AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

MODELING IN-PATIENT MORBIDITY AND MORTALITY CASES OF SOME INFECTIOUS DISEASES

Manford, M[1]., and Oduro-Okyireh, T[2].

[1]Planning Unit, Cape Coast, Cape Coast- Ghana
[2]Department of Mathematics, Statistics and Computer Studies, Cape Coast Polytechnic, Cape Coast - Ghana

Abstract

The study is an attempt to assess the appropriateness of Binomial and Poisson distribution models, in measuring and modelling the monthly distribution of in-patient morbidity and mortality cases of the top six infectious diseases according to the World Health Organisation (2011) report: malaria, HIV/AIDS, pneumonia, hepatitis B, tuberculosis and typhoid, and use the appropriate models to determine the chances at which certain number of deaths occur in a month. Data for the study were obtained from the Biostatistics Unit of the Regional Hospital in the Central Region of Ghana and covered monthly data from the period of January, 2008 to December, 2012. To determine how well a statistical model can fit a particular distribution, model errors were calculated to determine the difference in the model and actual distribution of the data set. Also, two formal goodness-of-fit tests were considered; the Kolmogorov-Simirnov test and Chi-Square Goodness of Fit test were conducted to compare the discrepancies between the reality and what the distributions are predicting. At the end of the analyses, it was found at 5% significance level that, the monthly number of in-patient morbidity and mortality cases on Malaria, HIV/AIDS and Pneumonia significantly fit Poisson distribution better than Binomial. Finally, the research found that, it is highly unlikely that more than 10 admitted patients in the Central Hospital will die of malaria, HIV/AIDS and pneumonia in a particular month, and likely that less than 4 admitted patients will die of malaria, HIV/AIDS and pneumonia in a particular month.

Keywords: In-patient, Mortality, Morbidity, Binomial Distributions, Poisson Distributions

1. INTRODUCTION

Infectious diseases are known to thrive where poverty exists and some of them such as malaria, tuberculosis, HIV AIDS and diarrhoeal diseases are contagious and mostly prevalent in poor countries. World Bank (2010) report explained that infectious diseases remain the leading cause of mortality in developing countries. According to the World Health Organization, every year, infectious diseases claim 3.5 million lives, mostly children under 5 years (WHO, 2012). WHO (1994) reported malaria and measles as the most common causes of premature death. In children under 5, 70% of deaths were caused by an infection compounded by malnutrition. Boateng (2012) added that HIV/AIDS, malaria and tuberculosis, which are the three primary poverty-related diseases, account for 10 per cent of the global mortality of infectious diseases.

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

Infectious diseases threaten public health and contribute substantially to the high costs of health care in developing countries, especially. For example, the Ghana Health Service (2011) report said that malaria was the primary cause of morbidity and about 32.5 per cent of people admitted to Ghanaian medical facilities were admitted because of malaria.

As the world is known to be surrounded with uncertainties, day in and day out, human-beings are faced with health challenges and good decisions in terms of providing good health services. Statistical models are arguably, a proving tool in making decisions on health services concerning infectious diseases. These models can be used to study the probabilistic nature of the distribution of in-patient morbidity and mortality cases of infectious diseases, in order for health management and administrators to strategize policies that are capable of minimising the risk involved in decision making process.

Dimitrov and Meyers (2010) explained that modelling has long been an important tool for understanding and controlling the spread of infectious diseases. Most researchers normally model to project mortality and morbidity cases of infectious diseases and determine how the diseases progress. Dimitrov and Meyers (2010) added that models enlighten our understanding of the behaviour and nature of infectious diseases. This help in the development of a control measures against the prevalence of infectious diseases.

1.1 Justification for the Study

In sub-Saharan Africa, several factors have affected our exposure to infectious diseases, access to treatment, and ultimately, health outcomes (La Verle, 1994). Mandell, Bennett and Dollin (2005) explain that infectious diseases persist. A significant reason for this is the lack of research capacity incorporates with inadequate data, in particular, interdisciplinary capacity that can integrate knowledge and facilitate the identification and translation of technical solutions into interventions that are embedded within populations and health systems (Boateng, 2012).

