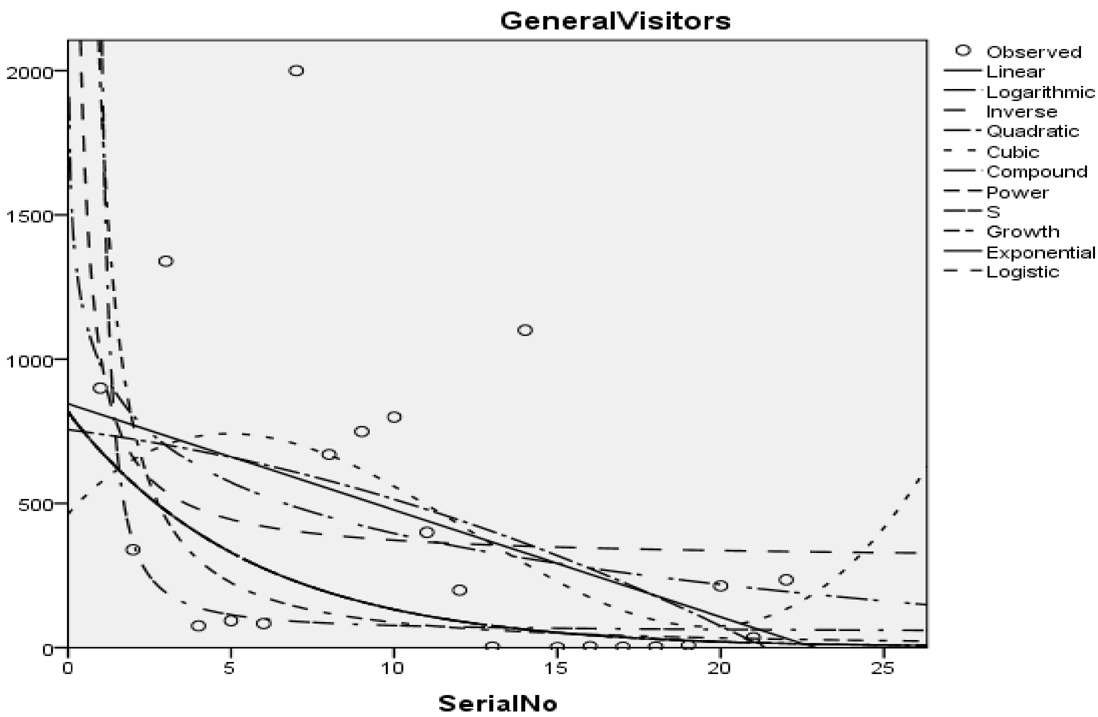

Figure 8: Graphical representation of regression models of general visitors.

7.450 and 1.713 respectively and with a coefficient of determination (R^2): 0.735. From the foregoing, while the pandemic is still witnessing exponential increase and fall on the daily basis, this study describes the entire trajectory of COVID-19 pandemic in the BHU as a risk assessment paradigm. Clearly, Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, Figure 18, Figure 19, Figure 20, Figure 21, Figure 22 and Figure 23 present simulation of individual interactions on the campus to checkmate probability of an infected case while equation (12) predicts summation of infected numbers on campus.

Conclusion

This work has reported risk assessment of COVID-19 pandemic at Bingham University Community. The statistical models used for the study involved linear regression model, logarithmic regression model, inverse regression model, quadratic regression model, cubic

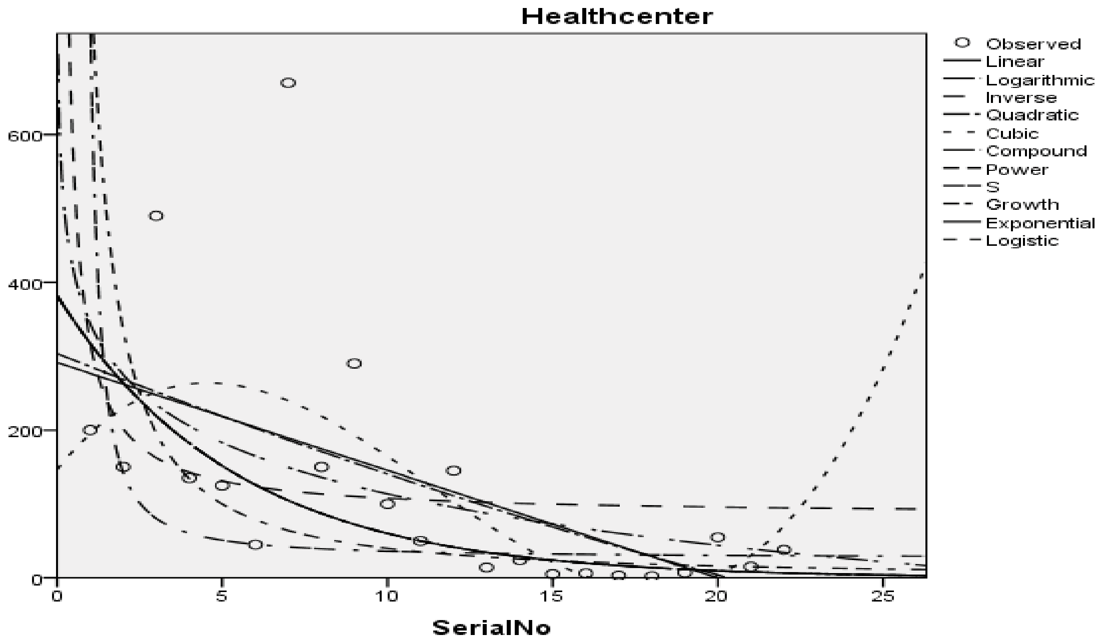

Figure 9: Graphical representation of regression models of health center.

