EVALUATION OF THE NOTIFIABLE DISEASE SURVEILLANCE SYSTEM IN GAUTENG PROVINCE, SOUTH AFRICA

by

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Declaration

I declare that the dissertation that I am hereby submitting to the University of Pretoria for the MMed Community Health degree is my own work and that I have never before submitted it to any other tertiary institution for any degree.

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Signed	At	Date

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Commissioner of oaths

The research protocol entitled "Evaluation of the Notifiable Disease Surveillance System in Gauteng Province, South Africa", Number 87/2006, was considered by the Faculty of Health Sciences Research Ethics Committee, University of Pretoria on 26/07/2006 and found to be acceptable.

Dedication

This dissertation is dedicated to my parents Dulcie and Klaus Weber who have given me a firm foundation, supported me tirelessly and inspire me to follow my dreams.

Acknowledgements

I wish to extend my deepest gratitude to my supervisor, Professor Maila John Matjila and my co-supervisor Dr Bernice N Harris for their sustained guidance and critical review throughout the planning and execution of this research.

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List of Acronyms

DoH	Department of Health
EPI	Expanded Programme on Immunisation in South Africa
HIV	Human Immunodeficiency Virus
ICD-10	International Classification of Diseases 10
IHR	International Health Regulations (2005 unless otherwise stipulated)
ISCP	Infection Surveillance and Control Programme
NDOH	National Department of Health
NHLS	National Health Laboratory Service
NICD	National Institute for Communicable diseases
OIE	Office International Des Epizooties (World Organisation for Animal Health)
TB	Tuberculosis
WHO	World Health Organisation
SADC	Southern African Development Community

ABSTRACT

Objectives. To describe the qualitative aspects of the notifiable diseases surveillance system of the Gauteng Province, South Africa; to conduct a cross-sectional survey on knowledge and practices pertaining to disease notification among private sector primary health care providers in Gauteng Province; to measure the degree of underreporting of notifiable diseases versus positive laboratory diagnoses using malaria as a cases study; and to identify the correctible short-comings in the Gauteng Health Department's diseases surveillance system and to recommend ways of addressing these to improve the system and its performance

Design. This is an evaluation study consisting of both the qualitative aspects and quantitative descriptive components of the notifiable disease system in Gauteng Province. The study designs used for the qualitative description were literature and policy review and a semi-structured interview with communicable disease coordinators. The quantitative research comprised of a telephonic questionnaire administered to a random sample of private general practioners and secondary data analysis comparing malaria cases notified to the Gauteng Provincial Department of Health with public and private sector laboratory data and clinical surveillance data.

Setting. The study setting was the Gauteng Provincial Health Department and public and private health care service providers in Gauteng Province. The study period extended from 1 January to 30 June 2006.

Subjects. The subjects of the study were the Gauteng Health Department's disease surveillance system, public and private sector health care providers including private primary health care practitioners

Outcome measures. Outcome measures for the qualitative system description were the status of selected system attributes namely usefulness, simplicity, flexibility, data quality, acceptability, sensitivity, positive predictive value,

representativeness and stability. Outcome measures for the knowledge and practice survey of private general practitioners were reporting compliance and knowledge of notifiable conditions. The primary outcome measure for the secondary data analysis was the proportion of laboratory diagnosed cases of malaria notified to the provincial health department.

Results. The notifiable disease surveillance system in Gauteng is deemed useful by the public sector communicable disease coordinators but less so by the private sector general practitioners. Data quality as indicated by completeness of residential detail reporting on meningococcal notifications varied between 29% and 57% by district. Thirty seven percent of general practitioners report compliance with notifications and the mean score for knowledge on notification status of medical conditions was 56%. The sensitivity of notifications of malaria compared with laboratory notifications was 26% with relatively higher notification rates where cases occurred in children under 15 years of age.

Conclusions. The notifiable disease surveillance system in Gauteng Province is relatively flexible and reasonably structured however this research suggests that there is suboptimal use of the information for local action in certain areas. Private General Practitioners self-report a low level of compliance citing time constraints and lack of motivation; knowledge of the notification status of selected medical conditions is lower than expected. The completeness and accuracy of notification data, as demonstrated in malaria notifications, is insufficient to gauge a true picture of burden of disease in the province.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Introduction

An effective health system is characterised by services that meet the health care needs of the population it serves. Sound health information systems are critical to measure the population's needs and to monitor the system performance. Notifiable disease surveillance plays an important role in health care service delivery as it is entails ongoing data collection, collation and analysis of data on priority diseases within a geographic area and in so doing guide public health planning and interventions.

The South African health care system is effectively a dual system consisting of public and private sectors serving approximately 80% and 20% of the population respectively.[1] The Notifiable Disease Surveillance System covers both public and private sectors in all nine provinces of South Africa and is administered by public sector organs at all three tiers of government namely national, provincial and district health authorities.

This evaluation was conducted with the purpose of describing the state of the notifiable disease surveillance system in Gauteng Province indicating how well the system was operating to meet its purpose and objectives. One of the main objectives of the research was to make recommendations for improved performance of this passive surveillance system. An evaluation of this kind had not yet been done in Gauteng Province. While the findings of this research cannot be generalised to all other provinces of South Africa, Gauteng forms the economic hub of the country and is relatively well resourced. The six health districts situated within the province expend more on primary health care per capita than the national average (Ekurhuleni Metro more than double that of South Africa as a

whole).[2] In contrast to the high provincial health expenditure per capita, the utilisation rate of public health services is proportionally low in comparison with the rest of the country as a relatively high proportion of the population consult private health care service providers.

The burden of communicable diseases within Gauteng Province is appreciable and the information guiding the planning of health care interventions is reliant on accurate and timely disease surveillance data supplemented by special research activities where indicated. The quality of the Notifiable Disease Surveillance System including its effectiveness and efficiency must be tested by appropriate validated methodology.

The research was conducted over a six month period from June to November 2006. It consisted of a combination of qualitative and quantitative assessments namely, the evaluation of system performance (measuring various attributes), a survey of primary health care providers in Gauteng and an analysis of completeness of malaria reporting in the province.

Background and Literature Review

1.1 Surveillance Systems and Notifiable Disease Surveillance

Public Health surveillance is defined as the ongoing and systematic collection, collation and analysis of data and the prompt dissemination of the resulting information so that action can result.[3] Communicable disease surveillance systems provide the information needed for public health planning, implementation of those plans and monitoring and evaluation of programmes as well as generating hypotheses that will, in turn, stimulate public health research[4]. Surveillance can be either passive or active. Passive surveillance requires health providers to notify public health authorities of cases of disease when they are diagnosed in the course of health care. Active surveillance of a disease or condition entails the active search by health authorities, for the occurrence of the disease or condition in a defined population. This includes the search for the disease (or condition) in people in the general population who do not necessarily seek health care. Active surveillance thus places the onus of searching for cases and generation of information on the health authorities.

Every disease surveillance system should be analyzed and re-evaluated periodically to ensure that it addresses the current priority diseases within the region in which it operates and to improve performance where necessary. A communicable disease surveillance system should remain efficient and utilize opportunities for the integration and harmonization of activities between parallel chains of information flow[5].

Public health policy forms the basis of evaluation of communicable diseases at both international and national levels. Resolutions passed by the World Health Assembly and the WHO Regional Committee for Africa have included *Resolution WHA48.13* (1995) urging Member States to strengthen their national and local surveillance programmes and *Resolution AFR/RC43/R7* (1993) which dedicated

the subsequent five years to the prevention of the occurrence of epidemics of communicable diseases through improved epidemiological surveillance at the district level. A review of national disease surveillance systems in selected African WHO member states revealed the following problems:

1. vertical surveillance systems established as part of specific disease control programmes sometimes resulted in duplication of efforts (both in reporting and administration)
2. there was often a delay in reporting of cases fitting standard case definitions by health care workers
3. there was a deficit in interpretation and use of surveillance data at district level as data were commonly submitted to provincial or national levels without further analysis; and feedback was generally poor at all levels
4. little attention had been given to opportunities for integration of disease surveillance activities
5. many surveillance systems did not include surveillance of childhood diarrhoea or pneumonia which both carry a high burden of disease in Africa
6. surveillance data were not used sufficiently for the evaluation of programmes and public health interventions
7. laboratory involvement in surveillance was inadequate
8. there was insufficient supervisory support for surveillance and timeliness and completeness of reporting was often lacking

All national disease surveillance systems need to comply with the requirements of the new International Health Regulations (IHR) with the final deadline being the year 2012. The principles contained in these regulations should be reflected in the policies and practices from national level all the way through to facility and individual level, where applicable. In article 5.1 of the regulations all state parties are required to develop, strengthen and maintain core surveillance capacity and the regulations include a tool for monitoring and evaluation thereof. This is

mirrored in the South African Guideline on Epidemic Preparedness and Response. The specific implementation of monitoring and evaluation in South Africa is yet to be clarified. **Figure 1.1**, adapted from a paper entitled "Global Public Health Surveillance" from the Emerging Infectious Disease Journal, July 2006, illustrates the disease reporting process as framed within the International Health Regulations[6].

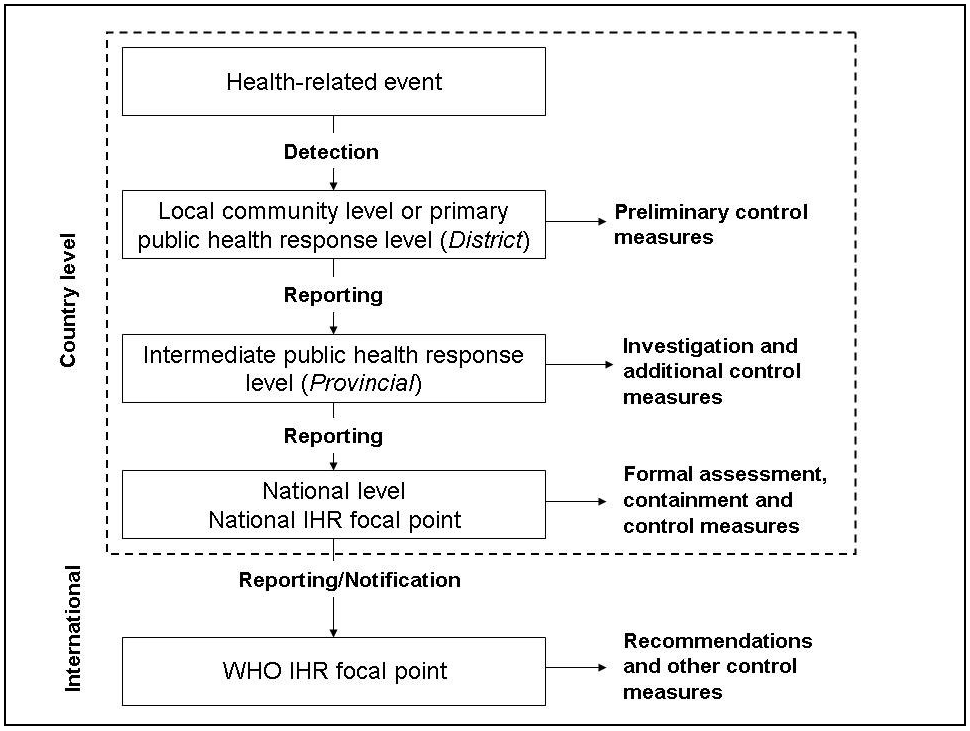

Figure 1.1 National and International Surveillance of Communicable Diseases according to the International Health Regulations

1.2 Communicable and Notifiable Disease Surveillance in South Africa

The National Health System of South Africa encompasses all public and private providers of health care in the country. Health departments at each level of government within the public sector (national, provincial and municipal) are tasked with the equitable provision of health care to the population within available resources. In accordance with the Constitution of the Republic of South Africa[7] the

specific roles and responsibilities of each of the aforementioned tiers of government are delineated in the National Health Act: the national department is responsible (amongst others) for establishing national health policy, setting norms and standards on health matters, identifying national health goals and monitoring the progress of their implementation, developing a national health plan and conducting systems research; the provincial health departments are responsible for implementing national policy, planning and managing the provincial health information system and support district health councils; and district health councils (comprising of municipal and provincial representation) are responsible for primary health care service delivery and maintenance of district health information systems. South Africa is made up of nine provinces and 53 health districts (6 metropolitan and 47 district councils). Gauteng is one of the nine provinces and is made up of six health districts.

The disease notification system is a national system operating within all nine provinces and it is designed to collect prescribed data on specific conditions. Most of the conditions are infectious in nature and the list is determined at the central (national) level. The historical legislative basis for the notification system is the Health Act No 63 of 1977 and the commensurate regulations on reporting issued by the Minister of health. At present 33 medical conditions are notifiable in South Africa and some of these have been further subdivided into different clinical manifestations of disease (*Appendix 1*). The National Health Act (Act 61, 2003) of South Africa has superseded the Health Act of 1977 but it does not explicitly mention the Notifiable Disease Surveillance System. The new legislation does address the responsibility of the national health department in facilitating and coordinating the establishment of health information systems as prescribed by the Minister in sections 74 and 75 of the Act. Sections 75 and 76 of the Act further stipulate the relevant responsibilities at provincial and district authority level. These responsibilities are described in the Expanded Programme on Immunisation (EPI) Disease Surveillance Field Guide as they pertain to EPI diseases. At health facility level responsibilities include the maintenance and analysis of patient

records to detect trends and report cases to the local health district; at district level reports are received from facilities and analysed to detect trends or outbreaks and investigate adverse events following immunisations as well as providing supervisory support and reporting to provincial health authorities; at provincial level district investigations are followed up, EPID numbers assigned and high risk districts identified and information is sent through to national level while feedback is given to the districts. At national level surveillance reports are received from provinces, analysed and where necessary policies and procedures are changed in response to or in anticipation of disease outbreaks.[8] The National Health Act also addresses the issue of confidentiality of patient information whereby information concerning users of health care services, be it health status, treatment or stay in a health facility, may not be disclosed unless non-disclosure thereof would present a serious threat to public health.[9] Although the Health Act 63 of 1977 has been repealed by the National Health Act 61 of 2003, the Regulations pertaining to notifiable diseases surveillance that were framed under the Health Act 63 of 1977 are still applicable.

The disease notification system can be described in terms of inputs, throughputs (or processes), outputs and feedback. The environment of this system is health care sector of South Africa. Inputs usually comprise of three different categories of resources namely human, equipment and natural, whereas funding is the means to secure these resources. Policy and legislation (as described above) have a direct bearing on the allocation and utilisation of these resources. The processes within the system are represented as a flowchart in Figure 1.2. These processes involve all the activities spanning from the initial presentation and detection of a person with a notifiable medical condition through data collection, collation, analysis and interpretation to dissemination of findings with the intent of stimulating public health action. The outputs are public health responses (e.g. outbreak investigations), reports and data banks of information on notifiable medical conditions. The feedback loop is comprised of dissemination of findings to all levels of health care service delivery and forms part of the monitoring and evaluation of surveillance

system performance. Beyond the internal environment of the system outcomes include prevention and control of epidemic prone diseases and effective public health interventions. The impact should be a reduction in morbidity and mortality associated with the notifiable medical conditions.

It is the responsibility of the first health care professional or facility to whom a patient with a notifiable disease presents to report the case to the department of health. In the event of a death due to such a disease occurring in the community setting, it is the responsibility of a member of the community to notify the relevant authorities. The process of disease report submissions is illustrated in Figure 1.2. During an outbreak rapid notification must take place by fax or telephonically but usually the notification can be made through the submission of a GW 17/5 form as demonstrated in Appendix B.

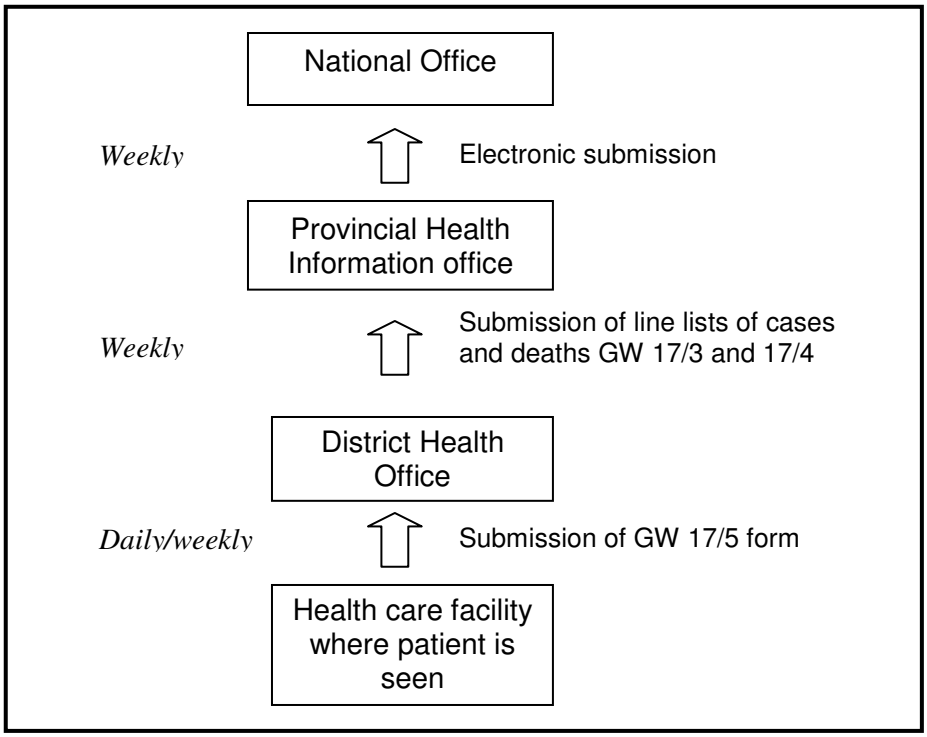

Figure 1.2 Flow diagram of Disease Notifications

Gauteng province introduced electronic reporting from district level to provincial and national level on 1 August 2006 and training was being conducted concurrent with the evaluation of the notifiable disease surveillance system.

