Placing the Dead:

The spatial distribution and spread of HIV in a major South African city

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Keywords

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Abstract

A negative population growth rate is a feared ultimate effect of pandemics. The spread of the Human Immunodeficiency Virus (HIV) has reached pandemic proportions, globally. In the South African context, HIV is under-studied at the magisterial district level and consequently underestimated and probably misunderstood at all other levels. Certainly, no study has been undertaken in South Africa to establish empirically the spatial distribution and spread of HIV/AIDS in a major city. Research is also compromised because data on the pandemic from state and municipal institutions are not readily available for dissemination and analysis. In this particular study, research results from different authorities regarding prevalence rates were frequently contradictory. The pandemic also raises many challenges to local governments: how to contain the spread of HIV and at the same time effect service delivery of health resources. The newly created "megacities" or metropoles have been given the responsibility of bringing better quality services and more accountable local government to all South Africans. One such "megacity" is the Nelson Mandela Metropole in the Eastern Cape Province of South Africa, which comprises the city of Port Elizabeth, the Despatch and Uitenhage areas, and their rural surrounds. The study seeks to establish: i) the local prevalence rate of HIV; ii) the proximal vectors that impinge on the spread; and iii) the effects that the epidemic has and might have on the demographic profile of the Metropole. The study also introduces innovative research techniques, which may impact on policies containing the spread of HIV and contribute to a new understanding of the epidemiology of the HIV pandemic. The use of Geographical Information Systems (GIS) should provide epidemiological insights into spatially referenced relationships between the sources of diseases and the movement of contagions. The study is an approach based on anonymised case-level data (N=27505), which was obtained from the Nelson Mandela AIDS, Training, Information, Counselling Centre (ATICC). The perception today is that public health measures are ineffective in containing the spread of HIV. The study hopes to illuminate the focal points of the HIV prevalence in the Nelson Mandela Metropole, and pinpoint the vectors that impinge on the spread, so that improved public health intervention may be facilitated.

Declaration

I declare that Placing the Dead: The spatial distribution and spread of HIV in a major South African city is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

PARBAVATI RAMA DECEMBER 2005

SIGNED:………………………

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Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Clinic
ART	Anti-retroviral therapy
ARV	Anti-retroviral
ASSA	Actuarial Society of South Africa
ATICC	AIDS Training Information Counselling Centre
CBD	Central Business District
CDC	Centres for Disease Control
CG	Conditional Grants
CHBCS	Community and Home-based Care and Support
DoH	Department of Health
DTT	Demographic Transition Theory
EA	Enumerator Area
EC	Eastern Cape
EPBTS	Eastern Province Blood Transfusion Services
FB	Fort Beaufort
GHT	Grahamstown
GIS	Geographical Information Systems
HIV	Human Immunodeficiency Virus
HSRC	Human Sciences Research Council
HTA	High Transmission Area
IDPR	Institute for Development Planning and Research
KZN	KwaZulu-Natal
MRC	Medical Research Council
MOH	Medical Officer of Health
MTCT	Mother-to-child transmission
NC	Northern Cape
NGO	Non-governmental Organisation
NMHSRC	Nelson Mandela Human Sciences Research Council

NMM	Nelson Mandela Metropole
PMTCT	Prevention of mother-to-child transmission
PSAM	Public Service Accountability Monitor
PE	Port Elizabeth
R_0	Reproductive rate
SADF	South African Defence Force
SAIMR	South African Institute for Medical Research
SE	Somerset East
Stats SA	Statistics South Africa
STI	Sexually transmitted infection
TAC	Treatment Action Campaign
TB	Tuberculosis
UCT	University of Cape Town
UN	United Nations
UNAIDS	United Nations AIDS Programme
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Fund
UPE	University of Port Elizabeth
USA	United States of America
UWC	University of the Western Cape
VCT	Voluntary Counselling and Training
WC	Western Cape
WHO	World Health Organisation

Definition of concepts

Demographic Transition Theory- Changes in economic development (or modernisation) alter population growth rates as a result of reductions in mortality and fertility (Mostert *et al.*, 1998:13).

Dependency ratio- May be defined as the ratio of the economically dependent parts (segments of the population in the 0-14 and 60-100 year age groups) to the productive part (middle age groups). It assumes that the latter generally provide support for the former, and hence the measure is an approximation of the economic burden carried by those in prime working ages (Pressat & Wilson, 1985:56; Nam & Philliber, 1984:368).

Epidemic- A widespread occurrence of a disease in a community at a particular time (Concise Oxford Dictionary, 1992:394).

Incidence- Occurrence of new cases of a specified disease in a specified community during a specified period of time (Lwanga *et al.*, 1999:120).

Life expectancy- The average number of years of life remaining to each of a group of persons reaching a particular age. At age zero (or birth), this measure, which is derived from a life table, is heavily influenced by survival rates during pregnancy (Nam & Philliber, 1984:371).

Migration- Movement of people across a critical boundary for the purpose of establishing a new permanent residence (Nam & Philliber, 1984:371).

Pandemic- The prevalence of a disease at over 2% in a population (CDC).

Pratique- The permission or licence granted to a ship to have dealings with a port after quarantine or on showing a clean bill of health (Concise Oxford Dictionary, 1992:936).

Prevalence- A measure of the total number of existing cases (episodes of events) of a disease or condition at a specified point in time (Lwanga *et al.*, 1999:120).

Sanitation Syndrome- A belief by the White population that Africans were the harbourers of contagion and they, therefore, demanded a wide distance between themselves and the African population (Swanson, 1977:387-410).

Surveillance Protocol- The on-going systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with timely dissemination of these data to those that need to know (Shell *et al.*, 2002:3).

Women Power Index- An index based on three variables: the highest school/class completed by women, income of women and age of mother at first birth (Abels, 2005:46).

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Chapter One

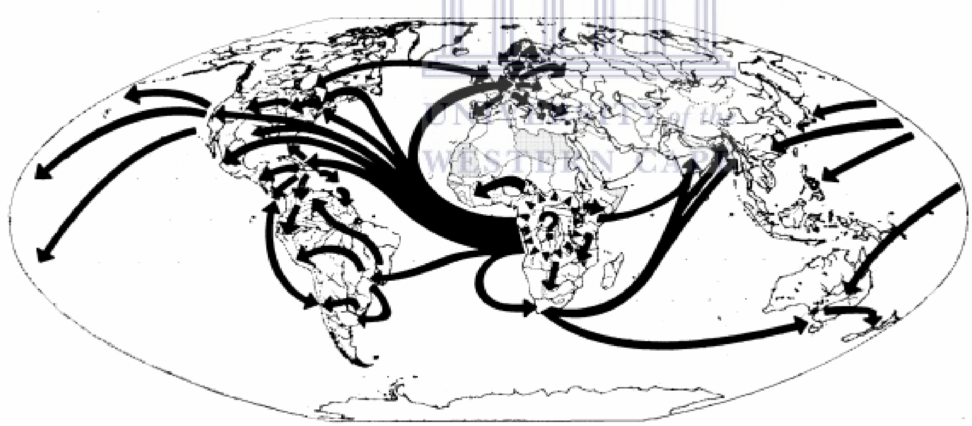
Introduction

The context of the study

Introduction and rationale

Plagues and diseases have decimated human populations globally in epidemic proportions for the last three millennia. For instance, soon after the First World War, the Spanish influenza accounted for 250000 lives in South Africa in a matter of a few months and approximately twenty million globally. Only St. Helena, New Guinea and a few Pacific Islands were not affected (Phillips 1984:88). Now, however, humans face a disease of pandemic proportion: the Human Immunodeficiency Virus (HIV) and the Acquired Immune Deficiency Syndrome (AIDS) have quickly become widespread (see Fig. 1.1). The Centres for Disease Control (CDC) defines the prevalence of a disease at over 2% in a population as a pandemic.

Figure 1.1: Origin and diffusion of HIV



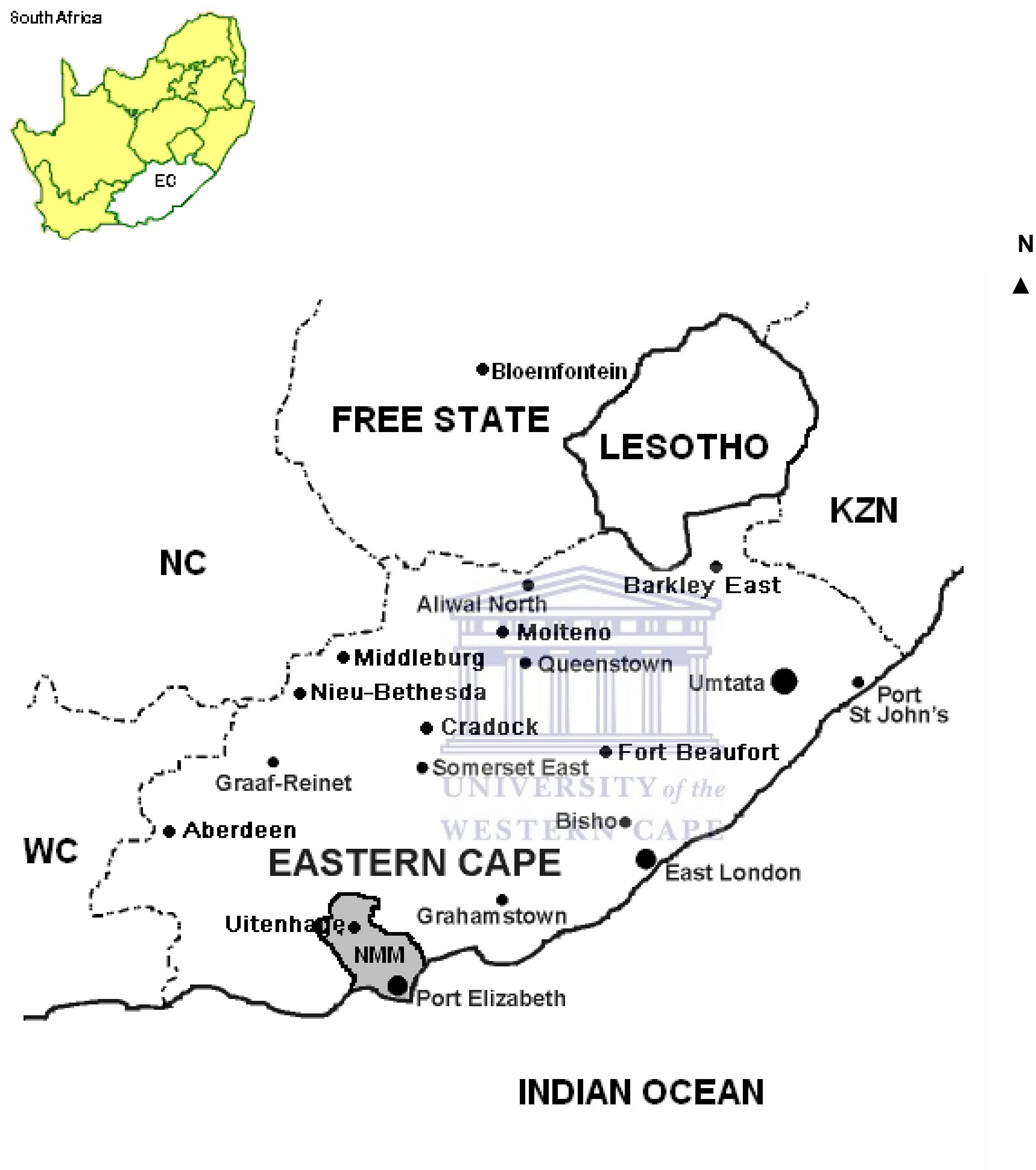
POSTULATED DIFFUSION OF AIDS DURING THE 1970s AND 1980s

Source: Shannon, GW & Pyle, GF. 1989. The origin and diffusion of AIDS: A view from medical geography. *Annals of the Association of American Geographers*, 79(1):12.

The absence of a vaccine, the long latency period of the HIV virus before the onset of AIDS and differential socio-economic conditions are some of the factors that have contributed to the spread. More than 70% of all people living with HIV/AIDS live in sub-Saharan Africa, according to the United Nations AIDS agency (UNAIDS) (Piot & Bartos, 2002:200). South Africa is one of the countries that have been the hardest hit by the HIV pandemic, as the virus has found its way into every niche of society. National HIV studies in South Africa have not been able to establish a reliable epidemiology of HIV in a country that exhibits a diverse cultural and demographic profile, different in each of the nine provinces and, indeed, different in each district of each province.

The Eastern Cape Province (EC) is the second largest province in South Africa (see Fig. 1.2), but is also the poorest province (Kondlo, 2001:2). In 2000, the EC comprised six district municipalities and the Nelson Mandela Metropole (Port Elizabeth, Uitenhage and Despatch) (see Appendix 3). However, before 2000 the Nelson Mandela Metropole (NMM) was part of Region A, which was one of five health regions in the EC (see Appendix 1). Region A, in turn, comprised many magisterial districts (see Appendix 24). The Local Government Act of 2000 has promoted the creation of “megacities” or metropoles with increasing autonomy (Cherry, 2000:76), but the health sector still operates under the auspices of the national Department of Health (DoH). Also, there has been no devolution of former health district boundaries to fit in with the new administrative units. Hence, the pandemic has raised many challenges to local governments: how to contain the spread of HIV and, at the same time, carry out health service delivery. Local governments are no longer responsible only for basic services such as health and the provision of electricity—they have been given the responsibility of bringing better quality services and more accountable local government to all South Africans, urban and rural.

Figure 1.2: Towns in the Eastern Cape showing the NMM in its provincial setting



Sources: www.breakaways.co.za; www.rocksport.co.za

Like any post-demographic transition European city in the nineteenth century, the Nelson Mandela Metropole offers similar challenges to local authorities in containing rapid urbanisation brought on by industrialisation. African cities are exceptional, however. Massive internal migration from rural areas to urban settings, due to breakdown in infrastructure in the smaller centres and the prospect of better jobs and better health services, has resulted in uncontrolled mushrooming of informal settlements. The migration inflow is not always known, especially since 1994, which complicates the challenges created by the HIV/AIDS pandemic. Local resources are placed under heavy strain as the demographic profile of an area changes rapidly because of both migration and of the pandemic.

Moreover, the HIV/AIDS pandemic is creating new challenges for the national, provincial and local governments in South Africa—to implement equity reforms for the previously disadvantaged communities and, at the same time, to contain the pandemic. However, the HIV/AIDS pandemic compounds the local service delivery responses to health, as the general perception today is that public health measures are ineffective in containing the spread of HIV. Incidentally, in 2004, the Public Service Accountability Monitor (PSAM) criticised the Eastern Cape Provincial Health Department for under-spending money for HIV/AIDS programmes in the province (Allan *et al.*, 2004:1-6).

Statement of the problem

In the South African context, HIV is under-studied at the magisterial district level. Moreover, the study of HIV is compromised as statistics are published on a national and provincial level in an aggregated form. HIV infection is then generalised, with no or little understanding of the local prevalence rates. An understanding of local prevalence rates will inform local government better about who is infected, where the infection arises and, therefore, about how best to address both prevention and treatment. No micro-study has yet been undertaken in South Africa to establish empirically the spatial distribution and spread of HIV in a major city, as such a study cannot be done at a local municipal level because of a lack of appropriate case-level data. A national antenatal clinic (ANC) surveillance system was implemented to track the HIV pandemic in South Africa during 1990 (DoH, 2000:13). Initially, owing to the relatively small sample sizes and small, but significant, changes in both methodology and protocols over time, a clear trend could be established. However, the fact that only pregnant women in the 15 to 49 age group were tested, limits useful extrapolation to the rest of the population as the HIV statistics for people who do not attend ANCs are modelled estimations thick with untested assumptions. Furthermore, upon perusal of the relevant literature on HIV/AIDS, it was observed that research results regarding HIV prevalence rates were frequently contradictory. For example, the ANC surveys, the Actuarial Sciences of South Africa (ASSA) mathematical models, and also the Nelson Mandela Human Science Research Council (NMHSRC) survey (Shisana & Simbayi, 2002:46) mention varying and conflicting HIV prevalence rates at both the national and provincial levels. In none of the studies is HIV statistics offered at the municipal level. In reality, research into the spatial distribution of HIV at the municipal level is also hampered by the stigmatisation attached to the disease. The Nelson Mandela Metropole has been used as a case study in this research to test the new methodology of the combination of case-level data (N=27505) and Geographical Information Systems (GIS) mapping.

Aim of the study

The aim of the study is to establish a new understanding of the epidemiology of HIV/AIDS at the municipal level, but at the same time upholding the anonymity of the HIV infected and AIDS sufferers. Innovative research techniques such as the use of GIS as a research tool contribute to disclosing the patterns of the HIV pandemic in the Nelson Mandela Metropole that were not obvious or visible before. For instance, GIS involves geographic maps that detect the spatial relationship between HIV prevalence rates and vectors that drive the pandemic. The study will draw on the diverse approaches that investigate aspects of the pandemic, such as the methodologies employed; the history of HIV prevalence rates; and the gaps and contradictions that exist among these findings.

Objectives of the study

This study seeks to establish:

1. the spatial distribution of HIV in the Nelson Mandela Metropole;
2. the proximal vectors that impinge on the spread;
3. the effect that the pandemic might have on the demographic profile of the Metropole.

Research hypotheses

The following research hypotheses will be tested:

1. HIV/AIDS prevalence rates are associated with the difference in attendance at HIV diagnostic institutions in Region A.

   The null hypothesis (H_o) states that there is no association between gender and attendance at HIV diagnostic institutions in Region A.

   The alternate hypothesis (H_1) states that there is an association between gender and attendance at HIV diagnostic institutions in Region A.

2. HIV/AIDS prevalence is associated with the difference in the various population groups.

   The null hypothesis (H_o) states that there is no association between gender and the various population groups.

   The alternate hypothesis (H_1) states that there is an association between gender and the various population groups.

3. HIV/AIDS prevalence is associated with the difference in attendance at HIV counselling institutions.

   The null hypothesis (H_o) states that there is no association between gender and attendance at HIV counselling institutions.

   The alternate hypothesis (H_1) states that there is an association between gender and attendance at HIV counselling institutions.

Organisation of the remainder of the report

The first chapter gives an introduction to the HIV pandemic in the Nelson Mandela Metropole and the challenges that face local governments generally in containing the spread.

Chapter Two provides the literature review around the epidemiology of HIV.

- Firstly, it suggests how prevalence rates are calculated by examining surveillance protocols in South Africa.
- Secondly, it examines the vectors that drive the HIV spread at the local level, as well as how the pandemic affects the demography of the region and how local government responds to the challenges created by the pandemic.
- Thirdly, the literature review presents examples and comparisons of the spread of HIV on the global level, but specifically in Africa.

Chapter Three describes the research methodology that is applicable to this particular study. Emphasis is placed on:

- the key concepts and variables;
- the research instruments;
- the sample design and sampling techniques used;
- the data collection processes;
- data-editing and data-coding procedures;
- the rationale behind the selection of data analysis procedures as well as the actual procedures used; and
- limitations of the original documents.

Chapter Four reports on the results of the study and discusses some of the implications.

Chapter Five discusses the implications of the results in detail.

Chapter Six sets out the conclusions and recommendations.

Chapter Two

Literature review

Literature review on the spread of HIV

Introduction

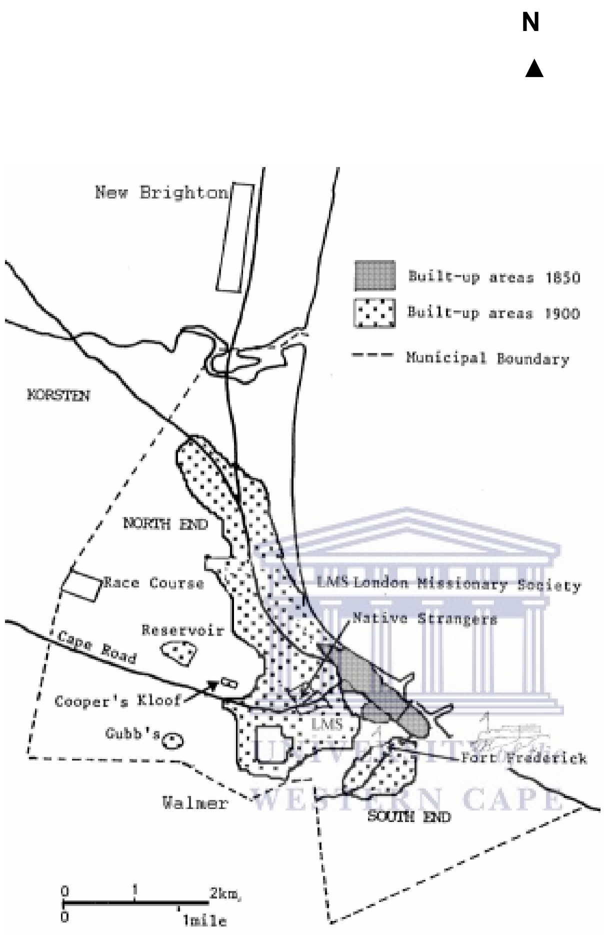
This chapter will briefly review the history of healthcare in Region A relevant to the spread of HIV in the Nelson Mandela Metropole and the link between racial segregation and population groups in terms of separate development and public health. The review will focus on the HIV surveillance protocols in South Africa—the prevalence rates, the proximal vectors that impinge on the spread, and the effects that the pandemic might have on the demographic profile of the Metropole. The review will also highlight the historical municipal responses to diseases such as the smallpox endemic (1858), the bubonic plagues (1901, 1937), the Spanish influenza (1918/1919), tuberculosis (TB) (1990s), syphilis and the HIV/AIDS pandemic from 1990 to 2000.