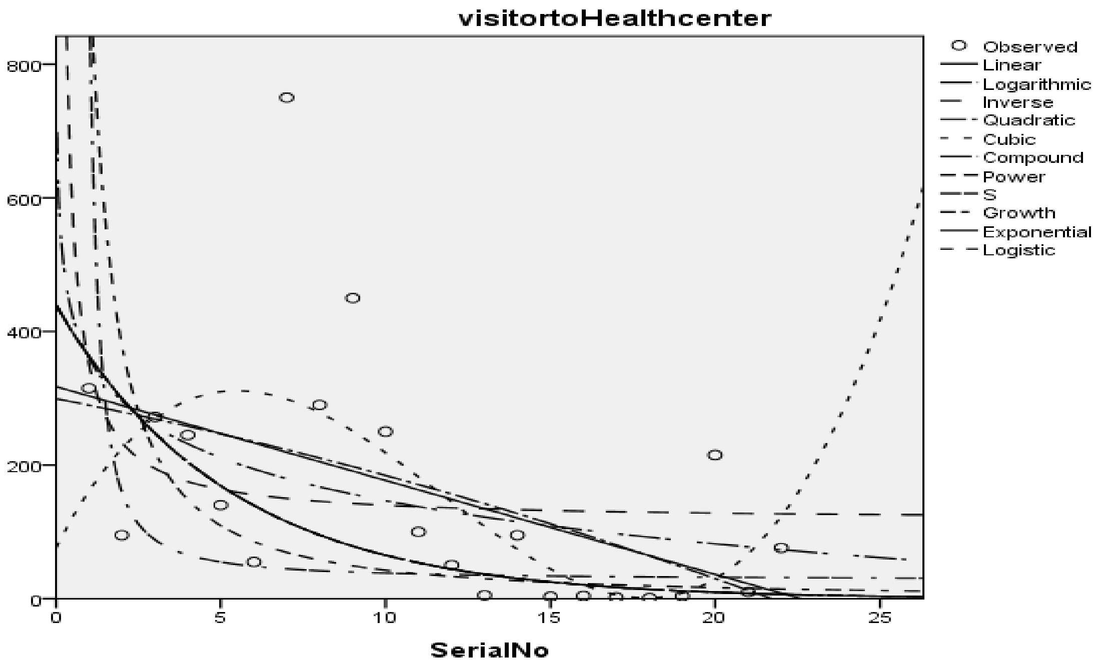

Figure 10: Graphical representation of regression models of visitor to health center.

regression model, power regression model, compound regression model, exponential regression model, growth regression model, logistic regression model, and S-curve model. The analysis of the data presented in Table 1, shows that Zankli visitors, Zankli staff and security staff are most vulnerable to infection outbreak with coefficient of determination at 0.823, 0.794 and 0.735 respectively. The Zankli visitors and Zankli staff data fitted most in cubic regression model, while the data for security staff fitted the inverse regression model. A new statistical model was developed as shown in equation (12); this is our logistic model. A high value of T in equation (12) indicates high probability of COVID-19 outbreak on the university campus and vice versa.

While writing this conclusion, there is no reported case of Coronavirus infection in the BHU Community. However, the number of affected cases in Nigeria is still on a rise as the Country is now in a second wave pandemic. Therefore, COVID-19 protocols as specified by WHO and the federal government of Nigeria need to be strengthened at all costs and students' behavior as well as the entire university community in order to prevent the outbreak on the campus. In Nigeria, it is difficult for the current health infrastructure to

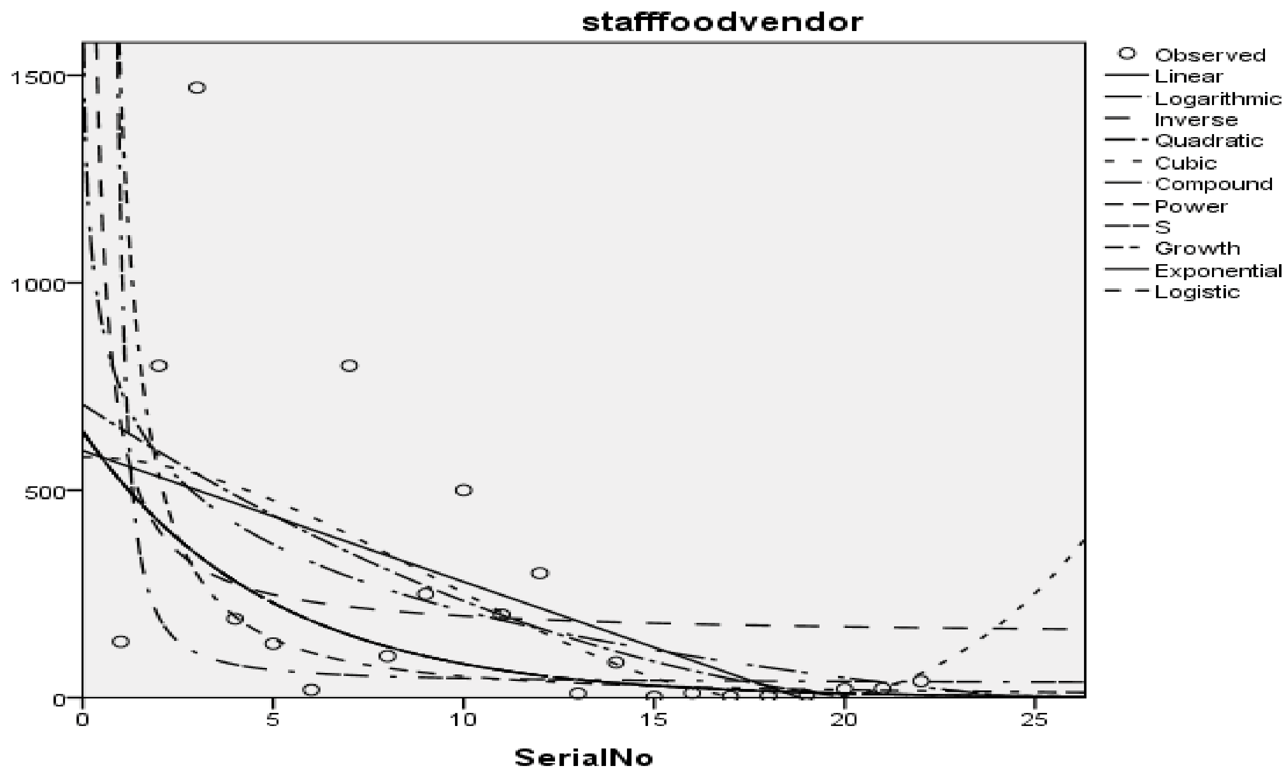

Figure 11: Graphical representation of regression models of staff food vendor.