1.3 Communicable Disease Burden in Gauteng Province, South Africa

South Africa is burdened with a host of communicable diseases. The prevalence of HIV infection is estimated to be 15% and the incidence of tuberculosis was 550 per 100 000 population in 2003[10]. Other commonly occurring infections such as childhood diarrhoeal diseases and acute respiratory tract infections are also prevalent. The risk factors for acquisition of infectious diseases abound with high levels of poverty, unemployment (22.8% in Gauteng Province[11]), overcrowding and high rates of population migration within the country and internationally.

Gauteng, the economic heartland of South Africa has a population of approximately 9 million people concentrated in a relatively small area (population density of 476 people per square kilometre) making it particularly vulnerable to infectious diseases. The province is subject to the effects of population migration both internally across its borders with influx of individuals from other provinces as well as neighbouring countries within the Southern African Development Community. The OR Tambo International Airport in Gauteng province is the busiest airport in Africa with a documented arrival of 100 258 passengers between April 2005 and March 2006[12] with the potential for importation of infected individuals, disease vectors or pathogens through air travel.

The communicable diseases diagnosed and treated most commonly in Gauteng Province include respiratory tract infections, gastroenteritis, HIV and tuberculosis. In a study of death certification data from 1997 to 2003, tuberculosis was cited as the cause of death in 12.1% of cases[13]. Tuberculosis surveillance is well established within South Africa but monitoring and evaluation of HIV infection is limited to data collected within the antiretroviral treatment programme. The

minimum dataset collected at primary health care facilities provides some indication of patient demographics and disease profiles but in some instances these data are incomplete or not analyzed frequently enough to guide public health action. Meningococcal disease appears to be increasing in Gauteng. According to surveillance data collected by the Respiratory and Meningeal Pathogens Unit of the National Institute of Communicable Diseases, the rate of meningococcal disease in Gauteng in 2005 was 3.5 per 100 000 – this is at least double the rate seen in any of the other provinces in South Africa. Acute flaccid paralysis surveillance in Gauteng has been suboptimal as the number of cases detected has been lower than required and thus contributed to a delay in South Africa achieving polio-free certification by the World Health Organisation.

1.4 Complementary Surveillance Activities in Gauteng Province

Surveillance of communicable diseases is not limited to notifiable disease reporting. In addition to the statutory notification system, surveillance activities are carried out by different organizations for multiple purposes including academic research and monitoring of morbidity patterns by health care service providers and funders.

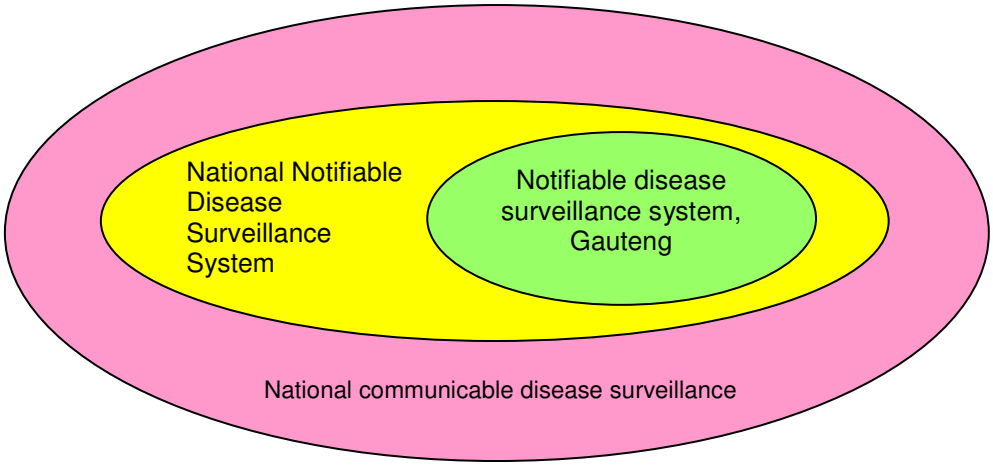

Figure 1.3 Venn diagram indicating context of the Gauteng component of the national disease notification system

Current surveillance activities within Gauteng Province include:

1. Laboratory-based surveillance conducted by the National Institute for Communicable Diseases[14]

   The National Health Laboratory Service Act of 2000 provides for the establishment of the National Health Laboratory Service (NHLS) as a juristic person to serve as the single national public entity providing laboratory services to public health facilities in South Africa.[15] The National Institute for Communicable Diseases (NICD) forms part of the NHLS and conducts laboratory based surveillance for a number of communicable diseases based on their public health importance and includes epidemic-prone diseases, vaccine-preventable diseases, diseases targeted for eradication or elimination and opportunistic infections (as proxy indicators for HIV-related morbidity). Examples of specific diseases monitored include measles and acute flaccid paralysis (the NICD houses the regional WHO-accredited Polio laboratory). The institute serves as the national reference centre for the confirmation of diagnosis of polio, measles, rubella, rabies and viral haemorrhagic fevers and as such collects data on the incidence of these diseases. Data collected by the NICD are communicated to the South African National Department of Health and is disseminated publicly through the NICD Bulletin and Communiqué publications. South African legislation does not require laboratories to report individual test results of notifiable diseases to the Department of Health but it does often occur that the provincial communicable disease coordinators are informed of such diagnoses in the interests of outbreak investigation and control. Laboratory results issued to health care providers have automated comments stipulating when a disease is notifiable and the onus is on them to contact the relevant authorities.

2. Line list reporting to local or provincial health authorities (e.g. diarrhoeal disease line listings) on priority diseases that require immediate notification

   Each week district communicable disease coordinators submit a line-list to provincial communicable disease departments of diseases constituting a subsection of the national notifiable diseases deemed to be of highest priority and provides for the addition of emerging or re-emerging infectious diseases. The notifiable diseases included on the list are cholera, malaria, meningococcal meningitis, hepatitis and typhoid fever.

3. Tuberculosis reporting system

   In addition to the inclusion of tuberculosis as a statutory notifiable disease which follows the path shown in figure 1 above, the South African Department of Health has implemented a specialised electronic tuberculosis register in all provinces which has improved the reporting system performance.[16] Limitations in use of the register are the need for computer literate staff and training in the use of the system.

4. Expanded Programme on Immunisation surveillance (Acute Flaccid Paralysis, Measles, Neonatal tetanus)

   Weekly line lists of three vaccine preventable illnesses, namely measles, polio (through acute flaccid paralysis surveillance) and neonatal tetanus, are submitted by health district offices to provincial communicable disease coordinators on a ‘zero-reporting’ basis i.e. numbers of cases must be indicated each week, even if that number is zero.

5. Environmental surveillance as conducted by either municipal or provincial environmental health officers (this includes surveillance of water sources for pathogens and inspection of abattoirs and food-handling facilities)

6. Veterinary disease surveillance
   Diseases of importance within the agricultural sector are monitored through surveillance as required by the South African National Department of

Agriculture and the OIE[17]. The diseases may be of importance for human health, firstly because of the effect of such diseases on the agricultural industry and thus on the socioeconomic circumstances affecting human health and secondly because of the potential for spread to humans. Diseases with zoonotic potential that are monitored by the Department of Agriculture include anthrax, brucellosis and more recently, avian influenza (although to date no highly pathogenic H5N1 influenza viruses have been detected in South Africa).

7. Medical schemes/medical aid surveillance of morbidity and health service provision and utilization patterns (usually using ICD-10 coding system); this may also include antimicrobial or other drug prescription patterns

8. Pharmaceutical Surveillance by pharmaceutical firms monitoring trends in drug sales and prescribing patterns

9. Private Hospital group surveillance of admission patterns and health care services delivered

10. Morbidity surveillance (absenteeism)

    The NICD influenza surveillance activities include sentinel general practitioners reporting on numbers of patients seen with respiratory complaints and sentinel schools providing absenteeism data at regular intervals. These trends are compared with laboratory influenza surveillance data.

The abovementioned list of surveillance activities is not exhaustive and many of these systems are completely independent of the others. Some surveillance systems may be collecting similar data elements but applying different methodologies or collecting and analysing information by different software packages. Merging notification datasets with laboratory datasets is complicated by differences in unique identifiers and inconsistencies in the spelling of names. There may be opportunities for collaboration and integration and existing models in other provinces or countries could be explored to suggest possibilities within Gauteng. Doyle and colleagues describe the Public Health Surveillance Knowledgebase

(PHSkb) and its implementation in the United States integrating multiple surveillance databases with the purpose of creating a basis for uniform vocabulary in notifiable diseases, providing queriable domain knowledge on these diseases and facilitating automated case detection and decision support.[18]

Internal quality checks are vital to the credibility of surveillance systems. An example of the application of quality assurance procedures can be seen within the National Health Laboratory Service which employs quality control procedures with regular checks on diagnostic accuracy accompanied by guidelines on system attributed such as the recommended turnaround time of specimens.

The surveillance data is generally expressed as disease (or health event) incidence rates which require population data as the denominator. These are sourced from the national Census, District Health Information System and district based demographic officers.

Information on surveillance activities is disseminated through various channels. Examples of such publications and reports include the Link (newsletter of the Respiratory and Meningeal Pathogens Unit of the NICD), the NICD Annual Report, Bulletin and Communiqué and Department of Health publications. Tables on diseases notified to the National Department of Health can be accessed on their website. The National Department of Health issues a quarterly publication (last published for the period October to December 2005) entitled “Epidemiological Comments” reporting recent epidemiological data and articles on current topics of importance within public health and epidemiology.

1.5 Evaluation of disease notification systems

Evaluation involves distinguishing the measured change in targeted results that can be attributed to a particular system, programme or intervention; or analysing input and activities to determine their contribution to results. The validity of disease

incidence and impact measures as reported through existing networks needs to be tested and part of the testing process includes a formal examination of the system to identify strengths and weaknesses. This informs decision-making to improve system performance.

In 2001 the Guidelines Working Group of the Centres for Disease Control and Prevention in Atlanta issued the Updated Guidelines for Evaluating Public Health Surveillance Systems[19] in response to the need for integration of surveillance and health information systems, establishment of a data standards and to adapt to a change in the focus of communicable disease surveillance in light of emerging and re-emerging health threats. The main objective of the guidelines is to address the need for integration of surveillance and health information systems.

In 2001 Saunders reported on notifiable disease surveillance in Fiji.[20] The country with a population of roughly 800 000 at the time of the evaluation had recently prioritised improvement of free and low-cost health care services and assessing the quality of health information systems was considered an integral part of the process. Eight problem areas were identified with regard to notifiable disease surveillance, namely an outdated disease list; lack of standard case definitions; under reporting and late reporting of data; lack of clearly defined public health actions to be taken; lack of resources to take action; lack of feedback to field officers from supervisory and statistics units; notifiable disease data was considered unreliable by system users; and lack of reporting compliance by private doctors. Recommendations arising from the findings of the evaluation included revision of notifiable disease lists with consideration of current priority diseases and determination of appropriateness of clinical versus laboratory reporting; training of health care workers in notification procedures; and improving feedback to reporting units.

The first evaluation of the Australian National Notifiable Disease Surveillance system was described by Miller in 2004.[21] Three stakeholder groups were identified

and surveyed. While the system was found to be acceptable, structurally simple and that the data were actively used by stakeholders certain problems were identified namely lack of clearly stated system objectives, inflexibility and poor timeliness.

Communicable diseases are underreported for numerous reasons.[22] Health seeking behaviour and access to services may be limited in lower income sectors of the population. This same population experiences a higher burden of disease and mortality rates as demonstrated by research on the "social gradient" where people further down the social ladder are at higher risk of acquiring infectious diseases and of higher mortality rates.[23]

Non-compliance with disease notifications by private general practitioners has been of concern locally and internationally. In 1988 the Acheson Committee reported on mandatory disease notifications in the United Kingdom and found that many doctors claimed they were unaware of their statutory obligation to report such conditions and a large number were unsure as to which diseases were notifiable at all. Durrheim and Thomas published a survey of Croydon general practitioners' awareness of notifiable infectious diseases in 1994 and their results showed a relatively high level of correct identification of notifiable conditions (79% of 56 respondents surveyed)[24] but low levels of motivation were deemed to be important in explaining incompleteness of disease reporting.

Successes in disease notification systems have also been documented. Smith et al reported on mandatory anonymous HIV-surveillance in Denmark and found that factors associated with the high (95%) compliance by physicians were the anonymity of reporting, the ability to routinely evaluate completeness of reporting and issuing of reminders to non-reporting physicians.[25]

Analysis of costs and benefits is critical to in evaluating disease surveillance systems and implicit in the International Health Regulations is the principle that

developed countries must assist developing countries in improving their surveillance activities as the resulting benefit is a global public good. As there is a paucity of this kind of information guidelines have been issued by the World Health Organisation[26] in order to stimulate research in this area. Traditional cost-effectiveness and cost-benefit studies are not feasible at present because of a lack of efficacy data and standards pertaining to disease surveillance and response. There are also difficulties in linking outcomes to specific disease surveillance activities. Benefits may be even more difficult to quantify and include those derived from averting cases, averting deaths, reduction of social and economic disruption and the psychological benefit of peace of mind. The current recommendation is that costs and benefits of disease surveillance and response activities should be studied separately until enough information is available to permit more complex research methodology.

Evaluations have been conducted on surveillance systems other than those pertaining to traditional notifiable diseases. In December 2000 Nguyen et al described the status of infection surveillance and control programmes (ISCP's) in a sample of facilities surveyed in the United States.[27] The study was conducted by circulating questionnaires to diverse categories of health care facilities and requesting information on their attributes in terms of human resources, hospital size and utilisation and management structure. It is of interest to note that this was the first study of its kind on a national level since the 1970's despite widespread acknowledgement of the growing problem of hospital acquired infections and their associated costs. Unfortunately the research paper failed to mention the response rate of the survey or discuss characteristics of non-responding facilities. It was found that facilities implementing infection control surveillance activities had increased by 44% (from 100 to 144 facilities) between 1992 and 1996. However, less than 30% of facilities were using indicator systems for nosocomial surveillance.

1.6 Malaria Surveillance

Malaria remains one of the leading infectious causes of morbidity and mortality worldwide with an estimated 300 to 500 million new cases and more than one million childhood deaths annually. Over 90% of estimated malaria-related deaths occur on the African continent[28] and more than 250 000 of those deaths affect citizens of SADC countries.

Malaria control in South Africa is well established under the national Malaria Control Programme that focuses on areas of seasonal transmission (namely Limpopo, Mpumalanga and KwaZuluNatal provinces). Measures employed to reduce the burden of malaria infection include vector control, surveillance, prophylaxis and case-management in the malaria endemic areas in South Africa. Much effort is expended on education and training to ensure disease control and case-reporting in these areas and health care providers are trained intensively in the recognition and management of patients with malaria. There is no specific programme to train health care workers in the non malaria-endemic areas of South Africa. Lack of awareness by both the public and health care workers could lead to late diagnosis and sub-optimal treatment.

At this time there is no apparent autochthonous transmission of malaria in Gauteng Province although historically parts of the geographic region were endemic for the disease. The current situation is attributed to the absence of competent anopheline mosquito vectors in the province and the virtual protective barrier provided by malaria control interventions in the surrounding provinces. Environmental health services in Gauteng province carry out surveillance on imported goods, notably tyres, to detect mosquito larvae and port health authorities require appropriate disinsection of passenger and freight vehicles (aeroplanes, train carriages) before permitting disembarkation.

Very little is known about the burden of disease in Gauteng. Despite being a notifiable disease, malaria cases outside of the three malaria provinces have been reported inconsistently since the late 1990's. Data from 1989 to 1994 were analysed and reported in the Epidemiological Comments publication of the South African Department of Health in 1995[29] and absolute numbers of notifications are shown in Figure 1. 4. The rate of new malaria cases per 100 000 population was only calculated for 1994 (population estimates based on 1991 census data) and was reported as 3.8 per 100 000.

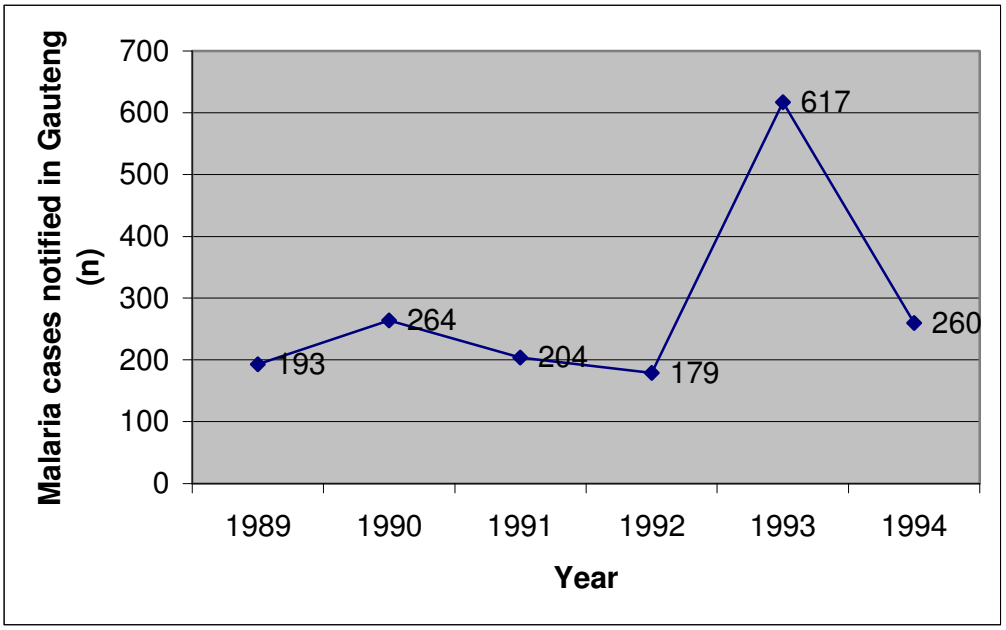

Figure 1.4 Malaria cases notified to the Department of Health from Gauteng Province from 1989 to 1994

There may be a lack of awareness regarding malaria in non-transmission areas resulting in a lower index of suspicion when patients present with fever. In 2002 the total number of malaria cases notified in provinces outside of malaria transmission areas was 503, this number subsequently declined to 72 in 2003 and only 19 in 2004[30].

