UNIVERSITY OF CAPE COAST

TREND ANALYSIS OF DISEASES REPORTED AT OUTPATIENT DEPARTMENTS: A CASE STUDY OF THE GREATER ACCRA REGION

BY

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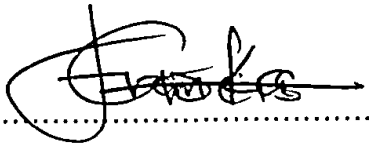
DECEMBER 2007

DECLARATION

STUDENT'S DECLARATION

I hereby declare that this dissertation is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: 

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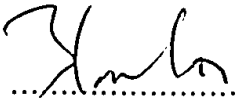
SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the university of Cape Coast.

Supervisor's Signature: 

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ABSTRACT

This study is about diseases reported at the outpatient departments (OPD) in the Greater Accra Region. The objectives of this study was to find the trend of the various diseases reported at the Outpatient Departments, forecast 2007 reported diseases and finally, to identify the most reported disease(s) within the period. Data was obtained from the Adabraka Polyclinic which is the coordinating center for the region's health statistics. The data covered the period 1996 to 2006.

Trend analysis was the main statistical technique used in the study. It was found that malaria constituted half of all cases reported at OPD each year. Malaria, upper respiratory tract infection and skin disease formed an overwhelming majority (about 52.4%) of diseases reported at the OPD each year. It was also found that all top ten diseases exhibited upward trends. Trend analysis of these diseases yielded various forecasted values for 2007.

ACKNOWLEDGEMENTS

My appreciation goes to my supervisor, Professor Benony K. Gordor whose criticism, encouragement and advice helped me to put together this great dissertation.

I am also grateful to the Greater Accra Regional Biostatistician for providing me with the data for this dissertation.

Lastly, I wish to express my profound gratitude to all my friends who contributed to the success of this work.

DEDICATION

To my wife, Erica Dzidzornu Goka and my daughter, Selase Abla Goka.

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CHAPTER ONE

INTRODUCTION

BACKGROUND

Human Disease, in medicine, is defined as any harmful change that interferes with the normal appearance, structure, or function of the body or any of its parts (http//Encarta.msn.com).

The study of the distribution of disease in human populations in a community has been the concern of medical research in recent times. The geographical distribution of a disease, the variations in its frequency at different times and the special characteristics of people affected by it are part of the basic description by means of which it is defined and recognized. Such information is used to plan and evaluate strategies to prevent illness and as a guide to the management of patients in whom disease has already developed (Barker *et al,* 1990).

In most African countries, a country-wide Health Management Information System (HMIS) compiles records about how many patients are being diagnosed with and treated for certain diseases. The actual data are meant to be collected and reported monthly by the individual health-care facilities. The HMIS compiles and analyzes these records, giving a picture of which patients are being treated across districts,

regions, and the entire country. Ideally, all facilities report their data promptly and comprehensively every month. This allows the construction of a matrix that shows which treatments are used across the country through space (where) and time (when).

In low-income countries, most people turn to outpatient departments for the prevention or treatment of most common diseases, including childhood diarrhea, lower respiratory infection, tuberculosis, sexually transmitted diseases and acute malaria. Outpatient services also account for the largest share of total health expenditure in most developing countries (Press Release WHO/47, 4 July 2000).

Ghana's President, John Kufuor, launched a National Insurance Health Scheme on Thursday 18 March 2004 in Accra. It has been designed to offer affordable medical care, especially to the poor and the vulnerable among Ghana's population. Before then Ghana operated a cost-recovery health delivery system generally referred to as the 'cash-and-carry' system since 1985. In this system, patients were required to pay up-front for health services at government clinics and hospitals. This however, pushed health care far beyond the reach of the ordinary Ghanaian. The government is currently financing the scheme by borrowing 2.5 percent out of a 17.5 percent levy that about 850,000 people in the formal sector already pay to the National Workers' Social Security Scheme. A new 2.5 percent National Health Insurance Levy will also be introduced into a fund to cater for those who cannot afford to make contributions (http: //www.irinnews.org/report.).

RESEARCH PROBLEM

According to WHO press release in July 4, 2000, many countries, rich or poor, find it difficult to assess how well their health systems are performing and how to make them perform better. But health systems are complex and have to a large extent defied precise evaluation. Outpatient services however, account for the largest share of total health expenditure in most developing countries including Ghana. This is due to the fact that most people turn to these services for the prevention or treatment of the most common diseases; and it has been noticed that most Governments in this developing world have been paying too little attention to the organization of these ambulatory health services. It is against this background that this research is being done.

OBJECTIVE OF THE STUDY

The objectives of the study are to

1. Find the trend of the various diseases reported at the outpatient departments (OPD) in the Greater Accra Region.
2. Forecast 2007 reported diseases at the OPD in the Region.
3. Estimate the annual average growth rates for the various diseases reported at OPD in the Greater Accra Region.
4. Identify the most reported disease(s) at the OPD within the period in the Region.

LIMITATION OF THE STUDY

This study analyzed cases seen at the outpatient department. We would not be able to tell if such cases have a direct link to the number of admissions or the number of deaths at the hospital. This then opens up other areas for further investigations in the future.

DATA

In Ghana, a country-wide health management information system (HMIS) compiles records about how many patients are being diagnosed with and treated for various diseases. The actual data are meant to be collected and reported monthly by the individual health-care facilities. The HMIS compiles and analyzes these records, giving a picture of which patients are being treated across districts, regions, and the entire country.

However, many of the health facilities operate under difficult circumstances, and reporting them every month is difficult. As a result, data are normally submitted two times in a year (i.e. mid-year and end-of-year) and most of these data are secondary. Diseases reported at the outpatient department is part of the data compiled by the HMIS each year. Patients who visited the outpatient department in a particular year are categorized by the type of disease they were diagnosed with. These data are sometimes put in a chart form, arranged in ascending order, where the highest reported diseases tops the chart and it follows in that order.

For the purpose of this dissertation, we would analyze the data compiled on reported diseases at the outpatient department in Greater Accra Region. These data cover the period from 1996 to 2006.

LITERATURE REVIEW

With a population of about 1,695,136 people (2000 National Population Census), Accra, Ghana's capital since 1877, is today one of the most populated and fast growing metropolis of Africa with an annual growth rate of 3.36%. It is estimated that the city accommodates between 2.5 million to 3 million people in terms of socio-economic activities aside the residential dimension captured by the 2000 National Population Census. The table below shows the population growth rate from five population censuses.

Table 1: Population Growth Rate from five Population Censuses

	1960	1970	1984	2000	2002
Population	338,396	636,667	969,195	1,658,937	1,801,606
Population growth rate	-	6.32%	7.51%	4.30%	4.3%

Source: 1960, 1970, 2000 and 2002 National Population Census.

Accra's population like that of other urban centers is a very youthful one with 56% of the population under the age of 24 years. We realized from the table below that 51%

of the population are females and the rest 49% males. This gives a sex ratio of 1:1.04 males to females. Age and sex structure of the Region can be found in Table 2.

Table 2: Age-sex Structure of the Accra Metropolitan Assembly (2000)

Population Cohort	Male Population	Female Population	Total Population	Total (%)
0-4	91,852	95,523	187,375	11.29
5-9	90,677	97,887	188,564	11.37
10-14	84,224	94,779	179,003	10.79
15-19	89,473	98,657	188,130	11.34
20-24	93,762	93,060	186,822	11.26
25-29	84,262	85,598	169,867	10.24
30-34	64,528	65,026	129,554	7.81
35-39	51,588	52,750	104,338	6.29
40-44	42,464	41,755	84,219	5.08
45-49	35,335	31,477	66,812	4.03
50-54	25,548	23,887	49,435	2.98
55-59	18,414	15,096	33,510	2.02
60-64	13,603	12,608	26,211	1.58
65+	31,636	33,461	65,097	3.92
TOTAL	**817,373**	**841,564**	**1,658,937**	**100.00**

Source: 2000 National Population Census

Table 3: Ratio of Physicians to the Population

Year	Ratio
1990-2004	5 per 100,000 people
1990-2003	9 per 100,000 people
1990-2002	6 per 100,000 people

Source: UNDP - Human Development Report 2006, 2000 and 2003

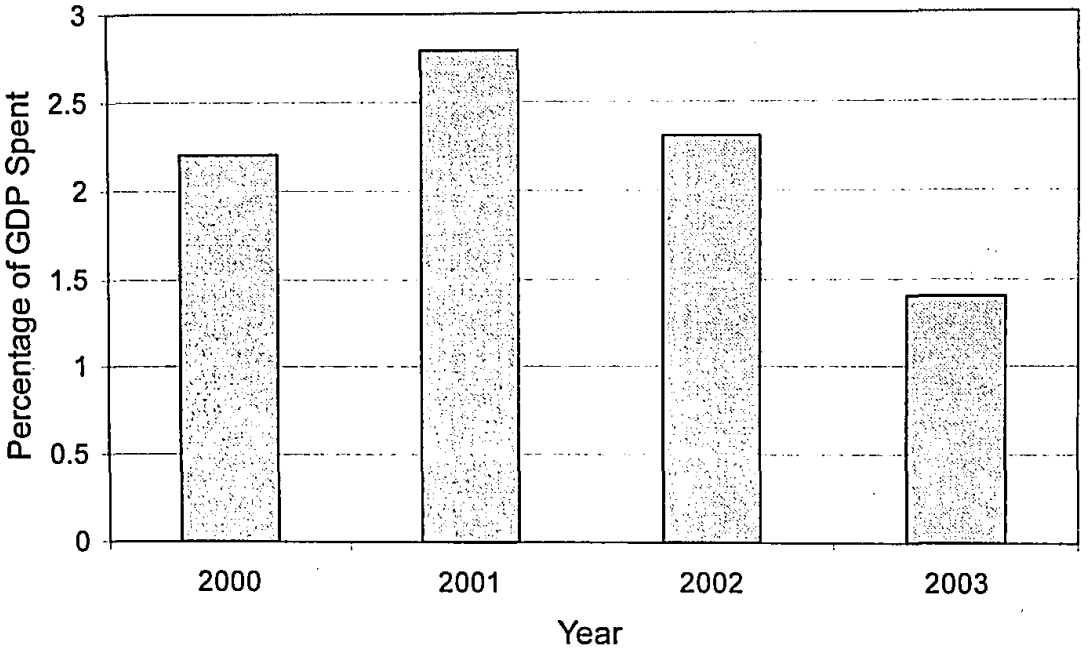

Figure 1: Percentage of GDP Spent on Health

Ghana Statistical Service report on health, nutrition and environmental Statistics Section for the year 2005 was based on data collated mainly from the 2000 Population and Housing Census Report, Secondary data from the Ghana Health Service and other Ministries, Departments and Agencies and Survey reports of the

Ghana Statistical Service (http://www.statsghana.gov.gh/Health_Nutrition.html).

The report focused on trends in the health, nutrition and environmental sanitation at the Regional level. This report looks at the structure of the health system including service delivery (both curative and preventive services) the availability of health facilities and health manpower levels. The main results indicate a general increase in health facilities nationwide from 251 in 1991 to 286 in 2003 for hospitals and 1138 for health centers and clinics in 1991 to 1487 in 2003. These are increases of 13.9% and 30.7% respectively, over a period of 12 years. The number of hospitals for Greater Accra region almost doubled within the period while those in Ashanti region increased by only 6.6%. On the other hand, the number of hospitals in the Central, Volta, Northern and Upper East regions decreased. With regards to health centres, however, substantial increases occurred in all the regions except Central and Greater Accra regions which experienced a fall in the number of health centres and clinics.

One major concern is the equitable distribution of health resources. Regions in the northern part of the country have fewer health facilities and lower coverage in preventive health services resulting in high hospital admission rates per capita for the people in those regions. Health manpower levels specifically for medical doctors and auxiliary nurses showed very little increase for Western and Central regions between 2002 and 2003 but with a fall for the other regions. However, apart from Eastern and Upper West regions all the other regions experienced very little increases in the level of professional nurses from 2002 to 2003. Health care services provided to the people both as curative and as preventive services showed improvements. The per capita out-patient visits rose from 0.42 in 2000 to 0.52 in 2004. Hospital admissions per 1000

population also increased from 32.1 to 35.3 during the same period. Coverage of immunization has been increasing over the years and the yearly target for immunization of 85% has been exceeded in some of the regions.

The pattern of the incidence of diseases in the population has not shown any appreciable change. Malaria continues to top the list of diseases managed at the out-patient departments of hospitals and clinics (44%), followed by upper respiratory track infections (7.2%), diarrhoeal diseases (4.3%), skin diseases (4.1%) and hypertension (2.7%). The major causes of morbidity and mortality in the country are preventable or communicable diseases such as malaria, tuberculosis and HIV/AIDS.

The 2003 performance report of Ghana Health Service also revealed that malaria continues to be the highest cause of outpatient visits and hospital admissions in health facilities across the country. Between 42% and 44% of all outpatient cases are due to malaria and 30% to 36% of all admissions are also due to malaria. From detailed information from 20 sentinel districts across the country, malaria accounts for nearly 18% of all deaths with its proportional mortality rate contributing to about 30% in children under five years old. The case fatality in the under five however dropped from 3.74% to 3.67% in 2003. Strategies for prevention do not appear to be preventing incidence even in areas where prevention coverage is high. Upper East region has the highest coverage in insecticide treated materials usage of over 90 per cent but still recorded a disproportionately high incidence of malaria cases in the current year.

Outpatient department attendance per capita was 0.50 as against 0.49 in 2002. The regional distribution showed that Western, Eastern, Volta and Northern regions remained well below the national average while Ashanti, Brong Ahafo and Upper East

regions performed above the national average (figure 2). Upper East Region had a per capita attendance almost double that of the northern region with the other deprived regions showing increased performance during the year. The increase in utilization in the Upper East Region was attributed to the disturbances and resultant state of emergency imposed on the northern region causing people to move out of the region to seek care in health facilities in the Upper East Region. The utilization figures show that this may have continued throughout 2003. The Ghana Health Service saw 68% of the total reported outpatient visit during the year. Mission facilities followed with 14% and the two teaching hospitals contributed 9%. Quasi government facilities and private providers saw 6% and 3% respectively of the total reported outpatients visit. These reported visits exclude the Military and the Trust Hospitals who have persistently not been able to provide utilization figures for compilation.