Historical demography of the Nelson Mandela Metropole

The historical demography of Port Elizabeth (Nelson Mandela Bay) shows that the Algoa Bay area of the pre-colonial era was inhabited by the semi-nomadic Khoi-San who had to forfeit their way of living in the face of colonialism, urbanisation and capitalism. In 1803, when the Bethelsdorp Mission Station was established, it had already absorbed most of the Khoi into the economic activities of the station (Bigge, 1830:307-351). As more Europeans settled in the area, "Free Blacks" (originated from the slave population, political exiles and from several hundred Chinese convicts) followed suit (Shell, 1994:xxxii). The Fingoes or Mfengus, who came into the area as refugees from the north after the Sixth Frontier War (1834-1835), were located in Fingo Village. They were the first Blacks to partake actively in the economy of the Bay as dockworkers (Appel, 1990:82; Baines, 1989:13; 1990:65). Initially, the colonial government had granted the London Missionary Society a site for a "Hottentot Location" in 1834 (the year slavery was abolished in the Cape Colony) (Baines, 1989:13; 1990:67; Christopher, 1988:5). The Native Strangers' Location was established for the Mfengu and other indigenous peoples in 1855 adjacent to the "Hottentot Location" (Baines, 1990:74; Christopher, 1988:5). Christopher (1988:5) states that the name Strangers' Location was "indicative of the official concept that the indigenous Blacks were only a temporary part of the urban population”. The Mfengus’ bargaining power and monopoly ended when Xhosa refugees overcrowded the Native Strangers’ Location and the Hottentot Location, which was bursting at its seams after the Cattle Killing in 1857 (Baines, 1989:14; Baines, 1990:66; Inggs, 1987:11). Thus, by the nineteenth century, all the indigenous people were subordinated and partially dispossessed of their ancestral land. These ethnic groups had to adjust from living in a settled rural environment to a high-density urban setting, which made them especially vulnerable to disease, crime and economic exploitation.

Despite the social and economic disadvantages, Africans who came to Port Elizabeth to eke out a living adjusted to their new situation by continuing their rural cultural practices. This was strongly evident when Gubb’s Location was established in 1863 to alleviate the population density in the inner locations within the periphery of the town (Baines, 1989:15). Gubb’s Location was a private location that gave Africans a degree of autonomy over their own lives—they were allowed to erect traditional huts, brew beer, and their lifestyles were not subject to municipal control (Baines, 1989:15). By 1865 there were 2000 Blacks living in the Port Elizabeth locations and of these 600 were living in Gubb’s Location (Baines, 1989:15; Christopher, 1988:5). Complaints from the local white population throughout the 1860s about the inner location inhabitants’ cultural habits, specifically, that they posed a threat to public health, were not addressed until the turn of the century (Appel, 1990:88; Baines, 1989:15). Pressure from Europeans forced the Council to adopt more formal patterns of residential segregation to control the influx of Africans as these locations increasingly posed a threat to the westward expansion of the “white” suburbs (Kirk, 1991a:295). However, Baines (1989:15) argues that it was pressure from property developers on the Town Council to move the residents of Strangers’ Location to Cooper’s Kloof. Baines (1990:62-64) contends that segregation in Port Elizabeth was a “product of a struggle between the commercial and propertied classes—the merchants were primarily concerned with the supply and cost of labour whilst the propertied class wanted the inner locations removed to safeguard their assets”. “In the colonial context, the social metaphor of disease became a particularly effective means of maintaining political pressure for Africans to be kept away from white residential areas" (Baines, 1990:77). Slowly, the city started segregating on the pretext of health.

Figure 2.1: Port Elizabeth's inner locations in the 19th century



Source: Christopher (1987:13)

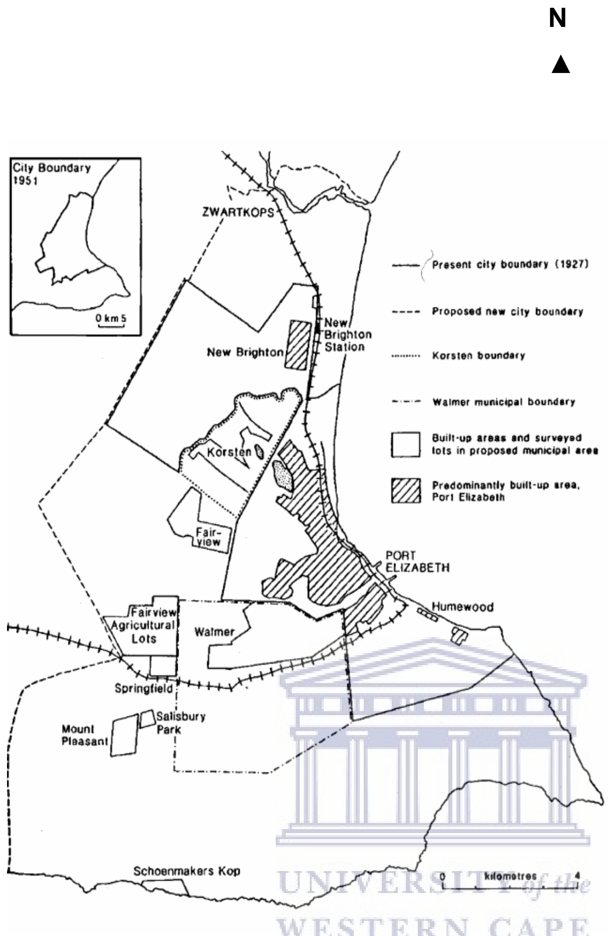
As the Europeans continued with their efforts for new municipal laws to get rid of African locations far away from their living space, the working class population, irrespective of race, were living in mixed suburbs. Christopher (1988:5) states that initially the various ethnic groups resided together in suburbs on the basis of their economic and social status. In the South End, Muslims and working class Europeans lived together in a mixed residential area (Appel, 1990:93; Baines, 1990:67; Christopher, 1988:5). Middle- and upper-class Europeans occupied areas adjacent to the Donkin

Reserve (see Fig. 2.1). Appel (1991:17) argues that class was the main factor that led to urban segregation among the city's population because a substantial portion of it was engaged in unskilled work. Appel's study (1995a:18) on housing in Port Elizabeth showed that accommodation was a pressing problem in the city during the early urbanisation and industrialisation phases. Consequently, a lack of housing could have contributed to mixed suburbs.

Periodic droughts, the bubonic plague of 1896 and the aftermath of the Anglo-Boer War (1899-1902) led to an influx of Afrikaners to the city (Terblanche, 1977:92). Many ended up living under slum and poor sanitary conditions in Korsten and Sidwell, which resulted in high infant mortality among the Afrikaner population (Terblanche, 1993:8-9). Dr. H. E. van Zyl commented: " …it certainly is a serious danger to public health and really is no credit to our city" (quoted in Terblanche, 1977:104). It is interesting to note that although the rural Afrikaners were the earlier European colonists, they were perceived as poor-whites and looked down upon by the class-conscious British immigrants. However, despite the hazardous health conditions under which they lived, as van Zyl had commented, they were not forcibly removed from Korsten to separate suburbs, as was the African population to New Brighton. Thus, both class and race played vital roles in urban segregation in the early history of Port Elizabeth, and not class alone as Appel has suggested (1991:17).

In 1931, the Port Elizabeth City Council extended its boundaries, and Korsten became part of the municipal area (see Fig. 2.2). For some senior Africans this was their third removal and took place despite many of them having the franchise and holding their property in tenure (Kirk, 1991b:311). However, the *Representation of Natives Act* and *Native Trust and Land Act* (passed in 1936) further limited African franchise and land rights throughout the Union (Christopher, 1988:7). These acts were passed at the same time as the Council sought the availability of serviced sites to market the city as an industrial centre. Clearly, the term, "a threat to public health" was used repeatedly to enact forced removals in the name of urban progress and to promote racial segregation.

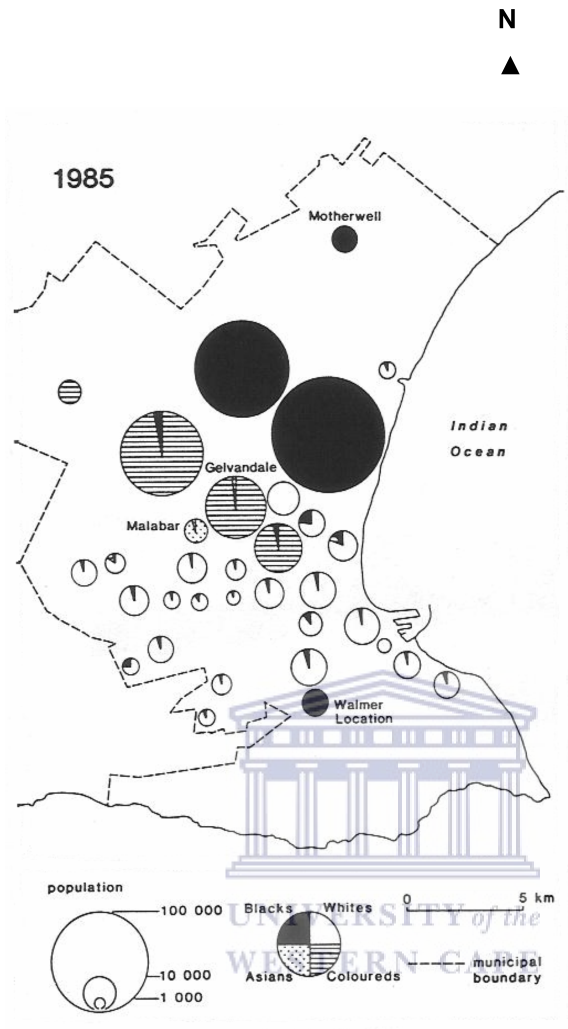
Figure 2.2: Proposed actual municipal boundary extensions, 1927 to 1951



Source: Robinson (1993:47)

After the 1948 election, the city experienced rapid development, but simultaneously experienced rigorous and advanced levels of separate development of the different population groups (Christopher, 1988:12) (see Fig. 2.3). A string of townships followed the establishment of McNamee Village: Kwaford, 1948-51; Boastville, 1948-9; Elundini, 195-4; a site-and-service scheme called Kwazakhele was established to the north of New Brighton during the 1950s; Thembalethu was built in 1962-3. Thus, the creation of locations initially forged by the harsh and continual associations between health and racial difference developed a curious, but distinctive history of its own.

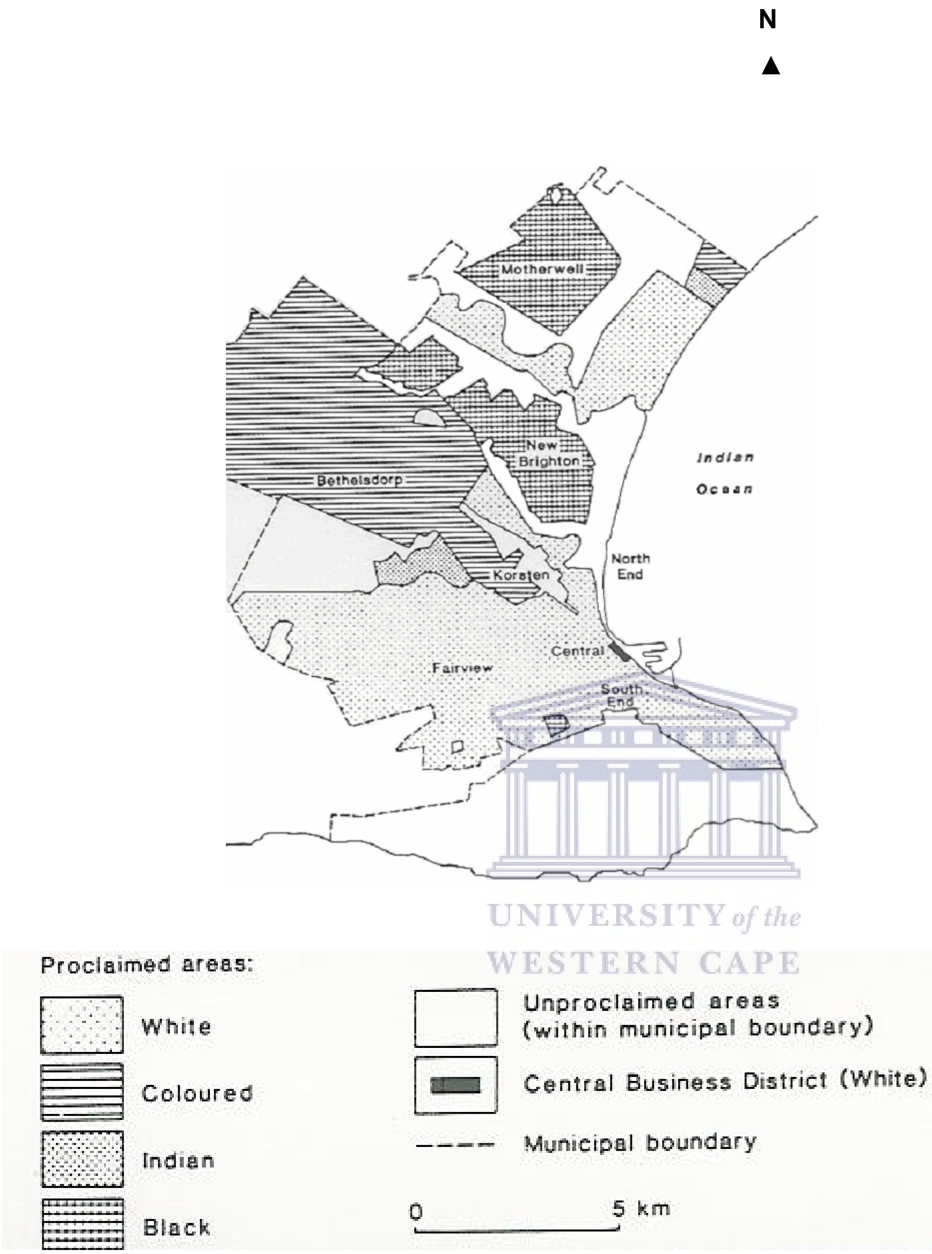
Figure 2.3: Group Areas, Port Elizabeth, 1985



Source: Christopher (1988:10)

By the 1980s, housing pressures in African areas resulted in the occupation of public and open spaces (Christopher, 2000:6) (see Fig. 2.4). Urbanisation in the NMM has been characterised by an overwhelming emergence of squatter settlements such as Soweto-on-Sea, Missionvale, Kleinskool, Helenvale, Walmer, Motherwell and Brickfields, all which accommodate a large percentage of the low-income groups. Local authorities have been unable to curb the development of squatter camps in the formal settlements of New Brighton, Kwazakhele and Zwide. These informal settlements are reminiscent of the conditions under which the early African population lived in Port Elizabeth, but after 1994, the municipality could not use a public health pretext to remove populations as it did in the nineteenth and the twentieth centuries.

Figure 2.4: Distribution of population, 1985



Source: Christopher (1988:8)

The fall of apartheid created both challenges and opportunities for Port Elizabeth. It was the first of the country's large cities to create a single local authority by uniting the European, coloured and black areas formerly administered respectively by the City Council, Northern Areas Management Committee, and Black Local Authority. Christopher (2000:7) contends that the apartheid legacy in the NMM will be felt longer than anticipated because the rate of urban development will be below that projected for

Gauteng and KwaZulu-Natal; there will be a slowdown in population movement from the rural hinterland to the Metropole, and the majority of the population cannot afford to live in integrated areas. Thus the integration of health services and, especially the HIV/AIDS prevention programmes, will in all probability, be hampered for a long time to come.

Historical public health responses in the Nelson Mandela Metropole

When a new disease makes its appearance in a population, health authorities establish the epidemiology of the disease as quickly as possible to keep mortality rates down, and thereby attempt to contain the spread of the disease. The responses can be in terms of new legislation, quarantine methods, the provision of drugs, awareness campaigns, prevention strategies, or a combination of all these.

However, in South Africa prior to 1994, during the colonial era (1702-1947) and apartheid era (1948-1994), healthcare was fragmented and based on racial, class and ethnic social systems and population structures, which influenced access to healthcare and facilities within that society (van Rensburg & Mans, 1982:2-5). Historically, the emergence of native locations and urban segregation has been linked to health and sanitation matters in Port Elizabeth since colonial times (Christopher, 1987:8). The post-Apartheid era has experienced a homogenised public healthcare system for the majority of the population, but pre-Apartheid socio-economic structures are hindering marginalised groups such as the poor from accessing healthcare facilities efficiently, which would have a beneficent effect on the HIV epidemic.

An examination of local government history shows that at the turn of the twentieth century Port Elizabeth's health authorities introduced what was dubbed the "sanitation syndrome" to combat the spread of bubonic plague (Swanson, 1977:387-410). The sanitation syndrome was a belief by the White population that Africans were the harbourers of contagion and they should be segregated from the African population.

Many of the officials in Port Elizabeth had an understanding of the British public health legislation and Victorian cities, which reinforced the perception that the working classes were the spreaders of disease, crime and poverty (Baines, 1990:77). Baines, however, argues that the "sanitation syndrome" was used in the Cape Colony, specifically in Port Elizabeth, far earlier than Swanson's study suggests. Thus, long before the plague came to Port Elizabeth in April 1901, perceptions among the white population had already been established that Africans and other minority groups were uncivilised, prone to crime, and, most cogently, that they posed a health hazard. This was evident in the response to the smallpox epidemic in 1858 when Africans were to be evicted from their homes, but this response was constrained by existing municipal regulations (Baines, 1990:76).

The inter-tribal riots that broke out in 1882 sealed the fate of Strangers' Location and the other inner-city locations (Baines, 1989:15). As a result of this, the Port Elizabeth Strangers' Location Act was passed in 1883 and led to the removal of blacks to the new Reservoir Location (Baines, 1989:15; Kirk, 1991a:294). Joyce Kirk (1991b:314) argues that when the Native Strangers' Location Bill was presented, the sanitation syndrome was used as an excuse to relocate blacks. However, the Bill was unenforceable since the cost of segregating urban blacks became too expensive for the Port Elizabeth Town Council (Baines, 1989:15).

In 1897, the Public Health Act of 1897 which gave municipalities of the Cape Colony authority to create new native locations in the name of public health, was passed (Baines, 1989:17). In April 1901 the first case of the bubonic plague was discovered in Port Elizabeth and an autonomous Plague Board was created (Baines, 1989:16-17). The first person to carry the plague was an African man living in Gubb's Location. This confirmed the fear whites had that the inner locations were the breeding grounds of diseases. Most of the properties were in the Strangers' Location and nearly 4000 people were removed. *The Report on Public Health for 1901* showed that the incidence of the disease was 22 people in the native locations while in some wards the incidence was as high as 81 people (Peerthum, 2000:6). Moreover, the Report on Public Health for 1901 clearly indicated that infectious diseases in Port Elizabeth were more common among the Blacks, Coloureds, and Asians. Contrary to the Report, in that year 401 whites suffered from typhoid fever, diphtheria, scarlet fever, chicken pox, the plague and other diseases, compared to only 224 Blacks, Coloureds and Asians (Peerthum, 2000:8). Drastic measures such as the removal of Blacks were not justified because, in the first instance, the plague had its origin in the town in the merchant warehouses (Baines, 1989:17). This clearly supports Baines' argument that the incidence of the plague was higher in other parts of Port Elizabeth than in the black locations and that "the plague eradication campaign rapidly assumed the form of an anti-black health and morality crusade" (1989:17). The Port Elizabeth municipality pushed through ordinances that allowed for people and whole suburbs to be placed under quarantine although the prevalence rate of bubonic plague was low in the black locations.

Other population groups, such as the Asians, experienced discriminatory treatment fairly similar to the Africans, namely that they, too, were spreaders of diseases. In this case in point, Elizabeth van Heyningen highlights an interesting perspective: "In Port Elizabeth, the Cape could not legally refuse pratique to ships from Asia or India" (pratique is defined as the permission or licence granted to a ship to have dealings with a port after quarantine or on showing a clean bill of health) and that "Schreiner was opposed to the question of plague control being confused with that of undesirable Asiatic immigration in an attack on the Port Elizabeth panic in which he argued that the sentiment was more anti-Coolie than anti-plague" (1984:72-73). It seemed that Europeans held the perceived notion that not only Africans, but also people of foreign cultures, posed a health risk.

Although municipal authorities had spatial information of the plague, they nevertheless responded by burning down the dwellings of the "natives" in the inner-city locations and forcefully caused their mass removal to New Brighton (Christopher, 1987:3-18; Holland, 1940:70-72; Kirk, 1991b:309). Many of the "natives" resisted the move and chose to reside in areas such as Korsten and Walmer, informal suburbs, free from racially discriminatory and restrictive regulations and falling outside the municipal boundaries (Baines, 1989:18; Kirk, 1991b:317). The 3000 black tenants who were evicted from Gubb's location went directly to Korsten to avoid New Brighton at all costs. The white merchant class objected to the removal of its work force to New Brighton (Baines, 1989:18). Baines reiterates that: "the discourse of public health provided a powerful rationale for residential segregation" (2002:43). Christopher Saunders' study of the patterns of segregation in Cape Town's African township of Ndabeni (1984:173-174) shows the same rationale: protect the white population from disease by creating segregated living space. In this regard, the Plague Board was able to achieve what the Port Elizabeth Town Council had been attempting to achieve for the last four decades. The Board's initial job was to eliminate the plague, but it ended up as an anti-black health and morality crusade, which led to clearly defined urban segregation ostensibly on the basis of health.

When the First World War ended in 1918, the Spanish influenza, which killed hundreds of thousands and affected millions in South Africa, only killed some two thousand people in Port Elizabeth. However, the severity of the epidemic in the Eastern Cape was especially bewildering to the rural inhabitants of the Transkei. The epidemic, like AIDS, but unlike other influenza strains, killed people in their prime years. "Witchcraft accusations, bogus cures, the proliferation of quacks and several millenarian movements (white and black) were some of the unexpected outcomes of the brief epidemic in the Eastern Cape" (Phillips, 1990:70, 161-166), which may be seen as a distant dress rehearsal for the far deadlier epidemic now gripping the city.

Forced removals of the black population continued unabated as the Port Elizabeth City Council extended its boundaries in 1931, and Korsten was included in the municipal area. Holland (1940:70) claims that the expansion was a health precautionary measure, as Korsten was a grave danger to the town. After another bubonic plague scare in 1937, the Council invoked the *Slums Act* to effect the removal of Korsten's erstwhile African residents to the new "model" township of McNamee Village in New Brighton **(**Holland, 1940:70), although Kirk (1991a:294) states that many Africans acquired middle-class status through the support of Cape liberal ideology. Holland (1940:72) claims that TB decreased in the city after the "natives" were moved to New Brighton. Adolph Schauder (1953:1), Chairman of the Housing Committee of the Port Elizabeth City Council, speaks proudly of the removal of the "natives" to New Brighton from the dreadful pestilence in Korsten, and their provision of sanitary housing conditions. Apart from furthering the goals of residential segregation, these removals released prime estate for industrial sites. As Jennifer Robinson (1993:44) points out, “the plans for McNamee Village were embedded in a self-consciously noble, liberal, and even religious rhetoric; the interpolation of health into racial matters made for a lively trope in which the perpetrators of segregation could emerge on moral high ground, but health was a real issue for some; the City Council itself claimed a lot of credit for their “progressive housing policy”, which became cited as a model throughout the Union and beyond”. New Brighton became the first of a string of African townships established on the outskirts of Port Elizabeth in the twentieth century because of the perceived connections between race and public health, an association, which has been rekindled with the current HIV/AIDS epidemic in the city (Shell *et al*., 1997:7). Once a suburb was segregated and any ill-health or pandemic broke out, then the racial argument could be used over and over again. Thus, race, class and health formed an ominous but dynamic partnership, which firmly established separate development not only in Port Elizabeth, but also in other major cities of South Africa.