Anecdotal reports indicate that there are a number of malaria cases in Gauteng with some of them resulting in severe complicated infections and even death. Early and accurate diagnosis followed by appropriate treatment is of vital importance to achieving a favourable outcome after malaria infection. The Guidelines for the treatment of malaria in South Africa compiled by the National Department of Health have changed in response to the development of parasite resistance to antimalarial drugs[31] (chloroquine, sulfadoxine-pyrimethamine). As the Malaria Control Programme only operates in the known transmission areas, healthcare professionals in Gauteng may not be aware of these changes.

Surveillance of imported malaria in Gauteng is reliant on the passive notification of cases. It is estimated that malaria cases are underreported for a variety of reasons such as delayed diagnosis, inconvenience and lack of motivation to report. Control measures are no longer required within the province although parts of the province were once endemic for the disease. The current communicable disease response strategy includes investigation of cases of malaria where no travel history is given and importation of an infected vector is the most likely source. The United States has documented several outbreaks of autochthonous transmission of malaria due to the accumulation of infected individuals and the presence of a competent vector (*Anopheles spp*) to propagate the infection to susceptible hosts. The guidelines for investigations of such outbreaks published by the Centers for Disease Control and Prevention[32] consist of a three-pronged approach with epidemiological, environmental and laboratory investigation components. Such outbreaks have not been documented in Gauteng Province, South Africa. Entomological surveys are not routinely done to investigate for the presence of mosquitoes able to transmit malaria. Entomological surveys in the province have usually focused on mosquitoes implicated as vectors in arboviral (arthropod-borne viral) diseases.[33]

The main purpose of malaria reporting is to target malaria control interventions in endemic regions as emphasised in the WHO Recommended Surveillance Standards[34] where essential components of the surveillance and recommended

case definitions are described. The current malaria notifications in South Africa provide for recording of age and sex of patients but not of pregnancy status (recognised as an independent risk factor for severe malaria). The WHO surveillance standards refer to data for decision-making and one of the purposes being for planning and resource allocation which is also of relevance in the Gauteng health care setting.

In addition to notifiable disease reporting for malaria, the NICD has been conducting a clinical surveillance study on malaria cases diagnosed in Gauteng Province between 1 December 2005 and 30 November (see figure below). Infection control and other clinical personnel from private and public hospitals were recruited to submit clinical questionnaires about each malaria patient to the NICD.

In the United Kingdom imported malaria cases are reported to the Health Protection Agency (HPA) Malaria Reference Laboratory. In 2005 a total of 1754 cases of malaria were reported in the country of which 70% were caused by *Plasmodium falciparum* consistent with trend noted over the preceding three decades.[35] The agency routinely collected data on use of chemoprophylaxis and 78% of the reported cases had not used the preventative measures advocated by the HPA. Groups identified higher at risk for acquiring malaria were those of African and south Asian ethnicity and it was evident that health messages about the importance of prophylaxis were not reaching these parts of the population. It was also found that the ratio of those acquiring malaria whilst visiting friends and relatives compared to holiday travellers was 6.8:1 which could be attributed to various factors including a lack of access to medical information, poor travel advice and lack of adherence because of reduced risk perception. These and other findings are used to review travel health recommendations and target risk groups for health communication and education.

CHAPTER 2

MOTIVATION, AIMS AND OBJECTIVES

Motivation for the study

A formal evaluation of the disease notification system in Gauteng province was necessary to gauge performance and had not previously been carried out. Among the aspects identified by majority of contributors and users of the health services as being inadequate were (i) poor compliance with the reporting of details of notifiable diseases (notably by private sector primary health care providers) and (ii) the under-reporting of cases in general. A description of the disease notification system and measurement of selected components was necessary to inform health policy and procedures within the Gauteng department of health and its reporting units.

Aim of the study

The aim of this research was to evaluate the adequacy of the notifiable disease surveillance system in Gauteng Province and to make recommendations for more effective and efficient operations of this surveillance system. The complexity of the notifiable disease surveillance system with numerous components of inputs, processes, outputs and feedback necessitated narrowing the focus to specific aspects for the purposes of this research. The aim of this exercise was to evaluate the notification system through a broad qualitative assessment of selected components of the notification system complemented by quantitative assessments of the systems' capacity and performance.

Objectives of the study

1. To describe the qualitative aspects of the structure, inputs, process and outputs of the notifiable diseases surveillance system in Gauteng Province, based on an established framework developed by the Centers for Disease Control and Prevention, Atlanta, USA and adapted to the South African setting.

2. To conduct a cross-sectional survey on the knowledge and practices of disease notification among primary health care providers in the private sector in Gauteng Province

3. To measure the degree of underreporting of notifiable diseases versus positive laboratory diagnoses using malaria as a cases study

4. To identify the correctible short-comings in the Gauteng Health Department's diseases surveillance system and to recommend ways of addressing these to improve the system and its performance

CHAPTER 3

METHODS

3.1 Period of coverage of study

This study was based on the data and information collected in the 6-months' period from 1 January to 30 June 2006

3.2 Study design

This is an evaluation study and thus consists of both the qualitative aspects and quantitative descriptive components of the notifiable disease system in Gauteng Province.

The subjects of the study were the Gauteng Health Department's disease surveillance system, public and private sector health care providers including private primary health care practitioners

3.3 Methods

For the purpose of convenience, the descriptions of the methods of data collection as well as that of the tools used for data collection are presented sequentially according to the objectives as set out in chapter 2 above. The description of the methods and tools used for the qualitative evaluation of the surveillance system is presented first. This is followed by the descriptions of the methods and tools used for the two quantitative studies – one on the knowledge and practice survey among the primary care practitioners and the other on the degree of underreporting of malaria cases by health care providers.

3.3.1 Surveillance System Evaluation

The methods used in this evaluation are based upon the Updated Guidelines for Evaluating Public Health Surveillance Systems published by the Centers for Disease Control and Prevention (Atlanta, USA). The Guidelines describe the critical attributes that a surveillance system should have to be effective and efficient.

Evaluation of the surveillance system consisted of semi-structured interviews with representatives of provincial and district communicable disease control offices, inputs of the key role players in the Department of Health

The surveillance system attributes on which data was collected were: level of usefulness; simplicity; flexibility; data quality; acceptability; sensitivity; positive predictive value; representativeness; and stability. The application of the Guideline was adapted to suit local circumstances.

(a) Variables studied for system's evaluation

i. The **usefulness** of the surveillance system is reflected by documented changes in policies and procedures as a result of information generated by the system. Provincial and district communicable disease control respondents were questioned about such changes in policies and procedures.

ii. **Simplicity** denotes the structure and ease of operation of the surveillance system. Based on information provided by communicable disease control coordinators during telephonic interviews a flow diagram was constructed to demonstrate processes and illustrate duplication and delays in the system.

iii. The **flexibility** of a surveillance system is its capacity to adapt to changing information needs or operating systems within minimal additional time,

personnel and funding. Interviews with communicable disease control coordinators in conjunction with a retrospective review of published material were used to assess the ease of introduction of new medical conditions into the reporting system.

iv. The **quality of data** reflects the completeness and validity of the data recorded in the notifiable disease surveillance system. The completeness was measured by calculating the percentage of blank fields in surveillance line lists (as transcribed from GW17/5 notification forms). The validity of data may be tested by repeat interviews of patients on whom the notification data is collected but is beyond the scope of this research.

v. The willingness of persons, institutions or organisations to participate in the surveillance system is an indication of its **acceptability**. This attribute was ascertained through interviews with system participants. An objective measure of willingness to participate in reporting is an assessment of submission rates by reporting units but such records were not available from Gauteng communicable disease control departments during the research period.

vi. **Sensitivity** has a two-fold meaning in surveillance systems: firstly, on a case detection basis it refers to the ability of the system to detect cases and secondly it refers to the ability of the system to detect outbreaks through trends in the notification data. Sensitivity was defined as the former for the purposes of this evaluation and was measured using malaria data by comparison of laboratory diagnoses as gold standard positives and notifications to the department of health as test positives.

vii. **Positive predictive value** refers to cases that actually have the health condition in question. The positive predictive value has a direct bearing on the quantity of resources expended on response to positive cases. The positive predictive value was determined by dividing notified case numbers

by the sum of notified case numbers with corroborating positive laboratory results and those without.

viii. The extent to which the surveillance system accurately describes the occurrence of medical conditions over time and their distribution in the population by place and person is an indication is its **representativeness**. This was assessed by comparing the characteristics of reported events to the expected occurrence of events based on existing epidemiological knowledge.

ix. **Stability** was assessed by questioning communicable disease control personnel on the frequency of system "down-times".

(b) Population under study

The study population included key stake holders in the public sector health care at the National Department of Health, National Institute of Communicable Diseases, the Gauteng Health Department personnel directly involved in the notifiable disease surveillance system (at provincial and district levels). Direct involvement in the system was defined as receiving, processing and reporting on disease notifications as submitted on GW17/5 forms. Personnel within the department but only peripherally involved in disease notifications were excluded from this qualitative analysis. The total number of provincial and district communicable disease coordinators in Gauteng Province is 9. Available communicable disease control co-ordinators - who included provincial and district coordinators - were interviewed.

(c) Data collection procedure

i. Stakeholders, defined as individuals or organisations that generate or use surveillance data for promotion of health and for prevention or control of

diseases or adverse exposures scheduled under the Notifiable Disease regulations, were engaged at the inception of the research process. Semi-structured interviews were conducted with representatives from provincial and district communicable disease control offices over a period of three days, each interview lasting approximately 45 minutes. Respondents were sent an electronic copy of the questionnaire prior to the telephonic interview for the purposes of gathering relevant data or documents pertinent to the survey. Permission for conducting the interviews was obtained from the respondents' respective supervisors (the questionnaire is attached as *Appendix 2*).

ii. The research protocol was circulated to Directorates in the national and provincial departments of health as well as the National Institute for Communicable Diseases for their inputs on the research methodology and composition of attributes that would be studied.

iii. A literature search was conducted on the epidemiology and public health significance of each of the notifiable conditions. The search was conducted on multiple databases namely OVID, Science Direct and Google Scholar using combinations of keywords "**disease/condition**", "epidemiology", "South Africa", "Gauteng", "public health" and "cost". Relevant textbooks and publications by the South African Departments of Health and Agriculture, respectively, were also consulted. A table was constructed listing each of the notifiable conditions, their indices of frequency and severity, disparities or inequities noted in the epidemiology of the disease in Gauteng, costs associated with it, preventability, natural history and extent of public interest.

iv. The National Department of Health and Gauteng provincial health department documents on notifiable diseases were reviewed. Hard copies of the documents were obtained where available; others were downloaded in electronic format from the website of the Department of Health.

(d) Data quality control

Standardised methods tested and validated by the Centers for Disease Control and Prevention (USA) were used. Interviews with communicable disease control coordinators were conducted in the same manner and according to a semi-structured questionnaire. In the measurement of data quality, sensitivity and positive predictive value quality controls included checks on database forms and manual reviews for consistency of data.

(e) Data analysis

As this was a qualitative descriptive study all the information gathered through interviews were coded and triangulated with policy documents, published reports and evidence gathered from reporting databases. Results were presented as a narrative and contingency tables were constructed for system sensitivity and positive predictive values.

3.3.2 Survey of private primary health care providers on their knowledge of notifiable diseases and their reporting practices

(a) Study Design

A cross-sectional design was used. A sample survey by means of a telephonic questionnaire was used to generalise the results of the study to the population of primary health care providers in the private sector in the Gauteng Province.

An alternative and objective method of assessing reporting practices of general practitioners would have been to conduct a practice-based record

review. However the costs of applying this method would have been prohibitive and access to such records would likely have been a limiting factor.

(b) Population under study

The study focused on the private sector primary health care providers in Gauteng Province as this sector was identified by the Gauteng Health Department a major problem. Within the public sector the PHC providers are medical doctors or professional nurses with a two-year postgraduate training in primary health care. In the private sector these services are delivered by medical doctors in independent practice. The Board of Health Care Funders has issued 3 980 active general practitioners in Gauteng Province with independent practice numbers (personal communication with the BHF Health Systems and Policy Department on 2 August 2004).

(c) Sampling process

The sample was drawn from a sampling frame of general practitioners listing their names, practice locations and telephone numbers. The Medpages database was used as it closely approximated the composition of register of independent practitioners of the Board of Health Care Funders (which is not openly accessible). The information collected by Medpages is updated regularly through personal communication and listed members are requested to submit contact information on their colleagues. The data supplied by Medpages is used primarily by pharmaceutical companies as well as medical practitioners as a directory for colleagues to whom they wish to refer patients.

The sample size of 375 was estimated using nQuery Advisor software for a one-group test for proportion (normal approximation) adjusted for a finite population. The specifications were for a two-sided test with the significance level, α, set at 0.05, and power of 60% to detect differences in knowledge and awareness of notifiable medical conditions. The Gauteng private general practitioners constitute a population size of 3980. Systematic random sampling was applied to the sampling frame to control for selection bias.

(d) Variables studied

The data collected included demographic variables and variables associated with disease notifications (compliance with disease notifications; availability of GW17/5 notification forms; contact with district communicable disease control coordinators; knowledge of notifiable diseases; availability of guidelines on statutory disease reporting) and means of communication.

(e) Data collection procedure

The survey using a structured questionnaire and administered by one interviewer, was conducted telephonically in the interests of time, cost and to maintain the integrity of the sequence of questions.

The data collection instrument was a structured questionnaire which is attached to this document (*Appendix 4*). The questionnaire form was designed in Microsoft Access with specific checks in place to avoid erroneous data entry.

All questionnaires were administered by a single interviewer namely the principal investigator. Verbal informed consent was obtained from each respondent and the interviews lasted between five and ten minutes each. At

the end of each telephonic interview the participant was thanked, given the opportunity to ask questions and offered supplementary information on notifiable and other communicable diseases.

Three attempts were made to contact each of the practitioners sampled. Failure to obtain a response by the third attempt or refusal to participate in the survey constituted a "non-response".

(e) Data quality control procedures

The data collection instrument was pre-tested on medical practitioners not selected as part of the systematic random sample. The data were entered directly into a Microsoft Access form which was reviewed after each interview. To check for consistency respondents were first asked whether they always report notifiable medical conditions to the department of health and then subsequently asked whether they have disease notification forms or books available in their practices.

(f) Data analysis

Data preparation included tabulation, coding and editing/cleaning. The need for data editing/cleaning was reduced at the outset by checks built into the questionnaire form but supplemented by manual checking of electronic forms immediately after completion. Open-ended questions were recoded into numerical codes to facilitate statistical analysis. Variable transformations included collapsing of response categories such as the years since medical graduation and average numbers of patients seen per day into discrete classes. Responses to questions on notifiable disease knowledge were counted and converted into scores.

Tabulation was performed electronically and the table generated in Access was exported to Microsoft Excel for editing and to Epi-Info version 3.3.2 and Stata 8 for analysis. Univariate and bivariate descriptive statistics and inferential statistics were calculated using Stata 8 statistical software package. Table shells that were constructed during the planning phase were completed.

3.3.3 Case study of malaria surveillance in Gauteng Province to measure under-reporting of malaria infections

(a) Study design

A retrospective secondary data analysis was performed comparing laboratory diagnostic data with provincial notification data on malaria cases to quantify underreporting of notifiable diseases in Gauteng Province. Malaria notifications were used as a proxy indicator for notification of other notifiable diseases as most cases of malaria in Gauteng are diagnosed in pathology laboratories. Laboratory services in Gauteng province are quite readily accessible to health care providers; rapid availability of malaria smear and antigen results precludes loss to follow-up of patients associated with prolonged diagnostic delays. Unlike malaria, other notifiable diseases are notified on clinical suspicion alone, often with no confirmatory laboratory evidence. A the survey of private general practitioners had shown that only a minority of private practitioners make use of malaria rapid tests as the positive predictive value of this test is said to be lower in a low incidence settings.

(b) Population

The entire population of Gauteng is the focus of the study. The estimate population size in the province in 2006 is approximately nine million of whom the proportion of undocumented migrants (in whom risk of malaria infection may be higher because of cross-border movements into malaria endemic countries) is uncertain.

(c) Data collection

Data was collected from three sources:

i. Laboratory databases: NHLS (public sector) and Lancet Laboratories (private sector)

The datasets were extracted (or "mined") from the larger database using a criteria search broad enough to capture all malaria tests. In the case of the NHLS data, the DISA system does not require malaria test coding to be entered in a uniform manner and multiple parameters needed to be included. The raw data were systematically manually cleaned to eliminate negative results and duplicate entries (multiple tests on the same patient). A limitation of this process is that patient names may be entered with minor variations in spelling and in the absence of unique identification numbers impairing control for duplication. The private laboratory data was submitted in the form of text delimited line lists. The variables collected for comparison with other databases were patient name; hospital number; facility from which specimen was submitted; patient age; diagnostic technique; and species of *Plasmodium* identified.

ii. The NICD Gauteng Malaria Surveillance database (recording clinical surveillance questionnaires)

The NICD initiated clinical surveillance on malaria in Gauteng Province in December 2005. The process entailed submission of questionnaires by health care facilities and health care providers to the NICD. Participants are issued monthly reminders to submit forms. As such it constitutes a collateral source of data on malaria cases in Gauteng Province. The

surveillance data is maintained in an EpiInfo version 3.3.2 (Windows operating system) database. The variables collected for comparison with other databases were patient name; facility from which the case was reported; patient age; diagnostic technique and species of Plasmodium identified.

iii. Gauteng provincial Communicable Disease Control notification line lists
The provincial line lists are stored in electronic format as Microsoft Excel spreadsheets with relevant patient data included in the listings. The variables collected for comparison with other databases were patient name; facility from which the case was reported; patient age.

