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Key Determinants of Number of Discharged Patients in a Health Care Center

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Abstract:
This study aimed at using hospital Statistics as a determinant of the effectiveness of quality services rendered in a health care center. A secondary data was collected from the health records units of Osun State Specialist Teaching Hospital, Asubiaro, Osogbo, Osun State, Nigeria from 2008 to 2010. The Chi-square test and Regression Analysis were employed in analyzing the data. R-software was used to analysis the data. It was concluded that the hospital does not have enough beds and members of staff.

Keywords: *Hospital, patients, records, chi square, regression analysis*

1. Introduction

Health statistics are routine data gathered from the health records of admitted, discharged or diseased patient from the out-patient unit and in-patient services of the hospital. These are collected from patient registration, clinic attendances, discharges summaries, information on accident and emergency cases, bed census and patient counts from the daily bed statement. Statistics about professional work performed in a hospital or health care facilities are compiled and made available for users for a series of reasons.

Hospital statistics means a lot if the health records professionals, the hospital administration and the medical staff members have mutual understanding about the various terms used tabulated information and the reasons for the collected data. This also applies to agencies and organizations outside the hospitals when such reports are sent to them. Health records practitioners must not only know what the basic elements of data are, but also where they are originated, how they can be compiled ,where they are needed in areas of hospitals management and the purposes they serve.

Statistics are facts set down as figures to serve this purpose, such figures must be relevant and must be reliable if anyone is to evaluate them accurately and use them for decision making. Preparing statistics involves collection, analysis, interpretation and presentation of fact as figures. Such facts can help us in implementing a plan for evaluation so that there will be appropriate utilization of hospital resources. To improve professional performance and supply report to the hospital management, the health records practitioners must keep abreast of technology in recording, editing and recording editing and retrieving of data.

The content of health information meets statistics need based on the decision of the health records director and as such, the extent of use of collected data varies from one health institution to another. The hospital administration and governing boards uses statistics to compare current operations with the past and uses it as a guide in planning for the futures. On the other hand, the hospital management uses statistics to evaluate its medical performance.

2. Methodology

This section presents the methods employed for the analysis data of the study. There are many statistical methods used for analyzing any given set of data. But in this study, Chi-square method was employed to analyze the given data and regression analysis will also be used to analyze.

2.1. Chi-Square (X^2)

The Chi-Square (χ^2) distribution provides a method for testing how a given probability distribution describes a population. Test of the kind measure of goodness of fit of the hypothesized distribution to sample data drawn from population.

2.2. The Usefulness of Chi-Square

i. Chi-Square is used to obtain a composite measure of how closely the expected and actual frequencies agree.
ii. It is used to test for independence.
iii. It is used to test for goodness of fit.
iv. It is used to test normal distribution of a particular population

- Contingency Table: A contingency table is a two-way frequency distribution. The Chi-square is a basic for some important procedure for the data found in a contingency table. They include a test for independent among events, is also a method use for comparing two or more multinomial populations.

i	ii	iii	TOTAL
A	a_1	a_2	a_3	Na
B	b_1	b_2	b_3	Nb
Total	N_1	N_2	N_3	N

$$e_{ij} = \frac{N_1 N_j}{N}$$

Where i =1, 2, 3 j=A, B

2.3. Test of Independence

With data classified in a contingency table, the chi-square distribution is often used to test for independence between two set of event. Then row of a contingency table represents k mutually exclusive events: A_1, $A_2 \ldots A_k$. Similarly, the column represent in mutually exhaustive event, B_1, B_2,…., B_M.

- H_0: A_i and B_j are independent where P (A_i and B_j) =P (A_i and B_j) for all i and j.
- H_1: A_i and B_j are dependent where P (A_i and B_j) ≠ P(A_i and B_j) for all i and j.

The method for testing the null hypothesis is to measure the total deviation of the observed from the expected frequencies.