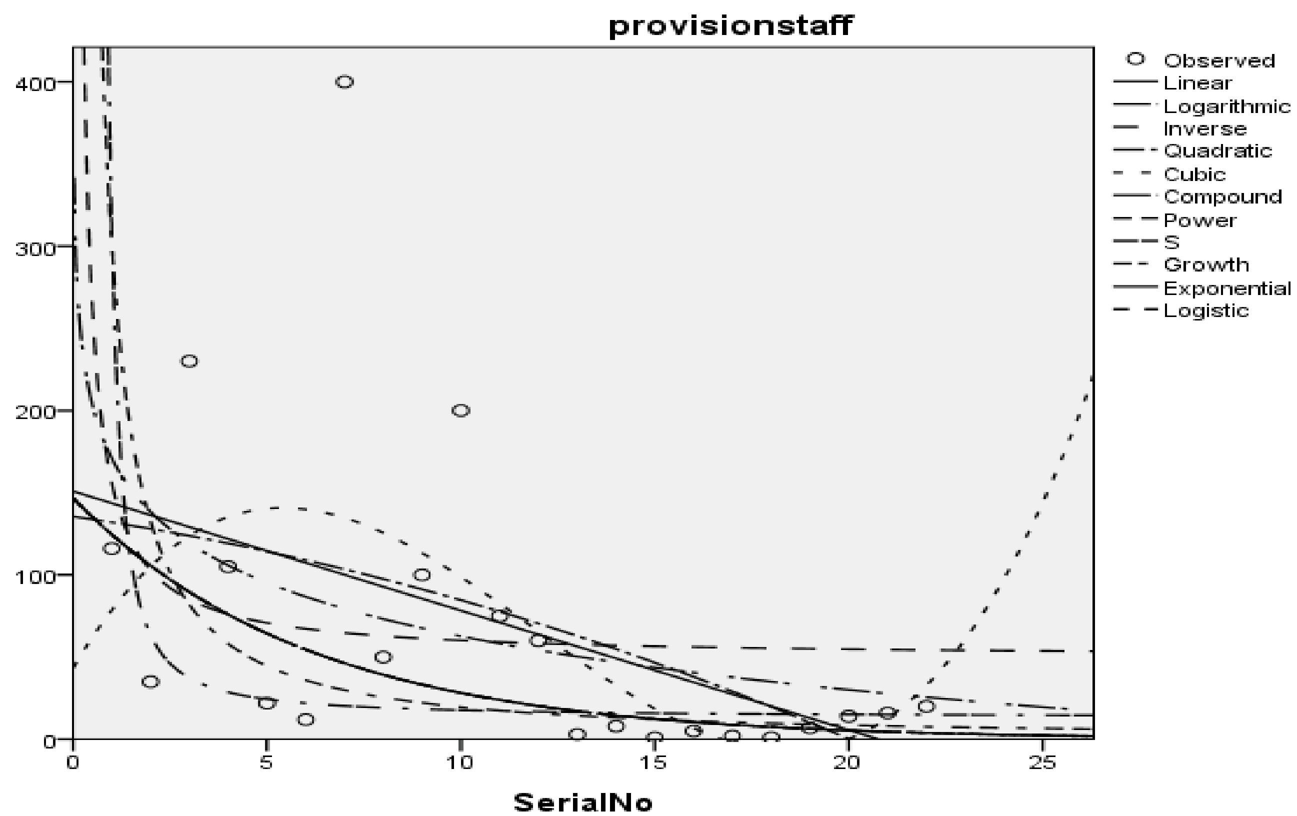

Figure 12: Graphical representation of regression models of provision staff.

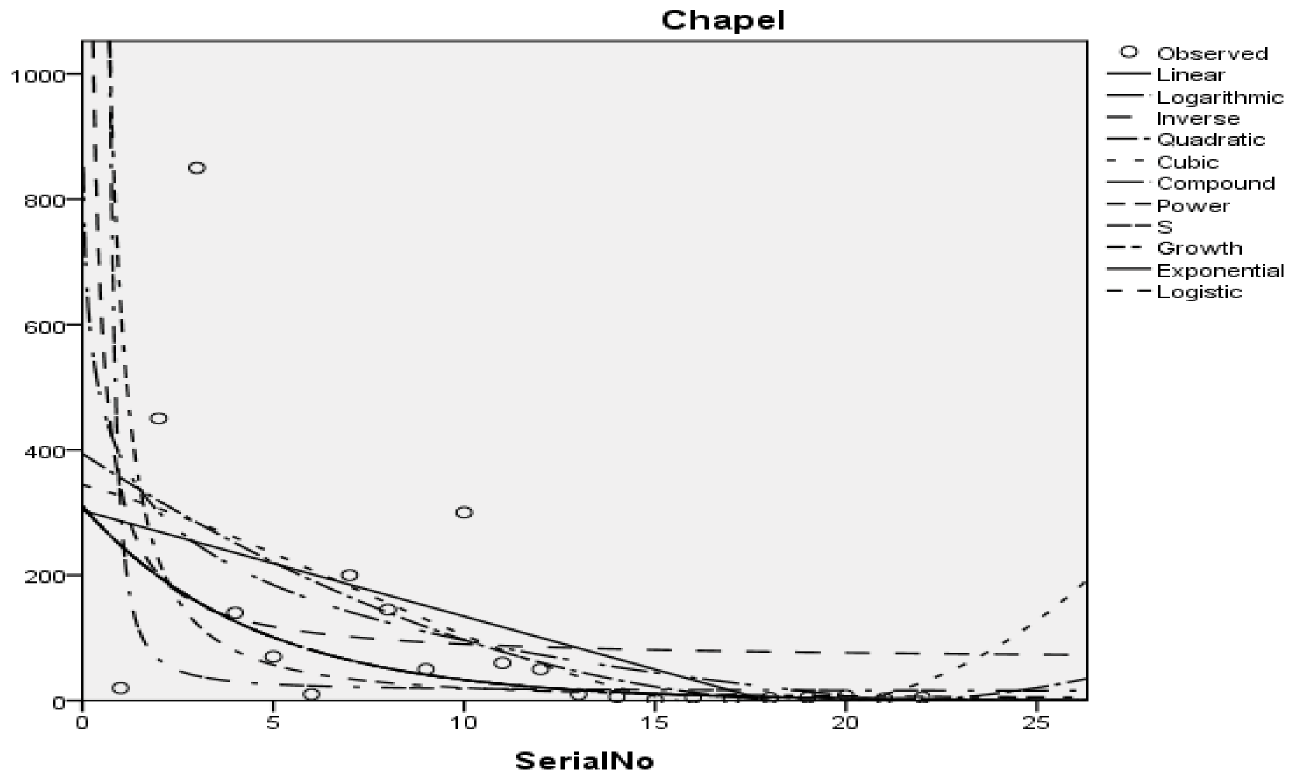

Figure 13: Graphical representation of regression models of Chapel.