(d) Inclusion criteria

The time period of January to June 2006 was selected because it would encompass a range of relatively high to relatively low case numbers and it constituted the time period immediately preceding the introduction of the integrated electronic reporting system by the Gauteng Department of Health. All cases with blood specimens diagnosed with malaria in Gauteng laboratories were included in the NHLS and Lancet laboratory data. All patients notified as malaria cases to the Gauteng provincial department of health from both public and private health care facilities were included.

(e) Data quality control

The laboratory database extraction involved specification of all parameters that could indicate a diagnosis of malaria. All specimens on an individual patient were manually consolidated into a single record controlling for duplication by examination of patient names together with hospital identification numbers and proximate dates of diagnosis. Uniform coding of plasmodia species was applied to all datasets. Provincial notification data were manually examined for duplication based on patient names, ages and

residence details. Databases could not be automatically concatenated and thus had to be merged based on patient names and dates of birth.

(f) Data analysis

Descriptive data were generated from the analysis and analysed using Epi-info and Stata 8.2 software packages. Tables and graphs were generated to depict gaps in notification data and trend lines over the six month period of the study.

3.4 Ethical approval

Ethical approval for the study was obtained from the Research and Ethics Committee of the University of Pretoria and permission to conduct the research was granted by the Gauteng Provincial Health Department, South African National Department of Health and the National Institute for Communicable diseases.

The ethical considerations of this research included the following:

(a) The measurement of various attributes of the surveillance system required tracking of specific patient records with the patients' names and demographic details. All data were anonymised in the databases used and data sharing was restricted. Each patient record in the study was assigned a unique study number. The unique study number was linked to the data. Patient's names and notification form or line-listing numbers had no correlation with the study number. The unique study number prevented patients from being identified to protect patients' privacy.

(b) The "Access to Patients' Data Form" was signed at the Gauteng Chief Director's office for her signature

(c) The questionnaire survey of the health practitioners and personnel within the communicable disease surveillance system was kept confidential.

(d) Participants were assured that this study would not lead to punitive measures for failure to comply with system requirements such as failure to report notifiable health events

3.5 Limitations

The qualitative study on the notifiable disease surveillance system in Gauteng was subject to constraints. As with any type of performance assessment, people working within the communicable disease surveillance system may be fearful of punitive measures or poor publicity if deficiencies are identified. Respondents were assured of anonymity and confidentiality and that the focus of the research was on constructive criticism of the system in order to achieve better results for all. Despite attempts to allay the respondents' concerns their responses may have been biased towards projecting a better image of their performance. The number of respondents was lower than anticipated because of the study period conflicting with other regional priorities.

The general practitioner survey may have been subject to non-response bias with non-respondents representing busier practices. Efforts to determine the characteristics of non-respondents were unsuccessful. Participant responses on compliance with notifications and experience with district communicable disease control departments may have been influenced by recall bias.

The completeness of reporting could have been measured in different ways including capture-recapture techniques employing multiple data sources to estimate the total number of cases occurring in a demographically closed population[36]. While it would have been desirable to apply the technique in this instance the logistical difficulties in linking databases preclude its use and the models required for the analysis are beyond the scope of this research.

Despite manual editing to control for duplication of laboratory diagnoses, the possibility of duplication because of incorrectly spelled names varying between multiple specimen submissions exists.

CHAPTER 4:

RESULTS

For the purpose of convenience, the results of the research are presented sequentially according to the objectives as set out in chapter 2. The results of the qualitative evaluation of the surveillance system are presented first. These are followed by the results of the two quantitative studies – one on the knowledge and practice survey among the primary care practitioners and the other on the degree of underreporting of malaria cases by health care providers.

4.1 Description of the notifiable disease surveillance system in Gauteng Province and measurement of selected attributes

4.1.1 Engagement of stakeholders

The research was discussed with disease notification participants and partners and on review of the objectives and methods of the research the National Cluster Manager: Health Information, Evaluation and Research, South African National Department of Health issued an official letter of support for the research. The Gauteng Provincial Communicable Disease Directorate: the Director for Public Health in the Province and the Assistant Director for Communicable Disease Control endorsed the research. The Provincial Research Committee of Gauteng issued a letter of approval for the research and for access to notification data. Experts from the National Institute for Communicable Diseases permitted access to laboratory records, reviewed the research methodology and made recommendations on data collection

Three communicable disease control coordinators participated in the qualitative interviews; their professional and situational characteristics are listed in Table 4.1

Table 4.1 Characteristics of respondents

	Respondent 1	Respondent 2	Respondent 3
Provincial or Local Authority Appointment	Provincial	Provincial	Local Authority
Level of reporting in the notifiable disease surveillance system	Provincial	District	District
Professional appointment	Deputy Director for EPI, Communicable Diseases, Outbreaks and Infection Control, Gauteng Department of Health	Assistant Director for Communicable Diseases, under the Director for Public Health, Gauteng Department of Health	Communicable Disease Control Coordinator, under Health Programmes (part of Social Development Department)
Size of population under surveillance (based on midyear estimates for 2006)	9 526 200	2 528 303	2 040 517

4.1.2 System Description

A detailed table of notifiable conditions, their indices of frequency and severity, disparities or inequities noted in the epidemiology of the disease in Gauteng, preventability, natural history and extent of public interest is attached in *Appendix 3*. The conditions can be grouped broadly and not in a mutually exclusive manner into categories as depicted in table 4.2

Table 4.2 Notifiable medical conditions and public health importance

Category	Examples of notifiable conditions	Public Health Importance
Expanded Programme on Immunisation target diseases	poliomyelitis, measles, tetanus	EPI target diseases are preventable through routine childhood immunisations in the absence of which they are responsible for a high burden of disease (childhood morbidity and mortality)
Epidemic-prone diseases	typhoid, viral haemorrhagic fevers	These diseases require prompt public health response to control against further spread (for example through implementation of basic infection control measures, isolation or quarantine). Interventions necessitate an intersectoral approach including environmental measures.
Zoonotic diseases	anthrax, brucellosis, rabies	These diseases have a high incidence in groups at risk due to close contact with infected animal populations or with contaminated animal products and usually require an integrated response between departments of agriculture and health
Diseases with the potential for vertical prevention	congenital syphilis, tetanus neonatorum	These are preventable diseases that require vaccination, diagnosis and/or treatment of pregnant women to prevent illness in their children and are reliant on programmes administered through antenatal care.
Diseases with a high incidences and potential for community spread	tuberculosis	These diseases do not require a rapid outbreak public health response but are priority diseases because of high morbidity and mortality. Routine surveillance is necessary to monitor and target interventions.
Those conditions for which reporting to the World Health Organisation is mandatory	cholera, plague and yellow fever	These three conditions have been mandatory reportable conditions to the World Health Organisation as specified in the International Health Regulations of 1969[37]

The National Department of Health states the objectives of the notification system are:[38]

i. to help the National Department of Health (NDOH) to plan and implement health promotion and intervention strategies;

ii. to help the NDOH to monitor disease trends over time (to permit an evaluation of the effectiveness of promotional and intervention strategies); and

iii. to help to implement immediate interventions at provincial and district level.

Gauteng communicable disease coordinators were interviewed and questioned about aspects of the system description. Respondents were well informed about the purpose of disease notifications in the control of communicable diseases. One respondent added that the data was further used to monitor disease occurrence, in the identification of high risk areas and populations for disease outbreaks and in alerting national and international role players and visitors of the risks. None of the respondents had explicit written documentation stating the objectives of the notifiable disease surveillance system but they did refer to documents such as the GW17/5 book, an accompanying information poster and the EPI Field Guide as explanatory resources.

4.1.3 Evaluation of surveillance system attributes

4.1.3.1 Level of usefulness

All three respondents indicated that surveillance data have been used to change policies and procedures. Respondents cited the example of recent notifications of *Klebsiella* infection outbreaks in neonatal wards in Gauteng and the resultant timely policy changes to infection control procedures. These changes included the tabling of schedules for regular infection control and environmental audits. The

respondents operating at district level indicated that follow-up investigations and disease control measures often result from such data. Additional users of the data identified were the National Department of Health and the World Health Organisation.

4.1.3.2 Simplicity

The processes of disease notification form part of the passive disease surveillance system. The process starts with the generation of a notification report by a health practitioner when a notifiable disease is diagnosed on presentation of the patient. Data so generated is passed through a series of statutorily defined routes through the different levels of health care to the National Department of Health. The patient's initial point of care is the site from which reporting takes place. The routes of notification vary between public and private sectors. Figure 4.1 below outlines the flow of data from its point of generation through to the National Department of Health as reported by respondents.

The respondents all indicated that notifiable disease reporting from facility to district level and from district level to provincial level occurred by facsimile, e-mail or telephonically (in the case of epidemic-prone diseases). Respondents stated that some facilities report cases directly to the provincial offices while others send the GW17/5 forms through to the district communicable disease control coordinator. The district communicable disease control office submits notification data to the provincial coordinator either in the form of a line listing or the original GW17/5 forms. Line listings are submitted more frequently in the event of a disease outbreak. The frequency of reporting varies according to the type of disease (for example an outbreak of shigellosis requires a more urgent response to control an outbreak than leprosy would). The NICD provides feedback on laboratory diagnosed notifications as well as results of laboratory findings in cases of disease outbreaks to the provincial communicable disease office on an ad hoc basis.

The human resources operating within the disease notification system in Gauteng are structured such that provincial communicable disease control coordinators are Gauteng Health Department appointees under the Public Health Directorate (usually in Assistant Director Posts). Their municipal counterparts on the other hand are local government appointees serving under the Department of Social Development.

All the respondents could produce flow diagrams available for reporting of notifiable diseases within their geographic surveillance area.

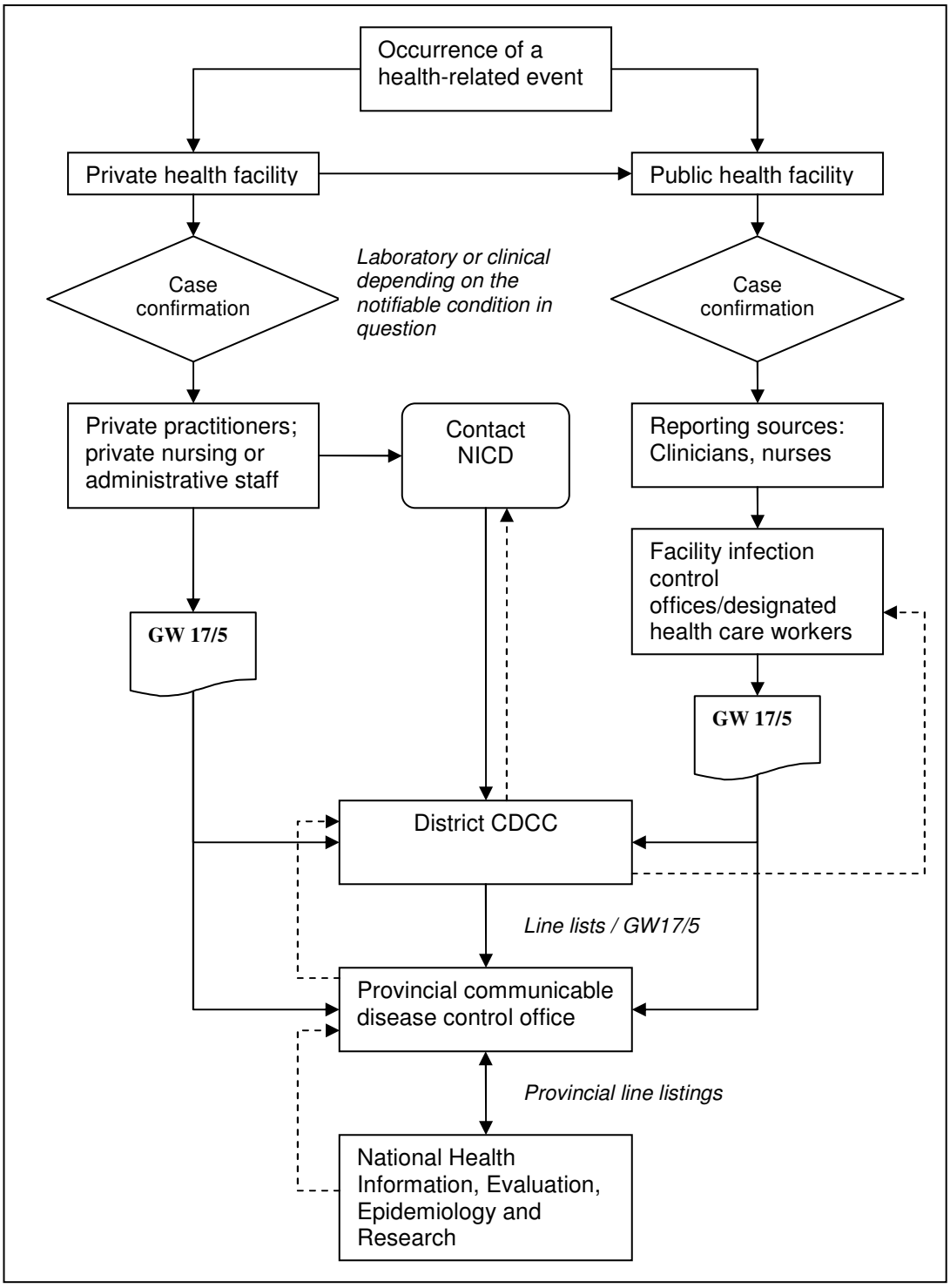

Figure 4.1 Notification processes flowchart for Gauteng Province (as at January to June 2006)

4.1.3.3 Flexibility

Changing the official national notification list is cumbersome and since the process is paper-based and not electronic at present, any alterations require reissuing of disease notification guidelines to all health care providers. The most recent inclusion into the list of notifiable medical conditions is human influenza caused by a new influenza virus subtype as regulated by the Minister of Health in September 2006.[39]

In South Africa the schedule of notifiable diseases is mandated by law under regulations issued by the Minister of Health. Additional diseases that a Provincial or Local Authority health department intends to have monitored may be included as the GW17/5 provides for accommodation of such conditions. An example of this is the priority disease notification line lists submitted on a weekly basis to the Provincial CDC office.

The electronic data capture at district and provincial levels in the form of Microsoft excel spreadsheets can be readily exported into compatible database systems such as Epi-Info.

4.1.3.4 Data quality

The quality of data reflects the completeness and validity of the data recorded in the notifiable disease surveillance system. Measurements of data quality include completeness and timeliness of reporting. Respondents indicated that due to the absence of a dedicated data-capturer, the reporting frequency timeliness and completeness of data submission was seldom checked. Respondents further stated that report submissions from facilities were erratic but that specific follow-up into reporting practices was done on an ad hoc basis on suspicion of irregularities.

A quantitative indication of completeness was estimated by calculating the percentage of line list entries with blank fields out of reports of meningococcal meningitis in Gauteng between January and June 2006 and is shown in Table 4.3.

The field "residential address" was used as a proxy measure of completeness of reporting as the information is critical for follow up of cases.

Table 4.3 Incompleteness of residential details on line listings for meningitis case notifications, January to June 2006

District	Total number of cases of meningococcal disease on line listing	Number of line list entries with blank/insufficient residential data
Johannesburg Metro	104	30 (29%)
Ekurhuleni Metro	28	16 (57%)
Tshwane Metro	19	7 (37%)
Sedibeng	6	0
West Rand	4	2 (50%)

4.1.3.5 Acceptability

The willingness of persons, institutions or organisations to participate in the surveillance system is an indication of its acceptability. Respondents operating at district level stated that compliance by health facilities in both public and private sectors was good but that private general practices were particularly problematic in under-reporting of notifiable diseases. The district communicable disease control officers meet with public sector health facilities on a monthly basis and make use of the opportunity to give feedback to the reporting units on surveillance data and outbreak response.

4.1.3.6 Sensitivity

The measurement of sensitivity is affected by the incidence of disease in the population under surveillance, the case-definitions and the reporting behaviour of health care providers. The respondents stated that while case-definitions were well-established for some of the notifiable conditions (such as Acute Flaccid

Paralysis), a complete list of case definitions on all the notifiable diseases was not yet available and some of the departments were making use of the Communicable Disease Control Handbook published by the American Public Health Association as an interim measure.

The quantitative estimation of the sensitivity of the notification system is further reported in Section 4.2 as calculated using malaria notifications and laboratory data.

4.1.3.7 Predictive value positive

This is the number of reported cases that actually have the health condition in question. The positive predictive value has a direct bearing on the quantity of resources expended on response to positive cases. Respondents indicated that variable amounts of time are expended on following up of reported cases of notifiable diseases and is largely dependent on human resource availability to assist with these investigations.

4.1.3.8 Representativeness

The degree to which the surveillance system reflects the actual distribution of health conditions in the population is its representativeness. This attribute is best addressed in quantitative terms as exemplified in the malaria notification example in Section 4.3.

4.1.3.9 Stability

Stability was assessed by questioning communicable disease control personnel on the frequency of system “down-times”. All respondents reported that there had been none in the preceding six-month period.