2.4. Test Statistics

$$\chi^2 = \sum\sum \left(\frac{(O_{ij} - E_{ij})^2}{E_{ij}} \right)$$

$$\chi^2_{\alpha,(r-1)(c-1)}$$

Where O_{ij} = observed frequency, E_{ij}= expected frequency

It is the Chi –square distribution with (r – 1)(c -1) degree of freedom

2.5. Assumption of Chi-square

i. The samples are independently obtained so that biasness is avoided.
ii. Observation falls into exactly one cell
iii. The sample are relatively large so that there will be a small difference between expected values.

2.6. Regression Analysis

Regression analysis refers to the statistical techniques developed in which the objective is to analyses the relationship between two or more variables. Reasons for the importance of regression, particularly in business and economics, is that can be used forecast variable such as product, demand, interest rates while several different forecasting techniques can be used. Regression analysis is one of the most popular.

The technique involves developing between the variable to be forecasted and variable(s) that the statistician believes are related to the forecasted variable. The variable to be forecasted is called the dependent variable and may be denoted by y while the independent variables may be denoted by $x_1, x_2, x_3, \ldots, x_n$ (where n is the number of independent variable), the first step is to identify the variables to be used in the analysis.

2.7. Simple Linear Model

In a simple linear model, we are interested in the dependent of a random variable y another x which is not necessarily a random variable. An equation which relates y to x is usually called regression equation. A change in the value of a variable may thereby induce change in the value of the other of variable. The model is of the form :

$$y = \alpha + \beta x + \varepsilon$$

Where y = Dependent Variable, x = Independent Variable, ε= Error term and

α and β are constant terms (the intercept and the slope)

2.8. Multiple Linear Model

Multiple linear regression analysis involves three or more variables. This is the type whereby we have dependent variable (y), which is determined by two or more predictors variables (X). The general linear model is of the form

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n$$

In matrix form, the regression parameters can be solve by the expression below,

$$\hat{\beta} = (X'X)^{-1}X'Y$$

2.9. Hypothesis Testing

Test for β_i

H_0: $\beta_i = 0$ (Not statistically significant)

H_1: $\beta_i \neq 0$ (Statistically significant)

$$t = \frac{\beta_i}{SE(\beta_i)} \text{ Against } t = \alpha/2, \text{ n-2}$$

Decision: If t calculated > t tabulated H_0 will be rejected.

Conclusion: This indicates that β_i is statistically significant.

2.10. Data and Presentation of Results

Here, we present the data collected from the hospital and then make necessary analysis on the data. The data gives us a comprehensive breakdown of the different wards (children, adults, maternity and gynae) in the hospital and their respective numbers of beds, doctors and nurses. We thereafter tested six hypotheses as regards the data.

- Hypothesis 1
  - H_0: The beds and staff members in the wards are not different
  - H_1: The beds and staff members in the wards are different

Wards	Beds	Doctors	Nurses	Total
ADULT	15	25	52	92
CHILDREN	10	21	30	61
MATERNITY	20	16	28	64
GYNAE	5	32	28	65
TOTAL	50	94	138	282

Table 1: Total Number of beds allocated, Doctors and Nurses for the years (2008-2010)

Wards	Beds	Doctors	Nurses
ADULT	16.31	30.67	45.02
CHILDREN	10.82	20.33	29.85
MATERNITY	11.35	21.33	31.32
GYNAE	11.52	21.67	31.81

Table 2: The expected frequencies of the total number of beds allocated, Doctors and Nurses for the years (2008-2010).

The estimated Chi square value is 19.6675 while the tabulated Chi square value at 5% level of significance with 6 degree of freedom is 12.59. This indicates that we reject the null hypothesis and conclude that the beds and staff members in the hospital are dependent on the wards in the hospital.

- Hypothesis 2
  - H_o: There is no significant different in efficiency of each ward
  - H_1: There is significant difference in efficiency of each ward.

Wards	Admission	Discharges	Death	Total
Adult	2575	2110	365	5050
Children	1182	942	232	2356
Maternity	3423	3064	353	6840
Gynae	1039	1039	0	2078
Total	8219	7155	950	16324

Table 3: Total number of admission discharges and death for three years (2008-2010)

Wards	Admission	Discharges	Deaths
Adult	2542.63	2213.47	293.89
Children	1186.23	1032.66	137.11
Maternity	3443.88	2998.05	398.06
Gynae	1046.26	910.81	120.93

Table 4: Expected frequency of total number of admission discharges and death for three years (2008-2010).