HIV/AIDS responses in the NMM

In 1996, Brazil, a country that exhibits the same socio-economic imbalance as South Africa, insofar as the Gini-Coefficient shows, passed a presidential decree that guaranteed the whole Brazilian population free universal access to Anti-retroviral therapy (ARV) (Nunes, 2001:3). Arnon Bar-On and Dolly Ntseane (2002:18-19) state that in neighbouring Botswana, the ruling party has shown political commitment firstly to prevent the spread of HIV and, secondly, to mitigate the impact of the disease at all levels of society, but HIV prevalence rates continue to increase. Tim Quinlan and Samantha Willan (2004:227-228) argue that the South African government is starting to confront the challenges of actually containing the HIV/AIDS epidemic, but its efforts are still constrained by lack of leadership from the President and the Minister of Health. On the national level, the responses to containing the epidemic range from the activities of the Treatment Action Campaign (TAC), to the report of the Taylor Committee (which is the government's commitment to satisfying everyone's constitutional right to social security, including appropriate social assistance), to the many practical programmes within and beyond government (Quinlan and Willan, 2004:245). However, by 2004 only 60000 of approximately 5.6 million HIV positive people had access to ARV in the public health sector (Stein, 2005:2; Hoosein, 2005:7).

Many AIDS experts contend that the Eastern Cape (EC) provincial health department officials lack the capacity and will to spend the HIV/AIDS health budget because they do not know the extent of the local epidemiology of HIV. Health experts such as Chris Kenyon, Mark Heywood and Shaun Conway argue, “the restructuring of the public sector at every level and a high turnover of staff are some of the reasons that have impeded effective service delivery” (Kenyon *et al.*, 2001:161). According to Alison Hickey and Paul Whelan, “the Eastern Cape and KwaZulu-Natal (KZN) have allocated their own funds towards the Prevention of mother-to-child treatment (PMTCT) and ironically, of all the new, nationally initiated interventions, these projects tend to be the most advanced in implementation, clearly indicating that political prioritisation can push implementation despite the lack of secure funding” (2001:26). Research done by Hickey, Ndlovu and Guthrie (2003:26) shows that some provinces had difficulties spending their Community and Home Based Care and Support (CHBCS) grants because of delays in transfers of Conditional Grants (CG) from the national department to provinces as a direct consequence of rigid and slow tender processes as well as delayed transfers of monies to implementing Non-Governmental Organisations (NGOs). Colm Allan of the Public Service Accountability Monitor (PSAM) offers differing views on the EC Health Department crisis. His findings on the poor responses to HIV/AIDS in the province highlighted the following salient points:

1. “The lives of 15000 children could have been saved in the EC had Nevirapine been rolled out for prevention of mother-to-child transmission purposes at all state health facilities in 1998 as opposed to mid-2003 (based on the estimation that 3000 lives could be saved per year in the province if Nevirapine had been available to all pregnant women).
2. Between 2000 and 2004, the department failed to produce business plans for almost 40% of its budget (or R93.2 million out of a total budget of R238.2 million). The

department only produced business plans for the equivalent of 77% of its conditional grant allocation, and 52% of its provincial government allocation for its HIV/AIDS programmes during this period.

3. During the period between 2000 and 2004, not a single HIV/AIDS business plan produced by the EC Department of Health was found to include reconciliation with HIV/AIDS budget allocations or expenditure for previous years.
4. Of the R123.2 million allocated from the EC budget for HIV/AIDS programmes in the period between 2000 and 2003, 26.8% (R33 million) was unspent, whilst 73.2% (R90.2 million) remains inadequately accounted for.
5. Between 2000 and 2004, HIV/AIDS related training accounted for R44.6 million or approximately one-third of the department's R145.08 million HIV/AIDS budget for which business plans were produced. Yet, the department was found to have no means of monitoring the quality, content or numbers of people obtaining HIV/AIDS training within the province" (Allan *et al.*, 2004:1-6).

Moreover, in a summary conclusion, the National Primary Health Care Facilities Survey 2003 of the Eastern Cape stated the following short-comings of HIV/AIDS health in the province: nurses (nationally and in the Eastern Cape) lacked knowledge concerning the appropriate BCG (Bacillus Calmette-Guerin vaccine) vaccination strategy for children with HIV; less than half of the facilities in the Eastern Cape had protocols on: Nevirapine (41%); HIV in children (42%); HIV rapid test (39%) and voluntary counselling and training (VCT) (49%); only two in ten facilities nationally and one in ten facilities in the Eastern Cape provided Nevirapine for the PMTCT; significantly less pregnant women attending a facility in the Eastern Cape (23%) than nationally (66%) where PMTCT was offered were tested for HIV; of the women who were tested, almost 15% more in the Eastern Cape (35%) than nationally (20%) were found to be HIV positive; overall, HIV treatment services and ARV were available at a small minority of facilities and this is mainly due to these services only being provided at pilot sites at the time of the survey; the number of people aged 15 to 59 who volunteered for HIV testing was extremely low both in the Eastern Cape and nationally (Karasaridis *et al.,* 2004:58-59). Inadequate provincial government HIV/AIDS policy implementation would impact negatively on the ability of local municipal governments in the EC to control the HIV pandemic.

How does local government machinery in the Nelson Mandela Metropole respond to the HIV/AIDS epidemic? The establishment of ATICC in the NMM in 1989 was to collect HIV data to promote awareness, support and prevention programmes in the Metropole (Shell, 1999:11). The NMM introduced a “High Transmission Area” (HTA) Project in 1999 in the HIV/AIDS prevention field. "HTA's" are defined as areas where HIV infection is most likely to occur. These include densely populated urban areas with: social mixing near commercial activity, high rates of unemployment and mobile, migrant populations. Sites in identified HTA's have high rates of "new partner" sexual interaction without condom use (Stanley, 2004). Under the auspices of the Department of Social Development, the HIV/AIDS Integrated Plan, which serves to link the interventions of health, education and welfare in the Nelson Mandela Metropolitan area, two AIDS Response Centres have been set up at Dora Nginza Hospital in KwaZakhele and in Motherwell (Van Donk, 2002a:4). Motherwell has been identified as a high HIV prevalence area by the DoH and the Truckers’ Association (Van Donk, 2002a:5). Furthermore, van Donk advances the argument that as HIV/AIDS is an urban development issue, the focus should not be on the epidemiology of HIV/AIDS, but to the social, political and economic context in which the epidemic occurs (2002b:8). Without a doubt, the Metropole should implement a multi-disciplinary approach in response to the growing pandemic.

N. T. Naidoo (2000:54) of the University of Port Elizabeth and of the Department of Health’s Traditional Healers’ forum expressed the sentiment that “the control of HIV is an urgent public health concern” in the Metropole. Shell (1998b:31) proposed in a pilot study in the Nelson Mandela Metropole that HIV prevalence varied across the Metropole and that local authorities should target interventions in areas where HIV occurred in clusters to bring down the incidence of HIV into pockets, which could be identified and targeted.

HIV surveillance protocols in South Africa

On the national level, the current pandemic has resulted in the origination of various HIV surveillance protocols to track the disease. The American government agency, the Centres for Disease Control (CDC), defines the surveillance of a disease as:

> the on-going systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with timely dissemination of these data to those that need to know (Shell *et al.,* 2002:3).

The annual antenatal clinic (ANC) sentinel site surveillance protocol, which was implemented in 1990 by the national Department of Health, is the most influential HIV sentinel surveillance protocol in South Africa (DoH, 2002a:1). During the month of October each year, based on the samples that are collected at the ANC sentinel sites, inferences are made on the HIV prevalence rates of the general population, nationally and provincially (DoH, 2000:1). Other protocols, such as the Actuarial Society of South Africa (ASSA) has developed mathematical models that calibrate HIV prevalence rates at the national and provincial levels based on the ANC surveys and the Department of Home Affairs mortality data (Dorrington *et al.*, 2002:1). A report released in December 2002 by the Nelson Mandela / Human Sciences Research Council (NMHSRC), the most comprehensive study of HIV prevalence according to socio-economic profiles in South Africa, thus far, conducted a national HIV survey but the methodology was influenced by the ANC surveillance protocol (Shisana & Simbayi, 2002:1-121). However, all three research endeavours have produced conflicting results due to various limitations and assumptions.

The ANC sentinel sites surveys were designed to provide comparative provincial indices of prevalence for the HIV/AIDS epidemic over a period of time, according to Farshid Meidany (1998:1). Since the ANC surveillance methodology has not been consistent in the provinces after the 1994 elections when the four provinces were redemarcated and nine provinces were established, a national protocol could not guarantee that the surveillance methodology was consistent in all of the nine provinces (DoH, 2000:1). The national protocol was only established in 1997 and phased in over a three-year period. The sample sizes collected so far by the ANC have varied annually, thus affecting the reliability of the data—it is only since 1998 that uniform sample sizes have been employed and a trend and consistency in the HIV protocol has been established (DoH, 2000:2-3). Initially, women were not asked whether they wished to take part in testing for HIV or not. This is important, according to the epidemiologist, Horst Kustner (2000) because research shows that where testing for HIV is voluntary, the results may significantly underestimate the incidence of the disease and bias may creep in. This is in contrast to a press release by the national DoH, which states, "since 1998, the outcome of the antenatal survey indicated that the HIV infection rate was levelling out and the level of syphilis was on a sharp decrease" (DoH, 2000:2). It is more likely that the decrease in recorded HIV infection rate is due to young women declining to take a test, as they were now asked if they wished to take the test.

The ANC surveillance protocol has further limitations built into its methodology. Only pregnant women of low socio-economic status in the age group 15-49 are tested for HIV anti-body information. Thus, all males are excluded from the ANC sample frame, as are all women who fall outside the childbearing age, or who consult private practitioners rather than attend public antenatal clinics (DoH, 2000:4; Shisana & Simbayi, 2002:1) or all women who are using contraception. Females from the white and Indian population groups are also under-represented in the ANC protocol. Individuals who have adopted key HIV prevention practices such as condom use are considerably less likely to be represented in the antenatal sample and these factors may also contribute to antenatal surveys under-estimating HIV prevalence, which might also occur as studies have shown that HIV lowers fertility (Shisana & Simbayi, 2002:1). These limitations reflect an inadequate surveillance protocol for females, let alone for the rest of the population.

The NMHSRC study is a multi-staged sampling methodology based on a combination of data from the national census and the ANC survey (Shisana & Simbayi, 2002:30). The only comprehensive database that the NMHSRC could use to establish a sampling frame was the 2001 Census data, and the ANC surveillance data informed the sampling methodology used in the study (Shisana & Simbayi, 2002:33). Because of the expected changes since 1996 and problems with outdated maps, which could not be used to compile reliable listings, the NMHSRC decided to use recent aerial photographs of approximately 1000 enumerator areas (EAs) in South Africa (just over 1% of EAs) as demarcated during the 2001 Census (Shisana & Simbayi, 2002:11). The original sample size was 14450, and 13518 people were actually visited, of whom only 9963 individuals agreed to be interviewed. Of these, 8840 gave samples of their saliva for testing (Shisana & Simbayi, 2002:11). The number of respondents varied between one and three in each household, and came from different age groups so that the prevalence across the age groups could be obtained (Shisana & Simbayi, 2002:18). The EAs that were excluded from the sampling frame included hospitals, military bases and schools as these institutions were perceived as high HIV prevalence holdings (Shisana & Simbayi, 2002:31). The NMHSRC study argued that the ANC data collected was from high transmission areas, but its sampling frame was, nevertheless, influenced by the ANC surveillance. The reliance on the ANC surveillance and the fact that nearly a third of the original sample size did not undertake the saliva test render their results questionable (Garbus, 2002:22).

The study also ignores HIV infections in the under-two age cohort (Shisana & Simbayi, 2002:32). A study in Rakai in Uganda, showed that fertility rates were substantially lower in HIV-positive women than in HIV-negative women (Gray *et al.*, 1997:29). “Mother-to-child transmission, which is estimated to occur in about 30% of births to infected mothers (in the absence of intervention), accounts for increased infant and child mortality” (Barnett & Whiteside, 2002:169). This means that fewer infants are born or survive in the 0-4 year age group.

The relatively small sample sizes per population group were another problem area in the NMHSRC study (Shisana & Simbayi, 2002:13-14). The NMHSRC study used a small sample (less than 0.5% of the total population of South Africa). However, the NMHSRC was faced with a formidable task in the absence of a reliable sampling frame because the extent of the epidemic among some of the population groups is largely unknown. Also, relatively few whites make use of the public health service (DoH, 2000:4-5). A study in 2001 by the Medical Research Council reflected record HIV rates for the white South African population (2%) (compared to 0.6% among the white populations in Europe and the United States), 2% among Indians and more than 3% among Coloureds (Mixed group) (Taitz, in *Sunday Times*, July 2001). The NMHSRC contends that HIV affects all population groups and the differences in the prevalence rates between the races are attributed to "social and behavioural determinants" (Shisana & Simbayi, 2002:101). For this reason, the use of the public health facilities is a reflection of class and economic structure. Evidence in the Nelson Mandela Metropole suggests that high variation exists between the population groups (PE ATICC, 2000). This comparison, however, does not provide an indication of observed or expected prevalence rates among the various population groups.

The NMHSRC study attempted a validation test by comparing the total prevalence rate from its own findings with those of the 2001 ANC survey (see Table 2.1). The comparison shows that the prevalence rates in the EC differ significantly from those of the ANC findings (Shisana & Simbayi, 2002:46). However, the projected ANC statistics to the general population on the provincial level is not available (DoH, 2001; DoH, 2002a). The 2002 ATICC prevalence rate was 31.2% for the NMM, which was the highest in the EC (EC DoH, 2003:4, 13). Statistics showed that there were wide variations within the EC province (see Appendix 3).

Table 2.1: Comparative national and the EC provincial prevalence rates

Study and Year	National HIV level rates %	EC Provincial HIV level rates %
ANC (2001)	12.03	21.7 (ANC Attendees)
HSRC (2002)	11.40	6.60
ASSA (2002)	14.20	11.30

Source: DoH, 2001:4; DoH, 2002a:12; Shisana & Simbayi, 2002:46; Dorrington *et al*., 2002:5

The Carletonville study near Johannesburg was the only South African study to test an entire population. The study concluded that "the HIV prevalence was high in all groups: 22% among men and 37% among women" in the general population, but 70% among women in hotspots (Williams *et al.*, 2000:355). This data, however, is not applicable to the entire country because Carletonville is a mining community in an area with a high HIV prevalence, and a unique demographic profile. The Carletonville study shows the risk factors associated with poor women and men with extra income (Williams *et al.*, 2000:351). Nevertheless, their study is indicative that prevalence rates at the local municipal level differ from the provincial level as each region has unique demographic profiles and internal vectors that operate within specific regions.

Great statistical variations exist in the prevalence rates of HIV infection in the provinces among the different studies and projections. There are limitations in averages, which hide variations in prevalence not only at the regional level, but also at the magisterial level within the respective provinces (Personal communication with Costa Gazi, November 2002). The EC DoH Strategic Plan 2003/4 states that HIV prevalence in the Western and Eastern parts of the province is more pronounced and that the Cacadu District Municipality and the Nelson Mandela Metropolitan Municipality had the most varied pattern of distribution of HIV infection (urban 26% and rural 7%) (DoH, 2003a:53). (Note that Cacadu and the NMM formed the major part of Region A before the demarcation process in 2001) (see Appendix 3). A study by Robert Shell in the Nelson Mandela Metropole shows that HIV occurs in clusters and that the prevalence rates are not uniform throughout the region (2000b:13). Evidence also exist that HIV prevalence rates vary at the suburban levels (Shell, 2000b:13).

No South African city, with the exception of the NMM, has an adequate database of city level and sub-city level HIV/AIDS statistics (Pailman, 2002:7). In the NMM, the AIDS, Training, Information and Counselling Centre (ATICC) has been at the forefront of collecting HIV data at the municipal level in South Africa (du Plessis, 1997:104-107). The data analysis may show up the unique variations in the Metropole.

Compounding the inconsistent prevalence rates are the differentials that exist between the use of and access to public health services (differences between urban and rural areas), as it is estimated that 80% of the South African population use public health services (DoH, 2000:4-5). Furthermore, great variation exists between rural and urban settings: rural women are infected less than urban women (Shisana & Simbayi, 2002:52, 60). In South Africa, more women than men are infected with HIV (Rehle & Shisana, 2004:1-8). This is in contrast to Cuba, for example, where more men reportedly are infected than women as the Cuban male population is tested for HIV unlike their South African male counterparts (UNAIDS, 2000:3). However, females in South Africa make more use of public health facilities than males because of pregnancy. Males were more admitted for TB and injuries, and females were more admitted for AIDS, diabetes and genitourinary conditions (Ramdas & Zungu, 2004:6). Moreover, a report by Stats SA shows that females were more likely to die of HIV, influenza and pneumonia, while males had higher mortality from TB (Lehohla, 2002:6). An assessment of patients that utilise private health facilities might reflect different infection ratios between the genders.

An examination of the various surveillance protocols has shown that the results have not been consistent. Large case-level data are perhaps the most appropriate data for accurate results rather than analysis based on assumptions. This study is based on 27505 cases, which is more than three times the NMHSRC survey.

Proximal vectors that impinge on the spread of HIV

Globally, core groups, in the order of haemophiliacs, bisexual/homosexual and needle-sharing drug users, were the dominant form of transmission of HIV in the 1980s (Bloor, 1995a:10). The HIV spread followed a similar pattern in South Africa: the initial core group was haemophiliacs, followed by the bisexual/homosexual pattern (Karim, 1998:16). However, heterosexual transmission, vertical transmission, (that is, from mother to child), and infection through accidental blood transmission are evident in new infections in the 1990s. In the HIV context, the impact of certain vectors can be generalised throughout the population, while others should be viewed in their regional, cultural and social contexts.

a. Social cohesion and inequities

Alan Whiteside and others have developed what they call the Jaipur paradigm, that is, that those societies with inequitable distribution of wealth and low social cohesion, AIDS will have the highest impact (Whiteside *et al.*, 1999:1). Social cohesion refers to the degree of homogeneity to which a society operates as a social, ethnic, linguistic and cultural unit (Whiteside *et al.*, 1999:1-3). The Jaipur Paradigm is then driven by both social cohesion and income. For instance, internal migration on the Eastern Seaboard of South Africa forces disadvantaged populations in rural and urban settlements to contend with diminished social capital (Bekker, 1999:218-223; Cross & Webb, 1999:17). This would also contribute to significant disparity in the wealth distribution in these communities.

Also, the Jaipur paradigm lacks any gender focus—it does not discuss the role of gender inequality in the spread of HIV and, moreover, severely divided countries such as Israel and Ireland have low prevalence rates (Shell, 2000b:8-9). Melissa Abels found sufficient evidence to indicate that the "women power index", which is influenced by the level of education, income and age of mother at birth, (based on Census 1996), affected the 2001 ANC HIV prevalence of child-bearing women in the Cape Metropole districts (2005:46). Still, even with qualifications, the Jaipur paradigm would anticipate a high prevalence because of the unequal distribution of wealth and the diverse cultures in the Nelson Mandela Metropole.

b. Gender inequality

Both male and female researchers have argued that gender inequality is a determinant that should be addressed if the incidence of HIV is to be reduced (Farmer, 1999:93; Floyd, 1997:8; Karim, 1998:24; Richardson, 1993:231-234). Betsi Pendry (1998:30) argues that there are links between gender violence and HIV/AIDS because sexual violence increases vulnerability to transmission due to the likely presence of blood trauma. In South Africa, girls are more physically vulnerable to "sexual abuse, violence, prostitution and the consequences of unprotected and premature…sexual relationships" than boys at the same age (Kaya, 1999:40).

A higher sex ratio among the general population has regional and social causes: in South Africa gang rape is common and on the rise (Vogelman & Lewis, 1999:1). In 2003, 43 reported child rapes a day occurred in South Africa (*Cape Times*, 7.12.2004:1) and child rape is definitely on the increase (Shilumani, 2004:1). The rape of virgins is particularly important as men are actively searching for the “virgin cure” (Kaya, 1999:16). Also, economic inequalities create typical feminisation of poverty that leads to women increasingly having to rely on men (Budlender, 2000:88). The pandemic is more easily driven by the middle-class than the poor (Kumar, 2004:161). Thus, poor women in general are in a powerless and vulnerable position that often leaves them with little or no choice in a sexual relationship.

c. Cultural practices

Although studies have shown a correlation between poverty and AIDS mortality rates, everybody is vulnerable to HIV infection through infected blood transfusions and unsafe sexual practices (Karim, 1998:16). Karim argues further that differences in cultural sex practices make certain societies more vulnerable to HIV infection (1998:18). This means that HIV will have adverse consequences for those who indulge in risky sexual behaviours (Foreman, 1999:35). Calle Almedal of the Joint United Nations AIDS Programme (UNAIDS) (cited in Foreman, 1999:viii) states that “the HIV epidemic is driven by men” and his opinion is shared by AIDS experts and backed by statistical evidence. Culture plays an important role in Africa in determining the level of health of the individual, the family and the community (Airhihenbuwa & Webster, 2004:4) and South Africa is considered one of the most patriarchal societies in the world. Statistics argue that the black female population is more infected, and therefore, African men should change their behaviour as the constraints on men are strongly social and cultural rather than economic and power-related.

d. The military

The military is a powerful state organisation whose task is to protect the citizenry. However, historically, the military has been implicated in infecting populations in South Africa with diseases as far back as the nineteenth century, either as a moving or as a stationary vector. In an examination of the relationship between syphilis and racism in

South Africa from 1880 and 1950, Karen Jochelson (2001:15) comments that district surgeons in Albany and Grahamstown noted that syphilis had started at the ports and military stations and then spread inland, following the extension of the railway line and roads. Elizabeth van Heyningen's study (1984:67-68) of the 1901 plague in Cape Town found that plagues spread along trade routes and that the military was implicated in their spread (1984:84). Howard Phillips' study of the Spanish 'flu epidemic of 1918/1919 found that soldiers returning home from World War I spread the disease along the railway system in South Africa (1990:22-167).