A research conducted by Adams *et al* (2004) revealed that outpatient attendance from 1985 to 2003 illustrated the increasing burden of malaria in Ghana. Communicable diseases accounted for about two third of outpatient visits, but their relative share has changed over time. While there is an overall consistent decrease of other infectious and parasitic diseases (from 31.8% in 1985 to 19.5% in 2003), there has been an increase in malaria cases (from 37.1% in 1985 to 44.7% in 2003). The decreasing trend in other communicable diseases is related to the downward trend in the percentage of outpatient visits for diarrhea diseases (from 8.3% in 1985 to 4.2% in 2003) and vaccine preventable diseases, such as measles (from 3.4% in 1985 to 0.1% in 2003).

Fluctuations over time were observed for non-communicable diseases, whereas

there was an increase in other (unspecified) diseases that were not individually reported in the list of diseases in the monthly outpatient form. Some important non-communicable diseases (such as diabetes) were not individually reported in this list and were included in the category of other (unspecified) diseases. This may have led to the underestimation of non-communicable diseases as well as to the inflation of cases of other (unspecified) diseases.

Analysis of patterns and trends of hospital resource use by cause and severity shows that to a large extent primary curative care is currently provided in hospital settings, with simple malaria cases accounting for a large share of outpatient and inpatient services even in referral facilities. In particular, malaria accounted for 20.8% of the admissions in regional hospitals and for a higher percentage in mission hospitals (24.9%) and in district government hospitals (28.9%).

Annual OPD visits in United States of America increased by 39% to approximately 90 million between the period 2003 to 2004. Although the majority (80%) of OPD patients was seen by a physician during 2003-2004, the role of mid-level providers (e.g., physician assistants, nurse practitioners, and midwives) became more prominent. Since 1993-1994, the percentage of visits in which only a mid-level provider was seen increased from approximately 6% to 11%. During the same period, the percentage of visits in which both a mid-level provider and physician were seen did not change, and the percentage of visits in which only a physician was seen decreased by 4%, from 81% to 78% (http://www.medscape.com/viewarticle/531789).

A retrospective analysis of data collected through the Manhiça morbidity surveillance system (Mozambique) on all paediatric visits (younger than 15 years) to the outpatient clinic from June 2003 to May 2005 revealed that a total of 94,941 outpatient visits were seen during the study period (http://www.malariajournal.com).

This paper describes the characteristics of children presenting with clinical malaria to the outpatient clinic of two health facilities in a rural area of southern Mozambique. Malaria represents a huge burden for the primary health care services, accounting for around 30% of the total visits. The age distribution of outpatient malaria is more spread out than that of malaria requiring admission to the wards, as children younger than three years represent 45% of the cases among outpatient attendees, while children younger than two years account for 58% of the cases among admitted children (Bassat *et al* 2008). Interestingly, children aged 5 to 14 years represent 36% of the malaria outpatient cases, whereas this percentage is only 9% among malaria cases that require admission to the hospital (Bassat *et al* 2008).

During 2004 and 2005, the Healthcare Commission in England carried out four national outpatient surveys across England. The NHS Surveys Advice Centre at Picker Institute Europe developed the questionnaires and methodology. Outpatient surveys were carried out in all 169 acute NHS trusts in England that have outpatient facilities. Maternity and psychiatric clinics were not included. Each NHS trust identified 850 patients who had attended its outpatient department in June, July or August 2004. Any patient aged 16 or over was eligible to participate in the survey. Sampled patients were sent a postal questionnaire and a covering letter. Patients who did not respond were sent up to two reminders.

In total, 143,596 patients were sent questionnaires and 84,280 completed questionnaires were returned. The overall response rate was 59% once undelivered questionnaires and questionnaires sent to deceased patients had been accounted for. Response rates varied among trusts, from between 38% and 78%. The 2003 outpatient survey had an overall response rate of 63%, with response rates varying from between 34% and 76%. Of those patients who returned completed questionnaires: 59% were female 10% were aged 16 to 35 years; 17% were aged 36 to 50; 29% were aged 51 to 65; and 43% were aged 66 or over 94% were white; 3% were Asian or Asian British; 2% were Black or Black British and 1% were of mixed race or from Chinese or other ethnic groups. The highest response rate (71%) came from men aged 66 years or over. The second highest response rate, at 69%, was from women in the 51-65 years old age group. Response rates were lowest for men aged 16-35 at 30%. Between 2003 and 2004/2005, the number of patients who saw a doctor during their outpatient visit was slightly fewer. Eighty two percent (82%) of patients said that they saw a doctor at some point during their outpatient appointment compared to 84% in 2003.

An article written by American Hospital Association in 1990 revealed that from 1979 through 1989, community hospital admissions and inpatient days declined by 11% and 15%, respectively, while the number of outpatient visits grew by 43.7%. Many factors have contributed to this rapid growth. Outpatient departments have proliferated. In 1984, 49% of all hospitals had an organized OPD; by 1988, more than three-quarters of all hospitals had an OPD, and by 1989, the proportion had risen still further to 81% (American Hospital Association, 1990).

Technological advances in surgery and anesthesia have enabled greater numbers of procedures to be performed safely on an ambulatory basis. From 1979 to 1989, the number of outpatient surgeries increased by 34%, while inpatient surgeries declined by 30%. Only 18% of all surgeries were performed on a hospital outpatient basis in 1979; by 1989, 49% of all surgeries were performed in an OPD. As payers concentrated on constraining costs growth for inpatient services, financial incentives were created to shift care to the outpatient setting whenever possible. Peer review organizations (PROs) have encouraged the shift to ambulatory care where appropriate. Finally, OPD use has grown as a result of increased hospital, physician, and patient acceptance of ambulatory care.

Kimberly *et al* (2005) also describes ambulatory care visits to hospital outpatient departments (OPDs) in the United States. Statistics were presented on selected hospital, patient, and visit characteristics. Selected trends in OPD utilization from 1995 to 2005 were also presented. The data presented in this report were collected in the 2005 National Hospital Ambulatory Medical Care Survey (NHAMCS), a national probability sample survey of visits to emergency and OPDs of nonfederal, short-stay, and general hospitals in the United States. Sampled data were weighted to produce annual national estimates. During 2005, an estimated 90.4 million visits were made to hospital OPDs in the United States, about 31.0 visits per 100 persons.

Females (37.2 per 100 persons) had higher OPD visit rates than males (24.7 visits per 100 persons), and black or African-American persons (56.8 visits per 100 persons) had higher OPD visit rates than white persons (28.3 visits per 100 persons).

Visit rates to OPD clinics for preventive care were highest for children under 1 year of age (43.1 per 100 persons). Almost one-half of OPD visits (46.1 percent) were made by patients with one or more chronic conditions. Hypertension was the most frequent chronic condition listed (19.7%). Visits with asthma declined with increasing age. From 1995 to 2005, the following visit characteristics changed: The visit rate for children under 15 years of age increased by 38%, the percentage of visits made by adults 18 years and over with depression indicated on the medical record increased by 48%; visits by adults with obesity, diabetes, and hypertension increased by 24%, 34%, and 43%, respectively; visits with counseling for tobacco use increased from 2.7 to 3.8 percent; visits with counseling for diet and nutrition increased from 9.4 to 15.7 percent; and visits with 6 or more medications prescribed or provided more than doubled, from 4.9 to 11.2 percent.

The data collected for this dissertation revealed that malaria, URTI and skin disease formed an overwhelming majority of diseases reported at the OPD in Greater Accra Region each year. Hypertension also showed the prominence of becoming a major disease at the OPD in the near future. A brief background of these diseases has been discussed below.

Malaria

About 1 to 5 million people die each year from malaria. World Health Organization puts the number of people affected annually at 300 million, but the Kenyan Medical Research Institute says there are actually 515 million cases a year of the deadliest form of malaria alone (http//www.AlertNet.org). According to the report,

malaria kills an African child every 30 seconds. It is also responsible for 20% of Africa's under-five mortality and 10 percent of the continent's overall disease burden. Less than five percent of people at greatest malaria risk have insecticide-treated mosquito nets to sleep under (http//www.AlertNet.org).

Malaria has infected humans for over 50,000 years, and may have been a human pathogen for the entire history of our species (Joy *et al,* 2003). References to the unique periodic fevers of malaria are found throughout recorded history, beginning in 2700 BC in China (Cox F. 2002). Malaria causes about 400–900 million cases of fever and approximately one to three million deaths annually (Breman J, 2001); this represents at least one death every 30 seconds. The vast majority of cases occur in children under the age of 5 years (Greenwood, *et al* 2005). Pregnant women are also especially vulnerable. Despite efforts to reduce transmission and increase treatment, there has been little change in which areas are at risk of this disease since 1992 (Hay, *et al* 2004). Indeed, if the prevalence of malaria stays on its present upwards course, the death rate could double in the next twenty years (Breman J 2001). Precise statistics are unknown because many cases occur in rural areas where people do not have access to hospitals or the means to afford health care. Consequently, the majority of cases are undocumented (Breman, 2001).

Malaria is presently endemic in a broad band around the equator, in areas of the Americas, many parts of Asia, and much of Africa; however, it is in sub-Saharan Africa where 85–90% of malaria fatalities occur. The geographic distribution of malaria within large regions is complex, and malarial and malaria-free areas are often found close to each other (Greenwood, 2002). In drier areas, outbreaks of malaria can

be predicted with reasonable accuracy by mapping rainfall (Grover, 2005). Malaria is more common in rural areas than in cities; this is in contrast to dengue fever where urban areas present the greater risk (Van, 2005). By contrast, in Africa, malaria is present in both rural and urban areas, though the risk is lower in the larger cities (Keiser, 2004).

Upper Respiratory Tract Infections

Upper respiratory tract infection (URTI) represents the most common acute illness evaluated in the outpatient setting. URTI's range from the common cold, typically a mild, self-limited, catarrhal syndrome of the nasopharynx, to life-threatening illnesses such as epiglottitis. Viruses account for most URTI's (http://www.emedicine.com/med/topic2339.htm).

The incidence of the common cold varies by age. Rates are highest in children younger than 5 years. Children who attend school or daycare are a large reservoir for URTI's, and they transfer infection to those who care for them. Children have about 3-8 viral respiratory illnesses per year. Adolescents and adults have approximately 2-4 colds a year, and people older than 60 years have fewer than 1 cold per year. Acute pharyngitis accounts for 1% of all ambulatory office visits.

The incidence of viral and bacterial pharyngitis peaks in children aged 4-7 years. Sinusitis is common in persons with viral URTI's. Transient changes in the paranasal sinuses are noted on CT scans in more than 80% of patients with uncomplicated viral URTI's. However, bacterial rhinosinusitis is a complication in only approximately 2% of persons with viral URTI's. Epiglottitis occurs at a rate of 6-

14 cases per 100,000 children, according to estimates from other countries. This condition typically occurs in children aged 2-7 years and has a peak incidence in those aged 3 years. Epiglottitis is estimated to occur at annual incidence of 9.7 cases per million adults. Vaccination has dramatically reduced rates of pertussis, including whooping cough. However, the incidence of whooping cough cases has recently increased to 4 cases per 100,000 United States of America's population in 2003. Adolescents and infants younger than 5 months account for many of these cases. In 2004, adults aged 19-64 years accounted for 7,008 (27%) of 25,827 reported cases of pertussis in the United States.

Challenges in laboratory diagnosis and over reliance on polymerase chain reaction (PCR) tests have resulted in recent reports of respiratory illness outbreaks mistakenly attributed to pertussis. Group A streptococcal bacteria cause approximately 5-15% of all pharyngitis infections, accounting for several million cases of streptococcal pharyngitis each year. This infection is rarely diagnosed in children younger than 2 years. Approximately 5-20% of Americans have the flu during each flu season. Early presentations include symptoms of URI.

EBV infection affects as many as 95% of American adults by age 35-40 years. Childhood EBV infection is indistinguishable from other transient childhood infections. Approximately 35-50% of adolescents and young adults who contract EBV infection have mononucleosis. After the advent of the diphtheria vaccine, case rates dramatically decreased in the United States. Since 1980, the prevalence has been approximately 0.001 case per 100,000 population. Diphtheria remains endemic in developing countries. Sporadic cases have recently affected adults. (http://www.eme

dicine.com/med/topic2339.htm).

Skin Diseases

The skin is the largest organ of the body and obviously the most visible. Although many skin diseases are isolated, some are manifestations of internal disease. Hence, a dermatologist is schooled in aspects of surgery, rheumatology (many rheumatic diseases can feature skin symptoms and signs), immunology, neurology (the "neurocuteaneous syndromes", such as neurofibromatosis and tuberous sclerosis), infectious diseases and endocrinology. The study of genetics is also becoming increasingly important (http://enWikipedia.org). Dermatologists are physicians (Medical Doctors, M.D.) or Doctors of Osteopathy (D.O.) specializing in the diagnosis and treatment of diseases and tumors of the skin and its appendages. There are medical and surgical sides to the specialty. Dermatologic surgeons practice skin cancer surgery (including Mohs' micrographic surgery), laser surgery, photodynamic therapy (PDT) and cosmetic procedures using botulinum toxin ('Botox'), soft tissue fillers, sclerotherapy and liposuction. Dermatopathologists interpret tissue under the microscope (histopathology). Pediatric dermatologists specialize in the diagnoses and treatment of skin disease in children. Immunodermatologists specialize in the diagnosis and management of skin diseases driven by an altered immune system including blistering (bullous) diseases like pemphigus. In addition, there is a wide range of congenital syndromes managed by dermatologists (http://enWikipedia.org).

Although diseases of the skin have been studied in some African countries, the provision of dermatology services is as yet a relatively underdeveloped aspect of

medicine in sub-Saharan Africa (Prosper, *et al* 2001). A study conducted by prosper, *et al (2001)* revealed the following. When diagnoses of the principal presenting complaint of 2254 consecutive new patients seen at the dermatology clinic of Komfo Anokye Teaching Hospital (KATH), Kumasi, Ghana, are presented and compared with those of 3383 consecutive new patients seen at the dermatology clinic of The William Harvey Hospital (WHH), Ashford, Kent, UK;

The most common conditions in Ghana were infections (46.3%; UK, 12%). In the UK, the most common conditions were malignant and premalignant diseases of the skin (22.2%; Ghana, 0.5%) and benign tumors (16.8%; Ghana, 0.5%). Dermatitis was common in both countries (Ghana, 18.4%; UK, 16.0%). Psoriasis was more common in the UK (6.2%) than in Ghana (0.4%). In Ghana, fixed drug eruption, mainly due to cotrimoxazole (Septrin), was not rare (27 cases), and complications from cosmetic skin lightening creams were a frequent problem among women (86 cases). No cases of rosacea were found in Ghana, but it was not uncommon in the UK (1.6%). The pattern of skin diseases of the two countries was seen to be different.