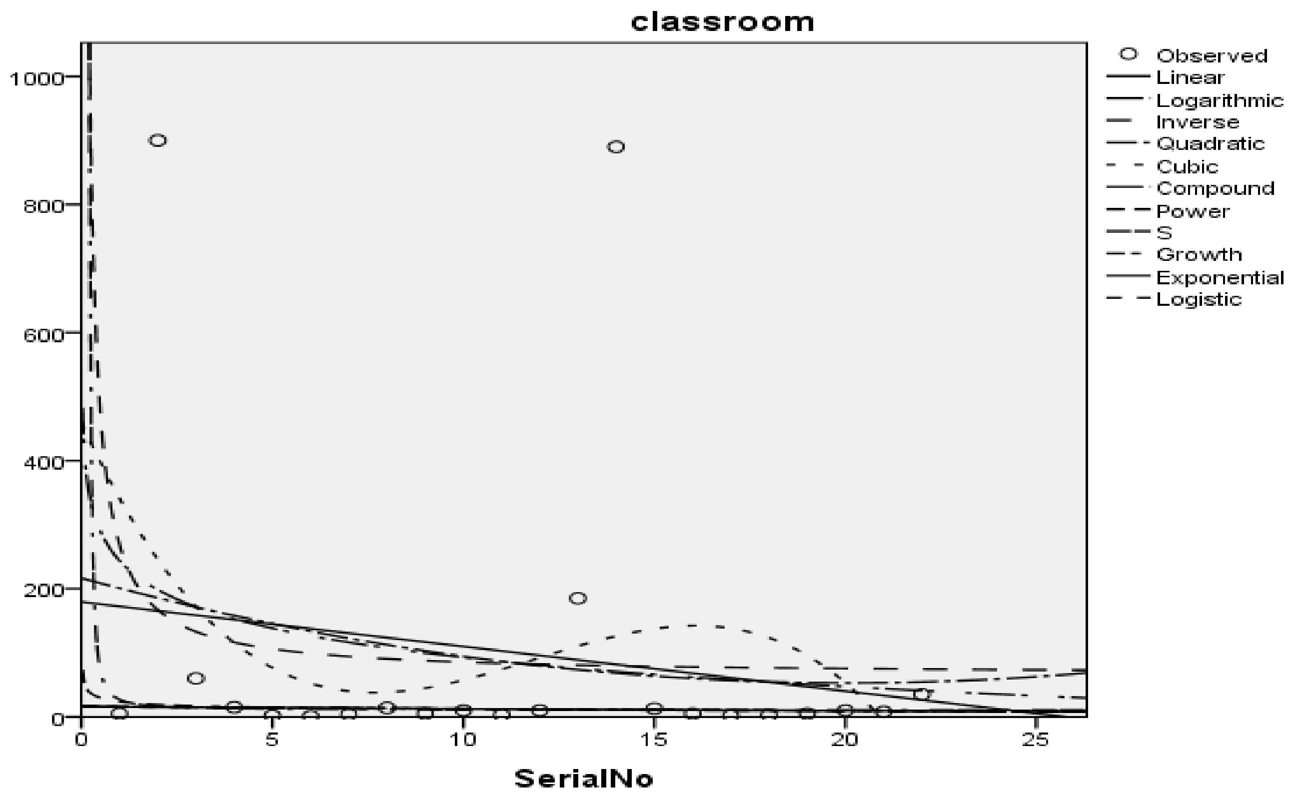

Figure 14: Graphical representation of regression models of classroom.

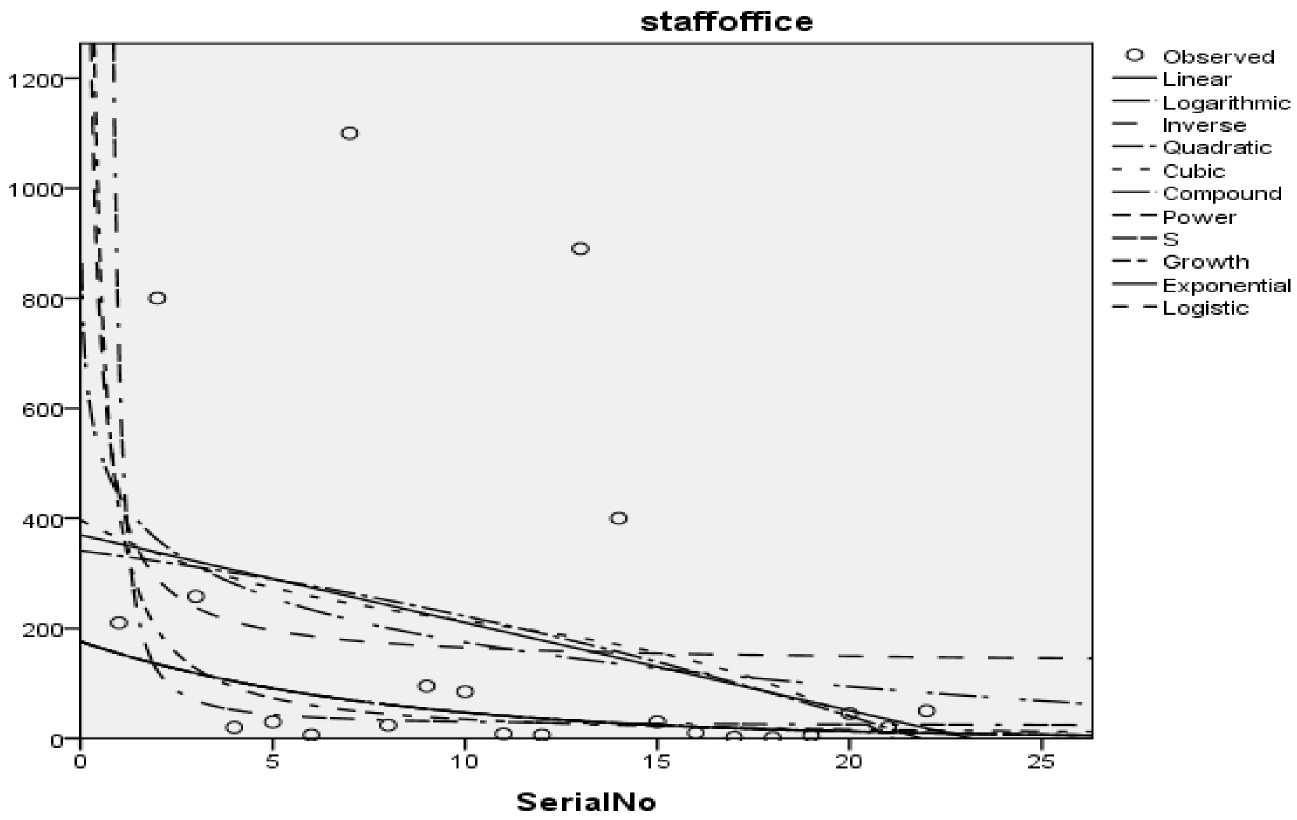

Figure 15: Graphical representation of the regression model of staff office.