Whiteside and FitzSimons (1992:30) note that soldiers are often a transmission vector for HIV. A 1998 UNAIDS study commented that military personnel had more money to spend than people with the same demographic profile in the local population, and the availability of commercial sex workers near military installations made them more vulnerable to HIV infection (UNAIDS, 1998). More recently, some researchers have implicated the military in the spread of HIV in the heterosexual population when former guerrillas were incorporated into the South African Defence Force after the 1994 elections without HIV screening (Mills, 2000:71). An article by L. Heinecken (2001:110) suggests that the HIV prevalence rates in the South African National Defence Force (SANDF) is similar to that of the general population, but that the rate is as high as 50% among the 23-29 year old combatants. Statistics from an army base in KwaZulu-Natal in 2004 showed that 89% of soldiers tested HIV positive from a sample of 1089 volunteers (*Sunday Independent,* August 2004). Official statistics suggest that almost a quarter of the 75000-strong SANDF is HIV-positive—AIDS statisticians argue that the figure is more realistically 40% (*The Star*, August 2004). In the Nelson Mandela Metropole the prevalence rates were found to be higher in townships bordering army bases (PE ATICC, 2000; Shell, 1999:37). Clearly, a reciprocal relationship exists between military personnel and the local population that needs further investigation. As a result of research, the EC has placed antenatal surveillance sites in Grahamstown (now removed from Region A).

e. Migration and urbanisation

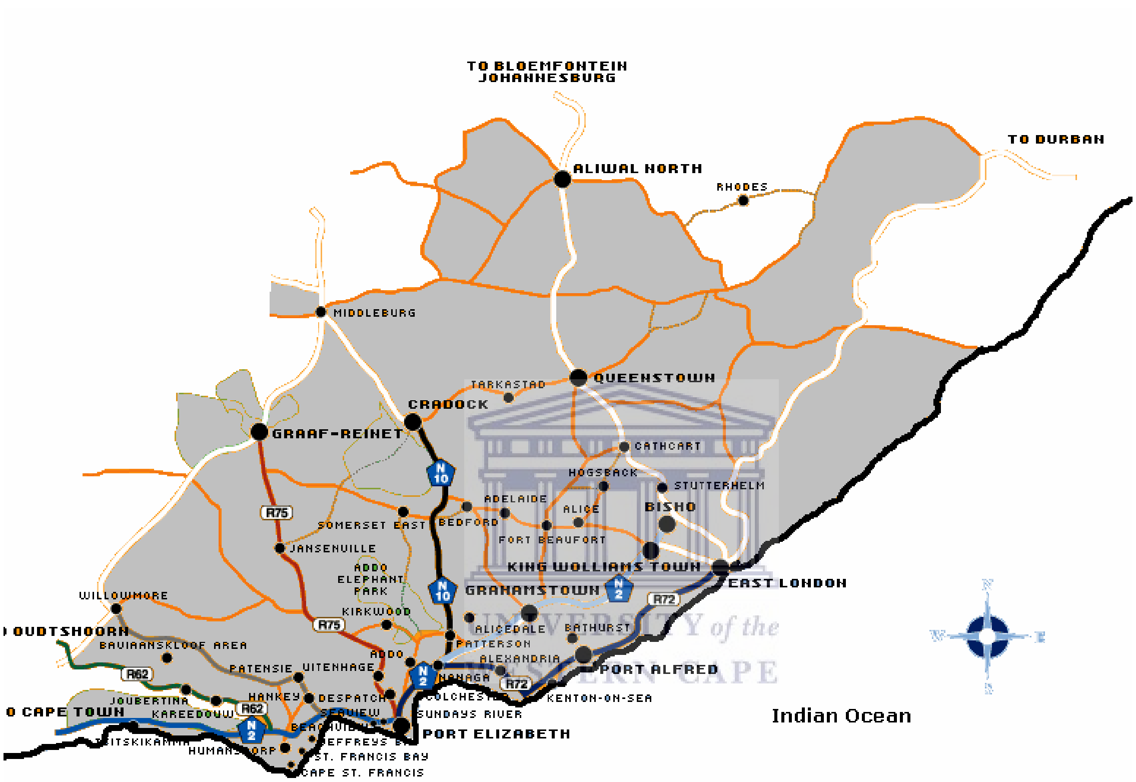
Complementary relationships also exist between migrants and people who have disposable incomes. Rapid urbanisation is creating a pool of unemployed poor who search out new partners for economic security (Haldenwang, 1993:11). Brian Williams and others state that oscillating migration, whereby rural men come to live and work in the mine centres without their wives or families, but return home regularly during periods of leave or after completion of their mining contracts, encourages unsafe sexual practices on the mines, and provides a conduit for the spread of HIV in the rural areas and is also an important determinant of reproductive health (Williams *et al.*, 2000:351). In this instance, the Eastern Cape provides a reservoir of labour to a wealthy province such as Gauteng, but households on the move in the EC move mainly within the province (Bekker, 1999:219). However, since 2000, there is a strong movement of not only households, but also of single people from the EC to the WC. The NMM has many established motor industries that attract migrants from all corners of the country and the continent. However, Region A, unlike the other regions, is not a sending region.

People do not migrate solely for better working conditions. In a study of rural-urban interactions and HIV/AIDS in Eastern Africa, WTS Gould (2004:35) challenges assumptions, which are no longer valid in a more mature epidemic that migrants are to be blamed for the fairly spatial diffusion of HIV. He argues that the epidemiology of the disease is established by different factors in the earlier stages and because of its changing nature, "HIV/AIDS also seems to be generating new forms and different mixes of population mobility or circulation, ranging from the mobility generated by infected persons seeking health care, and that generated near or after death by people returning to their home areas" (2004:35). The urban-rural HIV infection rates in Region A may be a reflection of these phenomena (PE ATICC, 2000).

f. Trucks, taxis and vector traffic

Truck drivers in India visit between 50 and 100 sex workers in a year and in Harare, Zimbabwe, a survey revealed similar figures, namely, that some men visited sex workers on average 7.4 times a month, representing many opportunities to contract or transmit HIV (Foreman, 1999:4-5). Initially, the excellent transport system, the high geographical mobility of the South African population and the migrant labour system were three conduits in the rapid spread of HIV (Shell, 2000b:13-14). In 1999, in six sites outside the major urban areas in South Africa, 56% of truck drivers tested were HIV positive (UNAIDS/WHO, 2004:2). In this regard, the NMM has excellent road and rail links to the rest of the country that makes the Metropole an accessible terminus in the HIV traffic (see Fig. 2.5 and Appendix 24).

Figure 2.5: Road links to the Nelson Mandela Metropole



Source: www.nmbt.co.za

g. Educational institutions

Playgrounds and classrooms are as much breeding grounds for HIV transmission as truck and taxi stops and military installations. South African girls (15-19 years old) who become sexually active may not know that a person with AIDS may look healthy (Shell & Zeitlin, 2000:6). There are strong positive associations between the risk of HIV infection and indicators of socio-economic status, such as level of education (Hargreaves *et al.*, 2002:489-498). Shell and Zeitlin (2000:8) claim that "teens of school-going age would account for almost 23% of acquired HIV in Region A of the Eastern Cape". In

Region A, a female in the 5-14 year age group is eight times more likely to be infected than her male counterpart, which is higher than the 2000 United Nations International Children's Fund (UNICEF) study (Shell and Zeitlin, 2000:9). A national cross-sectional study (2004) of views on sexual violence and risk of HIV infection and AIDS among South African school children aged 10-19 years in grades 6-11 found that "one third of the respondents thought they might be HIV positive and that both sexes' views were compatible with acceptance of sexual coercion and adaptive attitudes to survival in a violent society" (Andersson *et al.*, 2004:329-952).

A study at the University of Durban-Westville reflected high infection rates of 26% in women and 12% in men aged 20 to 24 (Stremlau & Nkosi, 2001:2). In contrast, the Rand Afrikaans University (now the University of Johannesburg) study showed low prevalence rates of HIV among its student body (Martin & Ichharam, 2002:45), but the study was criticised for the inclusion of a large number of virgins in the sample. Results of in-depth studies at other tertiary institutions in South Africa are unknown and the student role as a vector, therefore, remains largely unknown.

Not only pupils are at risk of HIV infection. In a Zimbabwean study, male and female teachers had a higher HIV infection rate than other adults in the general population (Gregson *et al.*, 2001:23). A UNICEF study (2000:72) claims that South Africa had the highest AIDS mortality rate among primary school teachers in Africa. Teachers are measured as middle-class public servants with high disposable incomes who have easy access to young female students and it can, therefore, be argued that in their case, at least, HIV is not necessarily a disease of the poor.

h. Prisons

HIV infection rates are high in many prison systems. In Western Europe particularly high rates have been reported in Portuguese (20 percent) and Spanish prisons (16.6 percent) (Canadian HIV/AIDS Legal Network, 2004). Prison inmates are five to ten times more likely than non-inmates to have AIDS or the virus that causes it, and recently-released prisoners account for one-sixth of the United States of America's AIDS cases (Cooper, 1999:1). Researcher KC Goyer (2003:1) estimates the real HIV prevalence rate at about

41.5 percent, in South African prisons, which is likely to rise even higher in coming years. "Prison health is public health," writes Goyer, noting that thousands of discharged prisoners return to society every month bringing infections with them. Goyer states that "prisoners come from communities that have limited access to public health services, and these are the same communities to which they return" (Benjamin in *Business Day*, 3 November 2003). However, in South Africa, the Department of Correctional Services does not know the HIV prevalence rate in its prison population and has never conducted a full study of HIV prevalence in its prisons. By the end of 1999, 60% of the HIV-positive prison population in Region A was in the Nelson Mandela Metropole penal system (PE ATICC, 2000), showing that prisoners follow the high density population pattern identified by Farshid Meidany.

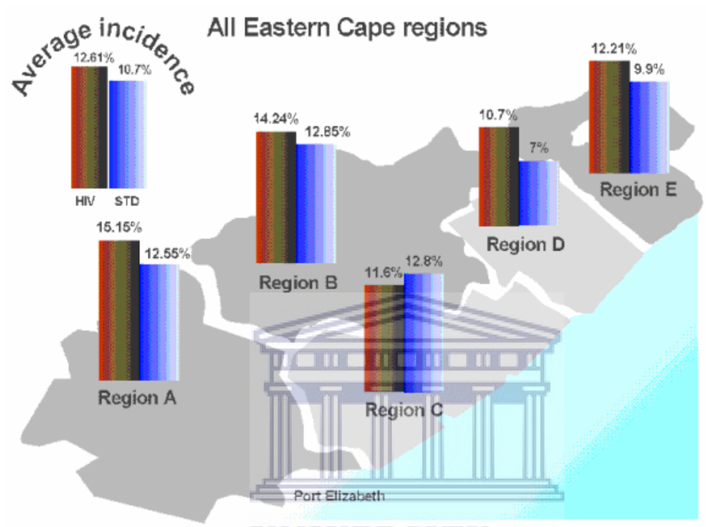
Profile of sexually transmitted infections and TB in relation to HIV

The human host is the carrier of a multitude of diseases. In this regard, the reciprocal effects of TB epidemics and the long-standing sexually transmitted infections (STIs) are the underlying causes of the HIV spread (DoH, 1999:2; Karim, 1998:18-19; Schoub, 1999:107). According to World Health Organisation (WHO), of the twenty-three countries in the world with the greatest number of TB cases, nine are in sub-Saharan Africa—South Africa is listed third in order of number of cases in Africa (Ridzon & Mayanja-Kizza, 2001:375). Since 1961, the incidence of TB in South Africa has been so high that the disease has been referred to as a continual TB epidemic, despite dramatic advances in the detection, limitation and treatment of TB during the past thirty years (van Rensburg & Mans, 1982:147-148). TB, pneumonia and cerebral toxoplasmosis are the most prevalent opportunistic diseases or conditions among patients dying in African hospitals (Colebunders *et al.*, 1989:357). In South Africa, TB is endemic and is by far the most common notifiable disease, with 80000 to 90000 cases reported annually (Tiemessen *et al.*, 2000:328). A global study of TB gave an estimate for South Africa of 392 new cases of the disease per 100000 people per year, but there are wide geographical and racial differences in infection rates (Williams *et al.*, 2000:298). There is an ominous synergy between Mycobacterium Tuberculosis and HIV—15% of HIV-associated deaths in Africa are caused by TB (Rang *et al.*, 2003:649). Because TB is transmissible to both persons with and without HIV infection, rising TB rates in Africa affect the health of the population as well the health of individuals (Ridzon & Mayanja-Kizza, 2001:373). TB epidemics are contained through vigorous medical procedures and health programmes, yet TB increased by a rate of 1.2% per annum in the Nelson Mandela Metropole in the 1990s (The Institute for Development Planning and Research (IDPR), 1997:28-29). The number of deaths caused by TB has increased by 79.5% in 1997; there were five TB deaths for every one AIDS death reported in the Nelson Mandela Metropole (IDPR, 1997:28), but it is possible that many TB cases are co-infected with HIV. There are several points of infection: people who have been 'cured' of TB may be easily reinfected once HIV positive. Second, TB lowers vulnerability and the lowered immune system might well result in quicker HIV infection (Schoub, 1999:107).

Similarly, the role of STIs in facilitating sexual transmission of HIV-1 strongly justifies STI control as a strategy to reduce further expansion of the HIV-1 epidemic in Africa (Kapiga & Aitken, 2001:245). HIV-1 pattern involves primarily white, homosexual or bisexual men and the HIV-2 pattern involves primarily black, heterosexual men and women (Bloor, 1995a:11; 1995b:29). In 2000, 64% of male and 50% of female STI clinic patients in South Africa tested HIV positive (UNAIDS, 2004:2). In Carletonville, HIV prevalence among women aged 24 was 66%, one of the highest rates ever reported in a general population. These remarkable findings are due to high rates of HIV transmission from men to women, and the major role played by HSV-2 (Herpes Simplex Virus Type 2) in the spread of HIV in this population (Williams *et al.,* 2000:355). Syphilis, like HIV, occurs in epidemic proportions in the Eastern Cape (Naidoo, 2000:54-55). Studies in the Eastern Cape have shown that the HIV incidences are higher among the populations that have syphilis and TB (Meidany, 1998:6) (see Fig. 2.6). With both diseases people may be unaware for some time that they are infected, and during this period both those with syphilis and HIV may be infectious to others. Importantly, syphilis once also evoked the same kinds of fears and condemnation that HIV/AIDS does today.

On the other hand, HIV is a pandemic of a different nature from TB and syphilis, both of which have cures. Antiretroviral drugs may extend the lives of HIV positive people, but symptoms may surface as AIDS after many years in the form of opportunistic diseases such as TB and respiratory disorders as the immune system becomes progressively depleted. It seems, therefore, that both TB and STIs are unremittingly attacking the economically depressed and disadvantaged population groups, especially those that have contracted TB before they acquire HIV.

Figure 2.6: Correlation between HIV and STDs in the Eastern Cape in 1998 (courtesy of Robert Shell)



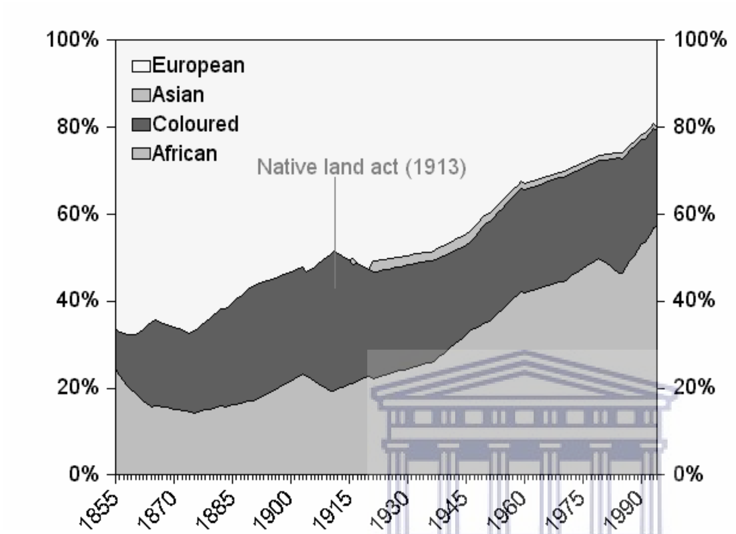
Source: Eastern Cape Epidemiological Notes 1, no 3 (June 1998): page 6

Influence of HIV on the demographic profile of the NMM

An analysis of the South African official censuses showed that the Europeans (whites) formed the biggest population group before the industrialisation phase in the latter half of the nineteenth century in Port Elizabeth (see Fig. 2.7). According to Fig. 2.7, they now form the minority group (together with the Asians). The graph shows an accelerated growth of the African population—by 1994 they easily constituted the largest ethnic group in the Metropole.

Official statistics such as the censuses of 1996 and 2001 give further indications of population dynamics by giving information on whether there have been any changes in the demographic profile for the NMM. Statistics South Africa (Stats SA) (2004) estimated that in mid-2002, 65% of the Eastern Cape population lived in rural areas and that the highest population density (562.05 per square km) was in the Nelson Mandela Metropole. Also, approximately 35% of all formal employment in the province is in Port Elizabeth.

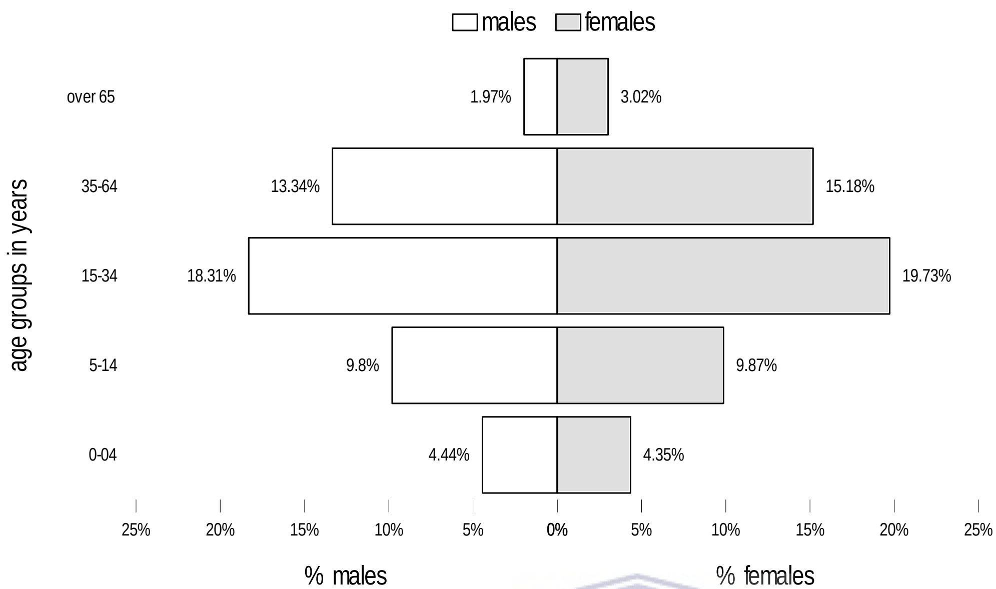
Figure 2.7: Growth of the different population groups in Port Elizabeth, 1855 to 1996 (courtesy of Robert Shell)



Sources: Cape, Union and Republican censuses

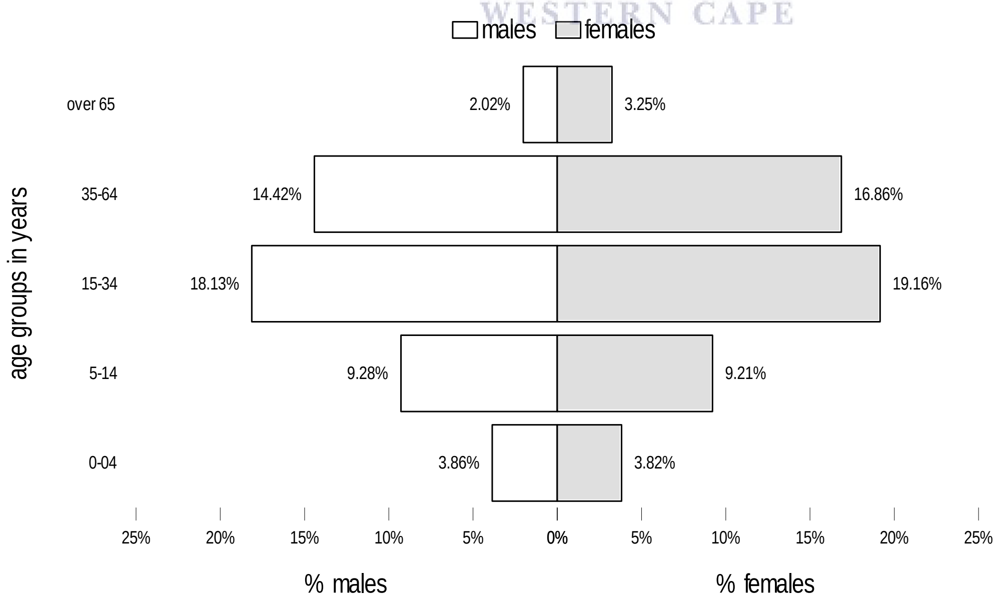
Based on the 1996 and 2001 census results, the age and sex structure of the NMM has changed significantly between 1996 and 2001(see Appendix 2). Especially, the difference of the 0-4 age group in the 2001 Census is more pronounced than the 1996 Census (see Fig. 2.8 and Fig. 2.9). The 2001 Census statistics show that the population had decreased in the 0-4 and 5-14 age groups for both males and females (Stats SA, 2004). The decline in the gender and age profiles in these age groups would suggest that HIV/AIDS could already have had an impact on the demographic profile of the Metropole. The dependency ratio will also rise, which will have an adverse effect on the living standards and quality of life of all surviving members. The dependency ratio may be defined as the ratio of the economically dependent parts of the population to the productive part (Pressat & Wilson, 1985:56).