Improving the understanding of the occurrence of certain infectious diseases has gained attention in the health sector. Attention also needs to be placed on the uncertainties surrounding the occurrence of infectious diseases. Efforts need to be made to ensure that likelihood of the occurrence of infectious diseases are identified. A lot of studies and literature focus on the trend but little attention has been given to modelling of in-patient morbidity and mortality of these infectious diseases.

The research study will help to inform the Regional Health Directorate about the occurrence of some infectious diseases at the hospital and develop strategies to minimise the occurrence. The research will also help the managers and the workers, to realise their obligations and responsibility towards, the reduction of death associated with infectious diseases at the hospital. It will also inform policy makers to find ways to curb the present undesirable situation and to understand pertinent issues concerning infectious diseases in regards to the hospital. The

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

research will in totality help to revive the hospital to a good functional state and somehow guarantee its effective and smooth existence. Last but not least, the study will add on to the existing literature on the modelling of inpatient morbidity and mortality data on some infectious diseases in the Central Regional Hospital

1.2 Purpose of the Study

Most of the studies and publications carried out in the area are based on time series, and only few of them attempted to measure the likelihood of the diseases occurring. Establishing a useful statistical model is a crucial phase in the measurement and control of infectious diseases. In order to improve our understanding of the distribution of in-patient morbidity and mortality data of infectious diseases hence, the study attempted to fill this gab by using two statistical models (that is Binomial and Poisson) to measure and model the monthly distribution of in-patient morbidity and mortality cases of some infectious diseases.

Specifically, the aim of the study is an attempt to:

i. determine which distribution (binomial and Poisson) significantly fit the monthly distribution of in-patient morbidity and mortality cases of the infectious diseases.
ii. use either of binomial and Poisson distribution to determine the likelihood at which certain number of deaths related to the infectious diseases could occur in a particular month.

2. LITERATURE REVIEW

In-patient mortality is the number of deaths pertaining to people who were hospitalized at a specific time, or from a specific cause.. On the other hand, inpatient morbidity is the frequency of occurrence of a disease pertaining to people who were hospitalized at a specific time, from a specific cause. (American Heritage Dictionary, 2009, Microsoft Student Encarta, 2009). Walker (2012) explained that mortality and morbidity together measure the health status of a population and stated that in-patient mortality and morbidity of infectious diseases can be used to measure the health status of a population at a specific place, in a period of time.

According to the World Health Organization (2011), the most common diseases in Ghana include those endemic to sub-Saharan African countries, particularly: cholera, typhoid, pulmonary tuberculosis, anthrax, pertussis, tetanus, chicken pox, yellow fever, measles, infectious hepatitis, trachoma, malaria, and schistosomiasis. Although, not as common, other regularly treated diseases include dracunculiasis, dysentery, river blindness or onchocerciasis, several kinds of pneumonia, dehydration, venereal diseases, and poliomyelitis. A few number of

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

research work on modelling infectious diseases have been made, and among them are the following:

Allard (1998) reviews the practical aspects of the use of ARIMA (autoregressive, integrated, moving average) modelling of time series as applied to the surveillance of reportable infectious diseases, with special reference to the widely available SSS1 package, produced by the Centers for Disease Control and Prevention. In this study, other methods, such as INAR modelling or Markov chain analysis, which can be applied to situations where ARIMA modelling fails were also dealt with, but they were less practical. The usefulness of ARIMA modelling resides mostly in providing an estimate of the variability to be expected among future observations. According to Allard (1998), this knowledge is helpful in deciding whether or not an unusual situation, possibly an outbreak, is developing.

Renzullo, McNeil, Gardner and Brundage (1991) conducted a research on inpatient morbidity among HIV-infected male soldiers prior to their diagnosis of HIV infection. Their study was a natural history study of human immunodeficiency virus (HIV) disease and it was carried out among 1575 HIV-infected US Army men and 6220 demographically similar uninfected soldiers. Inpatient morbidity occurring up to 8 years prior to the date of HIV infection diagnosis among those men who became HIV infected was evaluated for both groups. The authors calculated the Incidence density rates for hospital admissions. The authors then used Poisson regression to assess the trend in hospital admissions among those subsequently diagnosed with HIV infection.