Sustainability of human resources affects the stability of the system. The Provincial CDCC reported that the office had not had a dedicated surveillance data

capturer in some years. At the end of 2005 an assistant was appointed to the unit for 6 months but this only alleviated the situation temporarily.

4.2: Survey of private sector primary health care providers in Gauteng Province examining notifiable disease awareness and reporting practices

Characteristics of the sample

The survey was conducted over a period of six weeks and 69 private practitioners were interviewed. The response rate was 18.4% (69 out of 375). The majority of the non-responses (299) were due to unavailability of the practitioner at the times that calls were made. Three attempts were made to contact each practitioner before classifying them as a non-response. Three practitioners explicitly refused participation on the grounds that they were too busy. Another three were excluded on grounds of relevance to the study as two of them were exclusively doing anaesthetics and the third had moved out of clinical medicine into lifestyle counselling. The characteristics of the sample are reflected in Table 4.4.

Table 4.4 Characteristics of General Practitioners who responded

Characteristic	Number (n)	Percent (%)	95% Confidence Limits	
District where practice is situated				
Ekurhuleni Metro	10	15	7.2%	25%
Johannesburg Metro	30	44	31.6%	56%
Sedibeng	2	3	0.4%	10.1%
Tshwane Metro	19	28	17.5%	39.6%
West Rand	8	12	5.1%	21.6%
Years since medical graduation				
0 to 10 years	14	20	11.6%	31.7%
11 to 20 years	16	23	13.9%	34.9%
21 to 30 years	18	26	16.3%	38.1%
More than 30 years	21	30	19.9%	42.7%
Number of patients seen per day				
1 to 10	14	21	11.7%	32.1%
11 to 20	26	38	26.7%	50.8%
21 to 30	22	32	21.5%	44.8%
31 to 40	5	7	2.4%	16.3%
> 40	1	1	0%	7.9%
Access to communication media				
Land line telephone	68	99	92.2%	100%
Cellular Phone	57	83	71.6%	90.7%
Internet access at practice	46	67	54.3%	77.%
Fax machine at practice	64	93	83.9%	97.6%

The median length of time since qualification as a medical practitioner was 23 years (i.e. qualified in 1983) and the range was between 3 and 52 years. The

median number of general practitioners working at the respondents' practices was two (range 1 to 13), with a mode of one.

Thirty seven percent (n=26) of respondents stated that they always reported cases of notifiable conditions seen at their practices to the department of health. Twenty eight percent (19/69) of respondents reported having a notification book present in their practice. The commonest reasons cited for not consistently reporting cases were the assumption that facilities to which patients with such conditions were referred would notify them (10/69) and that the notification process was too cumbersome (9/69).

There appeared to be a negative association between compliance with disease notifications and number of years since qualification (Chi-squared test of variability, p=0.07) as shown in Table 4.5.

Table 4.5 Cross-tabulation of cohorts of years since qualification by self-reported compliance

Self-reported Compliance with Notifications

Years since qualifying	Not compliant	Compliant	TOTAL
1 to 10 years	5	9	14
Row %	35.7	64.3	100
Col %	11.6	34.6	20.3
11 to 20 years	9	7	16
Row %	56.3	43.8	100
Col %	20.9	26.9	23.2
21 to 30 years	14	4	18
Row %	77.8	22.2	100
Col %	32.6	15.4	26.1
> 30 years	15	6	21
Row %	71.4	28.6	100
Col %	34.9	23.1	30.4
TOTAL	43	26	69
Row %	62.3	37.7	100
Col %	100	100	100

Single Table Analysis

Chi-squared	df	Probability
7.0448	3	0.0705

Respondents were questioned on their awareness regarding whether or not specific medical conditions are notifiable. Of the twelve conditions listed in the survey questionnaire, nine were notifiable. Figure 4.2 demonstrates the responses to whether or not these diseases are notifiable.

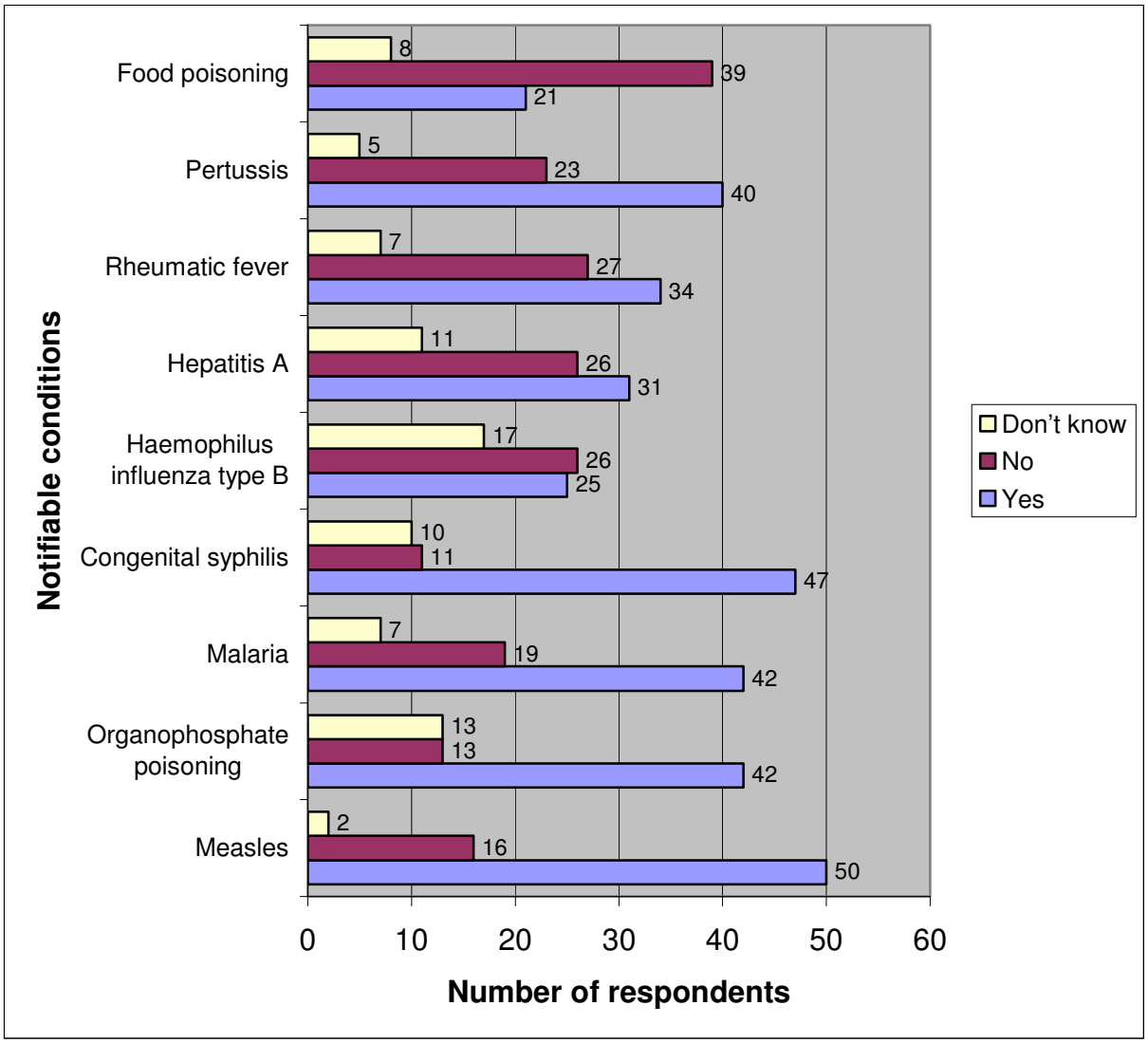

Figure 4.2 Participant responses on knowledge about notifiable diseases

A percentage score of correct answers i.e. number of correct answers as a percentage of total number of questions was calculated for each respondent. The

percentage results were approximately normally distributed around a mean of 59.5% (confidence limits 55.4% and 63.6% at α=0.05).

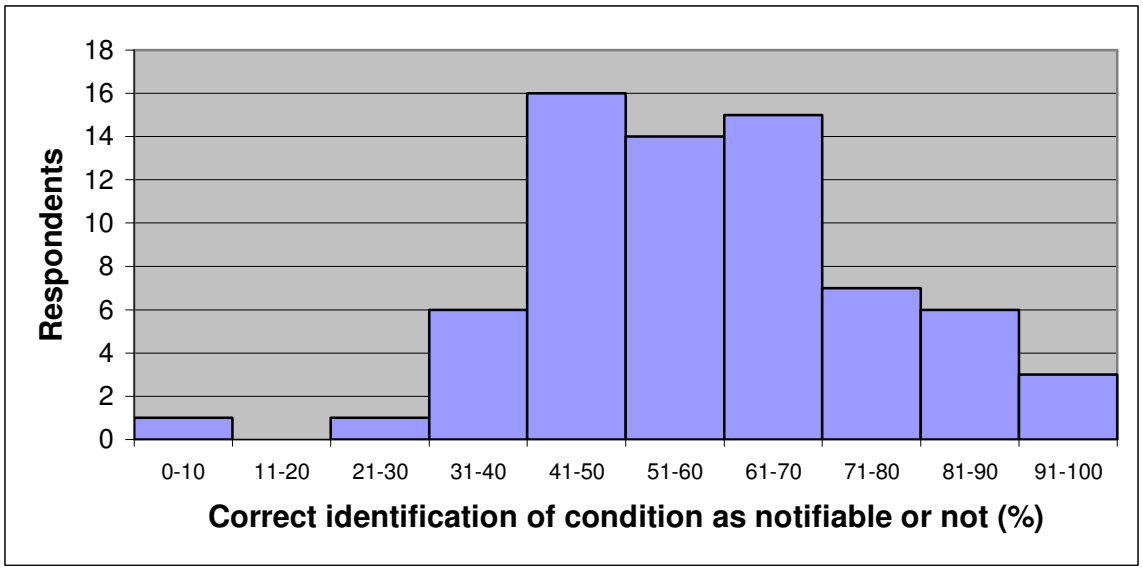

Figure 4.3 Frequency distribution of response scores on knowledge of notifiable diseases

The interval since medical graduation was inversely proportional to the result as demonstrated in figure 4.4. The linear regression model demonstrates a negative relationship is not statistically significant for α=0.05 (p=0.21).

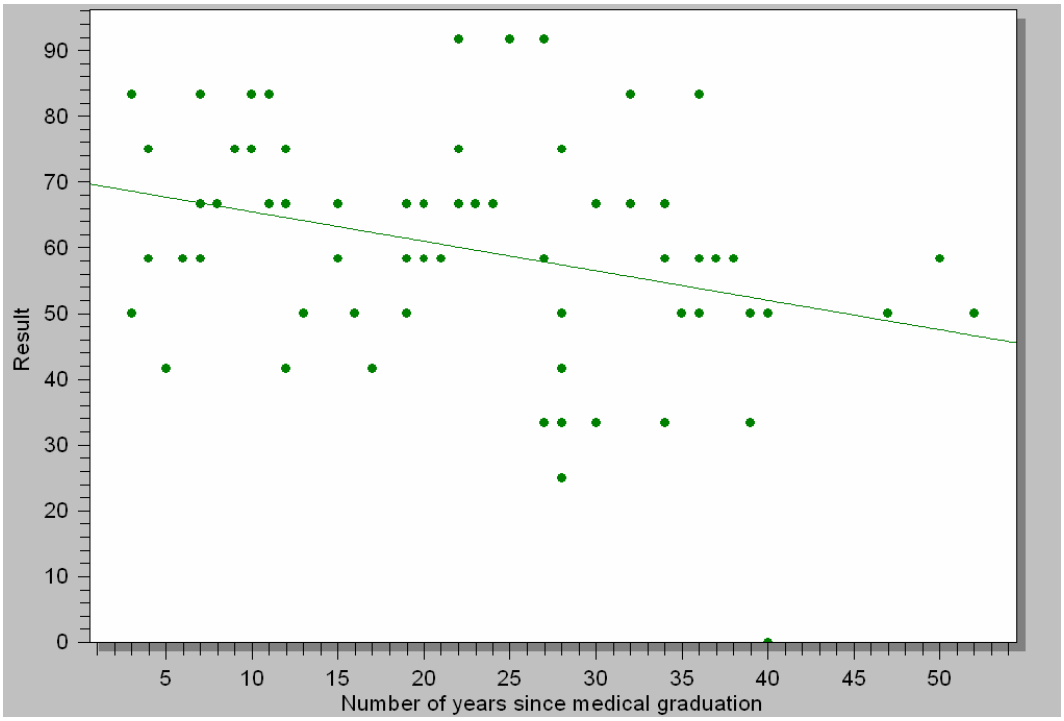

Figure 4.4 Scatter plot of number of years since graduation against percentage of notifiable and non-notifiable conditions correctly identified

Around half of the respondents (36/69) indicated that they had seen at least one case of malaria in their practice over the past year and only 7 respondents made use of malaria rapid diagnostic tests in their practice (5 of them routinely confirmed these tests by submitting bloods to private laboratories).

Sixteen respondents (23%) indicated that they do have guidelines for notification of medical conditions in their practices and two practitioners commented that they had approached the Department of Health to supply them with notification books but this had not yet occurred. Only two of the sixty nine respondents had been in contact with the department of health within the six months preceding the telephonic interview.

Seventy two percent of the respondents also indicated that they do access the internet for medical information, either at work or at home.

4.3: Case study of malaria notifications in Gauteng Province to measure under-reporting of notifiable conditions

A total of 4 695 patients were diagnosed with malaria by public sector (NHLS) laboratories in Gauteng between 1 January and 30 June 2006 and 184 by private sector (Lancet) laboratories. During the same period the provincial department of health received 1600 notifications of malaria from private and public sector health care facilities collectively. The National Institute for Communicable Diseases received notifications of 1508 cases of malaria as part of their clinical malaria surveillance as described in Section 3.3.3 (c) ii.

The sample characteristics are shown in Table 4.6.

Table 4.6 Malaria diagnoses and notifications: sample characteristics (January to June 2006)

Variable	Gauteng Notifications	NHLS diagnoses	NICD clinical surveillance
Total number of malaria cases	1600	4679	1508
Age distribution			
Under 5 years	236 (14.8%)	512 (10.9%)	231 (15.3%)
5 to 20 years	328 (20.5%)	663 (14.2%)	273 (18.1%)
21 to 40 years	819 (51.2%)	2189 (46.8%)	689 (45.7%)
Over 40 years	190 (11.9%)	546 (11.7%)	214 (14.2%)
Age not reported	27 (1.7%)	769 (16.4%)	101 (6.7%)
Sex distribution			
Female	493 (30.8%)	1340 (28.6%)	479 (31.8%)
Male	1094 (68.4%)	2917 (62.3%)	1023 (67.8%)
Sex not documented	13 (0.8%)	422 (9.0%)	6 (0.4%)

The number of cases of malaria reported through all the databases showed a bimodal distribution with the larger peak in the third week of 2006 and the second,

smaller peak through weeks 16 to 20. The NHLS data by week is shown in figure 4.4

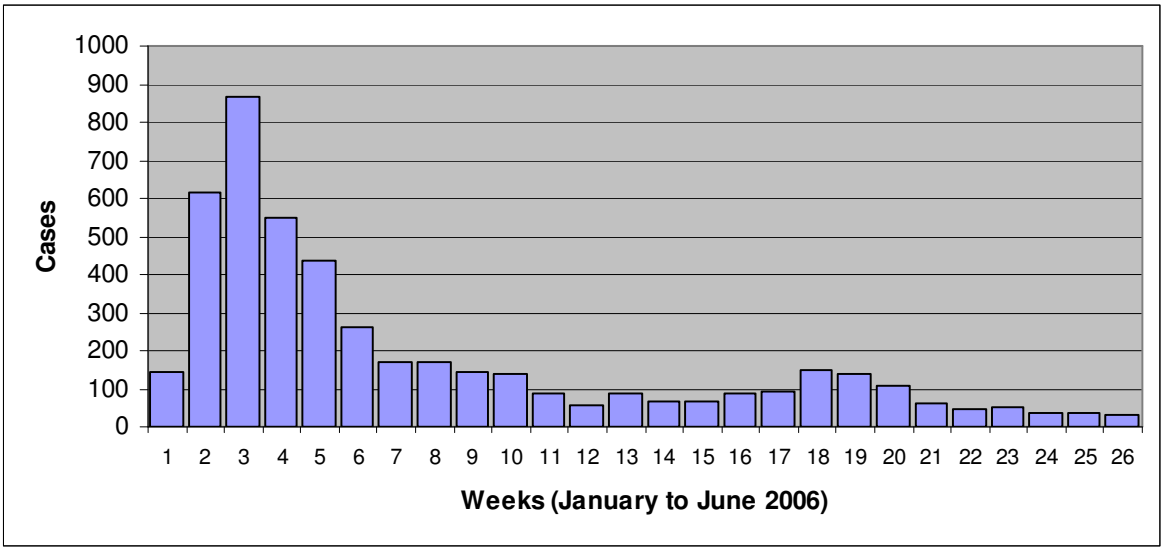

Figure 4.5 National Health Laboratory Service data: malaria cases diagnosed by week from January to May 2006

A comparison of the monthly totals of cases of malaria recorded by the different data sources is shown in figure 4.6 demonstrating the gap between laboratory diagnosed malaria cases and those reported to the Gauteng Department of Health. The NICD surveillance data trends closely resembled those of the provincial notification data.