Figure 2.8: Population pyramid showing age and gender profile of the NMM, 1996



Sources: Census 1996 (N=959314)

Figure 2.9: Population pyramid showing age and gender profile of the NMM, 2001



Sources: Census 2001 (N=1005778)

But, without detailed information on the course of the HIV/AIDS pandemic, it becomes difficult to forecast demographic trends. The efforts of Kustner, Swanevelder and Van Middelkop to collect data in 1990 at the ANCs resulted in South Africa having good data on HIV infection rates (in Williams *et al.,* 2000:297). In the Nelson Mandela Metropole, the late Etienne du Plessis collected case-level data since 1990, which are the best in terms of data sampling in that detailed inferences can be made on how the HIV pandemic influences the demographic profile of the Metropole (PE ATICC, 2000).

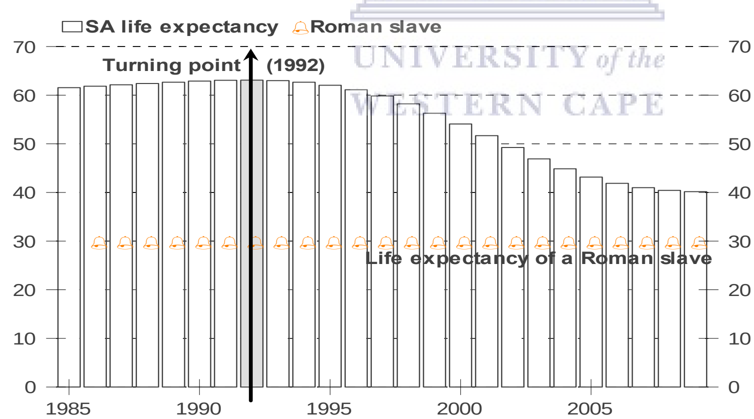
Pandemics have an adverse effect on populations in terms of numbers and growth rates because of the atypical high level of mortality in the population. The HIV/AIDS pandemic is increasing its impact on mortality and this will have an impact on the demographic transition in South Africa in the long term. The Demographic Transition Theory (DTT) marks changes in the economic development (or modernisation) which alter population growth rates as a result of reductions in mortality and fertility (Mostert *et al.,* 1998:13). The demographic transition for the European population group in South Africa started at the turn of the twentieth century and in contrast, the demographic transition for the Mixed group and African group started much later, in the 1940s and the 1950s, respectively (Mostert *et al.*, 1998:14-15; 125). Based on population projections of the ASSA2002 model, AIDS is projected to impact on black mortality significantly and will hasten the fertility decline slightly which will then alter the demographic transition for this particular group (Matanyaire, 2004:77). Mortality will rise to pre-transition levels, while fertility will continue to fall.

In sub-Saharan Africa, young women aged 15 to 24 were found to be 2.5 times more likely to be infected than young men (UNAIDS, 2004:2-3). The national DoH’s 2002 ANC survey states that there were 2.95 million infected females to 2.30 million infected males in the 15 to 49 age groups (2003a:11). The NMHSRC study reports that more women than men are infected in South Africa (2002:46). Also, an estimated 3.2 million women, in the (15-49) age group are reported to be infected with HIV (Dorrington *et al.,* 2002:4). Shell (2000b:4) argues that the high infection rate for females can be attributed to “the reporting structures and clients of both antenatal clinics and the hospital system”.

Already the differences in the various research endeavours make it difficult to model the epidemic based on inconsistent assumptions and wildly differing sampling frames.

HIV has a direct impact on life expectancy. Life expectancy at birth is the average number of years of life to be lived by a group of babies born at the same time (Nam & Philliber, 1984:62). In South Africa, life expectancy fell from 63.7 in 1994 to 53.2 in 1998 (UNDP, 2000). The United States Bureau of the Census gave the 2000 life expectancy figure as 51.1 and a 2010 life expectancy projection of 35.5 for South Africa (Barnett & Whiteside, 2002:278). The life expectancy of South Africans has been dropping since 1992, according to Fig. 2.8 (Shell, 2000b:16). By 2001, the life expectancy was still above 50 years, but by 2003, it had dropped below 50 years (see Fig. 2.10). Based on these projections, the government should not drag its feet on the pandemic.

Figure 2.10: The AIDS dystopia: predicted SA life expectancy, 1985 to 2009. (Graph courtesy of Robert Shell (2000b:16))



Source: ASSA600c component projection, courtesy of Prof Robert Dorrington, UCT

Conclusion

The literature reveals that gaps and contradictions exist in the findings on prevalence rates at the national and provincial levels that make it difficult to recognise and act on the proximal vectors. The HIV surveillance protocols in South Africa have failed to establish the HIV prevalence at the local level, although the HSRC did a comprehensive study that exposed many of the limitations of the ANC surveys. As argued previously, evidence suggests that the prevalence of HIV varies substantially between different areas, with some areas not being affected greatly, while clusters of prevalence were observed elsewhere. These gaps highlight the importance that analyses of the age/gender/race projections for HIV should be done on the local level, since statistical generalisation at the provincial or national level compromises targeting spending on health at the local government level.

Furthermore, local government responses in the Nelson Mandela Metropole to the HIV/AIDS epidemic are inadequate, as health policies are also imbued with human rights issues. The contrasting responses to health and sanitation in the past between the black locations and the slums in the inner city, and that of the white residential and business sectors show up the historic racial discrimination and biases of the local authorities. Now, HIV/AIDS may affect populations in a similar manner if municipal responses are inadequate as the pandemic is hitting a well segregated city.

Although public health resources are considered relatively ineffective in containing the HIV/AIDS pandemic, they are seen to be effective in generating and maintaining divisions between social groups and establishing the relative worth of different social groups.

Chapter Three

Research design and methodology

Research design and methodology

Introduction

This chapter describes the research methodology and design used to study the spread of HIV and its spatial distribution in the Nelson Mandela Metropole. The researcher motivates the selection of the geographical area for the study before describing the research methodology and design. The researcher explains the purposes and characteristics of the research instruments, showing briefly how these instruments aid in establishing the epidemiology of HIV. The criteria for the choice of sample size are explained, as well as the sample design and sampling techniques. The researcher also defines a plan of action and sets out procedures used for the collection of the data. The issues involved in the utilisation of existing statistics and secondary analysis, as they relate to this particular study, are discussed. Finally, possible limitations of and gaps in the data are stated.

Site selection

The geographical area selected for this study is the Nelson Mandela Metropole in Region A of the Eastern Cape. The criteria for selecting this area are:

- The case-level dataset of HIV positive subjects;
- Port Elizabeth is the biggest city in the poorest province of South Africa; and
- The Nelson Mandela Metropole displays a unique cultural and socio-economic diversity patterns.

Research design and instruments

No research instruments such as a questionnaire or survey were employed. Rather, the research was based on existing statistics; that is, a dataset with case-level entries from the Aids Training Information and Counselling Centre (ATICC) organisation in the Nelson Mandela Metropole. Existing statistics are tools that are valuable in exploratory, descriptive and explanatory research (Neuman, 1998:35). The ATICC data are far different from the National Antenatal Clinic data because the former data represent both male and female cases from all the population groups across the various age groupings.

To produce an objective evaluation of the area, quantitative social research techniques were used for data analysis. Quantitative analysis can reveal definitive overall patterns and structures in society.

The technique of prosopography (Stone, 1981:45) which is the compilation of a collective biography, was used to analyse the cultural and economic status of the HIV positive subjects as defined by the Jaipur paradigm. Each case-level entry is a micro-biography in the data, which reveals some of the risks and behaviour patterns involved in acquiring HIV and also the reason for the rapid spread of HIV. Since the data was collected over a ten-year period, the speed at which HIV has spread can also be ascertained.

Matrix of the population and its variables under scrutiny

A total of 27505 HIV positive cases were transcribed onto a spreadsheet. There are a total of 63 variables, which forms a 63 x 27505 matrix in the spreadsheet, forming the entire dataset. The identity numbers appear vertically on the left-hand side and the names of the variables horizontally on top. The dataset was cleaned in a spreadsheet programme, but the analysis was done in a statistical package. After the dataset was cleaned for errors, several derived variables were added to aid in the analysis of the research process.

The variables created for the study are identical to those used in a pilot study in Walmer Township, Port Elizabeth, by the Population Research Unit at Rhodes University **(**Shell, 2000b:4). However, the sample size in this later study is bigger and the time span over which the data was collected is longer. Statistical analyses such as frequencies of the different variables, cross-tabulations between selected variables was employed to show the relationships and estimations between nominal, interval and ordinal variables within the dataset. This allowed new knowledge to be generated from variation in the recorded data. Graphs generated by statistical computer packages facilitated the discussion of the relevant issues concerning demographic analyses.

Original documents

The original documents from which the data was transcribed were the medical records of people who had visited the various public hospitals, blood transfusion services, private medical doctors, district surgeons, prisons, military bases and clinics from all of Region A between January 1991 and April 2000. The anonymised data was collected by ATICC in Brister House, Govan Mbeki Street, Port Elizabeth for HIV tracking purposes. The subjects' blood samples had been tested for their HIV status at the South African Institute for Medical Research (SAIMR) laboratories on a volunteer basis. Some of the most important variables in the anonymised data were the date of birth, race, gender, the magisterial district and the year of diagnosis. The age variable was grouped into five-year age groups to facilitate analysis. The research concentrated strictly on the magisterial codes for the GIS analysis. The anonymised PE 2000 ATICC dataset was acquired by Professor Robert Shell from the late Dr Etienne du Plessis, the Chief Medical Officer of Health in Port Elizabeth, and was made available to the researcher so that she could pursue an analysis of the magisterial district-based spatial distribution of HIV in the Nelson Mandela Metropole. The PE ATICC 2000 is also known as the NMM ATICC 2000 dataset.

The researcher was not able to acquire the primary case-level data from the period, May 2000 to December 2003, as ATICC had not transcribed the subsequent medical records into a database. However, in 2002, ATICC provided the researcher with aggregated data for the period 1989 to 2002 (see Appendices 4 and 14). ATICC also provided aggregated data for the year 2001 which reflect HIV infection per gender and population group (see Appendix 5). Most of the analyses will be based on the ATICC case-level data from the period January 1991 to April 2000. The rest of the analysis will be based on the ATICC aggregated data from January 1989 to December 2002. The total aggregated dataset population is 49156 HIV cases. The aggregated data reflects an additional 6139 AIDS deaths (PE ATICC, 2002).

A non-probability sampling technique has been utilised in an existing surveillance protocol such as the PE 2000 ATICC dataset since the sample collection is non-random.

In so far as the technique is concerned, the data can therefore be described as convenient or pre-purposive sampling. The dataset is representative only of the subjects that tested positively for HIV, as subjects who tested negatively for HIV were not recorded. It is unknown, therefore, what percentage the 27505 case-level entries comprised of the total population that had been tested. Males and females of all ages and population groups formed part of the dataset. The European population group is also known as the White group. Subjects in the Mixed group were formally classified as the "Coloured" people before 1994. These categories were retained in the dataset after 1994.

The population of the Nelson Mandela Metropolitan area in 2001 was 1005778, according to the Census 2001 (Stats SA, 2004). Region A has an approximate total population of 1400000 (this total was obtained by including the population of the Cacadu Municipality, which was part of Region A before the new demarcation), according to Census 2001 (Stats SA, 2004). The 27505 case-level entries, therefore, represent 1.97% of the total Region A population as at 2001. The aggregated data represents 3.51% of the total Region A population. The number of HIV positive cases in the Nelson Mandela Metropole was 21322 cases which represent 79.2% of the dataset population (PE ATICC, 2000) (see Appendix 6**).**

Measures used to minimise errors

The researcher used the sorting technique to minimise errors in the data. The box-plot procedure was used to see if there were any outliers in the analysis of the age variable. The frequency of the variables was run to see if there were missing values. There were several missing values for the different variables, but these missing values were not significant when analysing the age, gender and population groups. Missing values were significant when the mortality variable (2208) was analysed as not all deaths were recorded.

In the dataset, the variables were defined as numerical or string data. They were further defined as nominal, ordinal or scale data so that the appropriate statistical analysis could be carried out. For example, the variable magisterial district is nominal data, which limits the statistical analysis of the variable. On the other hand, age is a numerical and continuous scale data variable, which allows for more sophisticated statistical analysis using, for example, regression techniques.

South African informal settlement suburbs are often named after South African freedom fighters and heroes of the anti-Apartheid struggle and, as such, the names are duplicated in most magisterial districts in Region A. However, the researcher was able to reconcile the names of the informal settlement and the magisterial district by means of analysing the place of diagnosis.

Justification for choice of methods and techniques

A statistical analysis can bring forth patterns that cannot be captured by using qualitative methods. Utilising a statistical technique such as the frequency of a variable in a huge dataset enables one to calculate the number of observations within the variable. Cross-tabulations, on the other hand, allow one to test hypotheses between two or more variables. Graphical programmes allow for the representation of graphics such as graphs, pie charts and population pyramids. GIS facilitates analyses by representing the data spatially on maps in graphical format. Therefore, quantitative analysis that utilises statistics is appropriate for case-level data such as the PE ATICC 2000 dataset.

Geographical information systems as a technique in research

GIS provides excellent means for visualising and analysing epidemiological data, revealing trends, dependencies and inter-relationships. It can acquire, store, manage, and geographically integrate large amounts of information from different sources, programmes and sectors. “The application of GIS to health in South Africa can be divided into a macro- and a micro-level. These can be applied to health issues such as the provision of health infrastructure, the mapping of disease, the investigation of the spatial dynamics of communicable, environmental and infectious disease transmission, and lastly to the modelling of health service utilisation and disease control intervention” (Medical Research Council of SA, 2001).

By tracking the sources of diseases and the movement of contagions, health agencies can respond more effectively to the outbreaks of epidemics by identifying populations at risk. In a classic study of the spread of cholera in London in 1855, John Snow created a spatial distribution of the disease by household level and street level enabling him to recognise an infected water pump as the proximal vector (1856:239-257). The methodology used by John Snow was to link the disease to possible point sources of contamination (see Fig. 3.1). This technique provided a point pattern, also indicating the proximity of events (i.e. their location in relation to each other) and could potentially represent significant patterns. John Snow would have revelled in the modern technology that is available to scientists today where GIS software and the relevant digital (data captured by computer) data can be used to produce a map that pinpoints the location of the disease, even to the household level.

Figure 3.1: Spatial distribution of cholera in London, 1855

Source: Epi Info, 2002

In Uganda, by the end of 1989, it was estimated that there were at least one million carriers of HIV, with 12000 reported cases of AIDS. Matthew Smallman-Raynor and Andrew Cliff (1991:69-80) mapped the incidence rates of AIDS in 34 districts in Uganda which pointed to two foci of incidence. These maps pointed the way to three hypotheses that explained the observed variation in the map. One was that infection is acquired by those working in major urban areas who return home to infect partners in rural areas; another was that infection is passed along major routes or “corridors”; and a third involved contact between soldiers and prostitutes. Explanatory variables such as accessibility to roads, in- and out-migration rates and army recruitment were used in the analyses and only the last hypothesis could explain a significant proportion of variation in AIDS incidence.

The literature reveals that GIS methodologies have only been used to a limited extent as a tool in South Africa to reveal an accurate epidemiology of the HIV pandemic. The location of the health clinics used in the sampling of the surveillance system is plotted yearly by the national DoH**.** Health researchers have successfully utilised spatial methodologies to establish the spatial distribution of epidemics such as malaria. The Medical Research Council (MRC) of South Africa states that “the GIS capability of the National Malaria Research Programme and its implications for disease control have been recognised internationally and have led to a wholly African collaborative effort to map malaria throughout the continent” to promote health research and delivery in the country (MRC, 2001). However, malaria does not carry the same stigmatisation as HIV/AIDS (*i.e.* it is, primarily, a sexually transmitted disease) and, therefore, HIV/AIDS has never been plotted using case-level data. The spatial distribution of HIV could be determined by using data (*i.e.* spatial data that has been aggregated to aerial units such as district zones and census zones) since vectors that impinge on the spread of HIV are many and varied at the local level.

Data and methodology for GIS

Maps using Geographic Information Systems (GIS) programming have highlighted the spatial distribution and spread of HIV to reflect the magisterial district- and town-level incidence of HIV in the Nelson Mandela Metropole. In addition, GIS information on Region A, aerial maps that indicate informal settlements, truck stops, educational institutions, military bases, prisons and highways that could reflect hidden or exposed vectors were obtained from the Port Elizabeth municipality. In this way, a correlation between the focal points of the spread and the vectors could be established.

Mapping enables the researcher to view the data spatially and to establish spatial relationships. According to C. Block and L. Green (1994:11), two things are necessary for computer mapping: a computerised map and a way to place information on that map. To develop a computerised map, one must assign x- and y- coordinates to the suburbs, landmarks and other features on the map. This process is called digitising – a process of translating map features (such as municipal districts, boundaries or bodies of water) to an x-and y-coordinate grid for computer mapping. After this process has been completed, information can be placed on the map by assigning an x- and y-coordinate to each piece of information (such as the location of each rape HIV incident within a municipal district boundary). This process is called geo-coding, the computer equivalent of pushing pins into a suburban map on a pin board.

Geo-coding is vitally important for mapping since it is the most commonly used way of inserting data into a GIS. Facilities such as clinics and hospitals almost always have suburban localities or other locational attributes, and this information enables the link between the database and the map. The facility names were captured in a statistical programme to enable geo-coding. This data was used by the Surveyor-General to assign a longitude and latitude to the location of the HIV cases. In addition to the alpha-numeric data, a GIS requires vector data (*i.e*. a specific type of data) that is obtained from various sources such as the census data to geo-code the cases by converting the suburban address into a pair of co-ordinates. In South Africa, this is done through mapping to the centroid of the erf (property), while other countries, such as the United States of America (USA) use a methodology where points are interpolated along the edge of a street block. One needs a unique key field in the database that provides a spatial reference by a geographic identifier to geo-code a field (an indirect spatial reference [ISO/TC 211 1998]). This indirect reference could also be the name of a magisterial district, the name of a suburb or the name of a local authority (Schmitz *et al.,* 2000:1).

Various layers of vector data were used as backdrop such as the suburbs, place names and railway lines. The different datasets first had to be edited and re-projected before they could be overlaid successfully due to different reference points and differences in the geometric or vector data. The magisterial district is a derived variable which shows the demarcation of Region A as defined by the national census of 1996 (see Appendix 24).

The suburb names assisted in the coding of the magisterial districts to generate GIS maps. In the research, the values of the longitudinal and latitudinal co-ordinates of magisterial districts in Region A are further derived variables which are utilised to establish the spatial distribution of HIV. The researcher obtained the co-ordinates and the magisterial district codes from the Surveyor-General's office in Mowbray, Cape Town.

Reliability

Reliability and validity are two desirable characteristics of data-measuring procedures. A reliable procedure is one that gives consistent results when it is applied more than once to the same subject under similar conditions (Lwanga *et al.,* 1999:14). Since the research is based on existing statistics, that is, the data is in a quantitative and standardised form, the reliability is of a high standard. However, the researcher has been unable to determine the reliability of the initial procedure, that is, the inherent variation of the data procedure, fluctuations in the variable being measured and observer error when the data was originally collected and transcribed to a spread sheet.

The reliability of the data may ultimately be verified by ATICC in Govan Mbeki Street in Port Elizabeth. Acquiring the same data and analysing it may verify the statistical analysis of the relevant nominal, ordinal and interval data.

Validity

A sample set that is representative of a population exhibits the demographic characteristics of the population. Deviations from this compromise the validity of the results. The sample is representative of both males and females. However, the gender ratio is low: an approximate 3:7 ratio, which compromises the sample representivity (N=27505) and, therefore, the validity. To fulfil the representivity criterion, the dataset should reflect approximate ratios to that of the total population of the Nelson Mandela Metropole.

Ethical issues

This study is of great interest to the research community because besides the Carletonville study, no other study exist which shows how HIV/AIDS is distributed across a South African city. The research is of great epidemiological importance and the researcher is of the opinion that constructive and sensitive research can be pursued while confidentiality is maintained at all times. Stigmatisation runs deep in the South African society, hence the research does not involve the risk of revealing an individual's HIV/AIDS status as no mention is made of names or street addresses.

Limitations of the original documents

Clerks did not always transcribe the original documents from the various state health institutions accurately. Furthermore, despite a systematic attempt to homogenise the data, various institutions have different collection policies and, therefore, this data was by no means perfect. For this reason, the transfer of information from the original document to the electronic dataset may render some of the case-level entry variables inaccurate. In some instances, suburb names were missing. Subjects from tests for credit application to financial institutions and the personal details acquired from prisoners and army personnel were all anonymous. Although these subjects' suburban locations were missing, this did not compromise the spatial distribution as the respective addresses of these institutions, derived from published directories, serve as points of reference. Another limitation is that some subjects could have visited two or more different health institutions to have their blood tested and were thus tested more than once.

Since race and gender are known, this information may encourage stereotyping and prejudices on the part of the researcher. A further limitation is migration which is an unknown variable and its influence on the dynamics of the HIV spread can only be assumed (Shell, 1998c:1).

Conclusion

HIV, in comparison to other diseases, requires a major societal effort to contain the pandemic. Statistical methods and graphics aid in analysing the data, but these techniques have inherent limitations. Thus, the innovative research technique such as GIS was discussed to show how this implementation would enhance how the disease is spread across the NMM. In this case, case-level data was shown to be the most reliable in terms of analysing how the HIV epidemic affects age, gender and race profiles by using this technique.

Chapter Four

Results

Results and presentation

Introduction

This chapter describes the actual sample and its characteristics. Then the main results, positive and negative, are described and summarised to see the trends, patterns and connections that have emerged. Thereafter, the GIS technology will show the spatial relations between variables that ordinary analysis may overlook. Chapter Five discusses the implications of the results in more detail, taking into account the conceptual framework and the literature review.

Description of the sample set and its characteristics

In Chapter Three many of the characteristics of the Nelson Mandela Metropole ATICC data set representing the whole sample population were described and discussed. All the entries in the data set are people who are HIV positive. Normal attrition caused by factors such as missing values reduced the frequencies of the variables that were analysed. The most important variables are:

- Demographic variables: age, gender and population/ethnic group;
- Other variables: Year of diagnosis
- Relationship between subjects
- Institution where tested
- Year of death
- Type of dwelling
- Magisterial district
- Urban/rural area
- Suburb
- Counselling place
- Transmission pattern

Names and street addresses do not form part of the data set to ensure confidentiality. Since the data is anonymised, the researcher has at her disposal only the names of the suburbs in which people lived, worked or diagnosed as HIV positive. These suburb names assisted in the coding of magisterial districts.