Oduro-Okyireh and Manford (2014), explored the in-patient mortality and morbidity data for this study to assess which of the distributions, binomial and poisson is a better fit to the data. The top three frequent cases that led to admission of patients with infections were malaria, pneumonia and HIV/AIDS. Also, the top three cases that were mentioned to lead to inpatients deaths were HIV/AIDS, malaria and pneumonia. However, the distributions of deaths related to malaria and HIV/AIDS were suggested to be uniform. On the other hand, deaths due to pneumonia and tuberculosis, typhoid fever are not uniformly distributed. Also, for morbidity cases, Binomial fits malaria data better than it does to HIV/AIDS and Pneumonia; while Poisson fits Pneumonia better than the rest of the diseases. For mortality, HIV/AIDS fit both Binominal and Poisson distribution better than malaria and pneumonia.

3. RESEARCH METHODS

The data were obtained from the Biostatistics Unit of the Regional Hospital in the Central Region of Ghana on a monthly in-patient morbidity and mortality data which covers 168 diseases and medical conditions for 5-year period; from 2008 to 2012. For the purpose of the study, the top six infectious diseases that according World Health Organization (2011) report were considered as having high degree of risk in sub-Saharan Africa, were extracted from the 168 diseases or medical conditions. They are malaria, HIV/AIDS, pneumonia, hepatitis B,

www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

tuberculosis and typhoid. Obviously, the data generated are from a secondary source by which we could not have a full understanding of the mode of data compilation. However, any inferences made on this study must therefore be seen in this regard.

In other to determine how well a statistical model can fit a particular distribution, model errors are calculated which explains the difference in the model and actual distribution of the data set. Measurement of model errors helps in selecting an appropriate statistical model to represent the monthly distribution of in-patient morbidity and mortality cases of infectious diseases. Some of the accuracy measures include Mean Absolute Deviation (MAD), Mean Square Error and Root Mean Square Error. These measures (error) help in selecting an appropriate statistical model to represent the monthly distribution of in-patient morbidity and mortality cases of infectious diseases. The statistical model with the smallest error is preferred.

The goodness-of-fit tests are designed to compare the discrepancies between the reality and what the distribution is predicting (Cruz, 2002). It is very important to test the fitness of the models and see which one is the most appropriate. In this study, two formal goodness-of-fit tests were considered; the Kolmogorov-Simirnov test and Chi-Square Goodness of Fit test. Romeu (2003) explained that goodness-of-fit tests are essentially based on either of two distribution elements: the cumulative distribution function (CDF) or the probability density function (PDF). The Chi-square test is based on the PDF, whiles the Kolmogorov-Simirnov test uses the CDF.

4. RESULTS AND DISCUSSION

An initial analysis of the morbidity and mortality data for the infectious diseases under study by Oduro-Okyireh and Manford (2014), revealed the nature of the distribution of each infectious disease over the period under study. In this research, calculations and deductions for the various statistical distributions would be made to find the type of probability distribution which significantly fits the data under study. These techniques would be the tools with which judgment would be made on the probability distribution that fits morbidity and mortality cases of some infectious diseases reported at the Regional Hospital, Central Region. From our initial analysis, the top three infectious diseases with the most reported morbidity and mortality cases were Malaria, HIV/AIDS and pneumonia respectively. Thus, the analysis in this chapter would be based on these three diseases.

4.1 Measurement of Models' Error

In order to determine how well the statistical models fit the distribution of inpatient morbidity and mortality cases of malaria, HIV/AIDS and hepatitis B, three types of measuring error where used; namely the Mean Absolute Deviation (MAD), the Mean Square Error (MSE) and the Root Mean Square Error (RMSE). These errors were to aid in the selection of the statistical model fit the monthly distribution of in-patient morbidity and mortality cases of malaria, HIV/AIDS and pneumonia. Table 1 present the results.