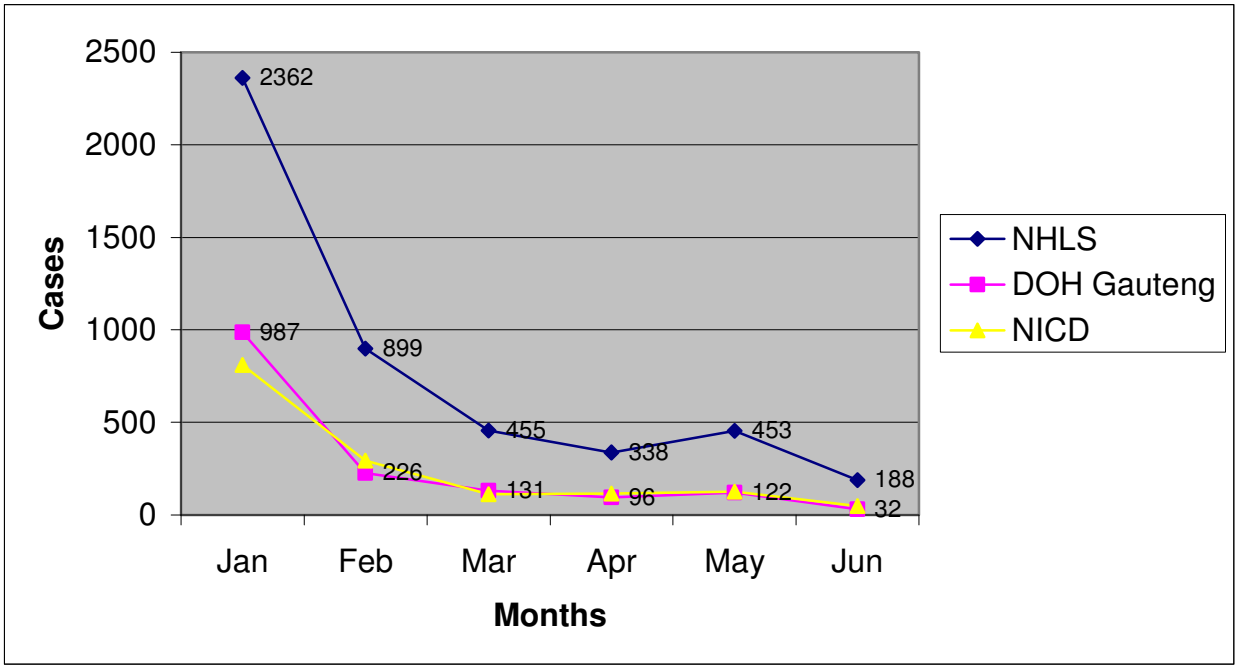

Figure 4.6 Absolute numbers of malaria cases documented through different sources (not species-specific)

The GW17/5 reporting form has a field for entry of the results of laboratory investigations but the provincial line listings do not capture *Plasmodium* species diagnoses. The National Health Laboratory service and private laboratory databases do capture details of malaria parasite species and the frequency of these diagnoses during the study period are shown in Table 4.7.

Table 4.7 Laboratory diagnoses of malaria parasite species, January to June 2006

	Laboratory Database	
	National Health Laboratory Service	**Lancet Laboratories**
P. falciparum	4 214	172
P. ovale	10	2
P. vivax	6	4
P. malariae	4	2
Mixed infection	15	3
Not specified	414 (30 antigen-negative)	1

Table 4.8 shows the two-by-two contingency table that was used to calculate an estimate of system sensitivity. To calculate sensitivity, a sample of 100 of the laboratory diagnosed malaria cases were selected by simple random sampling. The variables of patient name, reporting facility/facility submitting specimens and date of diagnosis were used to cross-link records between the NHLS database and the Gauteng provincial disease notification line lists.

Table 4.8 Sensitivity of malaria notifications

	Laboratory diagnosis positive	Laboratory diagnosis negative	**Totals**
Cases notified	26	0	26
Cases not notified	74	0	74
Totals	100	0	100

Sensitivity = cases notified / “gold standard” number of cases = 26/100 = 26% (95% confidence interval 17.4 to 34.5%).

CHAPTER 5
DISCUSSION OF FINDINGS

Since the inception of democratic governance in 1994, the health care system in South Africa has been focused on achieving comprehensive and equitable service delivery to the entire population of the country. Prior to 1994 health services were fragmented under multiple departments of health and grossly inequitable. Similarly the national disease notification system is rooted in a disjointed health service where health information systems have functioned sub-optimally and in some places not at all. The Department of Health of Gauteng Province faces the same challenges and facets of its operations are still in a transitional phase. Despite these acknowledged constraints the performance of the department's programmes and routine health information systems needs to be monitored and evaluated. The enthusiasm with which stakeholders participated in and endorsed this evaluation is an indication of willingness to assess and improve notifiable disease surveillance.

The public health importance of diseases included in the list of notifiable medical conditions should be reviewed periodically. The current list of conditions in South Africa has remained relatively constant since the regulations to the Health Act in 1977. Changes have included removal of smallpox subsequent to global eradication and the addition of *Haemophilus influenzae* type b since introduction of the Hib-vaccine into the routine childhood vaccination schedule. Current and explicit case definitions are necessary to clarify what should be reported. The Department of Health's website on disease notification states that all conditions on the list are notifiable on clinical grounds alone yet in other publications by the department malaria, for example, is said to be notified only on the basis of a positive smear (or antigen test).

The National Department of Health has documented the objectives and purposes of the disease notification system but the absence of documents to that effect at provincial and district levels indicates that that information flow to other levels of the health care system is lacking. Similarly there appears to be some confusion regarding the legislative basis for notifiable disease reporting as evidenced in CDCC interviews. The data collected on notifiable diseases in Gauteng could be used for many purposes but at present the resulting information is used predominantly for outbreak response (such as meningococcal disease) and to fulfil mandatory requirements.

All of the attributes of surveillance systems assessed in this study vary in their relative importance depending on the objectives of the system. The attributes may even detract from one another, for example improved timeliness may compromise completeness if data are cumbersome to obtain.

This research revealed contradictory views about the usefulness of the notifiable disease surveillance system. The communicable disease coordinators cited that the system was useful in stimulating changes in public health policy in response to surveillance data on outbreaks. Some of the private general practitioners surveyed, however indicated that they felt there was no purpose in reporting cases as they perceived that there was little public health action arising from the notifications. Feedback sessions are held monthly within the public sector in Gauteng between the provincial and local health departments and public hospitals and primary health care facilities. Such interaction is lacking between the public and private sectors and this may result in lack of communication.

The organisational structure of the disease notification system and the procedures for notification do not conform to ideal routine health information system design. There is substantial potential for duplication of notifications because of variations in reporting from facility, through district, to provincial communicable disease control

offices. Reporting procedures vary within facilities. In some public hospitals laboratories report diagnoses of notifiable conditions to infection control staff who pursue the notifications further whereas other facilities rely on physicians alerting infection control staff or other designated parties responsible for disease notifications. In the private sector the onus is on the practitioner alone to report notifiable conditions. The human resource structure of the system incorporating provincial and local authority personnel is in a phase of organisational change to form a unified public service. On interview with key stakeholders in the system it appears that cooperation between provincial and local authority personnel is very good. Cooperative outbreak response teams have been formed in each district and the workload is divided amongst the participants.

There is already a reasonable degree of integration of a number of vertical components at provincial and district communicable disease control levels. The expanded programme on immunisations and the notifiable disease reporting systems operate through the same departments – this enables local use of information to monitor the impact of immunisations and other disease control interventions.

The disease notification system in Gauteng demonstrates reasonable flexibility both in terms of diseases notified and the data submission process. Diseases may be added to the reporting list on a local level through communication with reporting units although nationally notifiable diseases require legislative changes. These are expedited through provisions in the National Health Act for the Minister of Health to issue regulations in this regard. The degree of flexibility of the data submission process will be tested through the recent introduction of electronic data submission from district level.

The quality of notification surveillance data in Gauteng is a particular challenge. Interviews with key stakeholders in the system suggest that there is scepticism as

to the validity of the data. The example of incompleteness of reporting of meningococcal disease line lists in chapter four showed that residential data essential for community-based follow up of cases, case detection and administration of chemoprophylaxis, was insufficient in 27 to 57% of cases (Sedibeng district only reported six cases thus the sample size is insufficient for comment). The province should be monitoring compliance with notifications on a checklist of reporting units but due to the fact that there has been no dedicated surveillance officer at the unit since 2004 this kind of detailed monitoring is low on the priority list after the more pressing responsibilities of the limited staff complement. Archived surveillance data on notifiable diseases is available at the provincial office but only from 2004 and the quality of the data is uncertain. The Communicable Disease Control line-lists of notifications only include date of onset of illness but not date of receipt of the notification forms. It is not possible retrospectively to determine delays in reporting without this critical information but incorporation of recording of these dates in the health information system would be valuable for prospective analysis.

The positive predictive value of disease notifications has a direct bearing on the resources expended on following up reported cases of medical conditions. In a system based on clinical suspicion rather than laboratory results there is the potential for high numbers of false positive reports unless the occurrence of the condition is high and diagnostic features are specific. The communicable disease control survey respondents all indicated a high workload on a limited number of staff further emphasising the importance of reliable notifications.

The malaria cases reports have been consistent with pre-existing epidemiological assumptions about imported malaria infections with regard to distribution of cases by demographic characteristics but total case numbers have been under-reported. If diagnostic modalities do not exist to adequately detect cases, they will be underreported.

Subsequent to the completion of this study (on 1 August 2006) the notifiable disease reporting process was changed to allow for electronic submission of data from the district level through to provincial and national health departments. This was done through incorporation of the reporting of notifiable diseases into the existing electronic routine health information system. Electronic data entry should ease legibility but basic computer skills will be required. However, this method of reporting does not guarantee that accurate data will be entered. This research provides a baseline against which the performance of the new process can be measured.

Provincial and District Communicable Disease Control coordinators have repeatedly cited compliance in notification amongst private practitioners as a major challenge to effective surveillance. This situation is not unique to Gauteng Province or even to South Africa. The primary health care provider survey conducted between September and the first week of December 2006 yielded an 18.4% response rate. There may have been non-response bias where practitioners not participating in interviews were systematically different from respondents in that their practices were busier. Given the median number of patients seen by respondents as 20 per day this may confirm that the practices are less busy than average although there is little published on relevant averages within South Africa. A postal survey regarding travel medicine consultations in private general practices in the United Kingdom in 2004 found that physicians reported spending a median of 11 minutes per consultation with a range of five minutes to over thirty minutes.[40] In a study comparing patients' perceptions of consultation times with actual consultation times, the measured time per consultation was even shorter with a mean of 8.35 minutes and standard deviation of 3.87 minutes.[41] Depending on turnaround time practitioners could see between 3 and 4 patients an hour and given a standard working day of 8 hours this would translate to 24 to 32 patients per day.

Despite the risk that participants could terminate the interview easily by hanging up the telephone all interviews that were initiated were completed. There may have been less interviewer credibility than in in-person interviews. Another limitation of the survey is that potential respondents were limited to those whose details were captured on the database.

On interpretation of the results of the survey numerous aspects were highlighted that should be considered by the provincial department of health in strategies to improve private sector compliance with notifications. Six of the nine listed notifiable conditions were recognised as reportable by at least half of the respondents namely measles, congenital syphilis, organophosphate poisoning, malaria and pertussis (whooping cough). Thirty seven percent (n=26) of respondents stated that Hepatitis A is not a notifiable disease – this is particularly worrisome as it is an epidemic-prone disease requiring swift public health intervention. There is substantial uncertainty on notifiable status of *Haemophilus influenzae* type b infection, probably because it was only recently added to the list of notifiable diseases. This reporting is necessary to assess the effectiveness of introduction of Hib-vaccine into the national childhood immunisation schedule in 1999. Fifty five percent (n=38) of respondents stated that food poisoning was not reportable yet this is an area in which public health response is very important, particularly where continued exposure of susceptibles to contaminated foodstuffs or water sources is possible

On termination of the interview respondents were asked whether they would like to receive more information regarding communicable and reportable medical conditions and 60 of them showed keen interest. Electronic copies of the Department of Health's "Why notify" document and the latest NICD Communiqué were e-mailed to respondents with Internet access and copies faxed to those without it. This may indicate a willingness to participate in communicable disease information sharing and learning. In order to increase notification compliance by

private practitioners it is necessary for the notification system to maintain this type of communication and feedback on a regular basis.

Malaria notifications from Gauteng Province have declined since the mid 1990's. In 2005 the total number of malaria notifications in the province was 204. The provincial notification line-list for January to June, 2006 indicates 1 600 malaria notifications, almost an eightfold increase from the previous year. The reasons for the increase are uncertain but possibilities include improved reporting compliance from health care facilities. In December 2005 when the NICD introduced malaria clinical surveillance in Gauteng multiple introductory briefings were conducted amongst health service providers in public and private sectors and this may have raised awareness of malaria reporting. Other possible reasons for the increase in reported case numbers may be increased population movements from malaria endemic areas, or increased malaria transmission in areas visited by travellers.

The number of cases diagnosed in public sector laboratories from January to June, 2006 was three times higher than the provincial notifications (n=4679). The Lancet private laboratories in Gauteng diagnosed 184 cases of malaria in the same period although these are not the sole private pathology service providers in the province. Despite the fourfold increase in malaria notifications between 2005 and 2006, two thirds of the laboratory cases were still not notified indicating that more needs to be done to improve disease notification. Although these findings pertain to malaria reporting the shortcomings identified are likely to apply or be even worse with other conditions because of the enhanced awareness of malaria notifications since December 2005 and because malaria test results are predominantly laboratory-confirmed and readily available to health care providers.

The proportional distribution of the cases by age and sex are similar comparing the NHLS, notification and NICD datasets although the proportionally higher representation of children in the latter two datasets may indicate the propensity to treat children as in-patients thereby increasing their chances of being reported by infection control staff at the facilities.

Neither routine malaria notifications nor laboratory datasets provide information on length of hospital stay or on the severity of infection, other than fatal outcomes indicated on GW17/5. The NICD surveillance has established that 20% of malaria cases seen at facilities in Gauteng Province are classified as severe and complicated. The South African malaria treatment guidelines permit the use of Artemisinin-based combination therapy for treatment of uncomplicated malaria but this medication is not available in the public sector in Gauteng province. Given the favourable side-effect profile of the latter medication and the short course of ambulatory treatment required drug policy changes could result in savings on health care expenditure for up to 80% of patients with malaria.

The notification system does not usually capture information on malaria species diagnosed in Gauteng province and, as can be seen from this research, the burden of non-falciparum malaria appears to be negligible. A caveat to this assumption is that such cases may be less readily identified by inexperienced microscopists.

The sensitivity of malaria reporting is only 26%. The sensitivity of the system is important for purposes of detecting disease outbreaks and accurately quantifying the burden of disease. It could be assumed that sensitivity for priority epidemic prone diseases such as meningococcal disease would be higher but this would require a confirmatory study comparing meningococcal laboratory reports as well as patient records (some cases are clinically diagnosed without laboratory culture confirmation) in comparison with notifications to the department of health. Nevertheless, in light of the results of malaria notification the degree of underreporting for the majority of the 33 notifiable medical conditions is likely to be worse.

Conclusions

This evaluation has revealed strengths and weaknesses in the notifiable disease surveillance system in Gauteng Province. The personnel working in the notification system appear to be dedicated, informed and conscientious. However, this research suggests that there is suboptimal use of the information for local action in certain areas. The completeness and accuracy of notification data, as demonstrated in malaria notifications, is insufficient to gauge a true picture of burden of disease in the province. Identification of new and emerging health threats will likely be through routes other than the notifiable disease surveillance.

This assessment serves to enlighten policy-makers on the current state of the communicable disease surveillance system in Gauteng Province. It highlights areas in which improvements can be made as well as reinforcing successful practices. The communicable disease surveillance systems form an integral part of the health system and public health planning and implementation.

CHAPTER 6
RECOMMENDATIONS

The goal of strengthening notifiable disease reporting at each level of the health care system is to produce a system that values information for its role in guiding decision making. The following actions are recommended

1. Evaluation of the notifiable disease surveillance system will need to be conducted at regular intervals and the results of this research could be used as a baseline for such assessments. The methodologies used during this study could be adapted and used in other provinces in South Africa or elsewhere.
    a. Evaluations should incorporate supplementary data sources and methods should be developed to ease integration of datasets to eliminate duplications
    b. External validation of evaluation methods can be enhanced for quality assurance through the use of established standards and guidelines

2. The national, provincial and district health departments together with key stakeholders and experts should critically examine the diseases included in the notification system with particular consideration of what could better be assessed through surveys or laboratory notifications. Priority considerations should include whether a public health response is warranted for the condition in question and what the consequences would be should cases not be notified.

3. The universal shortage of human resources for health impedes notification system performance. Planning for human resources for health should take cognisance of the need for adequate and skilled personnel.

4. Training and support of reporters of notifiable diseases in both the public and private sector are necessary components of quality assurance. Incorporation of notifiable disease reporting as a theme in continued medical education

programmes may be effective in raising awareness and competency amongst medical professionals.

5. Facilitation of private practitioner compliance with notifiable disease reporting

    a. Regular bidirectional communication should be maintained between the public sector notification system components and private general practitioners

    b. A software programme could be distributed to general practitioners on compact disc with automated notification alerts linked to ICD-codes which are entered for purposes of medical aid claims. A “pop-up” window would alert the practitioner that the condition should be notified to the Department of Health and additional information such as contact details of communicable disease control offices could also be included.

6. Dissemination of the results and interpretation of notification data should be published and available to a wider audience of health care providers with elucidation on how it has influenced responses to outbreaks or been used to assess health interventions. Frequent and timely feedback is essential.