The objectives of the research are:

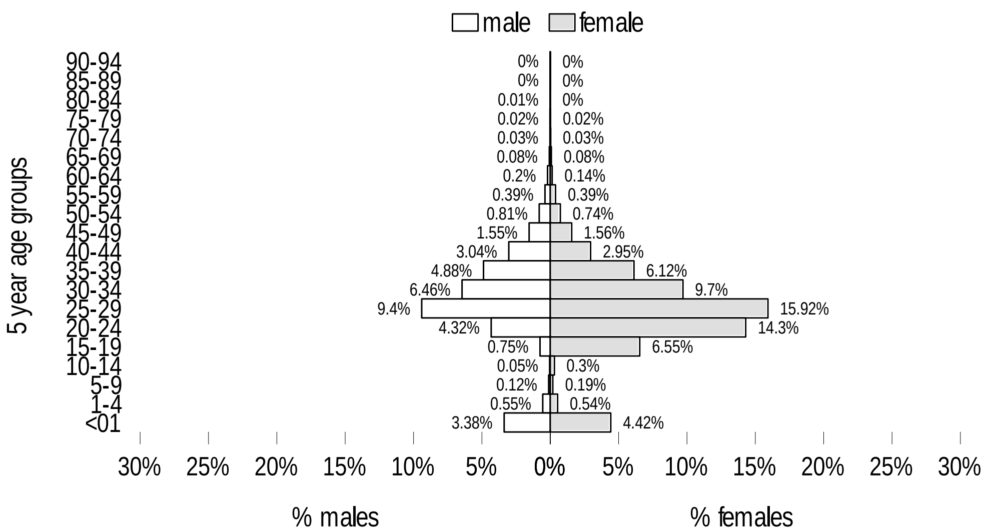
- To determine the speed of the HIV spread by means of the prevalence rates;
- To recognise proximal vectors that impinge on the spread; and
- To determine the effect that the pandemic has had on the demographic profile of the Nelson Mandela Metropole and rural surround.

The shape of the sample population

Perhaps the most striking characteristic of the sample population is that it is not normally distributed in terms of the age and gender variables (see Appendix 7). A normal distribution has a "frequency distribution of intervally scaled data that is bell-shaped, symmetrical and unimodal and has its highest frequency in the middle; it can be specified by a particular mathematical equation for which the mean and the standard deviation are parameters" (Saslow, 1982:409). The sample population is bimodal. The age and gender distributions are skewed, that is, the distributions are asymmetrical (see Fig. 4.1). For both the male and female populations, the age distribution is skewed to the right which indicates that the mean value of the age variable is higher than if the populations were normally distributed. There is a substantial bulge in both the male population and the female population in the age group 25-29 years. The less than one year age group also showed high HIV infection numbers for both males and females.

It is interesting to note that there are an approximate equal number of males and females in the 40-44 year age groups and that there are more males than females who are infected in the subsequent older age groups (see Appendix 7).

Figure 4.1: Population pyramid showing age and gender profile of HIV carriers in Region A (January 1991 to April 2000)



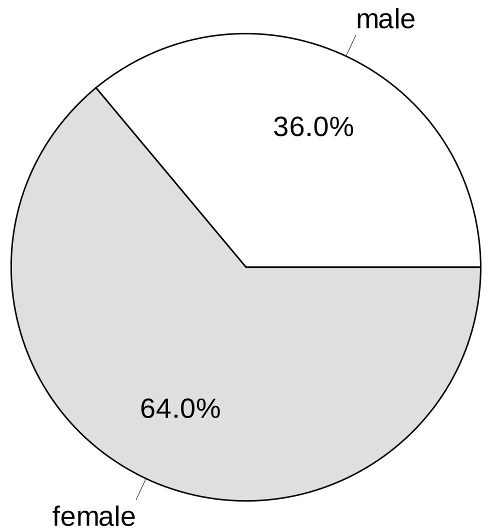
Source: Nelson Mandela Metropole ATICC, 2000 (N=27505)

The most skewed gender ratio is the 15-19 year age group: 210 (0.75%) males to 1790 (6.55%) females. Females between the 15-19 year age group to the 30-34 year age group represent 52.3% of the sample population. In contrast, the males between these age groups represent 20.8% of the sample population. The HIV infection in these age groups is 73.1% of the sample population.

Collectively, twice as many females are infected than males. In the 20-24 year age group, there are three times as many infected females than males. In the 15-19 year age group the female infection is eight times higher than the male infection.

The total HIV-infection rate for the NMM is 2.74% (using Census 2001 as the base population), which is far less than the 31.2% prevalence rate of the ANC data for the NMM 2002 (see Appendix 3) and the 15.15% prevalence rate of Region A for 1998 (see Fig. 2.6).

Figure 4.2: Sex composition of HIV carriers in Region A

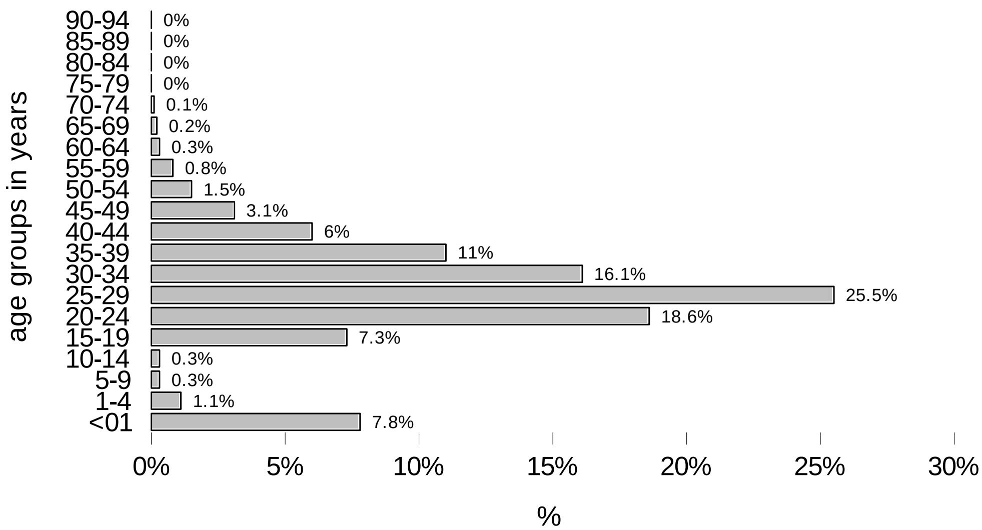


Source: Nelson Mandela Metropole ATICC, 2000 (N=27346)

There were 9855 males to 17491 females in the sample population (see Appendix 8). There were only 159 missing cases. The missing cases represent the omitted information for the gender variable from the data population. The overall gender composition was 36% males to 64% females, resulting in a sex ratio of 56.34% (see Fig. 4.2). By comparison, the sex ratios of the total population of the NMM are 91.79% (Census 1996) and 91.24% (Census 2001).

The NMM sex ratio of HIV carriers follows the same trend as that of the ANC surveillance protocol and the other surveys and models quoted in this research. But, the NMM sex ratio, as well as that of the total HIV-infected population of South Africa, is in direct contrast to the Cuban sex ratio, which shows that more males are infected than females (UNAIDS, 2000:3). This may be indicative that the respective surveillance protocols capture both the male or female HIV infection poorly.

Figure 4.3: Age composition of HIV-infected people in Region A

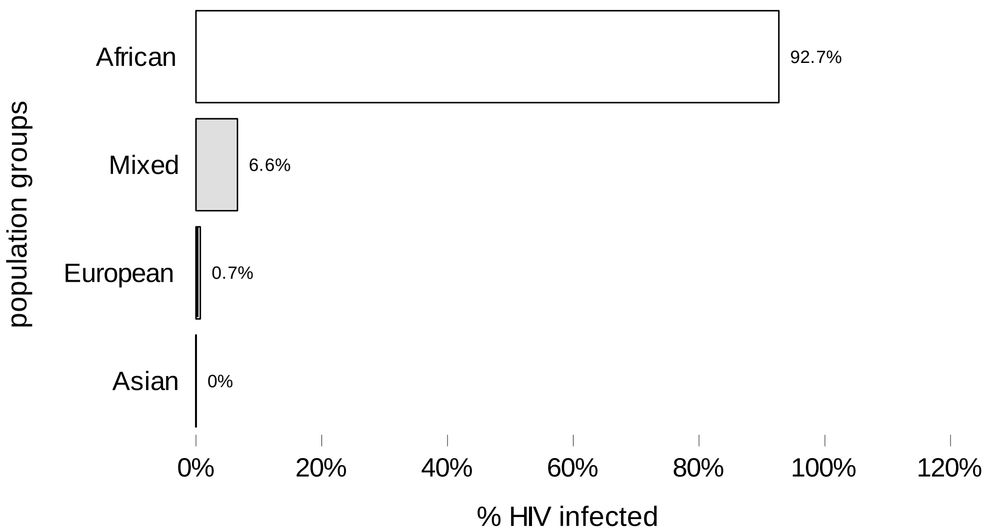


Source: Nelson Mandela Metropole ATICC, 2000 (N=27482)

The age variable ranged from 0 years to 91 years with a mean of 27.23 years and a median of 28 years (see Fig. 4.1 and Appendix 23). There were 23 missing cases. The age distribution is skewed to the right and the distribution is bimodal. HIV infection is not equally represented across the age groups. Collectively, the largest percentage of HIV-infected people in Region A is in the 25-29 year age group (see Fig. 4.3). The bulk of the infection is in the 20-24 year age group to the 35-39 year age group (71.2%). These are also sexually the most active groups. The less than one year age group (the babies) constitutes 7.8% of the sample. The combined HIV infected group aged 20-24 to the 35-39 year and those younger than one year comprised approximately 80% of the sample population. In the 1-4, 5-9 and 10-14 year age groups, the HIV infection was the lowest in the sample population (1.7%) although the NMHSRC's survey asserted that HIV seriously affects children in the 2-14 year age group (5.6%) (Shisana & Simbayi, 2002:47, 63).

HIV infection rates in the 1-4 and 4-9 year age groups may be attributed to either rape or blood trauma since subjects in these age groups are not generally sexually active. In the 10-14 year age group subjects were either sexually active or were raped.

Figure 4.4: Population group composition of HIV-infected people in Region A



Source: Nelson Mandela Metropole ATICC, 2000 (N= 27475)

The data sample set comprised all the population groups, that is, African, European, Mixed and Asian. There were 25465 Africans, 199 Europeans, 1801 Mixed, and 10 Asians who were infected (see Fig. 4.4 and Appendix 10). There were only 30 missing cases. The HIV infection percentage among the population groups varied greatly. The African population was the most representative of the HIV sample population (92.7%). HIV infection percentage was the least among the Asian group (a total of 10 cases).

The sample HIV infection percentage in the NMM for the various population groups differ significantly from the NMHSRC 2002 survey (see Table 4.1). Table 4.1 shows the observed national prevalence rate among the various population groups by the NMHSRC survey. The researcher aggregated the number of infected people in each population group to obtain the infection rate for each group in the NMHSRC sample sub-set (see Appendix 11).

Table 4.1: National HIV prevalence by population group, 2002

Population group	HIV Positive (%)	95% CI	% of sample
African	12.9	11.2–14.5	79.5
Mixed	6.2	4.5–7.8	13.3
Asian	1.6	0–3.4%	1.7
European	6.2	3.1–9.2	5.4

Source: Shisana & Simbayi 2002, page 46

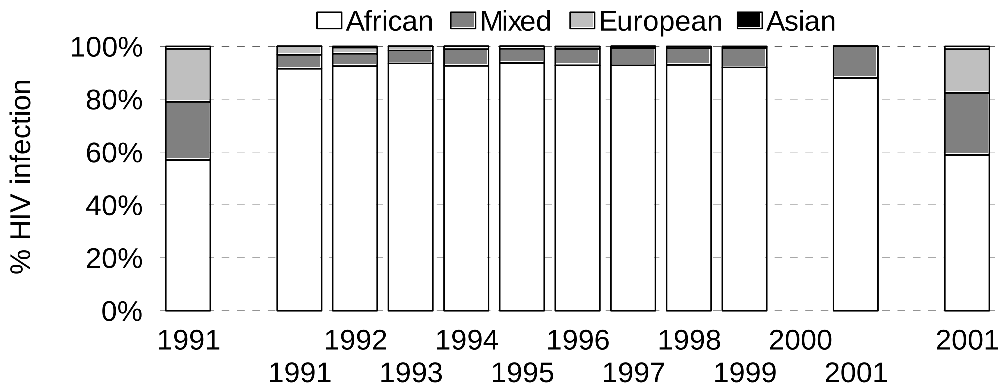
When the NMM HIV sample was compared with the racial composition of the total population of the NMM, they reflected the racial composition of the NMM. However, the HIV infection percentages within the racial groups were disproportionate to the racial composition of the total population of the NMM (see Table 4.2). For example, the African population comprises 55.49% of the total population of the NMM (Census 1996), but displays a HIV infection percentage of 92.7% (see also Appendix 27).

Table 4.2: Comparison of NMM HIV-infected sample to the total population of the NMM by racial composition

Population group	Census 1996	Census 2001	% of NMM sample
African	538133 (55.49%)	592355 (59.00%)	92.7%
Mixed	235992 (24.34%)	236160 (23.48%)	6.6%
Asian	11100 (1.15%)	11237 (1.12%)	0.0%
European	173548 (17.92%)	166026 (16.50%)	0.7%

Source: Nelson Mandela Metropole ATICC, 2000; Census 1996; Census 2001

Figure 4.5: Population group composition of the HIV-infected population (1991-2001) of the NMM compared to the population groups of the total population of the NMM (1991 and 2001)



	1991	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2001
Asian	9618	0	0.5	0	0	0	0.1	0	0.1	0.1		0	11237
European	193971	3.2	2.3	1.6	1.1	0.9	0.9	0.6	0.6	0.5		0	166026
Mixed	213368	5.3	4.7	4.9	6.3	5.4	6.2	6.6	6.4	7.4		12	236160
African	552817	91.6	92.6	93.5	92.6	93.7	92.8	92.8	93.5	92.1		88	592355

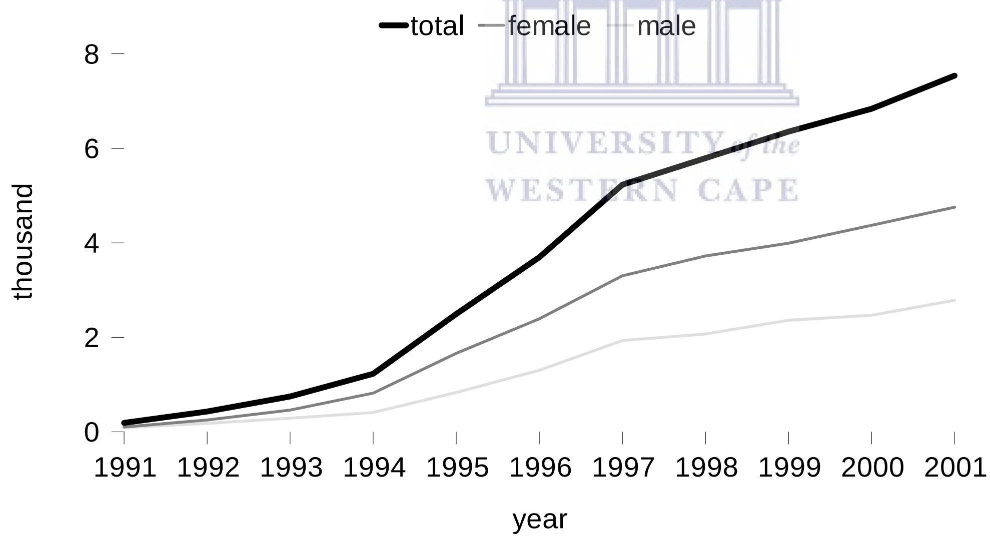
year

Source: Census 1991; Census 2001; NMM ATICC, 2000; NMM ATICC, 2002
(N=26303)

Figure 4.5 shows the racial composition of the HIV-infected people in each year against the population group composition of the total base population of the Nelson Mandela Metropole in 1991 and 2001 (see Appendix 12). Only partial data was available to analyse the HIV infection rate for the year 2000 and aggregated data was available for the year 2001 (see Appendix 5). Of the HIV positive population, for each year, except in 2001, over 90% were African. In comparison to the NMHSRC survey, the rate was just below 80% for the African population nationally (see Table 4.1). The HIV infection among the European group has decreased progressively since 1991 as the HIV infection pattern changed initially from being predominantly homosexual in character to heterosexual, in South Africa. In 1999, the HIV infection percentage among the European population group was 0.5% of the sample. In 2001, twelve (12) case-level data were collected for the European population (see Appendix 5). The NMHSRC study reflected a 6.2% HIV prevalence rate for the same group, nationally.

Census 1991 reflected an African population of 552817 people in Port Elizabeth. Against this figure, the 2001 Census (Stats SA, 2004) showed 592355 people, which means that the NMM African population increased by 7.15% over the decade (from 1991 to 2001). And, each year the NMM African population grew by less than 1% per year on average since 1991. In contrast, the White or European population experienced a negative growth rate between 1991 and 2001—probably the result of low fertility rate (below replacement level) and high out-migration. Both the Mixed and the Asian populations show growth rates of 10.68% and 16.83%, respectively over the ten-year period, growth rates that are higher than the African population. Since the African population are in an earlier phase of the demographic transition than the Mixed or Asian populations, the 7.15% growth rate over the 1991-2001 period suggests that either large out-migration had occurred, or the HIV/AIDS pandemic had altered the transition phase, or perhaps a drop in the net fertility rate for the African population had occurred as more females in the reproductive ages succumb to HIV/AIDS.

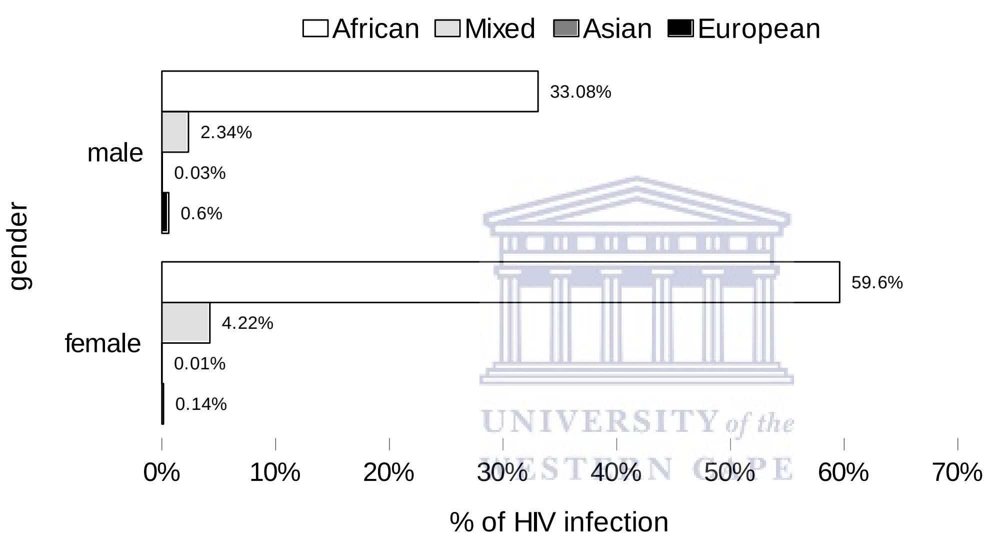
Figure 4.6: Number of male and female HIV infections per year in Region A



Source: Nelson Mandela Metropole ATICC, 2002 (N=41180)

The above graph is based on case-level data **(**up to April 2000**)** and aggregated data (up to December 2001) (see Appendix 5). Figure 4.6 shows that there was no difference in the infection rate for the gender variable at the beginning of the data collection in 1991. However, heterosexual transmission is strongly evident from 1992, but the female infection rate increased more rapidly than the male infection rate. The dip corresponds to the national DoH statement that HIV infection rate had decreased in this period. However, voluntary testing at ANC clinics in 1998 may have affected the number of women agreeing to be tested and since projections for male infections are made from the ANC studies, the male HIV rate would also have decreased proportionally to that of the female rate. From 1998 onwards, the number of male and female HIV carriers was progressively increasing.

Figure 4.7: Percentage of males and females infected across the population groups

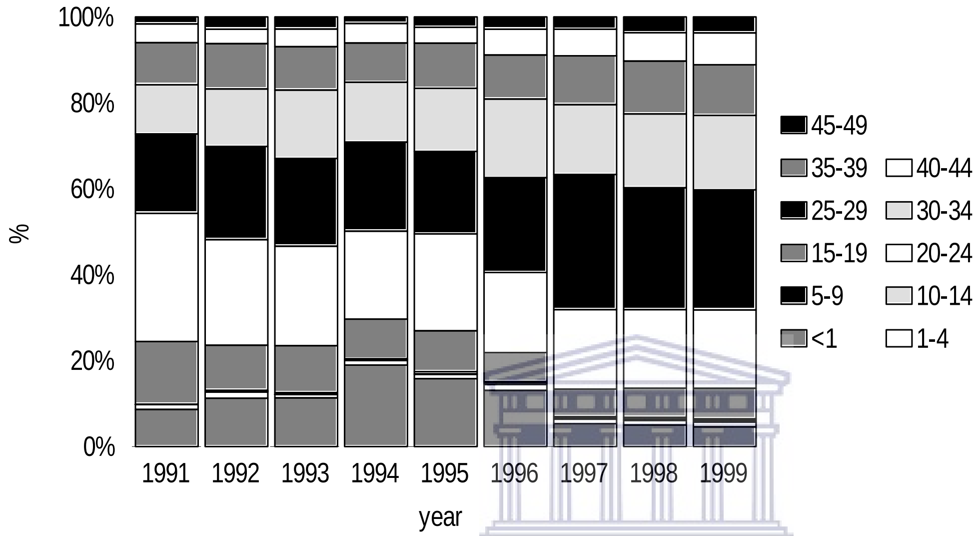


Source: Nelson Mandela Metropole ATICC, 2000 (N=27337)

There are more females infected than males in the African and Mixed population groups (see Fig. 4.7). The opposite holds true for the European and Asian populations where more males than females are infected (see Appendix 13). This pattern is peculiar. Perhaps this pattern, especially among the Europeans, reflects the mode of transmission that is primarily homosexual. The European, the African middle-class and the Asian population groups make more use of private health facilities and are consequently captured poorly in the database. The DoH has argued that 80% of the African population makes use of public health facilities and the majority are female (2000:4-5).