Hypertension

Hypertension is a condition of chronic elevated blood pressure in the arteries. Hypertension results from two major factors, which can be present independently or together. The heart pumps blood with excessive force or the body smaller blood vessels (known as arterioles) narrow, so that blood flow exerts more pressure against the vessels' walls (Schwartz *et al,* 1999).

Although the body can tolerate increase blood pressure for months and even years, eventually the heart may enlarge, which is a major factor in heart failure. Such pressure can also injure blood vessels in the heart, kidneys, the brain, and the eyes (Schwartz *et al,* 1999).

There are several categories of blood pressure. Normal blood pressure is Less than 120/80. Pre-hypertension measures 120-139/80-89. Stage one hypertension also measures140-159/90-99, whilst stage 2 hypertension measures160 and above/100 and above. People whose blood pressure is above the normal range should consult their doctor about methods for lowering it.The exact causes of hypertension are not known. Several factors and conditions may play a role in its development, including: Smoking, overweight, lack of physical activity, too much salt in the diet, too much alcohol consumption, stress, older age, genetics, family history of high blood pressure, Chronic kidney disease and adrenal and thyroid disorders.

There are usually no symptoms or signs of hypertension. In fact, nearly one-third of those who have it don't know it. The only way to know if you have hypertension definitely is to have your blood pressure checked. If your blood pressure is extremely high, there may be certain symptoms to look out for, including severe headache, fatigue or confusion, vision problems, chest pain, difficulty breathing, irregular heartbeat and blood in the urine. Hypertension is a serious condition that can damage the heart and blood vessels, and can eventually lead to several other conditions.

OUTLINE OF DISSERTATION

This dissertation has five chapters. Chapter 1, which is also known as Introduction wrote about the background of the study, stated the problem, and the purpose of this study. Readers can get an idea about the extent of the study including its limitations as well as data to be used in the study. Review of Literature displayed information (old and new) related to this research. The chapter consequently provided citations and sources. Chapter two reviewed the basic theories and methodologies used in analyzing the data. Preliminary analysis is the third chapter of this dissertation. Exploratory data analysis was used to describe the important characteristics of the data. The fourth chapter, further analysis, relied on the information preliminary analysis provided to determine the areas which needed to be further investigated. The last chapter summarized, discussed and gave conclusion on the findings based on the research objectives.

CHAPTER TWO

REVIEW OF BASIC THEORY AND METHODOLOGY

This chapter briefly reviews the basic theories and methods of statistical tools used in analyzing the data. Apart from the routine techniques such as graphs and tables, the discussion relies mainly on time series analysis. This technique is briefly reviewed in this section. For more discussion of time series, read books on time series analysis.

TIME SERIES

A time series is a sequence of data points, measured typically at successive times, spaced at (often uniform) time intervals. A time series analysis involves methods that attempt to understand such time series, often either to understand the underlying theory of the data points (where they come from, what generated them), or to make forecasts. There are two main goals of time series analysis. The first is to identifying the nature of the phenomenon represented by the sequence of observations, and forecasting (predicting future values of the time series variable). Both of these goals require that the pattern of observed time series data is identified and more or less

formally described. Once the pattern is established, we can interpret and integrate it with other data (http://www.statsoft.com).

In order to identify patterns in time data, it is often convenient to think of such data as consisting of several components: trend, cycle, seasonal variations and irregular fluctuations. Trend refers to the upward or downward movement that characterizes a time series over time. Cycle also refers to recurring up and down movements around trend levels. Seasonal variation is periodic patterns in a time series that complete themselves within a calendar year or less and then are repeated on a regular basis. Finally, irregular fluctuations are erratic time series movements that follow no recognizable or regular pattern. (Bowerman *et al,* 2001).

EXPONENTIAL SMOOTHING TECHNIQUE

Exponential smoothing refers to a particular type of moving average technique applied to time series data, either to produce smoothed data for presentation, or to make forecasts.

Even though significant work has been done to study the theoretical properties of (simple and complex) exponential smoothing the method has gained popularity mostly because of its usefulness as a forecasting tool. For example, empirical research has shown simple exponential smoothing to be the best choice for one-period-ahead forecasting, from among 24 other time series methods and using a variety of accuracy measures (Makridakis *et al,* 1983). Thus, regardless of the theoretical model for the process underlying the observed time series, simple exponential smoothing will often produce quite accurate forecasts.

SIMPLE EXPONENTIAL SMOOTHING

A simple and pragmatic model for a time series would be to consider each observation as consisting of a constant β_0 and an error component, ε (epsilon), that is:

$$y_T = \beta_0 + \varepsilon$$

The constant β_0 is relatively stable in each segment of the series, but may change slowly over time. If appropriate, then one way to isolate the true value of β_0, and thus the systematic or predictable part of the series, is to compute a kind of moving average, where the current and immediately preceding ("younger") observations are assigned greater weight than the respective older observations. Simple exponential smoothing accomplishes exactly such weighting, where exponentially smaller weights are assigned to older observations. The specific formula for simple exponential smoothing is:

$$S_T = \alpha y_T + (1-\alpha) S_{T-1}$$

where α is a smoothing constant between zero and one $(i.e.\ 0 \le \alpha \le 1)$ and S_{T-1} is the estimate of β_0 made in time period $T-1$. When applied recursively to each successive observation in the series, each new smoothed value (forecast) is computed as the weighted average of the current observation and the previous smoothed observation; the previous smoothed observation was computed in turn from the previous observed value and the smoothed value before the previous observation, and so on. Thus, in effect, each smoothed value is the weighted average of the previous observations, where the weights decrease exponentially depending on the value of

parameter α (alpha). If α is equal to 1 (one) then the previous observations are ignored entirely; if α is equal to 0 (zero), then the current observation is ignored entirely, and the smoothed value consists entirely of the previous smoothed value (which in turn is computed from the smoothed observation before it, and so on; thus all smoothed values will be equal to the initial smoothed value S_0 Values of α in-between will produce intermediate results.

DOUBLE EXPONENTIAL SMOOTHING

Single exponential smoothing provides good forecasts for series that in the short run vary around a reasonably constant means but for which the mean level changes over longer time periods. Other series may be better modeled by a process that assumes that the short-term behavior is approximated by a linear time trend but with the slope and intercept changing over a longer time horizon. Double exponential smoothing leads to estimates in this case. The model is written as

$$y_t = \beta_0 + \beta_1 t + \varepsilon$$

Where β_0 and β_1 vary over time. Estimates are obtained by smoothing the time series twice, hence the name double exponential smoothing. The estimation of β_0 uses a smoothing constant that MINITAB calls alpha and that of β_1 is called gamma.

CHOICE OF SMOOTHING CONSTANT

Some authors have suggested that the smoothing constant be selected rather arbitrarily, say, as $\alpha = 0.1$. Others have suggested choosing α based on a subjective

assessment of the variation in the series being smoothed. If the perceived changes in the level of the series seem to dominate the short-term variations, then a large value of α should be used. However, if the short-term variation is more prominent than the level changes, then a small value for the smoothing constant is advised. A more objective approach is to select a smoothing constant that leads to good "forecast" of the observed series. That is, use $\hat{\beta}_t$ to forecast y_{t+1} for a range of values of t and choose α to minimize the Root Mean Square Prediction Error (RMSPE).

Since the forecast involves powers of α, this minimization cannot be accomplished directly. Rather the smoothed series and the corresponding RMSPE are computed for a range of α values and the α chosen for the final smoothing is the one that produces the smallest value for RMSPE.

MEAN SQUARED DEVIATION AND MEAN ABSOLUTE DEVIATION

To calculate Mean Squared Deviation (MSD) we find the squared value of each forecast error and then average the resulting squared values. To calculate Mean Absolute Deviation (MAD), we find the absolute value of each forecast error and then average the resulting absolute values.

In general, we want a forecasting method that gives small values of the MAD and the MSD. Note, however that the MSD is the average of the squared forecast errors. It follows that the MSD, unlike the MAD, penalizes a forecasting method much more for large forecast errors than for small forecast errors. Therefore, the forecasting method that gives the smallest MSD may not be the forecasting method that gives the

smallest MAD. Furthermore, the forecaster who uses the MSD to choose a forecasting method would prefer several smaller forecast errors to one large error.

GROWTH RATES

Growth rates are calculated as annual averages and represented as percentages. Except where noted, growth rates of values are computed from constant price series. Three principal methods are used to calculate growth rates: least squares, exponential endpoint and geometric endpoint. Rates of change from one period to the next are calculated as proportional changes from the earlier period.

Least-Squares Growth Rate

Least-squares growth rates are used wherever there is a sufficiently long time series to permit a reliable calculation. No growth rate is calculated if more than half the observations in a period are missing. To estimate historical growth rates is by log-linear least squares regression. The regression method gives consideration to all data points in the series; thus, it is the least likely to be biased by a randomly high or low beginning or ending year. The only practical way to estimate a least squares growth rate is with a computer or a financial calculator.

Log-linear regression is a standard time-series linear regression in which the data for the dependent (Y) variable are plotted as natural logarithms. The slope of the regression line is then the average annual growth rate, assuming continuous compounding. These procedures can be used to find the growth rate of any variable that change over time.

Exponential Growth Rate

The growth rate between two points in time for certain demographic indicators, notably labor force and population, is calculated from the equation

$$r = \frac{\ln\left(p_n / p_1\right)}{n}$$

Where p_n and p_1 are the last and first observations in the period, n is the number of years in the period, and ln is the natural logarithm operator. This growth rate is based on a model of continuous, exponential growth between two points in time. It does not take into account the intermediate values of the series, nor does it correspond to the annual rate of change measured at a one-year interval, which is given by

$$\frac{\left(p_n - p_{n-1} / p_1\right)}{p_{n-1}}$$

Geometric Growth Rate

The geometric growth rate is applicable to compound growth over discrete periods, such as the payment and reinvestment of interest or dividends. Although continuous growth, as modeled by the exponential growth rate, may be more realistic, most economic phenomena are measured only at intervals, in which case the compound growth model is appropriate. The average growth rate over n periods is calculated as

$$r = \exp\left(\frac{\ln\left(p_n / p_1\right)}{n}\right) - 1$$

Like the exponential growth rate, it does not take into account intermediate values of the series.

CHAPTER THREE

PRELIMINARY ANALYSIS

In this chapter, we would be using exploratory data analysis which is a science of describing the important characteristics of a population or a sample. Graphical methods would be used to depict the data set and to study relationship between the different variables. Statistical tools such as simple bar charts and line graphs would be used to explore the data.

Table 2 below displays data on diseases reported at outpatient department from 1996 to 2006. Patients who visited outpatient departments in a particular year are categorized by the type of disease they were diagnosed with. The actual data are meant to be collected and reported monthly by the individual health-care facilities. However, many of the health facilities operate under difficult circumstances, and reporting them every month is difficult. As a result, data are normally submitted two times in a year (i.e. mid year and end of year). For classification of top ten diseases by year, see the Appendix.

Table 4: Data on Diseases Reported at Outpatient Departments in Greater Accra Region from 1996 to 2006

DISEASE/YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
MALARIA	285,954	299,696	273,975	254,003	260,475	358,249	399,306	399,261	400,378	472,146	450,308
URTI	71,947	69,735	63,601	67,781	71,637	80,781	84,805	89,556	96,084	105,059	100,938
SKIN DISEASE	53,776	43,242	41,757	36,362	43,311	53,358	57,202	64,872	55,180	68,999	62,366
ACCIDENT RELATED	35,624	29,833	28,804	29,848	36,213	36,640	23,551	43,273	28,187	30,259	-
DIARRHOEA	28,774	28,123	27,711	29,422	27,359	35,701	36,362	41,217	38,528	48,958	37,248
PREG. RELA COMPL.	18,338	19,723	21,378	24,212	24,000	23,440	29,624	27,463	25,709	39,403	27,330
HYPERTENSION	16,559	17,104	27,379	23,506	28,379	34,859	44,912	50,248	49,822	68,305	70,949
ACUTE EYE	16,818	13,243	17,157	18,081	24,989	21,681	32,817	42,054	34,673	38,292	38,444
DENTAL RELA.	-	17,234	20,050	19,189	18,490	18,072	19,849	23,520	-	27,590	-
RHEUMATISM	12,023	-	-	14,329	13,579	18,931	19,958	-	23,133	-	-
GYNAE	17,619	13,648	12,921	-	-	-	-	23,209	22,368	-	25,048
ANAEMIA	-	-	-	-	-	-	-	-	-	27,560	26,938
ACUTE EAR	-	-	-	-	-	-	-	-	-	-	25,430
TOTAL TOP TEN	557,432	551,581	534,733	516,733	548,432	681,712	748,386	804,673	774,062	926,571	864,999
ALL OTHER DISEASES	164,851	146,836	95,784	176,732	207,772	299,952	292,250	286,409	305,078	350,089	354,671
GRAND TOTAL	722,283	698,417	630,517	693,465	756,204	981,664	1,040,636	1,091,082	1,079,140	1,276,660	1,219,670

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GRAND TOTAL	722,283	698,417	630,517	693,465	756,204	981,664	1,040,636	1,091,082	1,079,140	1,276,660	1,219,670

A GENERAL VIEW AT THE ENTIRE DATA SET (1996-2006)

The table shows that 13 diseases were seen over the 11 year period. However, it is only eight of them that consistently appeared each year on the top ten chart throughout the period. It can also be observed that total number of patients seen at the OPD each year ranges from 630,517 to 1,276,660. On the average, about 926,340 cases are reported at OPD annually in Greater Accra Region.

Malaria tends to record the highest number of cases each year throughout the eleven years. We can therefore say it is the most reported disease at the OPD, with an average of 350,341 cases per year. It constitutes about 50% of the top ten diseases recorded every year. Whiles the other diseases which appeared on the top ten chart shared the remaining 50%. Upper respiratory tract infection (UTRI) and skin diseases maintained second and third positions respectively throughout the period, but the number of cases on them were far less than that of malaria.

Anaemia and acute ear infections are those diseases which only emerged in the last two years of the period. Rheumatism, gynaecological and dental related diseases did not appear regularly in the chart, but quite a higher number of cases were recorded on them whenever they emerge on the chart.