Using Chi square statistic, the calculated chi square value is 241.8001. This value is greater than the tabulated chi square value which is 12.59. This indicates that there is a significant difference in the efficiency of the wards.

2.11. Analysis Involving Regression

The use of Regression analysis in this project work is to examine if the available beds and members of staff determines its efficiency, that is the number of discharges

DISCHARGES (Y)	BEDS ALLOCATED (X_1)	STAFF (X_2)
730	15	30
380	10	24
420	20	15
420	5	16
700	15	17
260	10	10
1200	20	15
310	5	16
680	15	30
302	10	17
1444	20	13
309	5	14

Table 5: Total number of discharges, bed allocated and staff for three years (2008 – 2010)

2.12. Estimation of Parameters

$$\hat{\beta} = (X'X)^{-1}X'Y$$

$$X'X = \begin{pmatrix} n & \sum x_1 & \sum x_1 \\ \sum x_1 & \sum x_1^{\,2} & \sum x_1 x_2 \\ \sum x_2 & \sum x_1 x_2 & \sum x_2^{\,2} \end{pmatrix}$$

This data was inputed in r software and the analysis was done. The result below was obtained:

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	38.848	251.220	0.155	0.8805
Bedsallocated	49.372	14.951	3.302	0.0092 **
staff	-3.464	11.533	-0.300	0.7708

This indicates that the variable "bedsallocated" is statistically significant since it has a p-value of 0.0092. The is reasonable because the number of beds in the hospital should determine the number of patients in the hospital and also the numbers patients to be discharged while the variable "staff" is not statistically significant with p-value 0.7708.

For the regression coefficients, a unit increase in the "beds allocated" should bring about a 49.372 increase in the number of discharged patients while a unit increase in the staff would bring about a 3.464 decrease in the number of discharged patients.

2.13. Test Statistics

H_o: Availability of bed does not determine the number of discharges

H_1: Availability of bed determines the number of discharges

$$t_{\beta_1} = \frac{\beta_1 - 0}{S_{\beta_1}} = \frac{49.372 - 0}{14.951}$$

$$= 3.308$$

$$t_{0.05}, a = 2.262$$

Since $t_{cal} > t_{tab}$ we reject H_o, and conclude that availability of bed determines the number of discharges.

H_o: Availability of adequate staff members (doctors and nurses) does not determine the number of discharges

H_1: Availability of adequate staff members (doctors and nurses) determines the number of discharges

$$t_{\beta_2} = \frac{\beta_2 - 0}{S_{\beta_2}} = \frac{-3.464 - 0}{11.533}$$

$$= -0.3$$

$$t_{0.05}, a = 2.262$$

Since $t_{cal} < t_{tab}$ we accept H_o, and conclude that availability of adequate doctors and nurses does not determine the number of discharges.

3. Conclusion

From the analysis, it was observed that the proportions of beds and staff members are different across the ward in the hospital. It was observed also that availability beds and but not staff determines the number of discharges. It was also observed that there is a significant difference in efficiency of each ward.

Based on the findings above, one can conclude that a typical state specialist hospital does not have enough beds, since some of the death is as a result of insufficient staff and facility. Some wards in the hospital are not properly equipped with enough staff which, leads to a small number of patients that are discharged.

4. Recommendation

Government should increase the financial allocation of the health sectors. This will go a long way in providing some basic needs in the sector. There should be prompt and accurate collection of data from patients as soon as they report in the hospital. The government should upgrade the salary of the medical practitioners so as to encourage them in catering for the good health of people in the society. There should be induction training for new staff on the importance of hospital statistics in hospital set up as well as seminar/workshop to enlighten other health professionals and the populace on the importance of statistics in hospital management. There should be provision of essential facilities and equipments for use in the collection, compilation and storage of statistical of statistical data and information.

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