When the association between gender and population groups was tested statistically by cross-tabulation, the chi-square generated the probability, p=0.000 (significant if p<=0.05) which means that the association was not due to chance, *i.e.* it was significant (see Appendix 13).

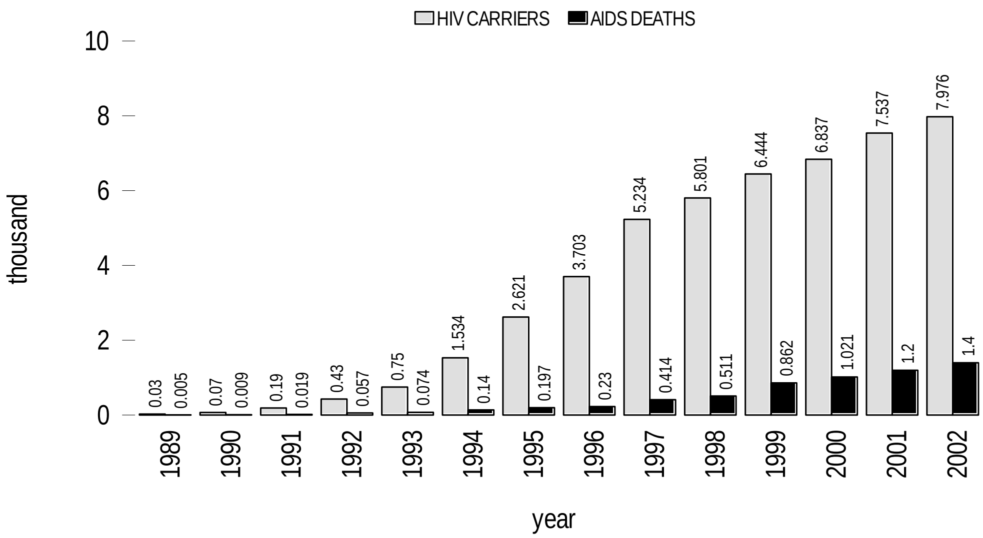
Figure 4.8: Percentage of HIV infections by age group in each year



Source: Nelson Mandela Metropole ATICC, 2000 (N=26281)

There were 26281 HIV positive cases from 1991 to 1999 in the 0 to 49 year age groups. There were 1224 missing cases. The 1224 missing cases include the HIV cases from January 2000 to April 2000. A total of 807 cases or 3% were in the age groups above the age of 49 years. Therefore, 97% of the HIV infections were in the under 49 year age group. This is consistent with the hypothesis that HIV is primarily a sexually transmitted disease. The age distribution of the infected population in 1997, 1998 and 1999 was approximately equal (see Fig. 4.8). There were more HIV positive people in the 45-49 year age group in 1999 than 1991 or 1995. Since 1991, it was evident that the HIV infections were concentrated mainly in the 20-24 to 30-34 year age groups. Encouraging is the decline in the proportion of HIV infected young people aged 15-19, which probably reflects increased condom usage, but hopefully reflects behavioural changes.

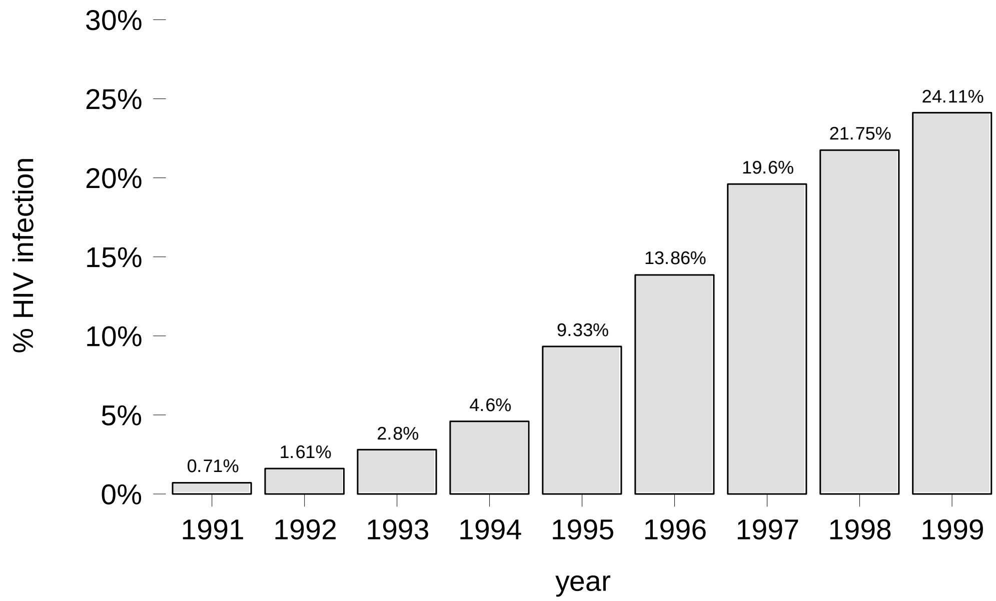
Figure 4.9: Number of HIV carriers and AIDS deaths per year in Region A



Source: Nelson Mandela Metropole ATICC, 2002 (N=50057)

The graph (Fig. 4.9) is based on aggregated data from the NMM ATICC (from 1989 to September 2002) (see Appendix 14). Figure 4.9 indicates that Region A hosts approximately 45000 HIV positive people as at September 2002. The graph shows a progressive increase in both new HIV cases and AIDS deaths from 1989 to 2002. The AIDS deaths follow a similar incremental pattern as the case-level HIV infection from 1991 through to 2002. There was one AIDS death for every eight HIV infections. However, there were more AIDS deaths in 2002 than the 1400 reflected in the graph as ATICC captured only partial data for the year 2002 (up to September 2002).

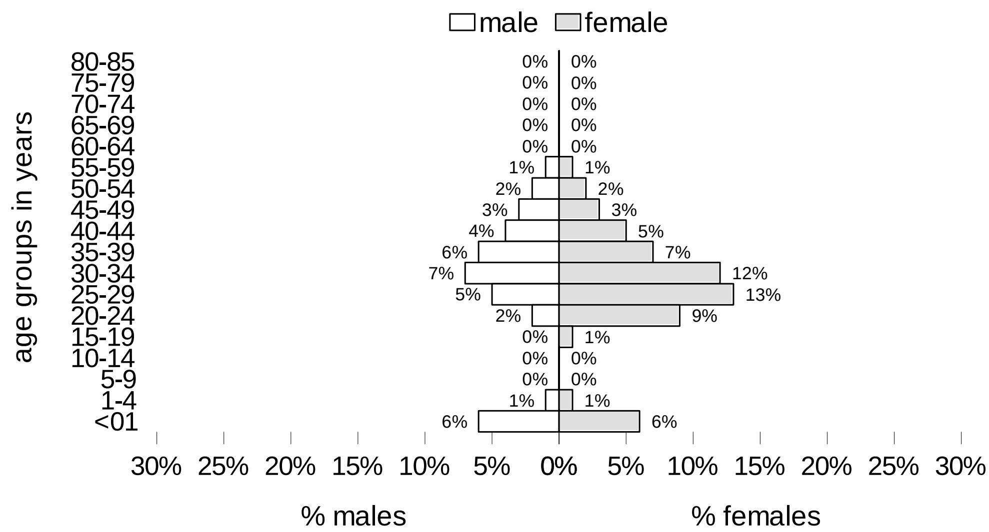
Figure 4.10: Bar graph showing progressive increase of HIV pandemic (1991 to 1999)



Source: NMM ATICC, 2000 (N=26706)

The above bar graph shows the annual increase of HIV infections from 1991 to 1999. There were no missing cases. The graph is skewed to the left. Of all the HIV infections recorded in the data set during the 1991-1999 period, less than 1% were registered in 1991, compared to 24.1% in 1999, indicating an accelerated growth of the pandemic in the NMM. Figure 4.10 reflects that the HIV/AIDS pandemic had not in reality matured as new and increasing incidences were recorded for each subsequent year in the NMM (also see Fig. 4.9). The prevalence decline in the less than 24 year age group between 1997 and 1999 may give an indication that the HIV pandemic is slowing down (see Fig. 4.8), but factors such as mortality rates, migration and fertility decline also contribute to prevalence trends. Therefore, incidence trends cannot be approximated directly from prevalence trends.

Figure 4.11: Age profile (or pyramid) of AIDS deaths (1991-2000)



Source: Nelson Mandela Metropole ATICC, 2000 (n=2208)

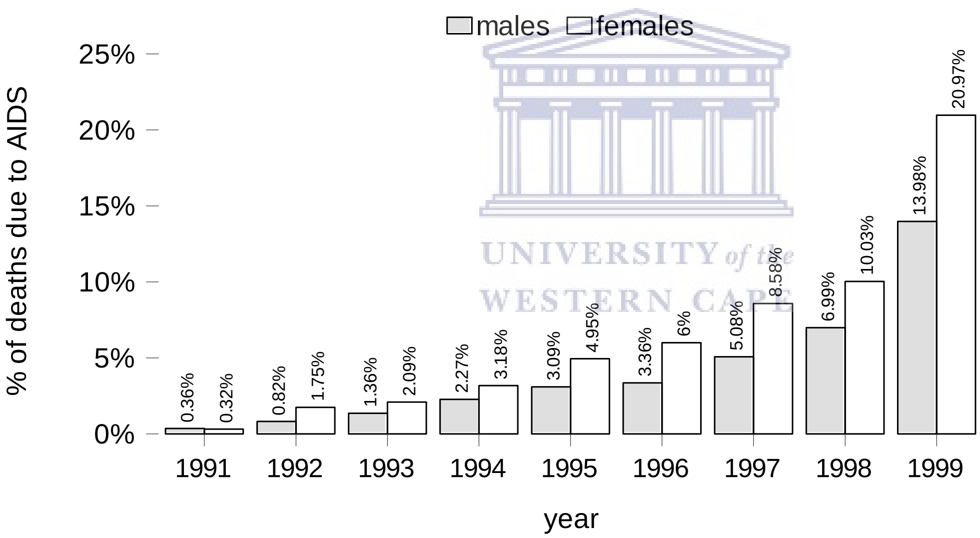
Only 2208 AIDS-related deaths are recorded in the data set (1991-2000). Moreover, the death pyramid (Fig. 4.11) is an artefact of the data population (see also Appendix 16). The male and female neonate mortality (less than one year age group) was approximately equal and reflected the corresponding HIV infection in this age group (see Fig. 4.1 and Fig. 4.11). The 5-9 and 10-14 year age groups show low mortality counts in comparison to the other age groups since most of the infected in the less than one year age group had already died. The highest mortality count for females is in the 25-29 year age group and for the males in the 30-34 year age group. The lowest mortality rate for both gender groups is in the 10-14 year age group.

This is a very "young" age profile, in the sense that, for example, 18% of all AIDS deaths fall in the 25-29 age group, which means that they were only 15-19 years old or even younger when they became infected.

More than 50% of deaths occur in three age groups: the 25-29, 30-34 and the 35-39 year age groups. The less than one year age group shows a high mortality rate (12.2%). The rate shows that life expectancy for HIV infants is rarely above one year. The 5-9 year age group had the least deaths and also the least HIV infection rates. The lowest mortality rate was in the 10-14 year age group (0.2%). It is likely that the HIV infected children in the 10-14 year age group are either sexually active or they were sexually abused by other infected individuals.

The deaths of many HIV infected people are not recorded as death by AIDS, but as opportunistic diseases such as pneumonia, cancers and TB. As a result, AIDS mortality is much higher than that recorded on death certificates. Also, the stigma attached to AIDS would make family members hide the true cause of death. However, every person in the data set was tested positive for HIV. This may suggest that the mortality data at the Department of Home Affairs are incorrectly coded.

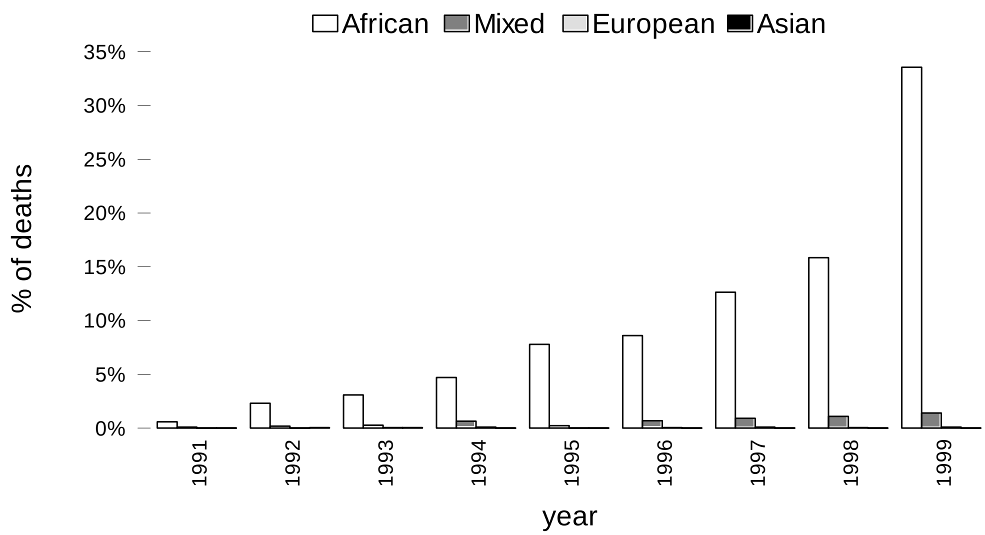
Figure 4.12: Percentage of recorded deaths by gender for each year



Source: Nelson Mandela Metropole, ATICC (n=2208)

Initially, slightly more males than females were dying of AIDS (in 1991, 0.36% males to 0.32% females) (see Fig. 4.12 and Appendix 16). From 1992, more females than males started dying as the mode of transmission changed and, as urbanisation started escalating before 1994, extending major cultural and societal changes. It is assumed that fertility levels will drop so that the age structure pyramid of the South African population will resemble a small 0-19 year population and a large 20-49 year population (ASSA600 component projection to 2010).

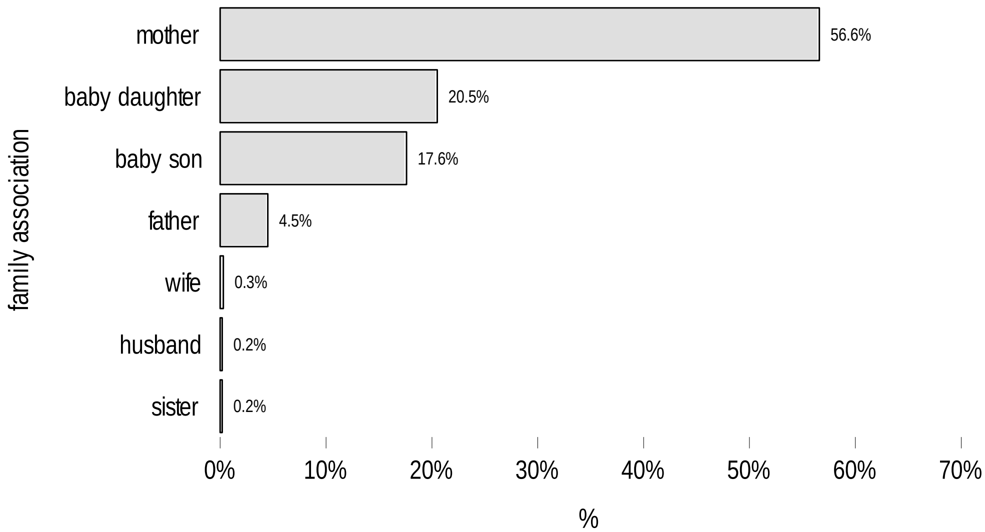
Figure 4.13: AIDS mortality by population group per year



Source: Nelson Mandela Metropole ATICC, 2000 (n=2208)

Since 1991 the mortality figures from AIDS have been increasing in the African and the Mixed population groups. In the European and Asian population groups, the AIDS mortality has remained stable with marginal changes (see Fig. 4.13 and Appendix 18). The mortality data gives a further indication that the HIV infection is concentrated mostly in the African population group.

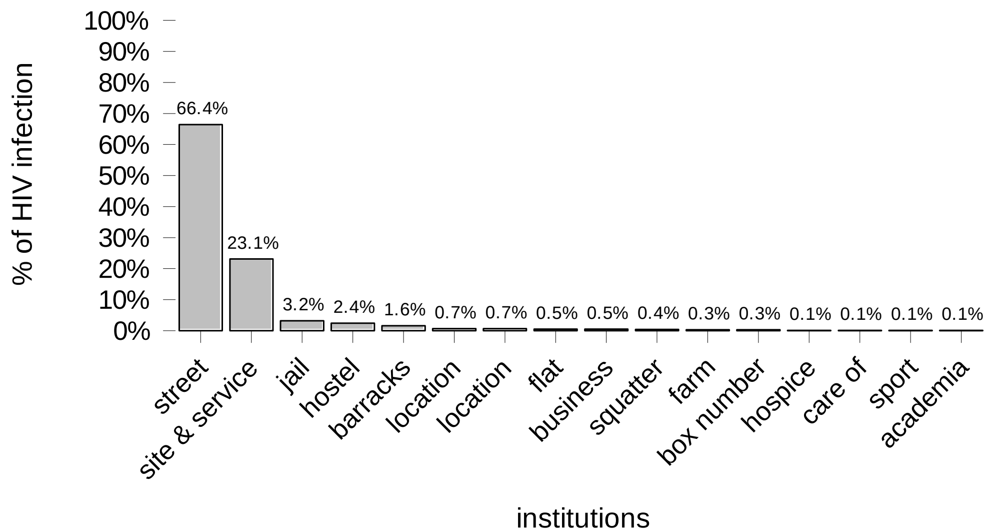
Figure 4.14: Recorded family association between HIV carriers



Source: Nelson Mandela Metropole ATICC, 2000 (n=1017)

There were 1017 recorded HIV carriers who were related to one another (see Appendix 19). There were 26488 missing cases. The data set obviously did not capture all the family associations and this would possibly contribute towards the highly skewed ratio. It is evident that in many instances more than one person per household was HIV positive. The vertical transmission is pictured strongly in Figure. 4.14 by the high percentage of babies that are infected. The statistics shows a large percentage of mothers infected in comparison to the fathers infected. The mothers are tested for HI viral load whereas the fathers are exempted from a test because reproduction is the burden of the females. Often, in a transient relationship, the father would abandon the family if both the mother and baby are HIV positive. However, again the differences in infection rates highlight that females are tested more often than males. The 56.6% of infected mothers against the 4.5% of fathers is indicative of a skewed pattern, which would reflect male denial and the reluctance to be tested. A person can deduce from this that perhaps whole households must be infected, a phenomenon that needs to be explored further.

Figure 4.15: Percentage of HIV carriers living or working at different institutions

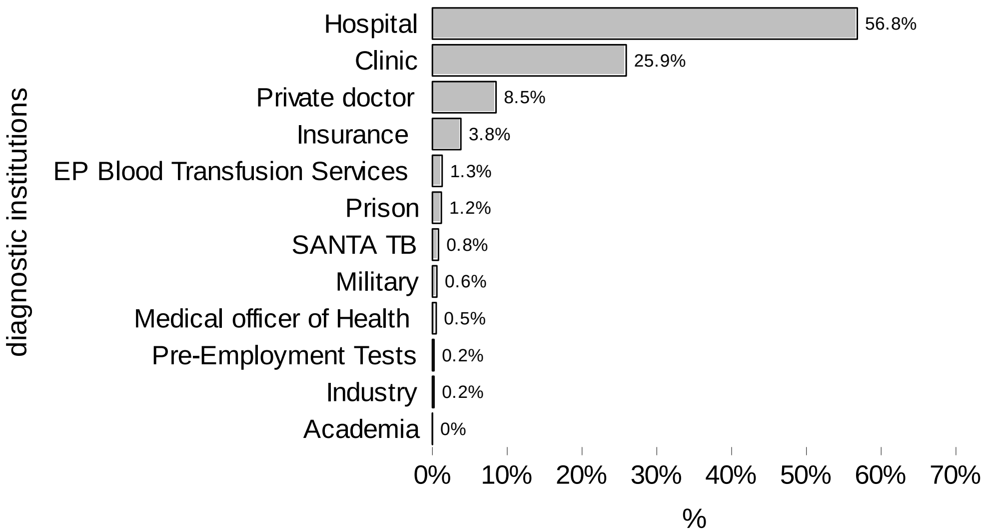


Source: Nelson Mandela Metropole ATICC, 2000 (n=11551)

Although not all the data were captured for HIV carriers who live or work at the different institutions (there were 15879 missing cases), the majority of HIV carriers had street addresses (where they live and work). These were anonymised as all reference to the street names were deleted from the data set. There were 3% and 2% HIV carriers in prisons and army barracks, respectively. The researcher does not know what percentage these HIV carriers constitute of the total population in the respective institutions. The majority of HIV carriers that had a street address (67%) (see Appendix 20) would reflect private home ownership or mortgage bondholders or rentals, but the majority would be in the lower-middle to middle class income groups. The data supports circumspectly the theory that not only poor people are infected with HIV. Hence, HIV cannot be said to be exclusively the disease of the poor.

The research proceeded to analyse the attendance by HIV subjects all the way through the diagnostic institutions to see whether differences existed linking attendance at private and public institutions.

Figure 4.16: Percentage of HIV carriers diagnosed in the different institutions



Source: Nelson Mandela Metropole ATICC, 2000 (N=27455)

Figure 4.16 indicates that the majority of the HIV diagnoses were made in the public hospitals (56.8%) and that 25.9% of HIV carriers were diagnosed in the public clinics (see Appendix 21). There were 50 missing cases. These figures show that more than 80% of the data population made use of public health facilities. Moreover, females utilised the public health service more than males (see Table 4.3). This attendance pattern does not make the data population representative of the gender variable in the research. A more gender-representative ratio was observed in the data that was collected by the blood transfusion services, mortgage and insurance applicants and the private doctors. Consequently, the private health institutions reflected a different picture of HIV prevalence of the gender variable.