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Appendix 1

List of Notifiable Medical Conditions in South Africa

ICD10 Code	Name
AFP	Acute flaccid paralysis
A22	Anthrax
A23	Brucellosis
A00	Cholera
A50	Congenital syphilis
A98	Crimean-Congo haemorrhagic fever
	Other viral haemorrhagic fevers
A36	Diphtheria
A02&A05	Food poisoning
HIB	Haemophilus influenzae type B
T56	Lead poisoning
A48	Legionellosis
A30	Leprosy
B54	Malaria
B05	Measles
A39	Meningococcal infection
A01	Paratyphoid fever
A20	Plague
T57&T60	Poisoning agricultural stock remedies
A80	Poliomyelitis (ICD10: Acute)
A82	Rabies
I00	Rheumatic fever
A35	Tetanus (ICD10: other)
A33	Tetanus neonatorum
A71	Trachoma
A16.7	Tuberculosis Primary
A16.2	Tuberculosis Pulmonary
A16.9	Tuberculosis (other respiratory organs)
A17.0&G01	Tuberculosis of meninges
A18.3	Tuberculosis of intestine, peritoneum
A18.0	Tuberculosis of bones and joints
A18.1	Tuberculosis of genito-urinary system
A18.8	Tuberculosis of other organs
A18.9	Tuberculosis miliary
	Tuberculosis total
A01	Typhoid fever (ICD10: Typhoid fever)
A75.0	Typhus fever (lice-borne)
A75.2	Typhus fever (ratflea-borne)
B15.9	Viral hepatitis type A (ICD10: Acute)
B16.9	Viral hepatitis type B (ICD10:Acute)
B17.8	Viral hepatitis non-A non-B (ICD10:Acute)
B19	Viral hepatitis unspecified
	Viral hepatitis total
A37	Whooping cough
A95	Yellow fever

Appendix 2

DISTRICT COMMUNICABLE DISEASE CONTROL COORDINATOR QUESTIONNAIRE

Respondent:
District:
A. Purpose and objectives of the system
1. What is the purpose of the notifiable disease surveillance system? ……
2. Do you have written documentation of the objectives of the surveillance system? ☐Yes ☐No ☐Don't know
3. What is the data you collect used for? ……
4. Who uses your data? ……
5. Do you have a list of case definitions available to you? ☐ Yes ☐No If so, from where? ……
6. What is your legal authority for data collection? ……
7. Where does your department reside within the notifiable disease system? ……..
8. To what extent is disease notification at your level integrated with other systems? ……
9. Do you have a flow chart of your notifiable disease system for your district? ☐ Yes ☐No If so, please could I have a copy?
B. Components of system
1. Could you describe the population under your surveillance with regard to notifiable diseases? ……

2. How frequently do you collect/receive data on notifiable diseases? ……..
3. How do you collect notifiable disease data? ……..
4. Who reports notifiable diseases to you/ what are your reporting sources of data? ……
5. With regard to data management:
a. Who enters the data? ……
b. What coding system is used to enter data? ……
c. Is the data checked/validated? If so, how? ……
d. Where are your data stored? ……
e. Do you make backups of data? If so, how? ……
6. How are your data analysed? ……..
7. To whom do you disseminate your data and how? ……..
8. How do you ensure patient privacy, data confidentiality, and system security? ……..
9. Do you make use of a records management program? ……..
C. System resource requirements
1. Under whose budget does notifiable disease surveillance fall? ……..
2. How many personnel are involved in notifiable disease reporting at your level?

……..
3. What percentages of your time are spent on notifiable disease surveillance and follow up? ……..
4. What other resources are needed for notifiable disease reporting?
a. Travel
b. Training
c. Supplies
d. Computer and other equipment
e. Related services
5. Can you describe any instances when your notifiable disease data has led to changes in policies or programmes in your district? ……..
D. System attributes
1. How much information is necessary to verify a case? ……..
2. How many forms need to be completed per case of disease?
a. At facility level
b. At district level
3. How many reporting units do you have in your district? ……..
4. What database do you use for private practitioners? ……..
5. How much follow up is necessary for notifiable diseases?
a. Priority conditions
b. Routine notifiable conditions
6. How easily can you add a disease onto your reporting system? ……..
7. How willing are reporting units to submit information to you?

……..
8. How do you check for timeliness and completeness of reporting? ……..
9. How often on a monthly basis is your system down? ……..
10. How long, on average, does it take from receiving data to processing and releasing it? ……..
11. Do you personally give any feedback to your reporting units and if so, how? ……..
12. What do you feel was your unit's greatest achievement? ……..
13. What do you feel is your unit's greatest challenge? ……..

Appendix 3

Table A.3.1 Epidemiology and Public Health Implications of Notifiable Diseases in Gauteng, South Africa

Notifiable Medical Condition	**Epidemiology**	**Preventability** (primary, secondary and tertiary; prevention of spread)	**Natural History**	**Public Interest and Public Health Importance**
Expanded Programme on Immunisation Priority Diseases				
Acute flaccid paralysis	The epidemiology varies by age group and the aetiology of the condition. In South Africa (SA) 216 AFP cases were notified during 2004.	Primary specific prevention: trivalent oral polio vaccine	Acute flaccid paralysis as a complex clinical syndrome with multiple potential aetiologies	The outbreak of poliomyelitis in Namibia between April and July in 2006 has highlighted the importance of AFP surveillance in neighbouring countries.
Diphtheria	Between January and June 2005 there were 138 cases of diphtheria notified nationally.	Primary specific prevention: diphtheria toxin vaccine (part of DPT, dT); secondary prevention: quarantine close contacts; tertiary prevention: isolation of cases	Agent: Reservoir: Humans Transmission: droplet spread Clinical: infection of the pharynx, tonsils, larynx and occasionally skin; may be complicated by myocarditis or neuritis	Diphtheria carries a mortality of 5 to 10% if untreated. The potential for outbreaks in susceptible populations is high and outbreak response includes mass vaccination and treatment of close contacts.
Poliomyelitis	Most wild type polio outbreaks occur due to wild type 1 poliovirus as was the case in Katatura, Namibia, in an outbreak between April and July 2006. Circulating wild type 2 poliovirus has not been detected since October 1999.	Primary specific prevention: trivalent oral polio vaccine, enteric precautions; secondary prevention: screening is not indicated; tertiary prevention: rehabilitation after paralytic polio (physiotherapy, orthopaedic corrective surgery, assistive devices)	Agent: Poliovirus types 1, 2, 3 Reservoir: Human (mostly through unapparent infection in children) Transmission: usually person-to-person spread through the faeco-oral route Incubation period: 7 to 14 days Clinical: 90% of infections are asymptomatic; 1% of cases paralytic amongst children (higher in adults)	Poliomyelitis is targeted for eradication by the World Health Organisation. The use of live attenuated trivalent oral polio vaccine poses the risk of vaccine associated paralytic poliomyelitis (one in every 2.5 million doses administered) but is still advocated in developing countries as the benefits far outweigh the risks.
Haemophilus influenza type B	According to the National Department of Health statistics, thirteen cases	Primary prevention: vaccination with conjugate Hib vaccine	Agent: *Haemophilus influenzae* type b Reservoir: humans	Haemophilus influenzae type b has been a major cause of childhood morbidity and mortality

Notifiable Medical Condition	Epidemiology	**Preventability** (primary, secondary and tertiary; prevention of spread)	Natural History	Public Interest and Public Health Importance
	of *H. influenzae* type b infection were reported in South Africa in 2003 and 6 in 2004 however the NICD surveillance detected 21 cases and 18 cases in 2004 and 2005 respectively.		Transmission: droplet spread Clinical: meningitis, pneumonia, epiglottitis; children between 6 months and 2 years of age at highest risk	due to pneumonia and meningitis but it is preventable through vaccination and is now included on the childhood routine immunisation schedule
Measles	A measles outbreak occurred in 2004 with 786 cases reported nationally (increased from 251 in 2003); there were 560 measles IgM-positive cases from Gauteng – this number decreased to 44 cases in 2004.[42] In sub-Saharan Africa there were 216 000 deaths attributable to measles in 2004. Communities with low socioeconomic status are most at risk.	Primary: vaccination with live attenuated measles vaccine; airborne transmission precautions; Secondary prevention: vitamin A supplementation, treatment of secondary infections and nutritional management; Tertiary prevention: prevention of visual complications	Agent: measles virus Reservoir: humans Transmission: airborne droplet transmission, highly infectious Clinical: incubation 1 to 2 weeks followed by high fever, coryza, cough, conjunctivitis and a rash at day 14 after exposure; complications include encephalitis, pneumonia, otitis media, blindness and severe diarrhoea	Measles is one of the most contagious diseases known and will be the next disease after polio to be targeted for eradication. It is still one of the five leading causes of under-five mortality in Africa.
Tetanus neonatorum	Seven cases were reported in South Africa in 2004, two of them fatal. Gauteng is predominantly urban whereas neonatal tetanus largely occurs in rural areas where traditional practices of applying cow dung to umbilical stumps persist.	Primary prevention: prevention of wound contamination by hygienic umbilical stump care; maternal antenatal vaccination with tetanus toxoid; treatment: tetanus antitoxin, supportive therapy	Agent: *Clostridium tetani* toxin Reservoir: commensal organism in large intestines of stock animals; persists in environment as spores	NNT has been notifiable as a separate entity since 1991 and is targeted for elimination by the World Health Organisation. The NNT control programme was introduced in South Africa in 1994 consisting of immunisation of women of childbearing age with tetanus toxoid.
Whooping cough	South Africa: 6 cases reported in 2004; 8 cases	Primary prevention: vaccination with either	Agent: *Bordatella pertussis* Reservoir: humans	The disease is readily transmissible and responsible for

Notifiable Medical Condition	Epidemiology	**Preventability** (primary, secondary and tertiary; prevention of spread)	Natural History	Public Interest and Public Health Importance
	in 2003	inactivated whole cell pertussis vaccine or acellular pertussis vaccine (in combination with diphtheria and tetanus vaccines)	Transmission: droplet spread Clinical: severe coughing spells lasting four to eight weeks, infants most at risk	significant morbidity in susceptible populations
Epidemic Prone Diseases				
Crimean-congo haemorrhagic fever (CCHF)	CCHF is endemic to South Africa. Sporadic cases occur annually, usually in arid regions of the Northern Cape and Free State Provinces. In 2006 there were two laboratory confirmed cases in Gauteng, acquired in the Sedibeng district; both cases were fatal.	Preventative measures include tick control and use of personal protective equipment by workers potentially exposed to infected ticks; blood and body fluid precautions in nosocomial settings	Agent: Crimean Congo Haemorrhagic Fever virus Reservoir: populations of hares, birds and *Hyalomma* ticks; domestic animals are amplifying hosts Transmission: bite of an infected tick; crushing an infected tick; or through exposure to blood or body fluids of an infected patient Clinical: acute onset of systemic symptoms; in 20% of cases haemorrhagic diatheses occur. Case fatality ranges between 2 and 50%.	There is significant potential for public hysteria and there is a high risk of secondary infection through exposure to an infected patient's blood or secretions
Other viral haemorrhagic fevers	In South Africa viral haemorrhagic fevers seen in the past have included Rift Valley Fever, Marburg and Ebola viral haemorrhagic fevers	Depending on the aetiological agents preventative measures may include blockage of transmission; as soon as patients are detected strict isolation and infection control must be implemented	Agent: viral haemorrhagic fever viruses Clinical: as above	There is significant potential for public hysteria and there is a high risk of secondary infection through exposure to an infected patient's blood or secretions
Food poisoning (four or more cases seen by	This condition is underreported because many milder cases do not	Primary prevention: health and hygiene education of	Agent: Bacterial, fungal or viral microorganisms or their toxins. The commonest causative	These diseases are preventable through proper application of public health surveillance and

Notifiable Medical Condition	**Epidemiology**	**Preventability** (primary, secondary and tertiary; prevention of spread)	**Natural History**	**Public Interest and Public Health Importance**
the same health practitioner or at the same health facility)	present at health facilities. In South Africa between the years of 1999 and 2004, 2015 cases were reported to the Department of Health. Of these, less than 50 were reported from Gauteng although this figure is acknowledged to be incomplete. Most affected are children, pregnant women and the elderly.	communities; stringent application of statutory requirements for food and milk handling	agents are *Staphylococcus aureus, Salmonella spp., Clostridium botulinum, Vibrio parahaemolyticus, Bacillus cereus, Campylobacter spp, Yersinia spp,* fungal toxins and *Clostridium spp.* Reservoir: varies by agent Transmission: ingestion of contaminated foodstuffs Clinical: usually gastrointestinal symptoms; may include neurological or other systemic symptoms	control measures. Diarrhoeal illness causes significant childhood morbidity and absenteeism with economic consequences.
Lead poisoning	One case of lead poisoning was reported nationally in 2004 compared with 221 (including 2 deaths) in 2003	Primary prevention: occupational hygiene control in workplaces dealing with lead; appropriate worker safety precautions and decontamination	Sources: industrial – smelters, lead recycling; environmental – motor vehicle exhausts where leaded petrol is used, lead-based paint chips, ceramics Routes of exposure: mainly through inhalation or ingestion Clinical: chronic exposure leads to damage of the nervous, reproductive and renal systems	Acute lead toxicity is of particular importance in the occupational environment. Chronic environmental lead poisoning is significant because of neurological effects on children
Legionellosis	The Gauteng provincial health department received one notification of Legionella pneumonia from a private hospital in June 2006. Prior to that no cases were reported either this year or in 2005.	Primary prevention: decontamination of water sources (surveillance must be maintained in high risk areas such as air-conditioning coolant water)	Agent: *Legionella pneumophila* Reservoir: the bacteria are found naturally in the environment and thrive in warm water sources Transmission: inhalation of aerosols containing *Legionella* bacteria Clinical: mild (Pontiac fever) and severe (Legionnaire's disease)	The epidemic potential of Legionnaire's disease has been documented in outbreaks that occurred associated with contaminated airconditioning systems and poorly maintained water features (amongst others). Elderly patients are particularly at risk. The disease is preventable through adherence to occupational and environmental

Notifiable Medical Condition	**Epidemiology**	**Preventability** (primary, secondary and tertiary; prevention of spread)	**Natural History**	**Public Interest and Public Health Importance**
				health standards.
Meningococcal infection	In 2004 notifications of 161 meningococcal infections were received in South Africa. During the same period the NICD reported 184 laboratory confirmed cases in Gauteng alone. In 2005 there were 355 laboratory confirmed cases. From January to June 2006 the Gauteng health department received 172 notifications of infections.	Primary prevention: polyvalent vaccines (A,C,Y,W-135) are available and indicated for use in certain institutional outbreak circumstances but not for routine immunisation in South Africa; secondary prevention through post-exposure prophylaxis with either ciprofloxacin, rifampycin or ceftriaxone	Agent: *Neisseria meningitidis* Reservoir: Humans Transmission: respiratory droplet spread Clinical: incubation period 2 to 10 days; bacterial meningitis; sometimes meningococcal septicaemia	Potential for institutional outbreaks; 5 to 10% mortality; high risk (up to 20%) for residual disability in survivors (e.g. deafness, blindness)
Paratyphoid fever	Six cases of paratyphoid fever were notified in South Africa in 2004, prior to that one case was notified in 1999.	Primary prevention: proper water purification treatment (chlorination), good hygiene and sanitation; secondary prevention: no screening indicated; treatment: fluid and electrolyte replacement; antibiotics only when indicated	Agent: *Salmonella paratyphi* Reservoir: Human and environment Transmission: ingestion of contaminated water or food Clinical: similar to typhoid fever but generally milder disease (see “Typhoid fever” below)	These diseases are preventable through proper application of public health surveillance and control measures. Potential for outbreaks associated with contaminated food or water.
Poisoning agricultural stock remedies	In 2004 there were 280 cases of such poisoning cases reported nationally in South Africa	Primary: correct storage and handling of agricultural stock remedies; occupational and environmental health policy and practice	The commonest agents are organophosphates causing an acute onset of cholinergic symptoms	These cases are entirely preventable through appropriate policies and practices
Rheumatic fever	SA: 21 cases notified in 2004 Global incidence: 500	Primary prevention: no vaccine available, early treatment of streptococcal	Aetiology: autoimmune response to infection with group A streptococcus	The main public health impact of acute rheumatic fever is related to the chronic effect of rheumatic

Notifiable Medical Condition	**Epidemiology**	**Preventability** (primary, secondary and tertiary; prevention of spread)	**Natural History**	**Public Interest and Public Health Importance**
	000 new cases of acute rheumatic fever annually (mostly in developing countries)	infections; secondary prophylaxis using penicillin		heart disease (valvular dysfunction and susceptibility to bacterial endocarditis)
Typhoid fever	Typhoid case numbers have varied depending on whether an outbreak has occurred in a particular year.	Primary prevention: proper water purification treatment (chlorination), good hygiene and sanitation; secondary prevention: no screening indicated; treatment: fluid and electrolyte replacement; antibiotics only when indicated	Agent: *Salmonella enteritidis* subspecies *enteritidis* serovar typhi Reservoir: human Transmission: ingestion of water or food contaminated by faecal material of a typhoid carrier or case Clinical: systemic febrile illness; may be severe sepsis	These diseases are preventable through proper application of public health surveillance and control measures. There is significant potential for outbreaks associated with contaminated food or water and identification and effective treatment of carriers
Typhus fever (lice-borne)	SA: two cases were reported in 2003 and none since according to notification statistics	Primary prevention: control of louse infestations; secondary prevention: antibiotic (tetracycline) treatment of illness; application of residual insecticides	Agent: *Rickettsia prowazekii* Vector: body louse (*Pediculus humanus)* Transmission: inoculation of contaminated louse faeces into breeches in the skin (abrasions, scratches) Clinical: acute febrile condition, systemic infection	This is of importance for its outbreak potential. The disease is highly infectious and carries a mortality of 10 to 40% if untreated.
Typhus fever (ratflea-borne)	SA: no cases have been reported in recent years	Primary prevention: control of rat populations; secondary prevention: antibiotic (tetracycline) treatment of illness; application of residual insecticides	Agent: *Rickettsia typhi* Vector: rat flea (*Cheopis xenopsylla)* Transmission: crushing of infected flea into skin wound Clinical: similar to lice-borne typhus but milder picture	This disease has the potential to cause outbreaks where human habitations are infested by rats.
Viral Hepatitis type A	174 cases reported nationally in 2004. Between 1999 and 2003 reported cases varied between 584 and 260 but	Primary prevention: prevent contamination of water and food sources, prepare foods correctly; specific protection	Agent: Hepatitis A virus (genus hepatovirus, family picornaviridae) Reservoir: human, can survive in the environment for	Hepatitis A is well known for its outbreak potential and requires a rapid public health response to identify the source of infection and to prevent further spread by