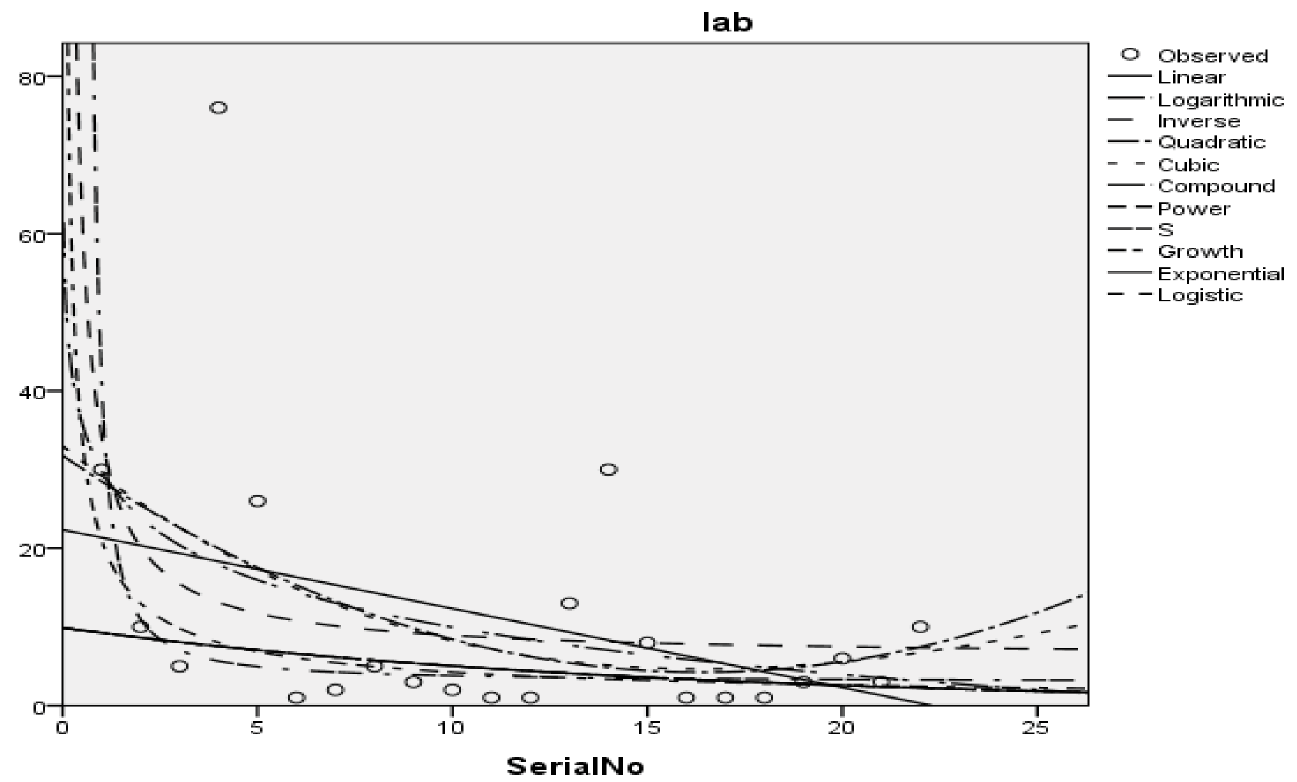

Figure 16: Graphical representation of regression models of laboratories.

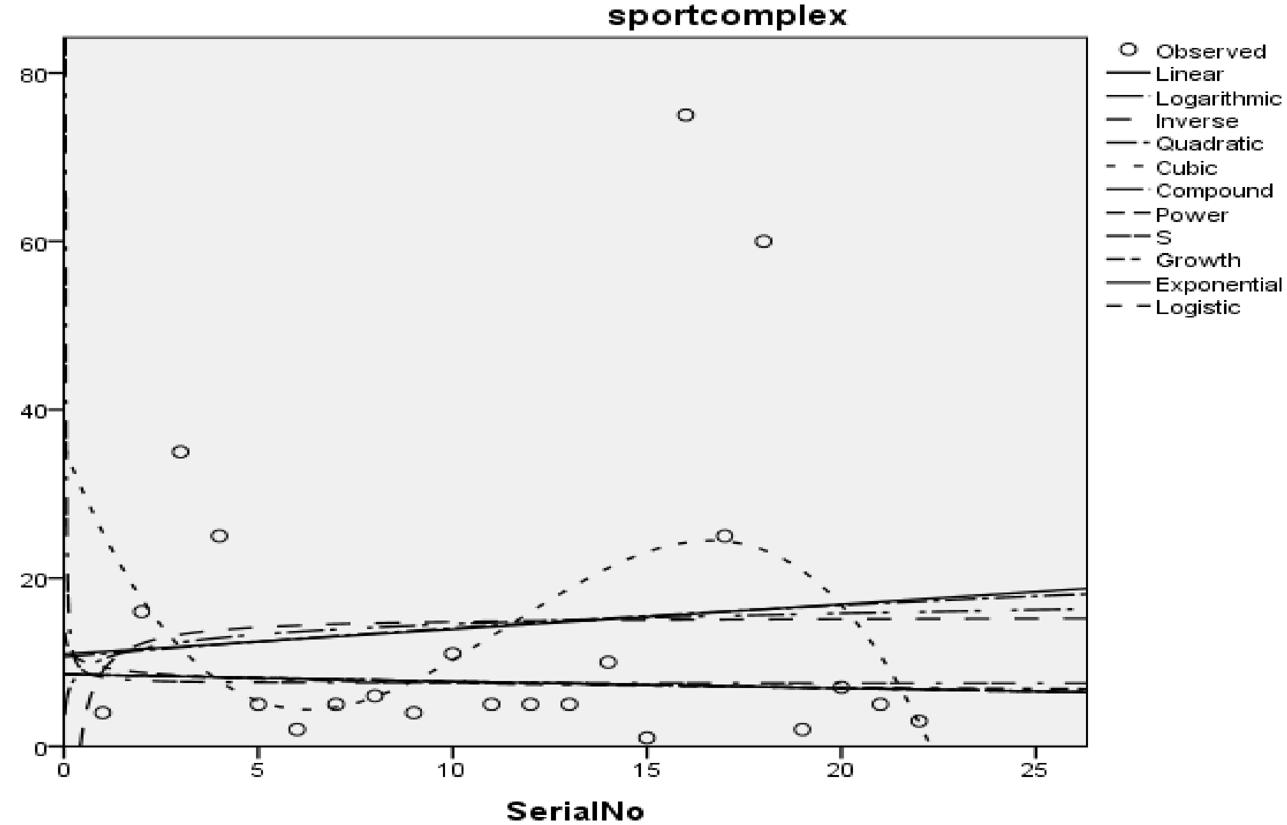

Figure 17: Graphical representation of regression models of the sport complex.