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

Table 1: Measurement of Model Error for Binomial and Poisson distribution for the Infectious Diseases

Distribution	Statistics	Malaria	HIV/AIDS	Pneumonia
Morbidity				
Binomial	MAD	2.532	3.013	3.749
	MSE	11.118	15.112	21.631
	RMSE	3.334	3.887	4.651
Poisson	MAD	1.700	2.177	2.201
	MSE	4.895	7.925	7.214
	RMSE	2.212	2.815	2.686
Mortality				
Binomial	MAD	2.613	2.022	2.684
	MSE	12.424	8.963	19.271
	RMSE	3.525	2.994	4.390
Poisson	MAD	1.849	1.519	2.250
	MSE	6.070	4.606	12.445
	RMSE	2.464	2.146	3.528

From Table 1, the standard error or the root mean square error (RMSE) between the distribution of inpatient morbidity of malaria and the Binomial fit was 3.334. That of the distribution of inpatients morbidity of HIV/AIDS and the Binomial fit was 3.887 and that of pneumonia and Binomial fit was 4.651. Again, the standard error between the distribution of inpatient morbidity of malaria, HIV/AIDS and Pneumonia and the Poisson fit were 2.212, 2.815 and 2.686 respectively. Comparatively, it seems the distribution of pneumonia fits both Binomial and Poisson distribution better than that of malaria and HIV/AIDS, since its RMSEs for the two distributions recorded the lowest among the two infectious diseases. Also, comparing the standard errors, it can deduce that the distribution of inpatient morbidity of the infectious diseases fit Poisson distribution better than Binomial distribution.

In the same table, the standard error or the root mean square error (RMSE) for the distribution of inpatient mortality of HIV/AIDS and the Poisson fit was 2.146. Also, the standard error for the distribution of inpatient mortality of HIV/AIDS and the Binomial fit was 2.994. Likewise, the of the distribution of inpatients mortality of malaria and the Binomial fit was 3.525 and that of pneumonia and Binomial fit was 4.390. Again, the standard error for the distribution of inpatient mortality of malaria and Pneumonia and the Poisson fit were 2.464 and 3.528 respectively. Comparatively, it seems the distribution of HIV/AIDS fits both Binomial and Poisson distributions better than that of malaria and pneumonia, since it's RMSEs for the both Binomial

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

and Poisson distributions recorded the lowest among the infectious diseases. Also, comparing the standard errors, it can be deduced that the distribution of inpatient morbidity of the infectious diseases fit Poisson distribution better than Binomial distribution.

4.2 Testing of the Statistical Models

This test was to aid in decision on which statistical distribution fit the data set. Table 4.2 present the result for Chi-square tests and Kolmogorov-Smirnov tests for the frequency distribution and cumulative frequency distribution respectively, for morbidity cases on malaria, HIV/AIDS and pneumonia.

Table 2: Goodness-of-fit test on Monthly Distribution In-patient Morbidity Cases

		Malaria	HIV/AIDS	Pneumonia
Chi-Square				
Binomial	Value	15.513	60.050	27.492
Poisson	Value	3.590	30.430	42.161
	Degrees of Freedom	5	4	4
	Critical Value	11.071	9.488	9.488
Kolmogorov-Smirnov (KS)				
Binomial	Value	.148	.340	.197
Poisson	Value	.075	.184	.091
	Critical Value	.377	.312	.453

From Table 2, based on the Chi-Square goodness-of-fit test result, it can be concluded that the monthly frequency distribution of patients admitted because they are suffering from malaria does not follows the density function of Binomial (BV=15.51>11.07), but follows Poisson (PV=3.59<11.07). Also, the KS tests statistic shows that monthly cumulative distribution of patients admitted because of malaria follows both the Cumulative Function of Binomial (BV=.148<.377) and Poisson (PV=.075<.377).

From the result in Table 2 again, the Chi-Square goodness-of-fit test value result, shows that the monthly frequency distribution of patients admitted because they are infected with HIV/AIDS does not follows both the Density function of Binomial (BV=60.05>9.49) and Poisson (PV=30.43>9.49). Also, the KS test shows that monthly cumulative distribution of patients admitted because of HIV/AIDS infections does not follows the Cumulative Function of Binomial (BV=.340>.312) but follows that of Poisson (PV=.184<.312).

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

In Table 2, the Chi-Square goodness-of-fit test value shows that the monthly frequency distribution of patients admitted because they are diagnosed with Pneumonia does not follows both the Density function of Binomial (BV=27.49>9.48) and Poisson (PV=42.16>9.49). on the other hand, the KS test statistic shows that monthly cumulative distribution of patients admitted because they are diagnosed with Pneumonia follows both the Cumulative Function of Binomial (BV=.197<.453) and Poisson (PV=.091<.453).