Notifiable Medical Condition	Epidemiology	**Preventability** (primary, secondary and tertiary; prevention of spread)	Natural History	Public Interest and Public Health Importance
	no trend was identified. Of the 2191 cases reported over the 5-year period, 18% of the reports were from Gauteng. In areas of high endemicity most infections occur during childhood.	conferred by hepatitis A vaccine or immunoglobulin to contacts of cases; management is supportive	prolonged periods Transmission: faeco-oral transmission through ingestion of contaminated food, water or by contact Clinical: incubation between 10 and 50 days; pre-icteric phase; icteric phase (sometimes fulminant hepatitis); convalescent phase	management of contacts. A particular challenge is that viral shedding in faeces commences about two weeks before symptoms start. Mortality is low but economic impact is marked (adults tend to have more severe disease and absence from work due to illness may be long)
Viral Hepatitis type B	SA: 144 cases notified in 2004 (117 in 2003) Gauteng: 87 cases notified between January and June 2006	Primary specific prevention: Hepatitis B recombinant DNA virus surface antigen vaccine; secondary prevention: post-exposure combination active-passive immunoprophylaxis with hepatitis B immunoglobulin and vaccine.	Agent: Hepatitis B virus (DNA) Reservoir: human Transmission: perinatal, child-to-child, unsafe injections and transfusions, sexual contact Clinical: acute hepatitis; may be followed by chronic hepatitis (especially if infected early in childhood)	This is a preventable disease with marked morbidity and mortality associated with chronic hepatitis and hepatocellular carcinoma
Viral hepatitis Non-A non-B	SA: 5 cases notified nationally in 2005 and only on in the preceding year although the population-based seroprevalence of antibodies against hepatitis C is estimated at 16%	Primary prevention: screening of blood donors, routine virus deactivation of plasma-derived products; secondary prevention: treatment with ribavirin and slow release interferons	Agents: Hepatitis C virus Reservoir: humans Transmission: infected blood products, needle sharing, occasionally through sexual contact Clinical: chronic hepatitis	Hepatitis C infection is a preventable cause of liver cirrhosis; public attention is often drawn to the safety of blood and blood products
Viral hepatitis unspecified	SA: one case notified in 2005	Prevention depends on aetiology	Agents: multiple hepatitis viruses Reservoir: depends on virus Transmission: depends on virus	Depends on the type of virus implicated: Hepatitis E virus transmitted faeco-orally; Hepatitis D virus transmitted together with

Notifiable Medical Condition	Epidemiology	**Preventability** (primary, secondary and tertiary; prevention of spread)	Natural History	Public Interest and Public Health Importance
			Clinical: acute or chronic hepatitis	Hepatitis B
Zoonotic diseases				
Anthrax	No cases of anthrax were reported to the department of health in 2004 and one case in 2003.	Primary prevention: specific prevention by immunisation with anthrax vaccine (not in SA), training of high risk individuals exposed to animal products; avoid autopsies on suspect animal cadavers; secondary: post-exposure antibiotic prophylaxis	Agent: *Bacillus anthracis* Reservoir: spores remain viable in environment for years (shed when infected animals die and blood and tissues are exposed to the atmosphere) Transmission: inoculation, inhalation or ingestion of spores Clinical: cutaneous, pulmonary or gastrointestinal anthrax	High mortality despite treatment; environmentally persistent. Heightened public awareness because of bioterrorism concerns.
Brucellosis	1 human case reported in 2004, five cases in 2000 and one in 1999. Bovine brucellosis outbreaks were reported in numerous sites in the outskirts of Gauteng bordering on Limpopo Province, Northwest Province and Mpumalanga Province in 2004.[43]	Primary prevention: a brucellosis live attenuated vaccine is available for animals but not humans; pasteurisation of milk; personal protective equipment for abattoir, agricultural and veterinary workers; secondary: screening is not indicated; tertiary: treatment is with streptomycin	Agent: *Brucella abortus, Brucella melitensis, Bacillus suis* Reservoir : cattle, swine, goats, sheep Transmission : contact through breaks in skin with animal tissues or fluids, ingestion of unpasteurised infected milk Clinical: Systemic bacterial disease, acute or insidious onset, suppurative infections of lymphoreticular organs	Brucellosis can present clinically like tuberculosis; the pathogen is not routinely identified; the disease can cause chronic illnesses including depression
Rabies	South Africa is classified as a rabies endemic country and rabies cycles in the country are divided into those involving jackals as reservoir host and those involving vivverid reservoir hosts.[44]	Primary prevention: vaccinate dogs against rabies; avoid human contact with stray dogs or vivirreds; secondary prevention: post-exposure prophylaxis with rabies vaccine and rabies	Agent: Rabies virus (genus Lyssavirus) , usually the classical rabies ; 2 human cases of Duvenhage virus in South Africa Reservoir/animal vector : black-backed jackal; bat-eared fox; yellow mongoose; domestic	Rabies is 100% fatal if not treated but 100% preventable when post-exposure treatment using therapeutic sera is available. Ninety-nine percent of rabies deaths worldwide occur in Africa (24 000 deaths in 2004) and Asia. The public perception (and rightly

Notifiable Medical Condition	Epidemiology	**Preventability** (primary, secondary and tertiary; prevention of spread)	Natural History	Public Interest and Public Health Importance
	Cases have not been reported in Gauteng in recent years but between August 2005 and May 2006 twenty three cases of rabies were diagnosed in the neighbouring province of Limpopo.	immunoglobulin for category 3 exposures	dog Transmission : contact with the saliva of an infected animal through a bite or licking of mucous membranes Clinical: incubation period is variable ; prodromal symptoms followed by neuropsychiatric disorders (furious or paralytic rabies)	so) of rabies is based on the horrible manner of death and despite its relatively low incidence it remains a high public health priority.
Illnesses that can be prevented through use of vaccines or chemoprophylaxis				
Congenital syphilis	Reported cases of congenital syphilis in South Africa have decreased from 203 in the year 2000 to only nine cases in 2004. This is consistent with the declining syphilis seroprevalence noted in the annual national antenatal seroprevalence surveys.	Primary prevention: prevention of sexually transmitted infections in women of reproductive age; secondary prevention: screening of pregnant women for syphilis infection and early treatment with intramuscular penicillin; tertiary prevention: management of disability	Agent: *Treponema pallidum* Reservoir: humans Transmission: vertical transmission (transplacental) from infected pregnant women to their unborn children Clinical: low birthweight infants; may have systemic illness; late manifestations may occur	Congenital syphilis can be prevented by screening and treating pregnant women. Foetal infections may cause abortions, stillbirth or preterm deliveries. Late manifestations include central nervous system defects and bony abnormalities. The burden associated with disabilities is significant.
Tetanus	In 2004 seven cases of tetanus were reported to the Department of Health.	Primary prevention: prevention of injuries with wound contamination; vaccination with tetanus toxoid; treatment: tetanus antitoxin, supportive therapy	Agent: *Clostridium tetani* Reservoir: intestines of horses and other animals; soil or fomites contaminated with animal or human faeces Transmission: spores introduced into body through puncture wound contaminated with soil; elaboration of exotoxin Clinical: titanic spasms, high fatality	Clinical tetanus disease is preventable through post-exposure administration of tetanus toxoid. Tetanus is targeted for elimination and tetanus vaccinations are included in the routine childhood vaccination schedule.

Notifiable Medical Condition	**Epidemiology**	**Preventability** (primary, secondary and tertiary; prevention of spread)	**Natural History**	**Public Interest and Public Health Importance**
Malaria	In 2005 the total number of malaria cases notified in Gauteng was 206. In the first half of 2006 alone there were 1600 cases reported. The laboratory data reflects threefold higher numbers.	Primary: avoidance of mosquito bites; chemoprophylaxis where indicated; secondary prevention: awareness of symptoms for early presentation to health care facilities; treatment with combination antimalarials plus supportive therapy	Agent: *Plasmodium falciparum, P. vivax, P. ovale, P. malariae* Reservoir: humans (malariae in non-human primates as well) Transmission: through the bite of an infected *Anopheles* mosquito Clinical: acute febrile illness, may be severe/fatal (predominantly due to cerebral malaria), vivax and ovale species may cause recurrent illness	Malaria causes over a million deaths annually. The disease may be rapidly progressive if not diagnosed early and treated appropriately.
Subacute or chronic conditions with a high burden of disease and public health impact and specific control programmes				
Leprosy	One new case of leprosy was reported in South Africa in 2004 following 2 cases in 2003	Primary prevention: no specific measures; secondary prevention: early detection and treatment of cases; tertiary prevention: often necessary in absence of early treatment, rehabilitation	Agent: *Mycobacterium leprae* Reservoir: Humans Transmission: close contact; transmission of infected nasal secretions Clinical: chronic disease of skin, peripheral nerves and upper airway	The WHO has targeted the disease for elimination (less than 1 case per 10 000 population). Although the transmissibility is low, leprosy remains important as the disease is treatable and in the absence of treatment results in marked disability
Trachoma	Only one case of trachoma was officially notified in South Africa in 2005 and none in the year prior to that. The disease is associated with overcrowding and poor sanitation and tends to occur in outbreaks.	Primary prevention: proper water and sanitation, hygienic practices; secondary prevention: early diagnosis and treatment; tertiary prevention: surgical management of trachomatous scarring	Agent: *Chlamydia trachomatis* Reservoir: Humans Transmission: direct contact with infectious ocular or nasal secretions or with contaminated fomites Clinical: chlamydial conjunctivitis of insidious or abrupt onset; common reinfection in hyperendemic areas with chronic complications of scarring and	This is a readily treatable preventable cause of blindness.

Notifiable Medical Condition	Epidemiology	**Preventability** (primary, secondary and tertiary; prevention of spread)	Natural History	Public Interest and Public Health Importance
			blindness	
Tuberculosis	New smear positive incidence rate in Gauteng 233.8 per 100 000 population in 2005 (Health Systems Trust statistics)	Primary prevention: improvement of standard of living, overcrowding, chemoprophylaxis of childhood contacts of TB cases and immunocompromised; secondary prevention: screening for tuberculosis (e.g. in mining industry), early diagnosis and treatment applying DOTS strategy	Agent: *Mycobacterium tuberculosis* complex Reservoir: humans Transmission: droplet nuclei spread	Massive epidemic in Sub-saharan Africa, associated with HIV pandemic in the region. Tuberculosis is a major cause of morbidity and mortality, adherence to short course treatment is critically important in management; emerging multidrug resistance is a public health crisis
WHO mandatory reporting				
Cholera	2781 cases reported in South Africa in 2004 (after a peak of 98059 in 2001, 65 cases in Gauteng)	Primary prevention: proper water purification treatment (chlorination); secondary prevention: no screening indicated; treatment: fluid and electrolyte replacement; antibiotics only when indicated	Agent: *Vibrio cholerae* Reservoir: human; viable non-culturable forms have been found in environmental samples Transmission: ingestion of contaminated water Clinical: most cases have mild diarrhoea but severe cases have massive diarrhoea with severe dehydration	Cholera has a marked epidemic potential especially in areas where water sources are not secure and not treated properly. The disease carries a mortality of around one percent.
Plague	There have been no recent reports of plague in South Africa. Last plague outbreak: Coega area near Port Elizabeth in 1982. Plague is currently in a quiescent phase in South Africa. The “Ratzooman” multi-	Primary prevention: control of rat populations; secondary prevention: antibiotic treatment of illness; application of residual insecticides	Agent: *Yersinia pestis* Reservoir: wild rodents (multimammate mouse) Transmission: through bites of infected fleas or through bites, scratches or respiratory droplets of infected cats; human to human droplet spread (pneumonic plague)	Bubonic plague outbreaks are associated with failure of public health interventions, notably control of vermin populations. Pneumonic plague is potentially highly infectious with high morbidity and mortality (50 to 60%)

Notifiable Medical Condition	**Epidemiology**	**Preventability** (primary, secondary and tertiary; prevention of spread)	**Natural History**	**Public Interest and Public Health Importance**
	country study on the zoonotic potential of 3 rodent-borne diseases in Africa included a survey of rats, dogs, humans and fleas in 3 centres in South Africa between 2003 and 2006 and no evidence of plague was found.			
Yellow fever	No reports of yellow fever	Primary prevention: avoidance of mosquito bites; vaccination with live attenuated yellow fever vaccine	Agent: yellow fever virus (*flavivirus* group) Reservoir: *Aedes* mosquitoes; sylvatic cycles maintained amongst non-human primates Transmission: by the bite of an infected mosquito Clinical: incubation 3 to 6 days, non-specific flu-like illness, 15% progress to a toxic phase (hepatitis and haemorrhagic phenomena)	Yellow fever vaccinations are mandatory for travellers returning or arriving from endemic countries. Competent vectors for yellow fever are present in South Africa but no cases of the disease have been reported here. The morbidity and mortality of the disease are high. Of the 15% of patients who enter the toxic phase of the illness, half are fatal.

Appendix 4

Private Practitioner Survey Questionnaire

Informed consent

Dear Doctor

You are requested to participate in this questionnaire survey as a part of an evaluation of the Notifiable Disease surveillance system in Gauteng Province in 2006. This research is being conducted by Dr Ingrid Weber as part of her Master of Medicine dissertation.

The purpose of the study is to describe the current state of the notifiable disease surveillance system in Gauteng Province and to make due recommendations for its improved performance.

This telephonically administered questionnaire will take about five minutes to complete and all information obtained will be entered electronically into a database that will not contain any information that could identify you personally.

Note:
The implication of continuing with this telephonic interview is that informed consent has been obtained from you. Thus any information derived from your form (which will be totally anonymous) may be used for e.g. publication, by the doctor in charge. As all information or data are anonymous, you must understand that you will not be able to recall your consent, as your information will not be traceable.
If you should wish to stop or terminate this telephonic interview at any stage, you are free to do so. If you have any queries with regard to this research, Dr Ingrid Weber may be contacted at 082 497 0254.

Yours faithfully
Dr Ingrid Weber

Questionnaire

1. GPID:	
2. In which district of Gauteng is your practice situated? …….	
3. How many doctors are working at your current practice?	
4. In what year did you qualify as a doctor?	
5. Please list any additional medical qualifications you obtained after your medical graduation: …….	
6. What is the average monthly household income of your patients? ……	
7. On average, how many patients do you personally see at your practice during the course of a day? …….	
8. What percentage of your professional time, if any, is spent in public sector practice? ……	
9. Do you always report mandatory notifiable medical conditions to the department of health? ☐Y ☐N	
10. Why not? …….	
11. Do you currently have a book with GW17/5 forms in your practice? ☐Y ☐N	
12. [Did question 11 require a prompt?] ☐Y ☐N	
13. When was the last time you had personal communication with your district communicable disease control coordinator or someone from that office? …….	
14. Which notifiable diseases have you seen within the last year? …….	
15. Which of the following conditions are notifiable by South African law? (Please answer yes/no/don't know)	
a. Measles	☐Y ☐N ☐DK
b. Varicella	☐Y ☐N ☐DK

c. Organophosphate poisoning	☐Y ☐N ☐DK
d. Malaria	☐Y ☐N ☐DK
e. Congenital syphilis	☐Y ☐N ☐DK
f. Mumps	☐Y ☐N ☐DK
g. Haemophilus influenza type b	☐Y ☐N ☐DK
h. Hepatitis A	☐Y ☐N ☐DK
i. Rheumatic fever	☐Y ☐N ☐DK
j. Viral influenza	☐Y ☐N ☐DK
k. Pertussis	☐Y ☐N ☐DK
l. Food poisoning	☐Y ☐N ☐DK
16. Have you seen any of the following diseases in your practice over the past year? (yes/no)	
a. Measles	☐Y ☐ N
b. Malaria	☐Y ☐N
c. Viral hepatitis	☐Y ☐N
17. Do you make use of a malaria rapid test in your practice?	☐Y ☐N
18. If you saw a meningococcal meningitis case in your practice now, how would you go about reporting/referring it? ……..	
19. Do you have guidelines on reporting of notifiable diseases in your practice? ☐Y ☐N	
20. Which of the following means of communication do you have in your practice?	
a. Land line	☐Y ☐N
b. Cellular phone	☐Y ☐N
c. Work internet access	☐Y ☐N
d. Home internet access	☐Y ☐N
e. Work e-mail address	☐Y ☐N
f. Home e-mail	☐Y ☐N
g. Fax	☐Y ☐N

21. Do you ever access the internet for medical information? ☐Y ☐N
22. Which websites do you use for medical information? …….
23. Where do you obtain information on communicable diseases? ☐Internet ☐Popular media ☐Textbooks ☐CPD ☐Journals ☐Other
24. In your experience, would you rate the communicable disease response in your district as good, adequate or poor or have you had no experience with it? ☐Good ☐Adequate ☐Poor ☐No experience

Thank you for participating in this survey. Would you like any further details on communicable disease resources? If so, please could you provide me with your e-mail address or fax number – this information will not be linked to your anonymous questionnaire. If not, good day.