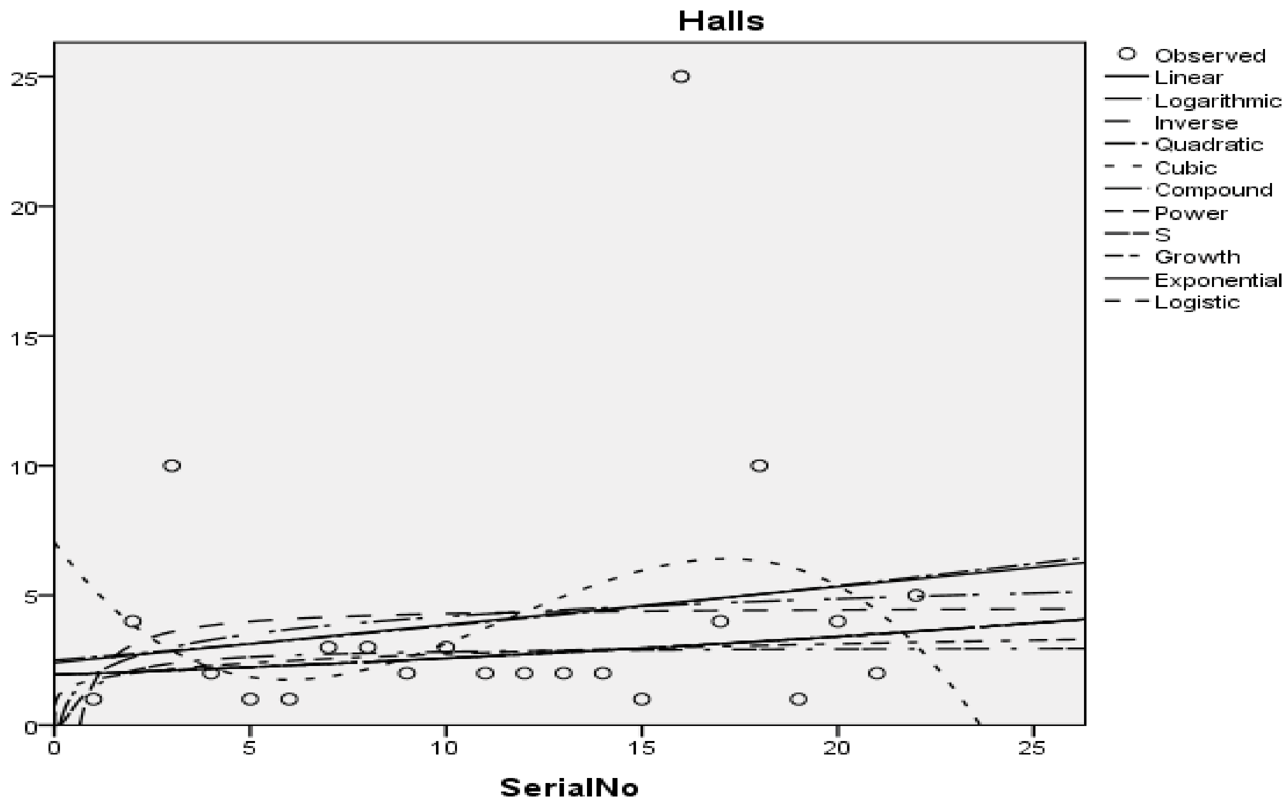

Figure 18: Graphical representation of regression models of halls.

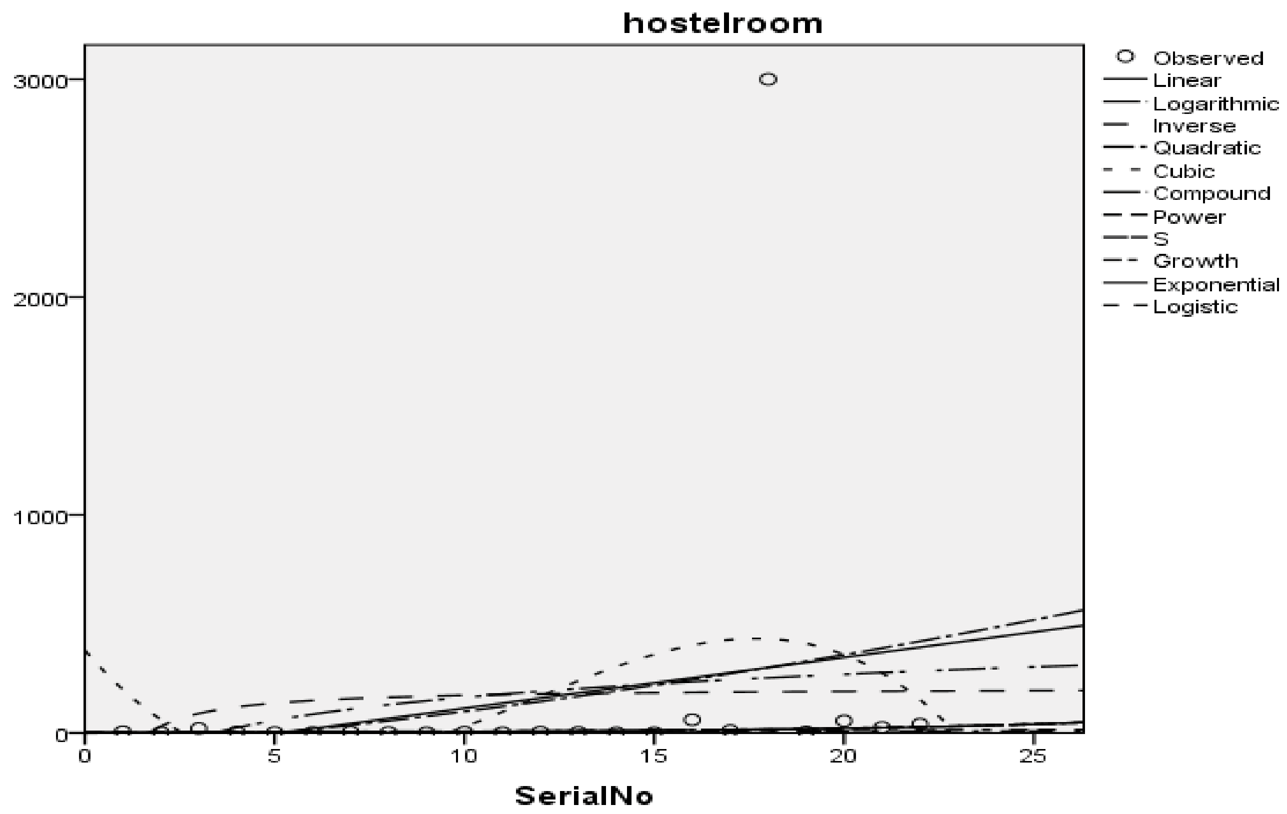

Figure 19: Graphical representation of regression models of hostel room.