Table 3: Goodness-of-fit test on Monthly Distribution In-patient Mortality Cases

		Malaria	HIV/AIDS	Pneumonia
Chi-Square				
Binomial	Value	26.564	6.605	17.706
Poisson	Value	10.401	3.181	9.739
	Degrees of Freedom	4	4	3
	Critical Value	9.488	9.488	7.815
Kolmogorov-Smirnov				
Binomial	Value	.125	.142	.166
Poisson	Value	.081	.104	.131
	Critical Value	.431	.393	.430

From Table 3, the Chi-Square goodness-of-fit test shows that the monthly frequency distribution of death of inpatients due to malaria does not follows both the density function of Binomial (BV=26.56>9.49) and Poisson (PV=10.40>9.49). Also, the KS tests statistic shows that monthly cumulative distribution of deaths due admission of malaria patients follows both the Cumulative Function of Binomial (BV=.125<.431) and Poisson (PV=.081<.431). Comparing the result of the two, Poisson will be a good fit than Binomial.

From the result in Table 3, the Chi-Square goodness-of-fit test value shows that the monthly frequency distribution of death of admitted patients due to HIV/AIDS infections follows the Density function of Binomial (BV=6.61<9.49) and Poisson (PV=3.18<9.49). Also, the KS test statistic shows that monthly cumulative distribution of inpatient mortality of HIV/AIDS infections follows the Cumulative Function of Binomial (BV=.142<.393) and Poisson (PV=.104<.393).

The Chi-Square goodness-of-fit test in Table 3 again shows that the monthly distribution of inpatient mortality associated with Pneumonia does not follows both the Density function of Binomial (BV=17.71>7.82) and Poisson (PV=9.74>7.82). Also, the KS test statistic shows that

AFRICAN JOURNAL OF APPLIED RESEARCH (AJAR)
www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

monthly cumulative distribution of inpatient mortality in connection with Pneumonia infections follows both the Cumulative Function of Binomial (BV=.166<.430) and Poisson (PV=.131<.430). Thus, it can be concluded that monthly cumulative distribution of inpatient mortality associated with Pneumonia infections follows the Cumulative Function of Poisson.

4.3 Estimation of Likelihood of Deaths

Since from all the analysis Poison distribution seems to be a better representation of the distributions related to inpatient mortality of malaria, HIV/AIDS and Pneumonia, it would be used to estimate the probabilities associated with deaths of inpatient due to malaria, HIV/AIDS and Pneumonia.

Table 4: Estimated Probabilities of Deaths for various infectious diseases

Number of Deaths per Month	Malaria		HIV/AIDS		Pneumonia	
	Density	Cumulative	Density	Cumulative	Density	Cumulative
0	0.119	0.119	0.059	0.06	0.202	0.202
1	0.253	0.372	0.167	0.226	0.323	0.525
2	0.270	0.642	0.236	0.462	0.258	0.783
3	0.191	0.833	0.223	0.685	0.138	0.921
4	0.102	0.935	0.158	0.843	0.055	0.976
5	0.043	0.978	0.089	0.932	0.018	0.994
6	0.015	0.994	0.042	0.974	0.005	0.999
7	0.005	0.998	0.017	0.991	0.001	1.000
8	0.001	1.000	0.006	0.997	0.000	1.000
9	0.000	1.000	0.002	0.999	0.000	1.000
10	0.000	1.000	0.001	1.000	0.000	1.000
10 >	0.000	1.000	0.000	1.000	0.000	1.000

From Table 4, it can be seen that the chance that no admitted patient will die of malaria is estimated to be .119. Also, it is highly unlikely that more 9 admitted patients will die of malaria, HIV/AIDS and pneumonia in a particular month, since their estimated probabilities were approximately zero. It is highly likely that less than three admitted patients will die of malaria, HIV/AIDS and pneumonia in a particular month, since the estimated probability were .833, .685 and .921 respectively.