ALL REPORTED DISEASES AT OPD FROM 1996 TO 2006

Figure 2 exhibits the trend of total number of diseases reported at the outpatient department within the period under review. Since all diseases are inclusive, the figure gives us a fair idea about the rate at which people in greater Accra Region visit the outpatient department each year

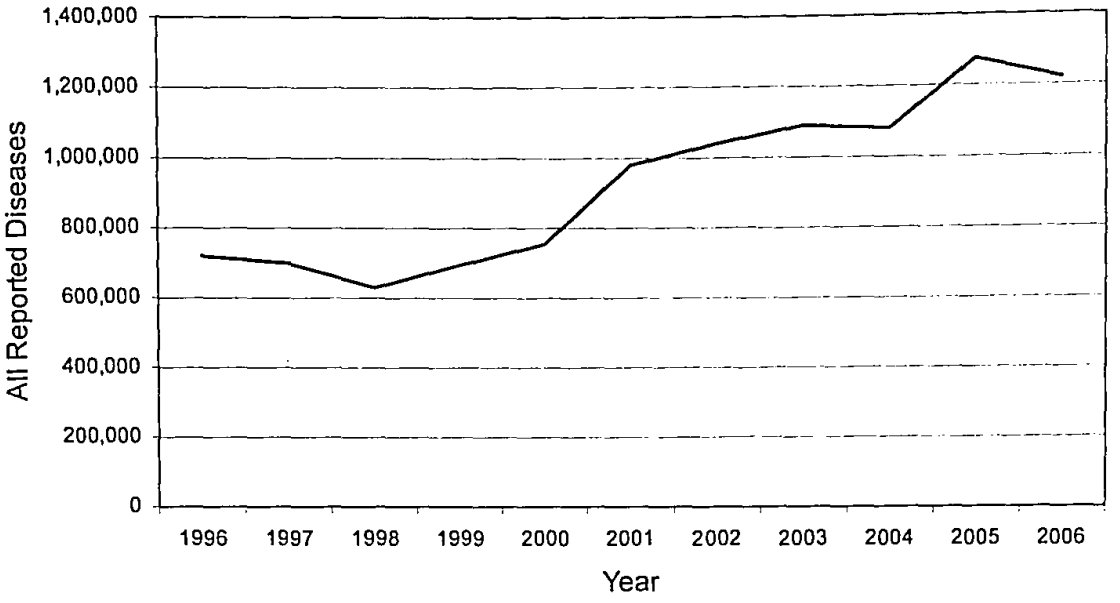


Figure 2: All Diseases reported at OPD in the Region

Generally, total number of cases reported at the outpatient department is increasing. Although cases reported decreased slightly in 1998, it increased till 2005 before experiencing another decrease. The highest number of reported cases was in 2005 whiles the minimum number of cases was recorded in the year 1998.

TREND OF TOP TEN AND OTHER DISEASES FROM 1996 TO 2006

Figure 3 compares the trends of top ten diseases and other diseases reported at the outpatient department within the period under review. The graph revealed that the total top ten diseases reported far exceeds that of other diseases. It is also evident that apart from occasional fluctuations in the number of cases reported at the out patient department, top ten and other diseases generally exhibited an increasing trend. However both top ten diseases and other disease experienced a decreasing trend from the beginning of the period before it started increasing.

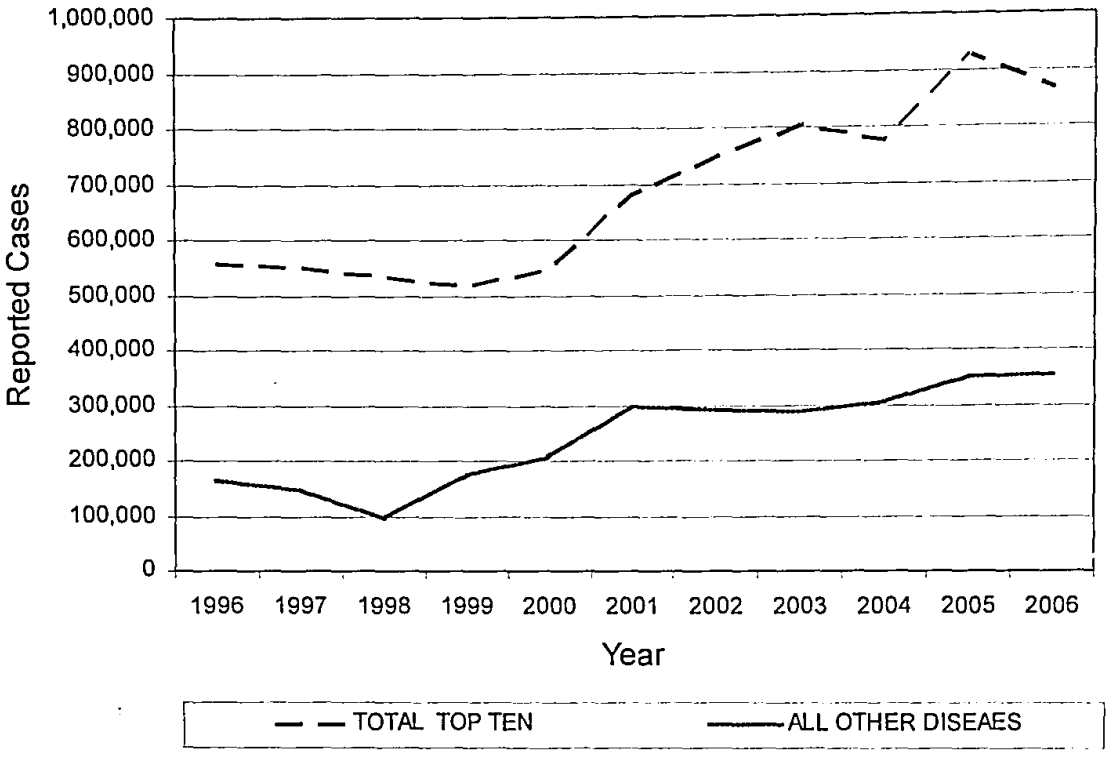


Figure 3: Top Ten and All Other Diseases at OPD in Greater Accra Region

DISTRIBUTION OF TOP TEN DISEASES FROM 1996 TO 2006

Figure 4 shows the distribution of top ten diseases reported at outpatient department in 1996. An overwhelming number of cases on malaria were recorded in 1996. It can also be observed that malaria had over 50% of the total cases reported and other diseases which appeared on the chart shared the remaining cases reported.

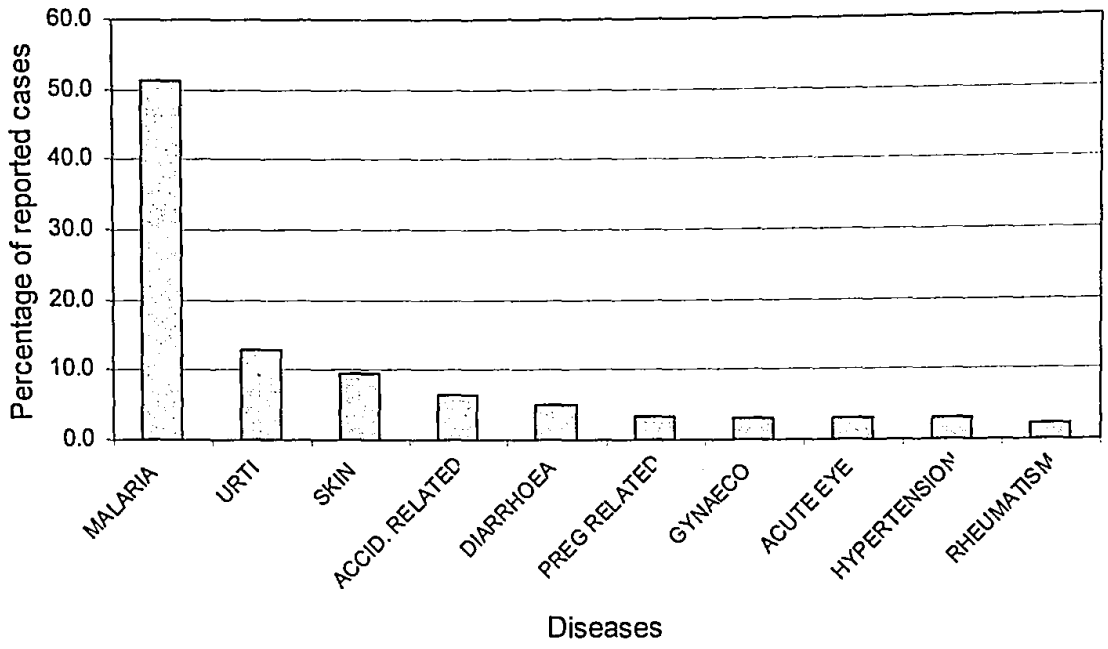


Figure 4: Top ten diseases at OPD in 1996

The number of cases recorded on every disease each year is expected to reveal how the various diseases fared on the top ten charts within the period. The distribution of the top ten diseases for the remaining years (i.e. from 1997 to 2006) can be found in the charts below. Various diseases that were recorded at OPD within the period have been labeled as follows:

1 represent malaria

2 represent upper respiratory tract infection

3 represent skin diseases

4 represent accident related cases

5 represents diarrhea

6 represent pregnant related complications

7 represent gynecological cases

8 represent acute eye diseases

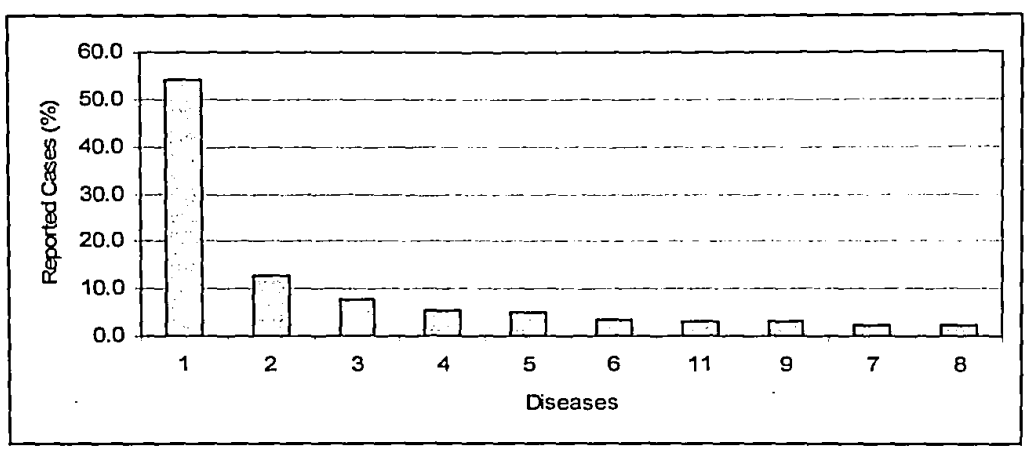
9 represent hypertension

10 represent rheumatism

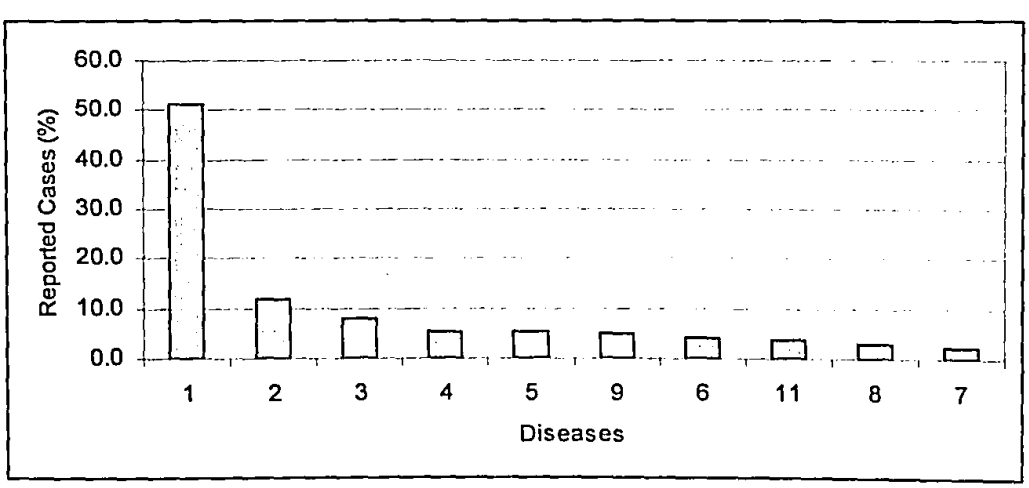
11 represent dental related cases

12 represent anemia

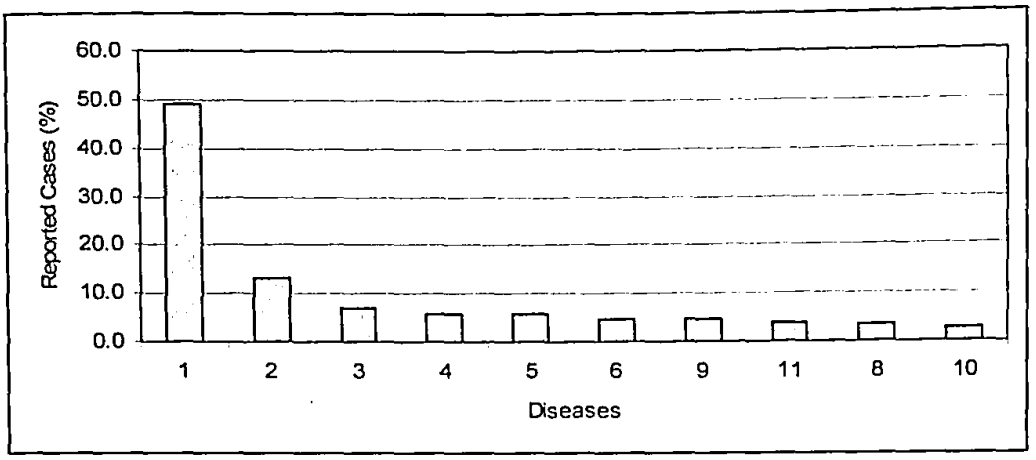
13 represent acute ear diseases



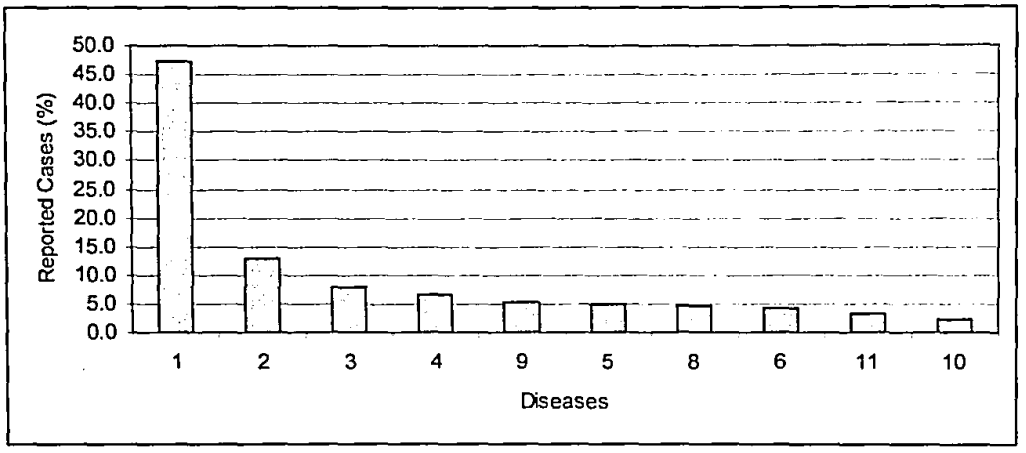
1997



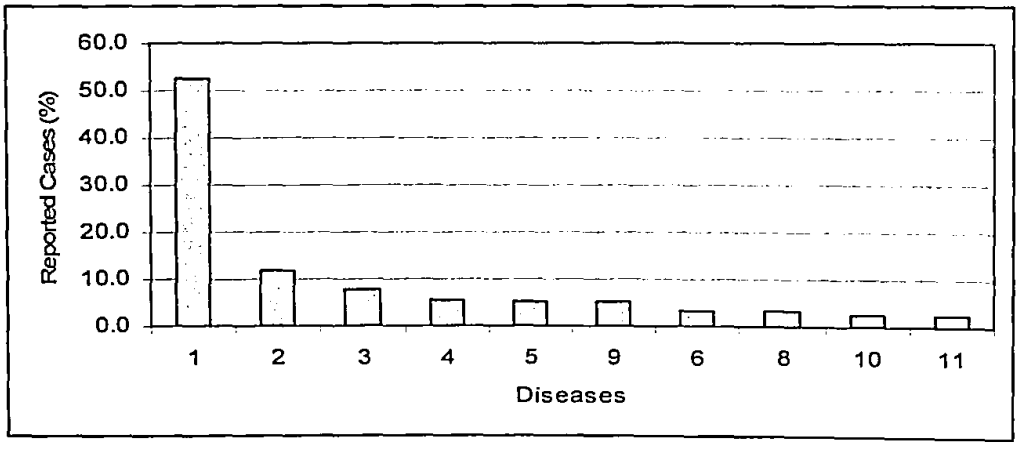
1998



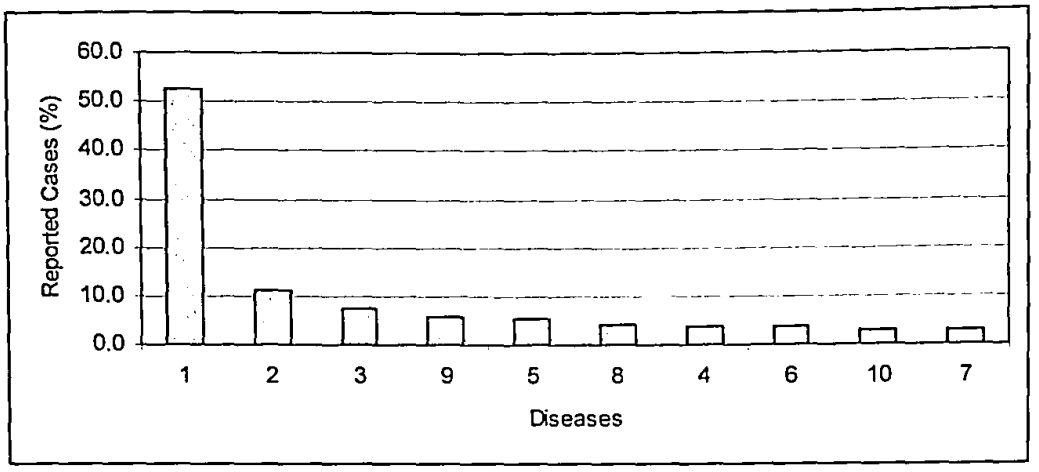
1999



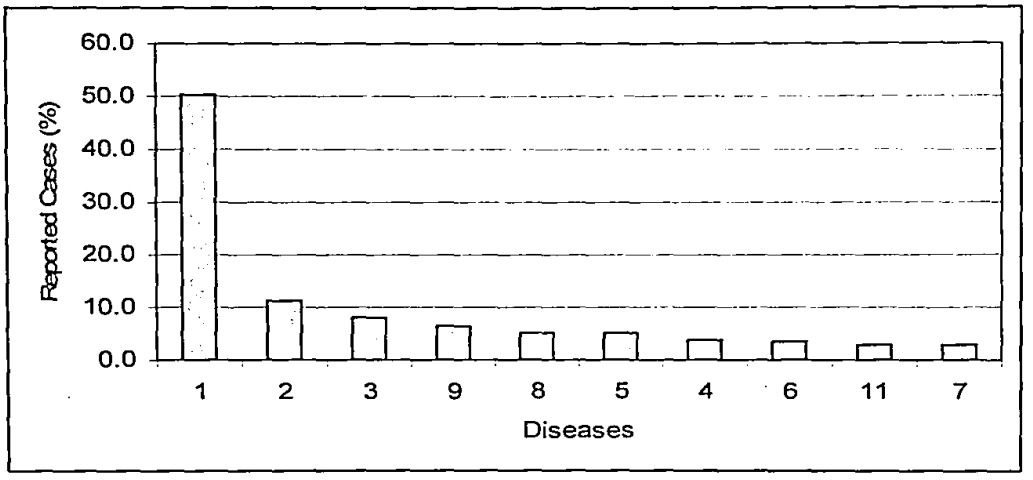
2000



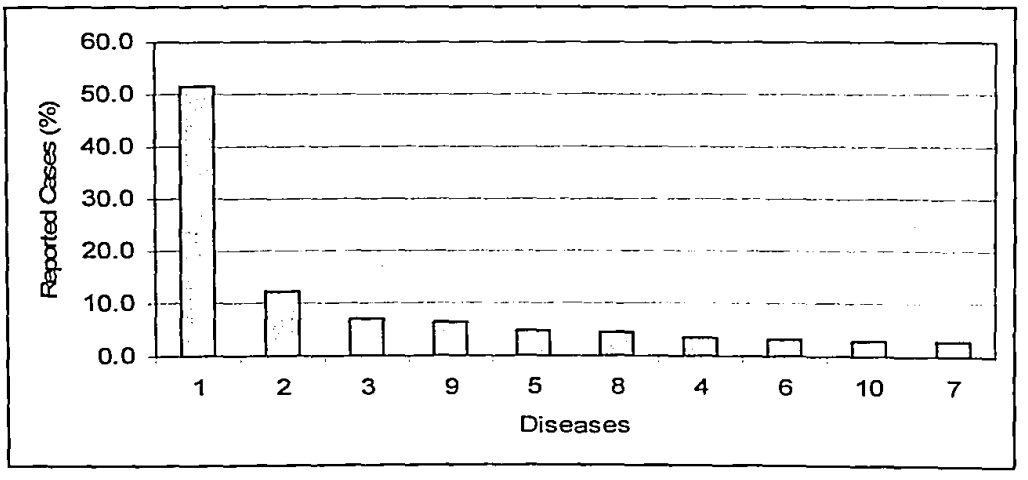
2001



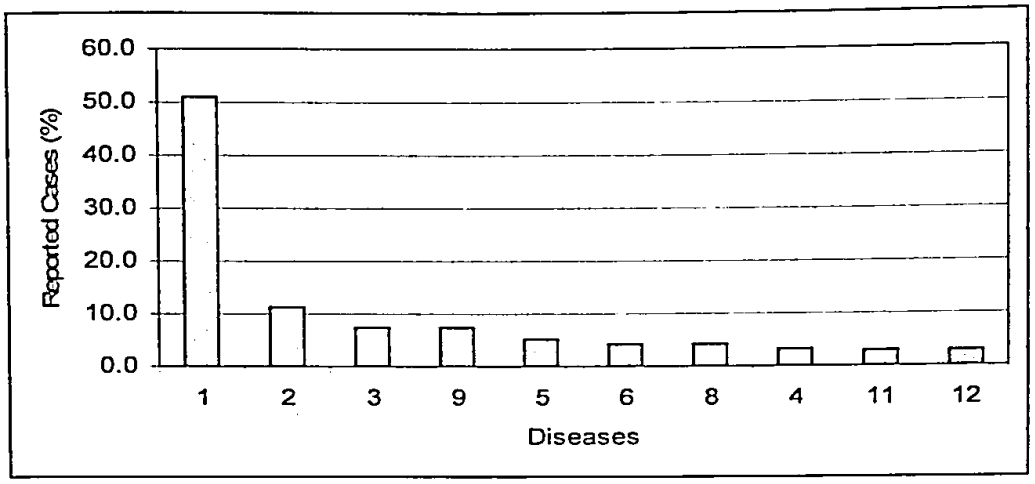
2002



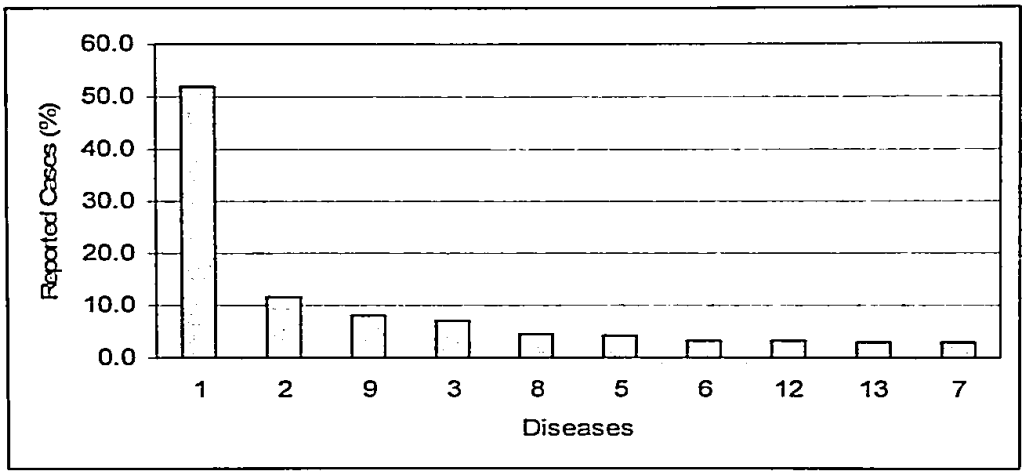
2003



2004



2005



2006

The Figures above displayed the distribution of the top ten diseases from 1997 to 2006. Malaria occupied the first position each year, whilst URTI consistently occupied the second position. Skin diseases however, remain at the third position from the beginning of the period till the last year before hypertension took its position. The remaining diseases occupied different positions from one year to another. For example, in 2003 accident related cases occupied seventh position. However in 2005, its position

became eighth. It can also be observed that hypertension moved from ninth position from the beginning of the period to the 3rd position in the last year.

TREND OF MALARIA, URTI AND HYPERTENSION IN THE REGION

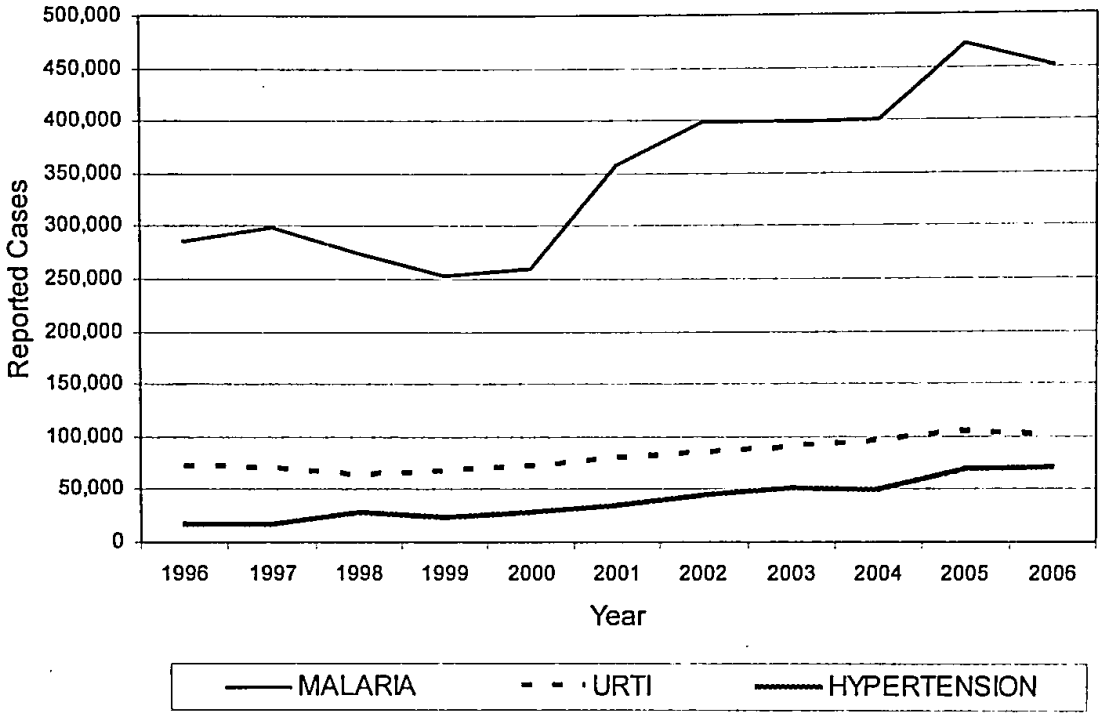


Figure 5: Malaria, URTI and Hypertension in the Region

From the graph, it can be observe that all the three top diseases reported at the OPD exhibit an increasing trend. URTI and hypertension exhibited similar trends, where reported cases increased slowly over the period. Malaria however, had a rapid increase in reported cases over the period, but it experienced more fluctuations.

In this preliminary analysis, a number of results emerged. It was observed that malaria constituted about 50% of all cases seen at OPD through the study period (1996 to 2006). Upper respiratory tract infection and skin diseases together with malaria constitute

the three most reported cases at the OPD (about 52.4%). Each of these cases exhibited an increasing trend. This means that the series is non-stationary. Consequently, an appropriate technique for forecasting diseases is a trend analysis rather than moving averages. In the next chapter, trend analysis is performed for various diseases

CHAPTER FOUR

FURTHER ANALYSIS

In the exploratory data analysis, it was observed that eight diseases occurred consistently in the top ten chart throughout the period. Hence, the trend of these diseases was investigated within the period and appropriate smoothing techniques were used for forecasting.