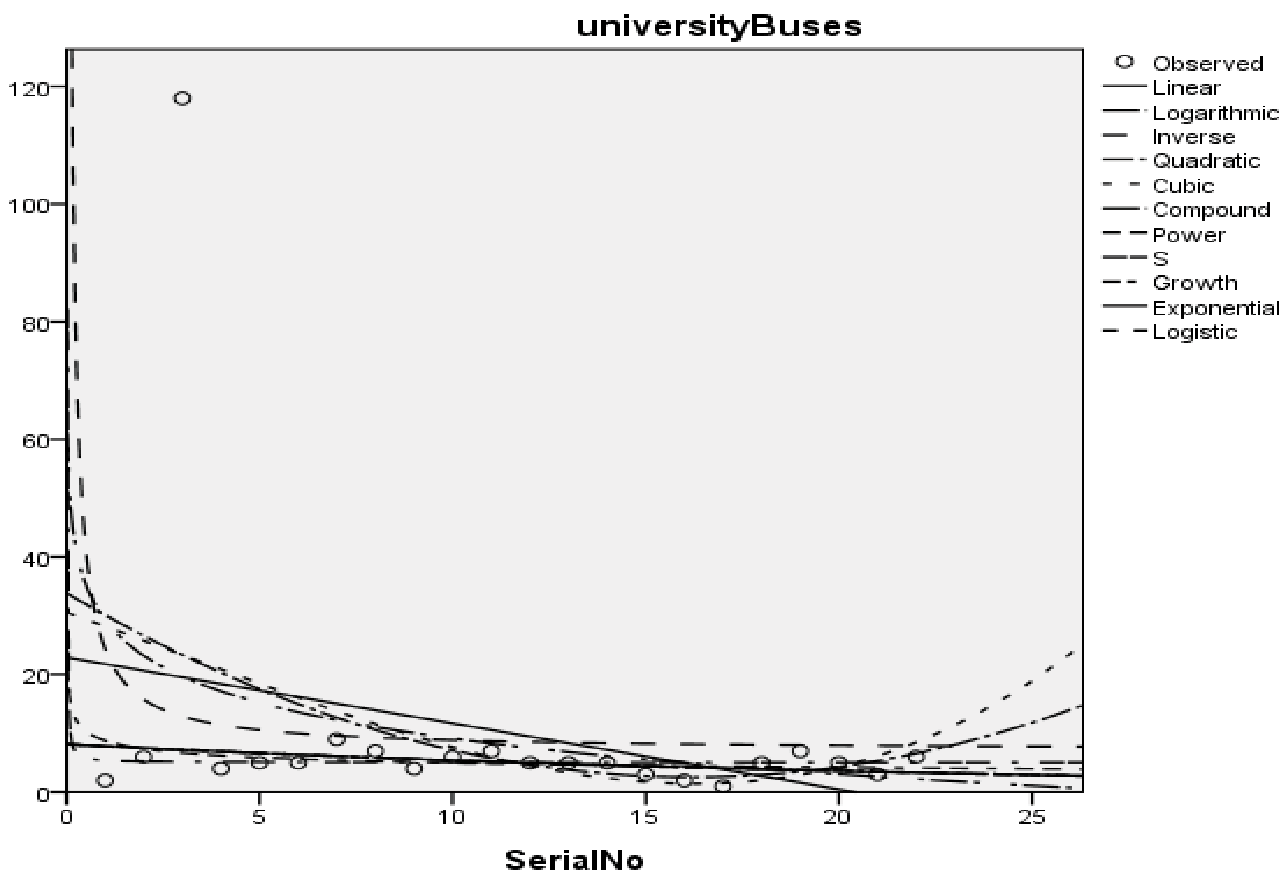

Figure 20: Graphical representation of regression models of university buses.

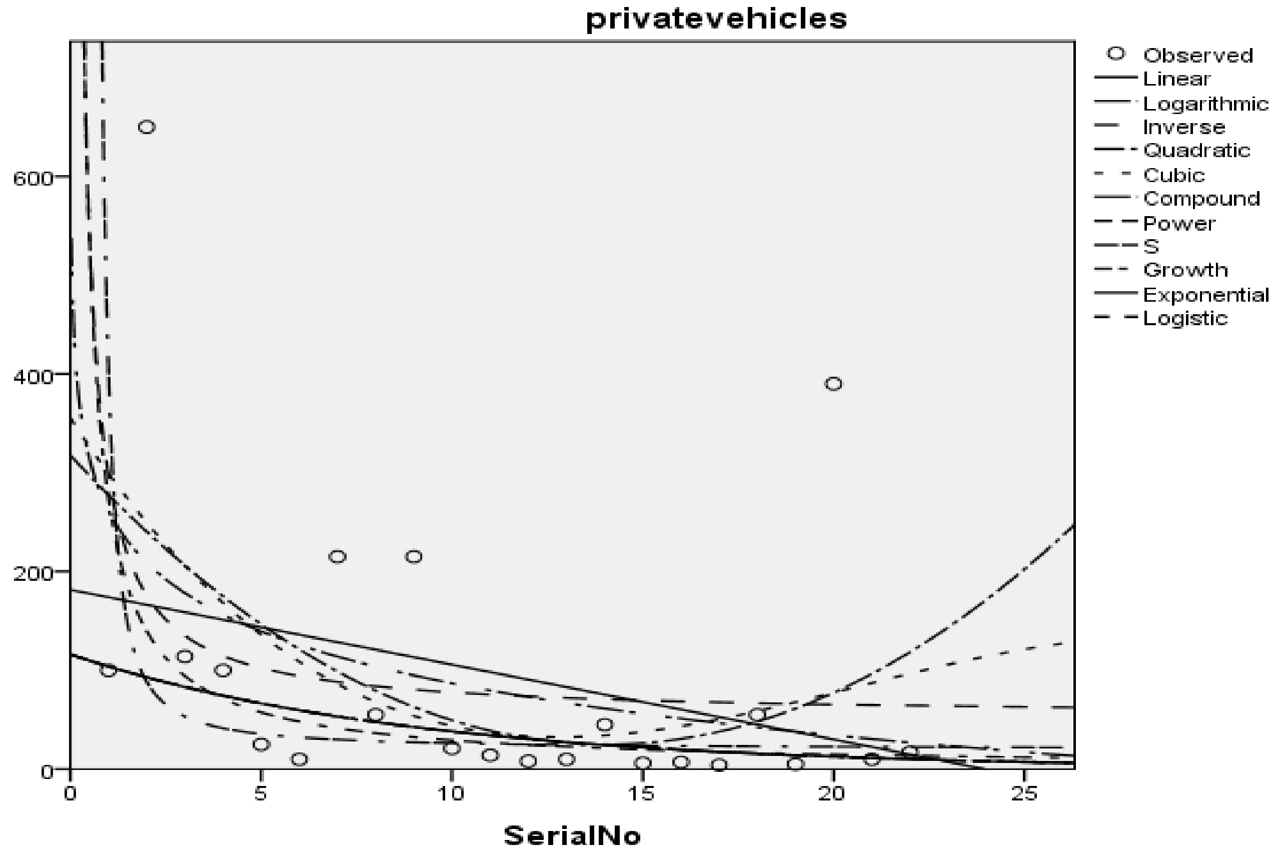

Figure 21: Graphical representation of regression models of private vehicles.