[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

The goodness of fit test revealed that Poisson is a good fit compared to Binomial. Thus, making Poisson a better representation of the data. The findings reveal that the probabilities associated with higher number of deaths at Central Regional Hospital in relation to malaria, HIV/AIDS and Pneumonia are very low, though a number of deaths were recorded over the period of study. But the chances of lower number of deaths for the infectious diseases studied were very high.

5. CONCLUSIONS

From the findings, it can be concluded that at 5% significance level, the monthly number of in-patient morbidity and mortality cases on Malaria, HIV/AIDS and Pneumonia significantly fits Poisson distribution better than Binomial.

Secondly, it is highly unlikely that more than 10 admitted patients will die of malaria, HIV/AIDS and pneumonia in a particular month. It is highly likely that less than 4 admitted patients will die of malaria, HIV/AIDS and pneumonia in a particular month.

6. RECOMMENDATIONS

It is recommended that the hospital should increase education and sensitisation of the general public on the incidence of infectious diseases in Ghana, through the provision of flyers and brochures. Also, interested researchers in this area may consider replicating the study in the other geographical region of the country.

REFERENCE

Allard, R. (1998). Use of Time-Series Analysis in Infectious Disease Surveillance. *Bulletin of the World Health Organization, 76*, 327–333.

American Heritage Dictionary (2009). *The American Heritage Dictionary of English Language* (4th ed). USA: Random House Publishing Group.

Boateng, C. (11th September, 2012). Infectious Diseases Kill More Poor People Annually. Daily Graphic Retrieved from http://www.modernghana. com/news/416916/1/infectious-diseases-kill-more-poor-people-annually.html on 4th March, 2014.

Cruz, M. G. (2002). *Modelling, measuring and hedging operational risk*. UK: John Wiley & Sons, Ltd.

Davison, A. C. (2003). *Statistical Models*. UK: Cambridge University Press.

Dimitroy, N. B., and Meyers, L. A. (2010). Mathematical Approaches to Infectious Disease Prediction and Control. *Tutorials in Operations Research*.

La Verle, B. (1994). *Ghana: A Country Study. Federal Research Division.* Washington, DC: Library of Congress.

www.ajaroniline.com Vol.1, No.1 ISSN 2408-7920 January 2015
[1] mykemanford@yahoo.com
[2]theodoke@yahoo.com
Manford, M[1]., and Oduro-Okyireh, T[2]. (2015) Modeling In-Patient Morbidity and Mortality Cases of Some Infectious Diseases. In: Mojekwu, J.N., Ogunsumi,L.O., Ojigi,L.M. Atepor, L., Thwala,D.W., Sackey,S. Awere E., and Bamfo-Agyei, E. (Eds) African Journal of Applied Research .(AJAR) Journal, Vol.1,No.1 ISSN 2408-7920 January 2015, Cape Coast, Ghana. 118-128

Mandell, G. L., Bennet, E., and Dolin, R. (2005). *Principles and Practice of Infectious Diseases* (6th ed.). New York, NY: Churchill Livingstone; Kearney DJ, McDonald GB.

Marcovitch, H. (2005). *Black's medical dictionary* (41st ed.). London. UK: A & C Black Publishers Limited.

Microsoft Student Encarta. (2009). *An Electronic Encyclopaedia.* USA: Microsoft Corporation.

Oduro-Okyireh, T., and Manford, M. (2014). *Distributions of inpatient morbidity and mortality cases of some infectious diseases at Central Regional hospital, Ghana. (Unpublished)*

Renzullo, P. O., McNeil, J. G., Gardner, L. I., and Brundage, J. F. (1991). Inpatient morbidity among HIV-infected male soldiers prior to their diagnosis of HIV infection. *American Journal of Public Health*, *81*(10), 1280–1284. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles /PMC1405324/on 7th March, 2014.

Romeu, J. L. (2003). Kolmogorov-simirnov: A goodness of fit test for small samples. *START: Selected Topics in Assurance Related Technologies*, *10*(6).

Walker, J. R. (2012). *Mortality, Morbidity and Health*. Population Economics. Springer.

World Bank. (2010). *World development report, 1993*. New York: Oxford University Press.

World Health Organization (2005). *Fact Sheet*. WHO.

World Health Organization (2011). *WHO Statistical Information System*. Retrieved from http://www.who.int/whosis /data/Search.jsp on 4th March, 2014.