Since there are some errors associated with point prediction, 95 percent confidence prediction interval was also used. Again, to help check the accuracy of the prediction, data recorded within the period 1996-2005 were used to forecast 2006 and 2007 figures. Then 2006 actual figures were compared with the predicted figures for 2006. This was used as the basis to check the accuracy of 2007 forecasted figures.

As discussed earlier in Chapter two, a more objective approach to select a smoothing constant is to select the one that leads to good "forecast" of the observed series. Hence all the smoothing constants that were used in the forecast were based on the closeness of the 2006 forecasted figures to the 2006 actual figures.

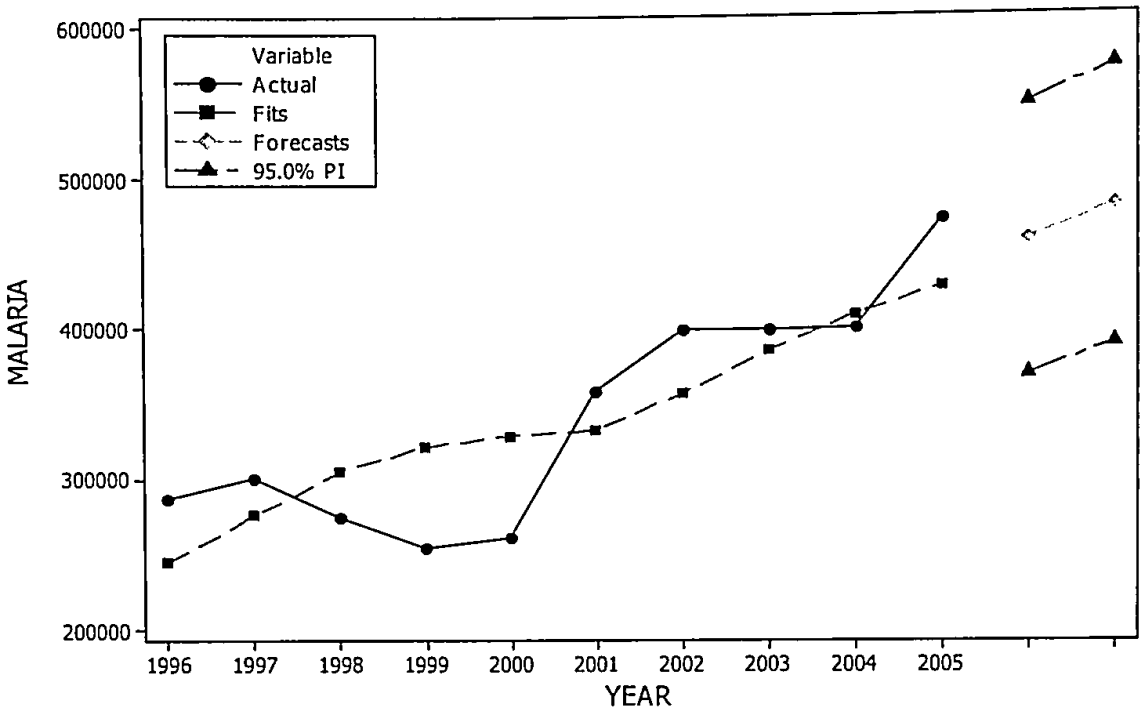


Figure 6: Malaria cases reported from 1996 to 2005

The figure reveals that cases seen at the outpatient department from 1996 through to 2005 generally experienced an increasing trend in malaria reported cases. Although there was an overall increasing trend, malaria cases experienced a decreasing trend from 1997 to 1999. It can also be observed that malaria cases between 2002 and 2004 did not register any significant change.

Double exponential smoothening technique was used in forecasting 2006 and 2007 cases. The smoothing constants chosen were $\beta_0 = 0.2$ and $\beta_1 = 0.2$. By comparison, 2006 actual figure and the forecasted figure registered an error of about 8,468 cases. However, 2007 forecasted figures for malaria gave 481,119 as point prediction and

[388,929, 573,309] prediction interval at 95% confidence. Hence we expect an increase in malaria cases in 2007 at OPD.

UPPER RESPIRATORY TRACT INFECTION

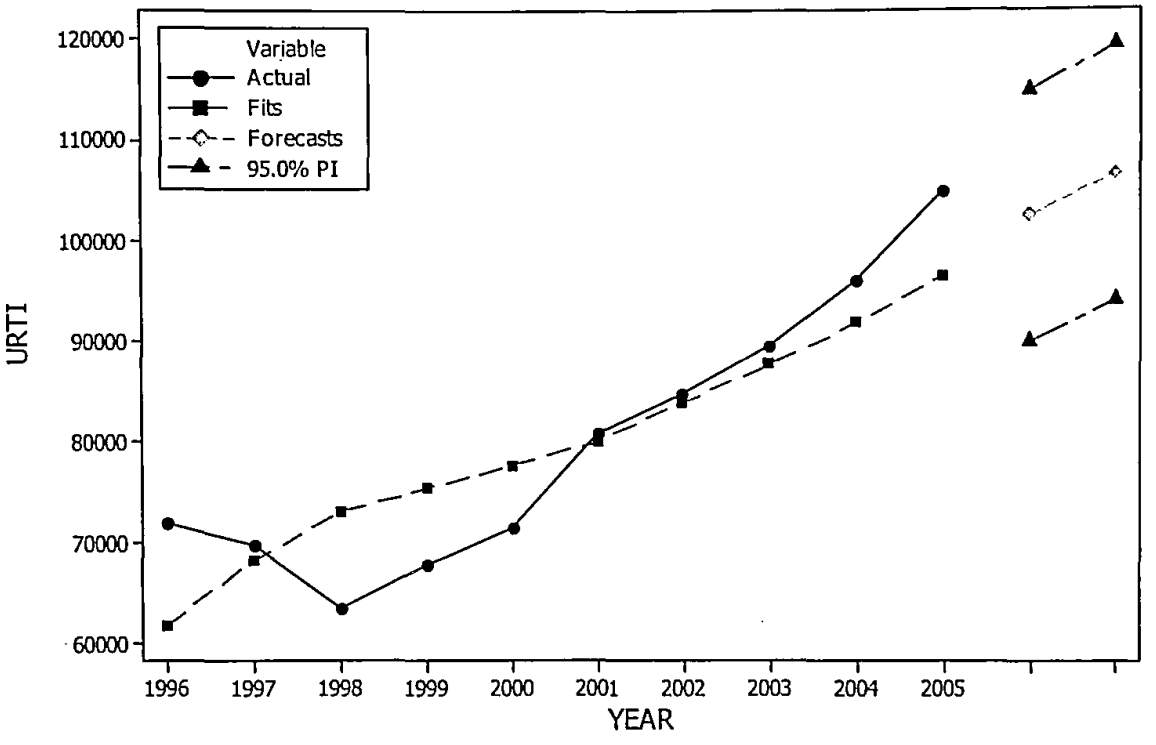


Figure 7: Upper Respiratory Tract Infection cases reported from 1996 to 2005

Figure 7 shows that URTI cases reported was generally increasing after experiencing a short decreasing trend within the first three years (i.e. 1996 – 1998). The year 1998 recorded the lowest cases in the period.

A good forecast was realized when $\beta_0 = 0.2$ and $\beta_1 = 0.2$ were chosen as smoothing constants. An error of about 1,629 cases was recorded when 2006 URTI reported cases were compared with the forecasted figure. Prediction for 2007 shows that

UTRI reported cases would increase to about 106,824 cases if point prediction should be relied on. But it is expected that 2007 UTRI cases will fall within the interval [94,099, 119,548] at 95% confidence.

SKIN DISEASES

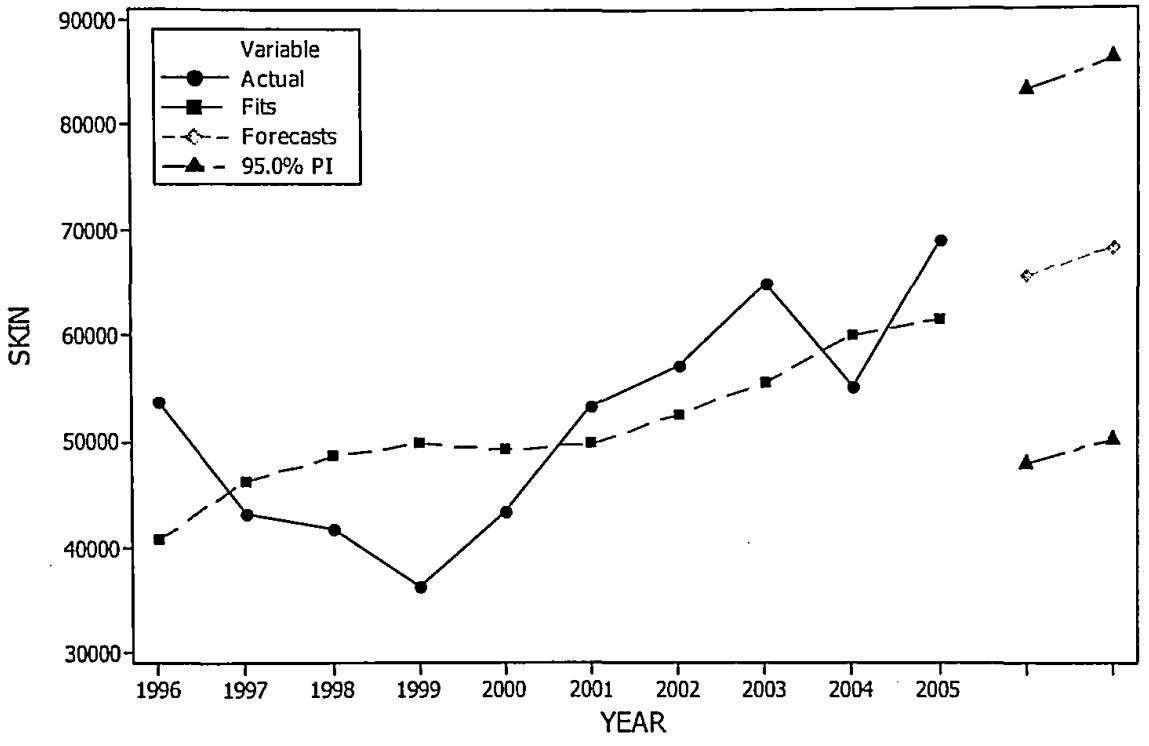


Figure 8: Trend of skin diseases reported from 1996 to 2005

In Figure 8, it can be observed that reported cases on skin related diseases continued to decreases from the beginning of the period till 1999 before cases started increasing. However, in the year 2004, skin related diseases experienced a decrease in trend once again, but shot up the following year. Generally, we can say that skin related diseases exhibited an increasing trend.

There was an error of about 3,183 when $\beta_0 = 0.2$ and $\beta_1 = 0.2$ was used to forecast 2006 and 2007 cases. With an error of about 5%, it is expected that 2007 skin related diseases will fall between 50,147 and 86,240 and the point prediction forecasted 68,193 cases.

DIARRHOEA

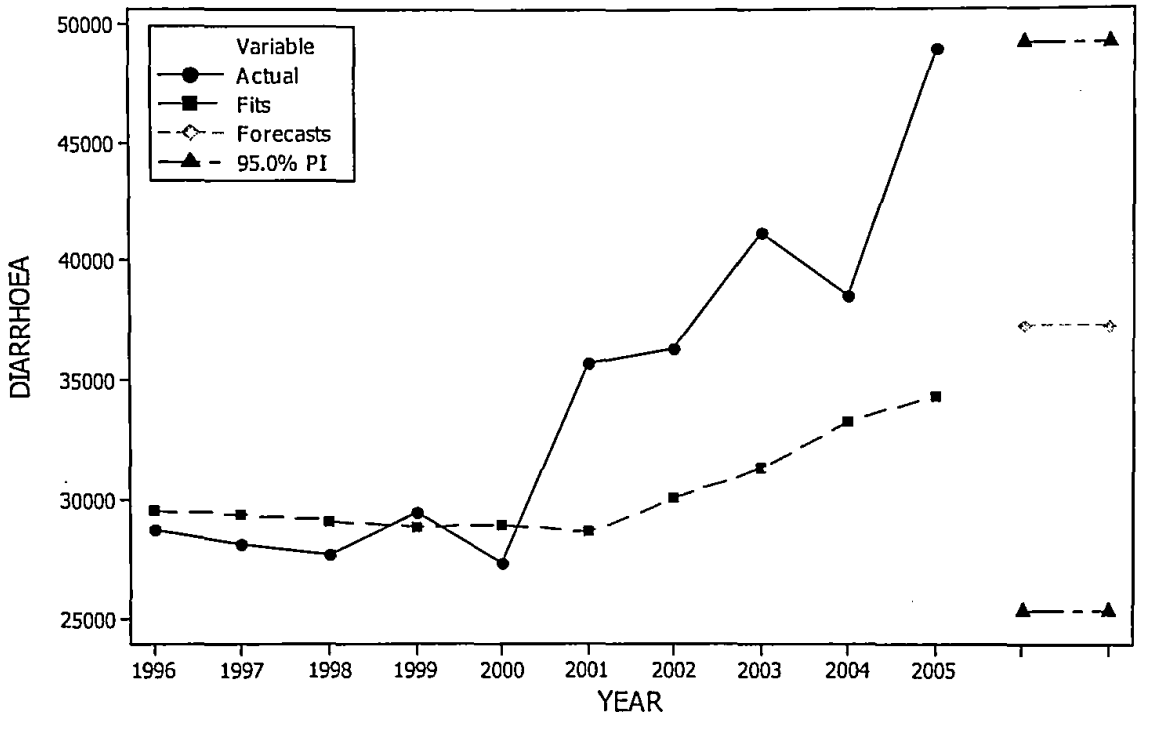


Figure 9: Trend of Diarrhea cases reported from 1996 to 2005

Diarrhea cases within the period under review generally experienced an increasing trend, as it can be seen in Figure 9. Reported cases actually started increasing from the year 2000 after a slight decrease in cases from the beginning of the period, but it experienced a drop once again in 2004.

Single exponential smoothing technique was used to forecast Diarrhea cases. The point prediction figure for 2006 tends to be almost accurate. This is due to the fact that prediction error was just 15 cases. Forecast for 2007 shows that about 37,263.0 cases are expected to be reported at the OPD if point estimation is to be used, whilst at 95% confidence diarrhea cases will be expected to fall between 25,329 and 49,198.