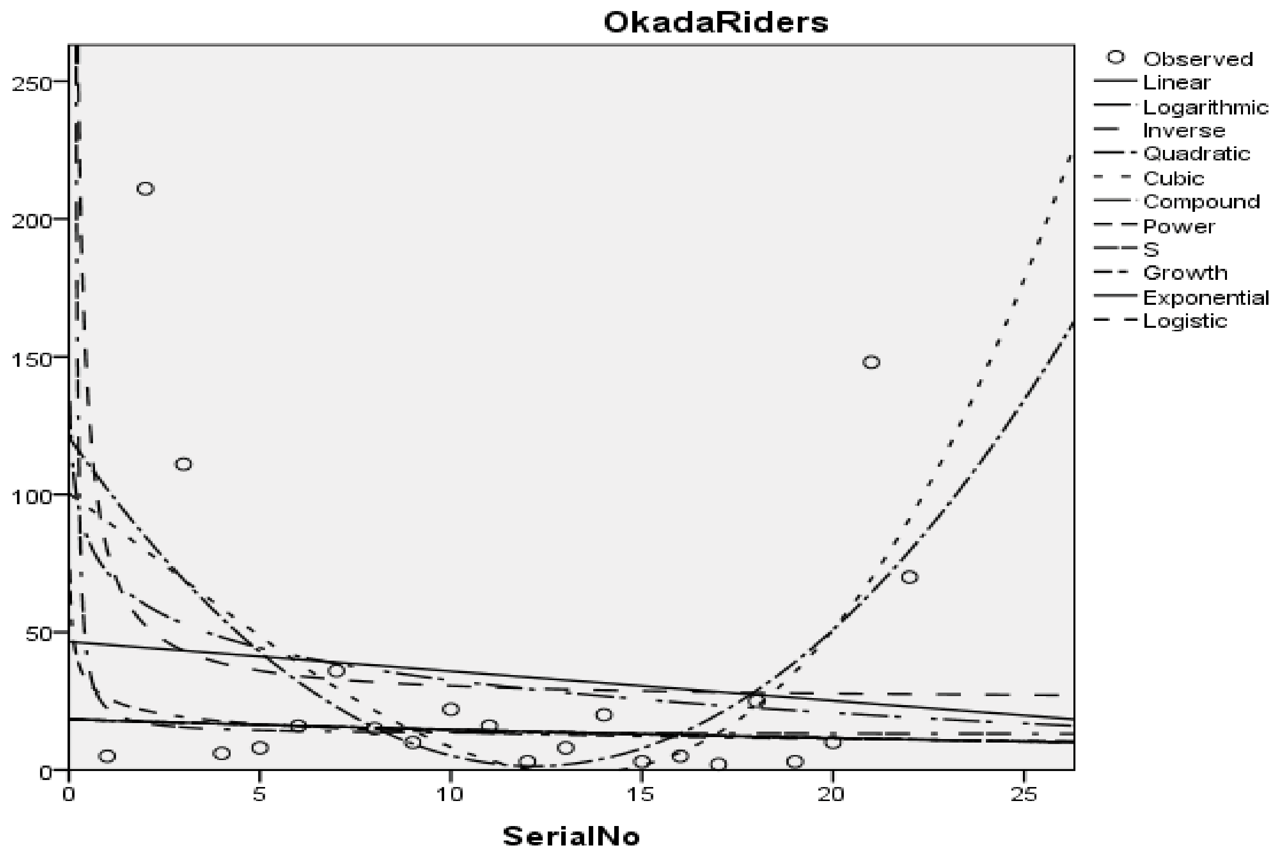

Figure 22: Graphical representation of regression models of Okada riders.

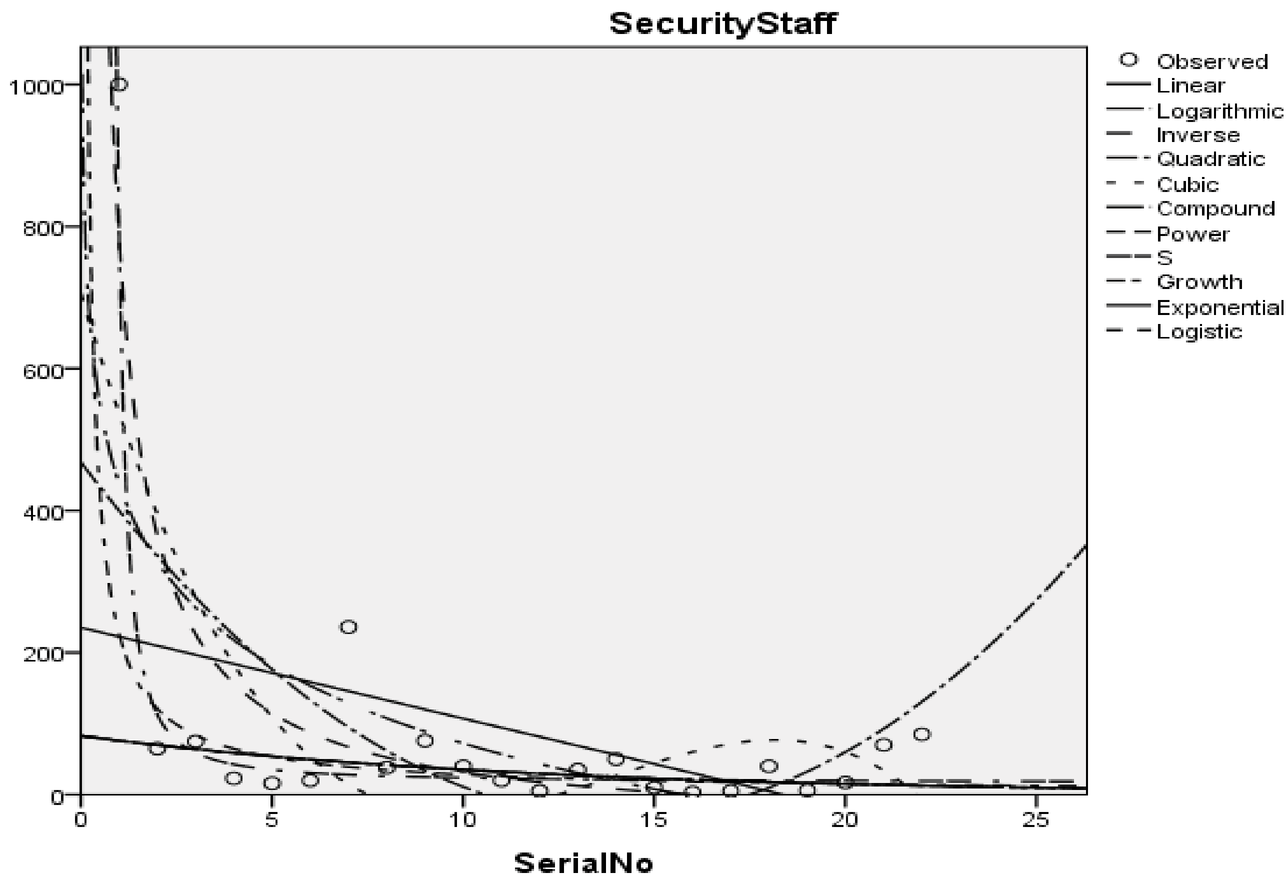

Figure 23: Graphical representation of regression models of security staff.

accommodate and treat the risen number of COVID-19 patients as had seen in the early phase of the second wave, it is best to follow the preventive protocols. This paper is an assessment tool to the university to ascertain the individual behavior, social compliance and exposure factors in order to find out relevant areas of non-pharmaceutical intervention and at the same time increase awareness generation among the university community. This is more of a surveillance gadget to the university management to ensure safety and adherence to preventive measures while the university operates with caution.

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Conflicts of Interest

The authors declare no conflict of interest.

Ethical Statement

No required.

Author Contributions

Bimba John Samson and Isah Omeiza Haroun conceived the original idea and planned the research. Emmanuel Azuaba and Tamber Abraham Jighjigh carried out the research and analyzed the data. Yusuf Musa wrote the manuscript with support from Akude Christian and Oniore Jonathan Ojarikre. Emmanuel Azuaba managed the research while Edwin Ehi Eseigbe and Bimba John Samson supervised the project.

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