PREGNANCY RELATED COMPLICATIONS

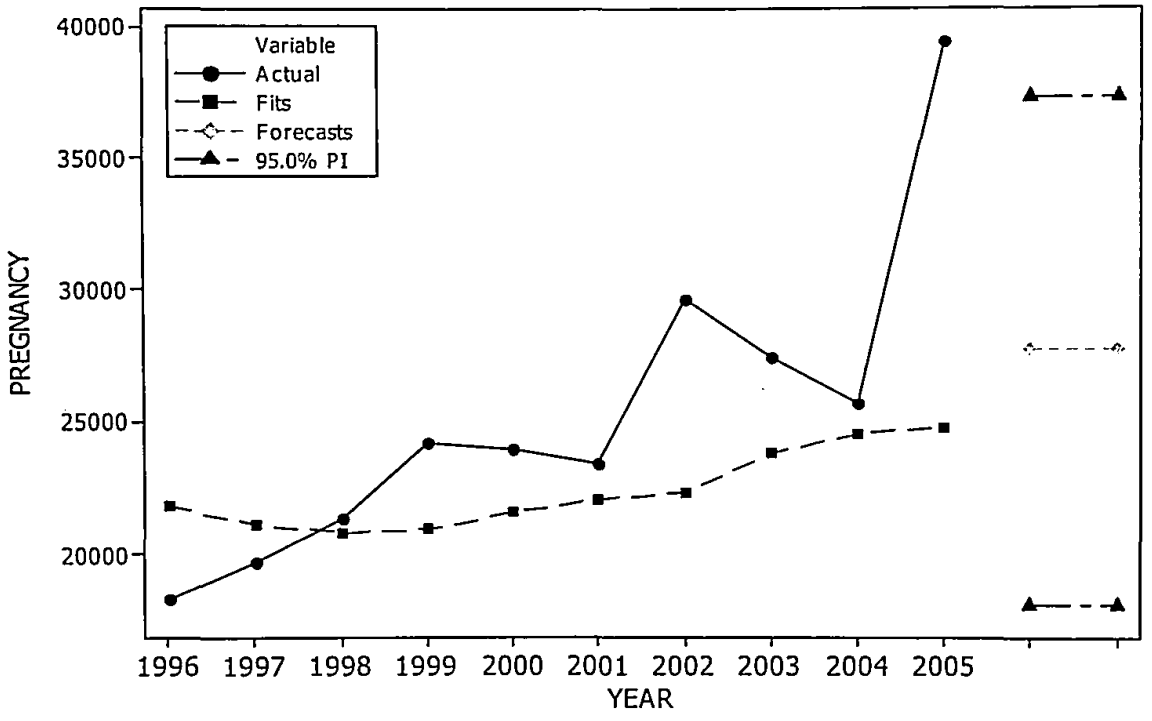


Figure 10: Trend of Pregnancy Related cases reported within 1996 to 2005

Whilst other diseases experienced a downward trend of reported cases in the first few years before any increment, the trend of pregnancy related cases appears different. Reported cases were on the increase from the beginning of the period till 1999. There was also a sharp increase in reported cases form 2005 to 2006.

With a smoothing constant of $\alpha = 0.2$, single exponential smoothing technique prediction for 2006 was also quite accurate. There was a prediction error of about 375 cases. The forecast revealed that 2007 pregnancy related cases will fall between 18,114 and 37,290, and 27,702 for point prediction.

HYPERTENSION

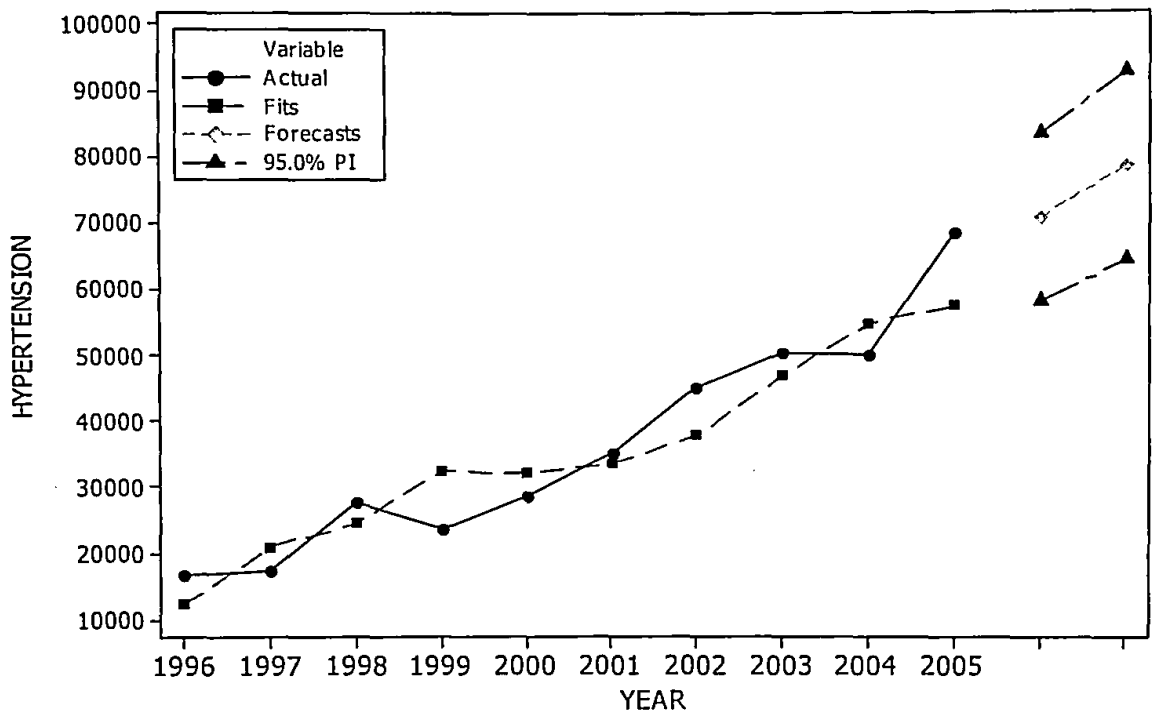


Figure 11: Trend of hypertension cases reported within 1996 to 2005

Hypertension cases generally showed an increasing trend as can be seen in the figure 11. It experienced a drop in cases in the year 1999 and 2004. The lowest number of cases was reported in 1996 and the highest was in 2006.

Point prediction error for 2006 was about 346 cases. The forecasted figure for 2007 showed that hypertension cases will increase in 2007, when both point and interval prediction is considered. With an error of about 5%, the technique predicted that 2007 hypertension cases will lie between 64,104 and 92,691 cases. Similarly, hypertension cases will also move up from 70,949 to 78,397 if point prediction is used.

ACUTE EYE DISEASE

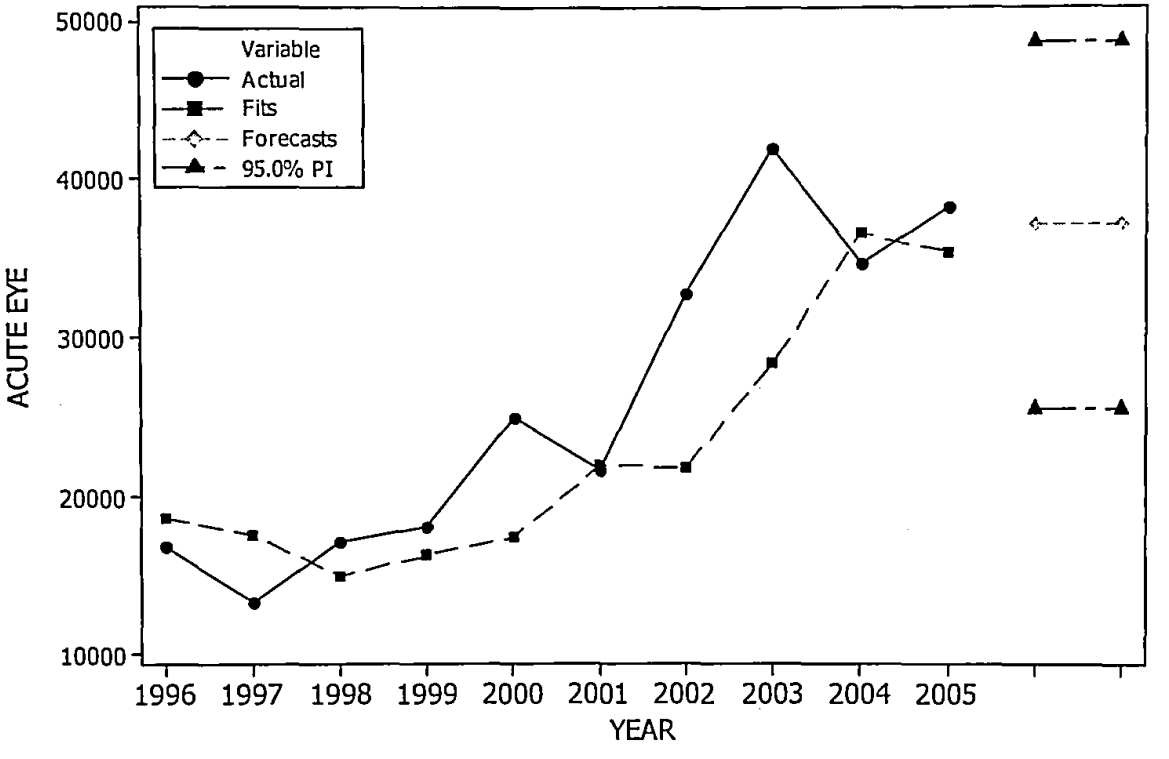


Figure 12: Trend of acute eye diseases reported within 1996 to 2005

Figure 12 shows an increasing trend as other diseases have shown in the previous figures, but the increasing trend of acute eye diseases does not appear to be smooth. It experienced a drop in reported cases at three different occasions within the period. In

2003, the disease under review experienced its highest number of cases whilst the lowest was in 1997.

Single exponential smoothing technique was used to predict 2006 and 2007 cases. The point prediction figure for 2006 was quite close to the actual figure. An error of about 1,293 cases was recorded. Forecasted figure for 2007 revealed that acute eye diseases at 95% confidence will fall between 25,518 and 48,785. However, 2007 forecasted cases for point prediction is 37,151.

ACCIDENT RELATED CASES

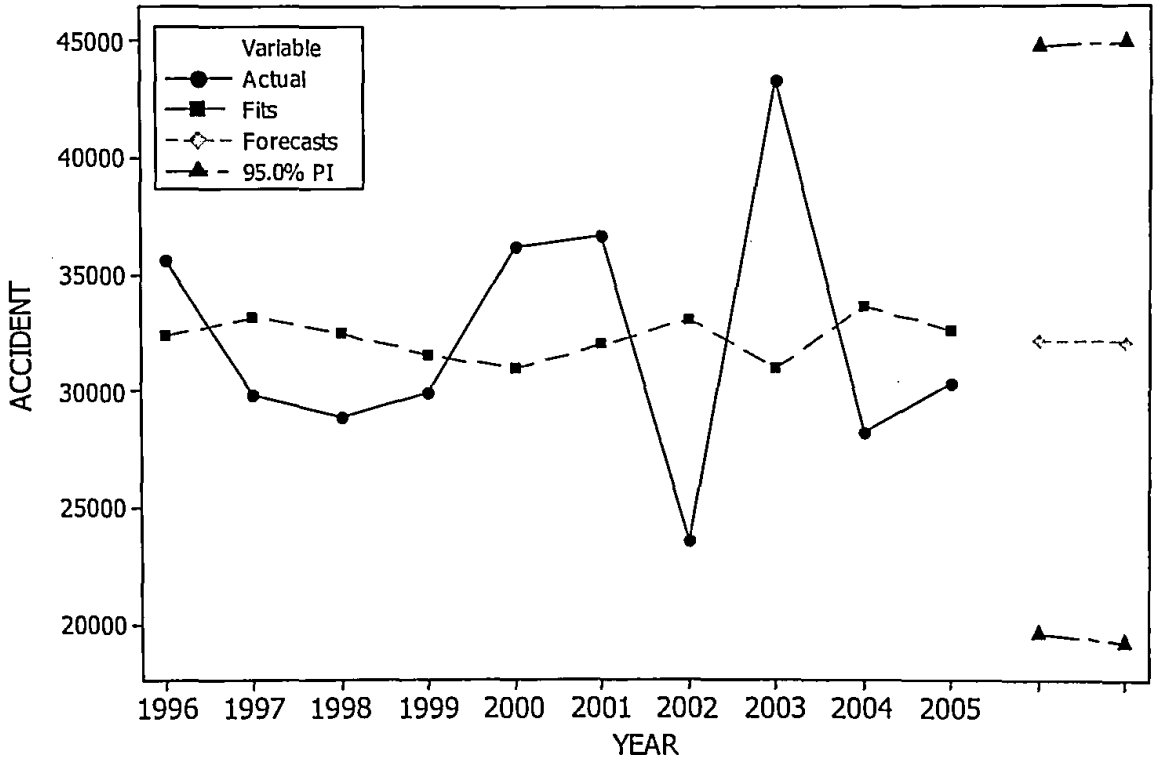


Figure 13: Trend of accident related cases reported within 1996 to 2005

Accident related cases did not exhibit any trend. Cases revolved around an average figure of about 32,223. The highest number of cases was reported in 2003 whiles the lowest was in 2002.

Double exponential smoothing technique predicted that point forecast for 2007 accident related cases will be 32,035, whilst with an error of about 5%, 2007 accident related cases is expected to fall between the interval [19,168, 44,901].

AVERAGE ANNUAL GROWTH RATE

Using the least-squares growth rates, the average annual growth rates of the various diseases reported at the out patient department were estimated. Table 3 below shows the results.

Table 3: Average Annual Growth Rate of Diseases Seen At OPD in the Region

DISEASE	AVERAGE ANNUAL GROWTH (%)
MALARIA	5.96
URTI	4.81
SKIN	4.44
ACCIDENT RELATED CASES	-0.32
DIARRHOEA	4.96
PREGNANCY RALATED CASES	5.25
HYPERTENSION	15.08
ACUTE EYE	11.32

The analysis revealed that most diseases recorded a considerable positive growth rate with the exception of accident related cases which had a negative growth rate. Hypertension had the highest growth rate of about 15.08% per annum. Surprisingly, acute eye diseases had the second highest growth rate (i.e. 11.32%), Whilst the other diseases had an average annual growth rates below 6%. This implies that hypertension and acute eye diseases are gradually becoming major diseases reported at outpatient department in the Region.

CHAPTER FIVE

SUMMARY, DISCUSSION AND CONCLUSIONS

This chapter presents a general discussion on the results of the preceding two chapters. The chapter also assesses how far the objectives of the research have been achieved. Finally, we present the main findings, compare and contrast some of the findings in relation to previous findings.

SUMMARY

This study is about diseases reported at the outpatient departments (OPD) in the Greater Accra Region. The objectives of this study was to find the trend of the various diseases reported at the Outpatient Departments, forecast 2007 reported diseases and finally, to identify the most reported disease(s) within the period. Data was obtained from the Adabraka Polyclinic which is the coordinating center for the region's health statistics. The data covered the period 1996 to 2006.

It was observed that from 1996 to 2006, thirteen (13) different types of diseases were reported at the outpatient department in various health facilities in the Region. However eight (8) diseases dominated the top ten chart within the period under study. The data also revealed that on the average, about 350,341 cases were reported at OPD

annually. Total number of patients seen at the OPD each year ranges from 630,517 to 1,276,660. Malaria was found to be the highest reported disease at the OPD. It registered an average of 350,341 cases annually, representing about 50% of all cases reported at OPD.

All reported diseases at outpatient department within the period, exhibited an increasing trend with the exception of accident related cases. Hypertension and acute eye disease had the highest annual growth rate of about 15.08% and 11.32% per annum respectively. Other diseases reported within the period, had average growth rate below 6%. This implies that hypertension and acute eye diseases is gradually becoming a major disease at outpatient department in the Region. Forecasted figures also suggested that cases on all diseases will increase in 2007.

DISCUSSION

Patients who visited the outpatient departments in a particular year are categorized by the type of disease they were diagnosed with. Thirteen (13) different types of diseases were reported over the 11 year period. Eight of these diseases were the most reported and they consistently appeared on the top ten chart throughout the period. Total number of patients seen at the OPD each year ranges from 630,517 to 1,276,660. Malaria tends to record the highest number of cases each year within the eleven years (an average of about 350,341 cases per year). This constitutes about 50% of the top ten diseases reported every year, whilst other diseases on the top ten chart, shared the remaining 50% of the reported cases. Upper respiratory tract infection (UTRI) and skin diseases maintained second and third positions respectively throughout the period. The remaining

diseases occupied different positions from one year to another. The number of cases on all other diseases was far less than that of malaria.

Trend analysis was the main statistical technique used in the study. It was evident that apart from occasional fluctuations in the number of cases reported at the outpatient department, top ten and other diseases generally exhibited an increasing trend, with the exception of accident related cases. However, both top ten diseases and other disease experienced a decreasing trend from the beginning of the period before it started increasing. Trend analysis of these diseases yielded various forecasted values for 2007, which suggested that cases on all diseases will increase.

The least square growth rate was also used to calculate the growth rate of the disease. Hypertension and acute eye disease had the highest growth rate at an average rate of about 15.8% and 11.32% per annum respectively, whilst other diseases had average growth rates below 6%.

CONCLUSIONS

Malaria was the major disease recorded at the OPD. This is because each year, 50% of all reported diseases at the OPD were malaria, whilst other diseases constituted the remaining 50%. Malaria, URTI and skin disease formed an overwhelming majority (about 52.4%) of diseases reported at the OPD each year. It was also found that the most consistent diseases reported at outpatient departments in the Region exhibited upward trends, except accident related diseases. Trend analysis of these diseases yielded various forecasted values, which suggested an increase in all reported cases in 2007. Hypertension and acute eye disease showed the prominence of becoming a major disease

at the OPD in the near future, since they recorded the highest annual growth rates (about 15.08% and 11.32%, respectively).

REFERENCES

Adams I., Darko D., Accorsi S. (2004). The Burden of Malaria: Patterns and Trends. Bulletin of Ghana Health Information.

American Hospital Association, (1990). Achieving cost control in the hospital outpatient department - Cost-Containment Issues, Methods, and Experiences. CNET Networks, Inc.

Barker, D.J.P. and Rose, G. (1990), Epidemiology in Medical Practice, 4th Pg. 15, Longman Singapore Publishers (Pte) Ltd., singapore.

Bassat Q, Guinovart C, Sigaúque B, Aide P, Sacarlal J, Nhampossa T, Bardají A, Nhacolo A, Macete E, Aponte JJ, Menéndez C, Alonso PL. (2008): Malaria in Rural Mozambique. Part II: Children admitted to hospital. *Malar J* 2008, 7(1):37. Epub ahead of print.

Bowerman L.B., O'Connell R.T., Hand M.L. (2001). Business Statistics in Practice, 2nd Edition, Pg. 627, McGraw-Hill companies, Inc.

Breman J. (2001). "The ears of the hippopotamus: manifestations, determinants, and estimates of the malaria burden." Am J Trop Med Hyg **64** (1-2 Suppl)

Cox F. (2002). "History of human parasitology.". Clin Microbiol Rev **15** (4): pp 595-612

Cryer J.D., Miller R.B., (1991). Statistics for Business: Data Analysis and Modelling. PWS-KENT publishing Company, Boston.

Dana L. Rowett. Learning About Outpatient Services: http://health.yahoo.com/healthcare-doctorvisit/outpatient-services/healthwise--ty7319.html (Accessed: December 17, 2007)

England Healthcare Commission (2005). Outpatient Department: Key Findings. Commission for Healthcare Audit and Inspection

Escalante A, Freeland D, Collins W, Lal A (1998). "The evolution of primate malaria parasites based on the gene encoding cytochrome b from the linear mitochondrial genome.". Proc Natl Acad Sci U S A **95** (14): pp 8124-9

The 2003 Final performance report of Ghana Health Service Ghana Health Service, July 2004 Ppme-Ghs

Greenwood B, Mutabingwa T (2002). "Malaria in 2002". Nature **415**: pp 670–2

Greenwood BM, Bojang K, Whitty CJ, Targett GA (2005). "Malaria". Lancet **365**: pp 1487-1498

Grover-Kopec E, Kawano M, Klaver R, Blumenthal B, Ceccato P, Connor S (2005)

Hay S, Guerra C, Tatem A, Noor A, Snow R (2004). "The global distribution and population at risk of malaria: past, present, and future". Lancet Infect Dis **4** (6): pp 327-36

http://www.malariajournal.com/content/7/1/36 (Accessed: July 17, 2008)

http://www.emedicine.com/med/topic2339.htm (Accessed: July 17, 2008)

http:www.wsh.nhs.uk/services/outpatient department (Accessed: July 17, 2008)

Humanitarian News and Analysis (IRIN Africa). UN Office for the Coordination of Humanitarian Affairs (2007). GHANA: National health insurance scheme launched. http://www.irinnews.org/report.aspx? reportid=49172 (Accessed: December 17, 2007)

http://www.statsghana.gov.gh/Health_Nutrition.html (Accessed: December 17, 2007)

Joy D, Feng X, Mu J, et al (2003). "Early origin and recent expansion of Plasmodium falciparum". Science **300** (5617): pp 318-21

Keiser J, Utzinger J, Caldas de Castro M, Smith T, Tanner M, Singer B. (2004). "Urbanization in sub-saharan Africa and implication for malaria control". Am J Trop Med Hyg 71 (2 Suppl): pp 118-27

Kimberly Middleton, B.S.N., M.P.H.; Esther Hing, M.P.H., Jianmin Xu, M.S. (2005). National Hospital Ambulatory Medical Care Survey: 2005 Outpatient Department Summary. Division of Health Care Statistics.

Makridakis, S. G., Wheelwright, S. C., & McGee, V. E. (1983). Forecasting: Methods and applications (2nd ed.). New York: Wiley.

MSN Encyclopedia Article. Human diseases http://encarta.msn.com/encyclopedia761566075/Human_Disease.html (Accessed: December 17, 2007)

National Population Census 1960, 1970, 2000 and 2002

Prosper T. Doe MDChBBScMMed, Alex Asiedu MDDSVD, J. W. Acheampong MDFWACP, Christopher M. E. RowlandPayne MBBSMRCP (2001) Skin diseases in Ghana and the UK International Journal of Dermatology 40 (5), 323–326

Press Release WHO/47 4 July 2000. Better Out-Patient Services Are the Key to Health Gains for the Poor.

Schwartz GL and Sheps SG. A review of the sixth report of the joint National Committee on Prevention, Detection, Ecaluation and Treatment of High Blood Pressure. Curr opin Cardiol 1999; 14:161-8.

StatSoft, Inc., 1984-2003; time series analysis. http://www.statsoft.com/textbook /sttimser.html (Accessed: December 17, 2007)

UNDP- Human Development Report 2000, 2003 and 2006

Van Benthem B, Vanwambeke S, Khantikul N, Burghoorn-Maas C, Panart K, Oskam L, Lambin E, Somboon P (2005). "Spatial patterns of and risk factors for seropositivity for dengue infection". Am J Trop Med Hyg 72 (2): pp 20

Wikipedia. Malaria. http://enWikipedia.org/wiki/malaria

APPENDIX

ANNUAL TOP TEN DISEASE CHART FOR OUT PATIENT DEPARTMENT

1996

	DISEASES	NO. OF CASES
1	MALARIA	285,954
2	URTI	71,947
3	SKIN	53,776
4	ACCID. RELATED	35,624
5	DIARRHOEA	28,774
6	PREG RELATED	18,338
7	GYNAECO	17,619
8	ACUTE EYE	16,818
9	HYPERTENSION	16,559
10	RHEUMATISM	12,023
	TOP TEN TOTAL	**557,432**
	ALL OTHER DISEASES	**164,851**
	GRAND TOTAL	**722,283**

1997

	DISEASES	NO. OF CASES
1	MALARIA	299,696
2	URTI	69,735
3	SKIN	43,242
4	ACCID RELATED	29,833
5	DIARRHOEA	28,123
6	PREG. RELATED	19,723
7	DENTAL	17,234
8	HYPERTENSION	17,104
9	GYNAECO	13,648
10	ACUTE EYE	13,243
	TOP TEN TOTAL	**551,581**
	ALL OTHER DISEASES	**146,836**
	GRAND TOTAL	**698,417**

1998

	DISEASES	NO. OF CASES
1	MALARIA	273,975
2	URTI	63,601
3	SKIN	41,757
4	ACCID RELATED	28,804
5	DIARRHOEA	27,711
6	HYPERTENSION	27,379
7	PREG. RELATED	21,378
8	DENTAL	20,050
9	ACUTE EYE	17,157
10	GYNAECO	12,921
	TOP TEN TOTAL	**534,733**
	ALL OTHER DISEASES	**95,784**
	GRAND TOTAL	**630,517**

1999

	DISEASES	NO. OF CASES
1	MALARIA	254,003
2	URTI	67,781
3	SIKN	36,362
4	ACCID RELATED	29,848
5	DIARRHOEA	29,422
6	PREG. RELATED	24,212
7	HYPERTENSION	23,506
8	DENTAL	19,189
9	ACUTE EYE	18,081
10	RHEUMATISM	14,329
	TOP TEN TOTAL	**516,733**
	ALL OTHER DISEASES	**176,732**
	GRAND TOTAL	**693,465**

2000

	DISEASES	NO. OF CASES
1	MALARIA	260,475
2	URTI	71,637
3	SKIN	43,311
4	ACCID RELATED	36,213
5	HYPERTENSION	28,379
6	DIARRHOEA	27,359
7	ACUTE EYE	24,989
8	PREG. RELATED	24,000
9	DENTAL	18,490
10	RHEUMATISM	13,579
	TOP TEN TOTAL	**548,432**
	ALL OTHER DISEASES	**207,772**
	GRAND TOTAL	**756,204**

2001

	DISEASES	NO. OF CASES
1	MALARIA	358,249
2	URTI	80,781
3	SKIN	53,358
4	ACCID RELATED	36,640
5	DIARRHOEA	35,701
6	HYPERTENSION	34,859
7	PREG. RELATED	23,440
8	ACUTE EYE	21,681
9	RHEUMATISM	18,931
10	DENTAL	18,072
	TOP TEN TOTAL	**681,712**
	ALL OTHER DISEASES	**299,952**
	GRAND TOTAL	**981,664**

2002

	DISEASES	NO. OF CASES
1	MALARIA	399,306
2	ARTI	84,807
3	SKIN	57,202
4	HYPER	44,909
5	DIARRHOEA	39,813
6	ACUTE EYE	33,048
7	ACCID. RELA	29,313
8	PREG RELA	26,770
9	RHEUMATISM	23,524
10	GYNAECO	21,968
	TOP TEN TOTAL	**760,660**
	ALL OTHER DISEASES	**279,976**
	GRAND TOTAL	**1,040,636**

2003

	DISEASES	NO. OF CASES
1	MALARIA	399,261
2	ARTI	89,556
3	SKIN	64,872
4	HYPERTENSION	50,248
5	ACUTE EYE	42,054
6	DIARRHOEA	41,217
7	ACCID RELATED	30,630
8	PREG RELATED	27,799
9	DENTAL	23,520
10	GYNAECO	23,209
	TOP TEN TOTAL	**792,366**
	ALL OTHER DISEASES	**297,785**
	GRAND TOTAL	**1,090,151**

2004

	DISEASES	NO. OF CASES
1	MALARIA	400,378
2	ARTI	96,084
3	SKIN	55,180
4	HYPERTENSION	49,822
5	DIARRHOEA	38,528
6	ACUTE EYE	34,673
7	ACCID RELATED	28,187
8	PREG RELATED	25,709
9	RHEUMATISM	23,133
10	GYNAECO	22,368
	TOP TEN TOTAL	**774,062**
	ALL OTHER DISEASES	**305,078**
	GRAND TOTAL	**1,079,140**

2005

	DISEASES	NO. OF CASES
1	MALARIA	472,146
2	ARTI	105,059
3	SKIN	68,999
4	HYPERTENSION	68,305
5	DIARRHOEA	48,958
6	PREG RELATED	39,403
7	ACUTE EYE	38,292
8	ACCID RELATED	30,259
9	DENTAL	27,590
10	ANAEMIA	27,560
	TOP TEN TOTAL	**926,571**
	ALL OTHER DISEASES	**350,089**
	GRAND TOTAL	**1,276,660**

2006

	DISEASES	NO. OF CASES
1	MALARIA	450,308
2	ARTI	100,938
3	HYPERTENSION	70,949
4	SKIN	62,366
5	ACUTE EYE	38,444
6	DIARRHOEA	37,248
7	PREG RELATED	27,330
8	ANAEMIA	26,938
9	ACUTE EAR	25,430
10	GYNAECO	25,048
	TOP TEN TOTAL	**864,999**
	ALL OTHER DISEASES	**354,671**
	GRAND TOTAL	**1,219,670**