Table 4.3: Number of HIV patients at public diagnostic institutions (n=22947)

Diagnostic Institution	Male	Female	Total
Hospital	4940 (21.53%)	10559 (46.01%)	15499
Clinic	2397 (10.45%)	4698 (20.47%)	7095
MOH	40 (0.17%)	88 (0.38%)	128
SANTA TB	97 (0.42%)	128 (0.56%)	225
Total	7474 (32.57%)	15473 (67.43%)	22947

Source: NMM ATICC, 2000

Table 4.3 gives the breakdown of HIV infected patients at public health institutions. The total figure represents 83.43% of the data set population. There are more than twice the number of HIV positive females than males who made use of public hospitals and clinics. Females attend health institutions more often than males because of their roles as mothers and care-givers in the family. Female data is captured frequently as they have to undergo pre- and post-natal tests, physiological check-ups, and give birth. Males mainly attend public health institutions only when they experience physical trauma (Ramdas & Zunga, 2004:6).

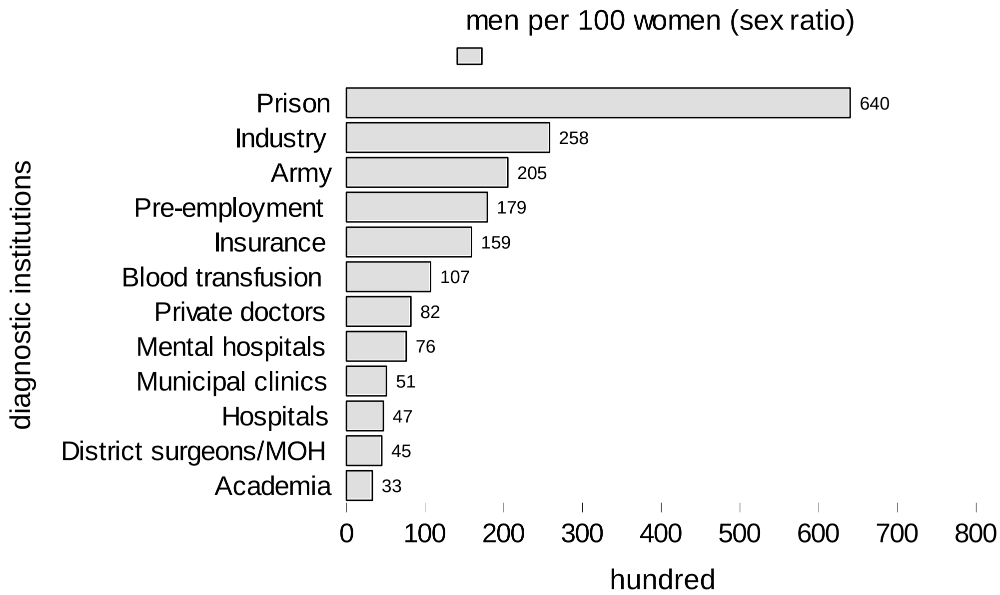
Table 4.4: Number of HIV patients at private diagnostic institutions (n=3800)

Diagnostic Institution	Male	Female	Total
Pre-Employment	43 (1.13%)	24 (0.63%)	67
Blood Bank	187 (4.92%)	174 (4.58%)	361
Insurance	646 (17.00%)	405 (10.66%)	1051
Private Doctors	1046 (27.53%)	1275 (33.55%)	2321
Total	1922 (50.58%)	1878 (49.42%)	3800

Source: NMM ATICC, 2000

Table 4.4 reflects 13.82% (n=3800) of the data population of people attending private diagnostic institutions. Except for attendance at the private doctors, there are more males than females recorded in the private diagnostic institutions. The cross-tabulation between gender and the diagnostic institutions furnished the chi-square probability, p=0.000 which means that the association is not due to chance, *i.e.* it was significant (see Appendix 21).

Figure 4.17: Sex ratio of HIV attendees at diagnostic institutions in Region A

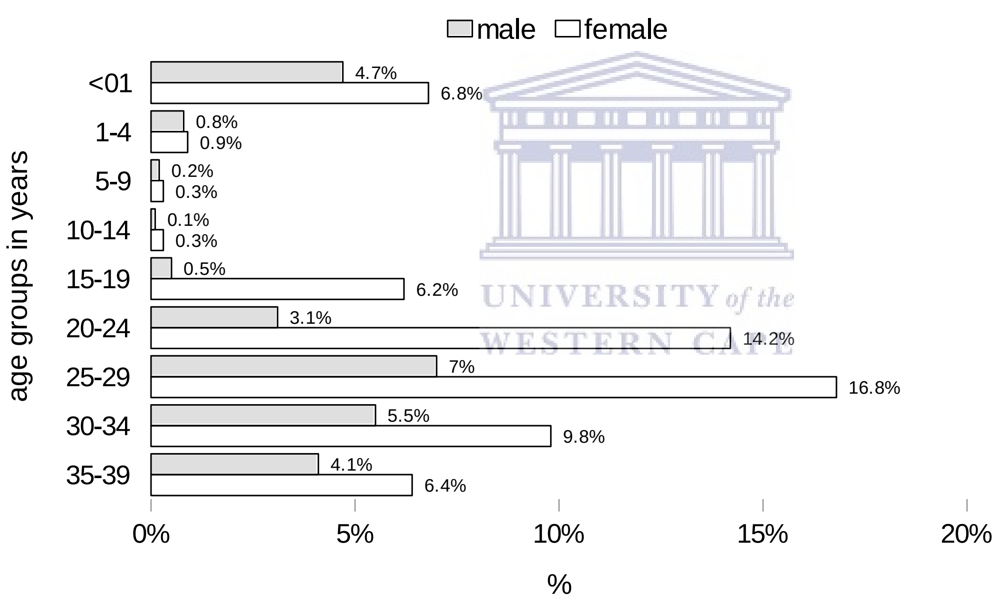


Source: Nelson Mandela Metropole ATICC, 2000 (N=27312)

When the sex ratios were compared by means of the diagnostic institutions, it was found that the ratio was higher than 105 in five diagnostic institutions (see Fig. 4.17). The private diagnostic institutions were able to capture the male infection rates more equitably than institutions such as the public clinics and hospitals. According to data from the Blood Transfusion Services of South Africa, on average, 73 males test HIV positive in South Africa, to every 100 women (Schönteich, 2000:65). The blood transfusion services in Region A captured a near normal sex ratio (see Fig. 4.17). Males also reflected highly in the life insurance diagnostic institution, which may indicate that HIV is not confined to the poor. However, they represent only 3.8% of the total HIV-infected group. The hospital system, clinics and the Medical Officer of Health (MOH) captured data with the lowest sex ratios. From this analysis, it may be deduced that the male infection rates may be higher than previously thought, although there may be regional variations. The analysis shows that the sex ratio is largely dependent on the collecting institution.

Prison and army populations are predominantly male. Male prisoners are infected six times as much as female prisoners. This phenomenon can be attributed to the presence of a strong male gang culture in the South African prison system (Kadalie, 1997:58). In military, male soldiers are infected twice as much as female soldiers. Initially, male soldiers were blamed for the spread of HIV when the former Mkonto Isizwe freedom fighters were incorporated into the South African Defence Force before 1994, without HIV screening. Moreover, the sex ratio in the military reflects that life is not stable for both male and female soldiers who often live a solitary existence, which make them vulnerable to risky behaviour. They are not only solo, but also salaried, often in poor areas.

Figure 4.18: HIV infection by gender and age (0-39 year age groups) in public hospitals

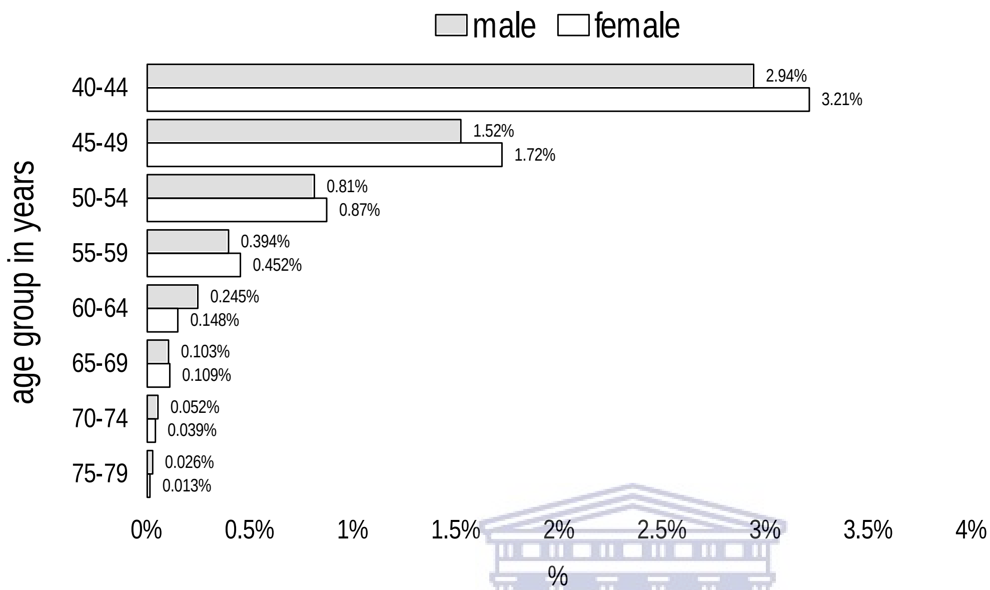


Source: Nelson Mandela Metropole ATICC, 2000 (n=15499)

When the distribution of HIV among the lower age groups (from younger than one year to 35-39) in the public institutions was analysed, it was observed that the percentage of female infection was in some instances double that of the male infection (see Fig. 4.18). In the 15-19 to the 20-24 year age groups, the observation was highly skewed. In all the age groups, the female infection was higher than the male infection. The following graph,

Figure 4.19 is a continuation of Figure 4.18 and shows the HIV infection rate in the upper age groups. The combined n-value for all the age groups was 15499.

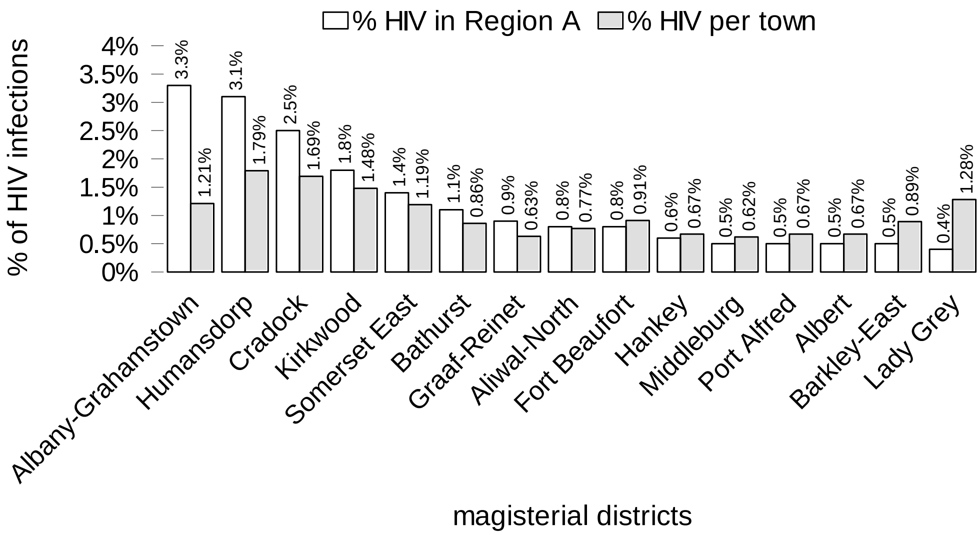
Figure 4.19: HIV infection by gender and age (40-79 year age groups) in public hospitals



Source: Nelson Mandela Metropole ATICC, 2000 (n=15499)

However, in the higher age groups (40-44 to 75-79) the observed gender differences are much less conspicuous (see Fig. 4.19). Perhaps this phenomenon informs that HIV infections are captured and reported more efficiently in the over- 40 year age groups than the under- 40 year age groups as senior citizens attend health institutions for ailments such as diabetes, hypertension and related health problems.

Figure 4.20: Comparison of HIV percentages in the rural towns of Region A

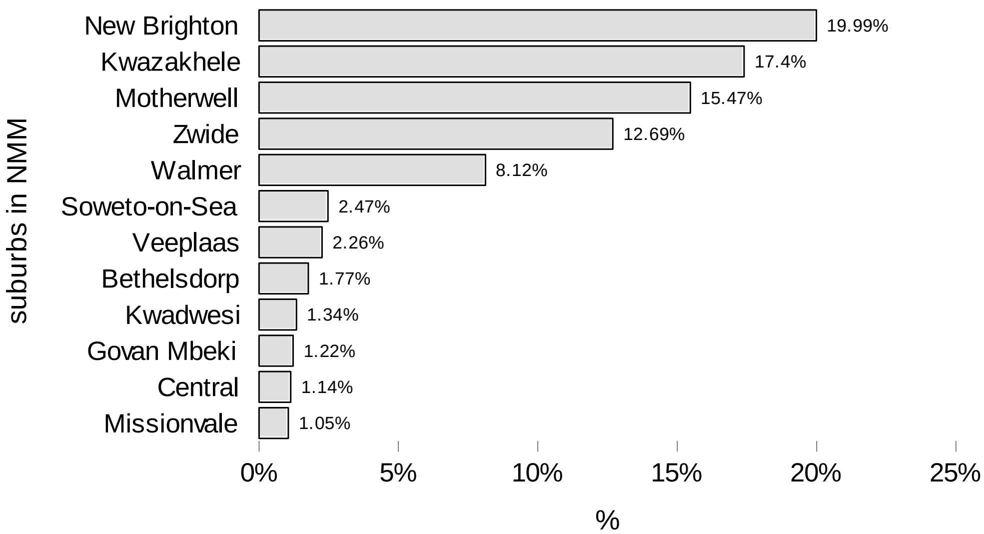


Source: Census 1996; Nelson Mandela Metropole ATICC, 2000 (n=4910)

The rural/urban divisional information was available for 26970 HIV cases in all the magisterial districts of Region A. There were 535 missing cases. Figure 4.20 covers the rural towns of Region A, which reflected HIV infection of more than a hundred cases per town. There were a total of 4910 cases for the fifteen towns, which is 18.21% of the total Region A infection percentage. The balance of the infections in the rest of the rural towns of Region A was 2.59% (see Appendix 6). Firstly, the HIV infection percentages were calculated for each rural town using the NMM ATICC data (see % of HIV in Region A in Fig. 4.20). Then, the number of HIV infected population for each town was divided by their respective populations (provided by Census 1996) to derive at a percentage for each town (see % of HIV per town in Fig. 4.20).

In approximately half of the towns, HIV infections were higher than the Region A statistics (based on ATICC data), which would indicate that HIV is slightly prevalent in some of the rural towns. Excellent transport and road systems through the rural towns of the EC reflect the HIV spread in some of the towns (see Figures 1.2 and 4.21). As the vector moves towards the south, the infections are highly concentrated at the receiving end, the Nelson Mandela Metropole (see Figure 4.21 and Appendix 6**)**.

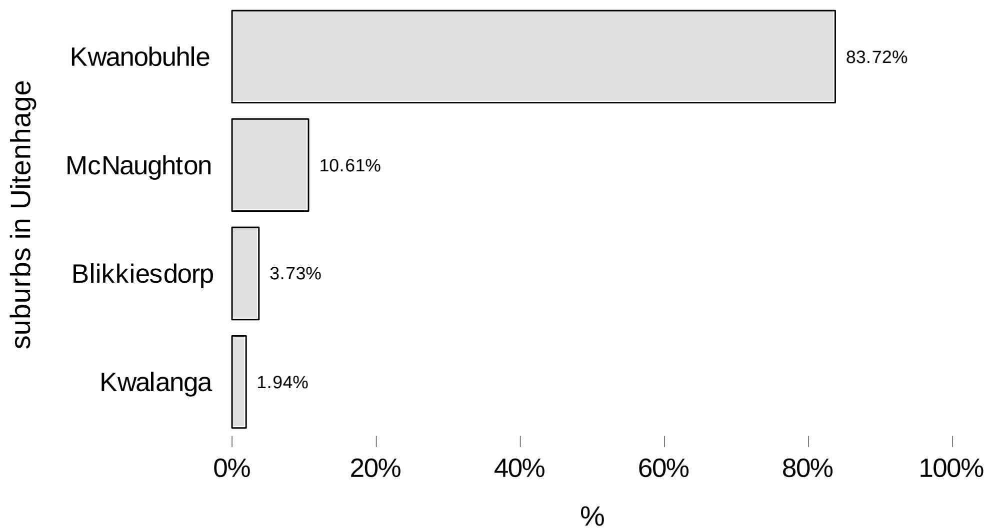
Figure 4.21: Distribution of HIV infection in the suburbs of Port Elizabeth



Source: Nelson Mandela ATICC, 2000 (n=8220)

Figure 4.21 shows the reported names of some suburbs in the city of Port Elizabeth. There were a total of 9681 HIV cases in the city that had suburb names. There were 9092 missing cases (see Appendix 6). Also, only suburbs which reflected a minimum of one hundred HIV cases were analysed (84.91%) (see Figure 4.21). New Brighton had the highest number of HIV carriers in its population (19.99%). New Brighton, Kwazakhele, Motherwell, Zwide, Soweto-on-Sea and Veeplaas are suburbs that are situated geographically to the North-East of the Uitenhage highway. Approximately 66% of the HIV-infected population of the Nelson Mandela magisterial districts were from these suburbs. The vast differences in the HIV infection rates that exist between the suburbs on either side of the Uitenhage highway confirm the suspicion that the HIV spread is approaching from the North-East into the city. In contrast, Bethelsdorp, Kwadwesi, Govan Mbeki and Missionvale, which lie to the North-West of the Uitenhage highway had a 5.38% of people living with HIV. Although 48.43% of the suburb data in Port Elizabeth were not recorded, the analysis nevertheless shows that there exist great variations in HIV infection rates at the suburb level.

Figure 4.22: Distribution of HIV infection in the suburbs of Uitenhage

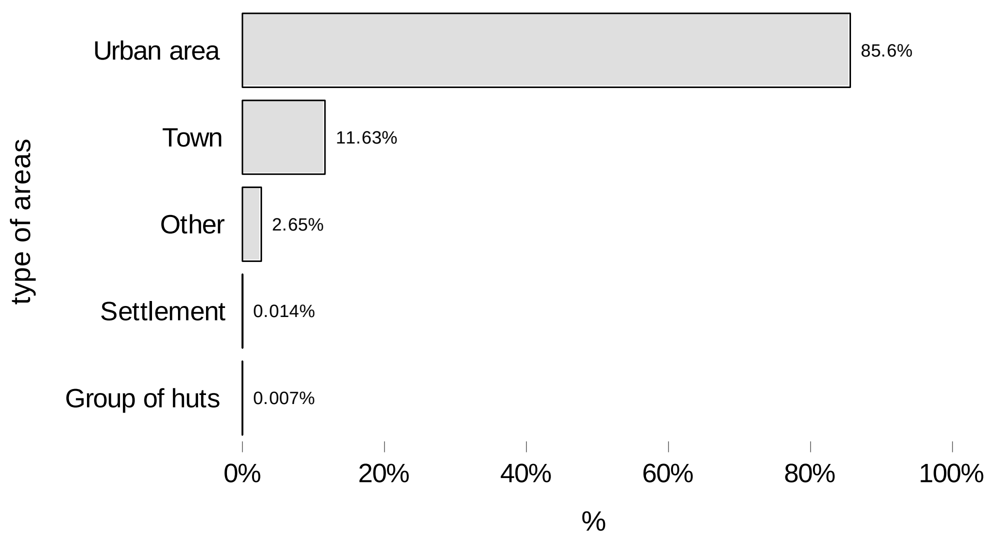


Source: Nelson Mandela Metropole ATICC, 2000 (n=1339)

Suburbs in Uitenhage are also affected by HIV. Only four suburbs reflected HIV infections in excess of fifty. Uitenhage is well-connected by road and rail systems with Port Elizabeth and Graaf-Reinet (see Fig. 2.5). More than 80% of the HIV infections in Uitenhage are in the Kwanobuhle suburb, which borders an industrial site surrounded by well-developed transport routes.

Although the suburbs in Despatch show few HIV infections, the surrounding informal settlements, Kwadwesi and Kwamagxaki (both in Port Elizabeth) show higher infection rates. Therefore, both Uitenhage and Despatch fit in the hypothesis that areas surrounding main transport routes are hotspots for HIV infections. As yet again, the transport vector repeatedly shows the influence it has on the spread of diseases (Shell, 2000b:13-14).

Figure 4.23: Distribution of HIV infection by area

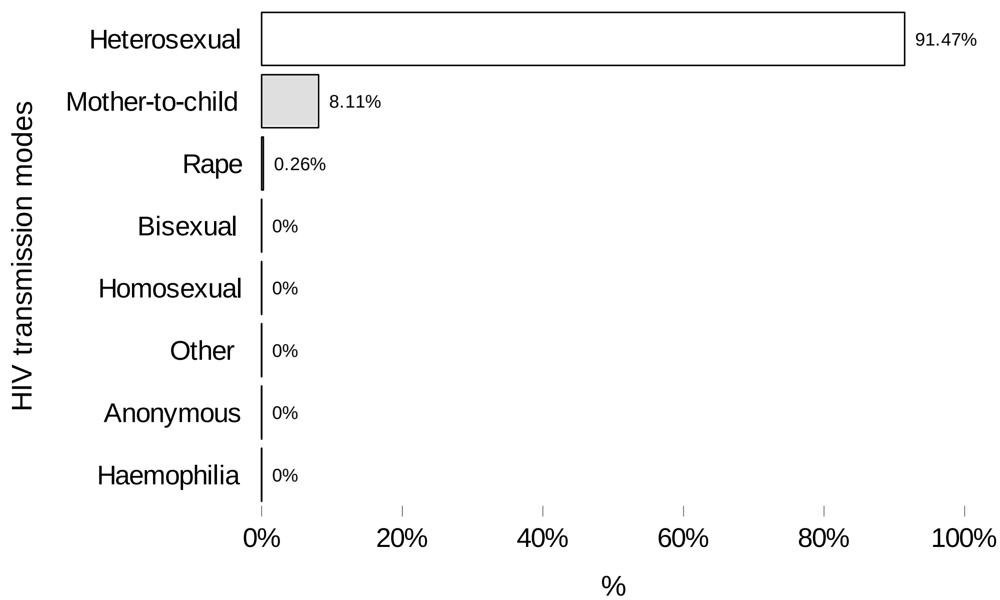


Source: Nelson Mandela Metropole ATICC, 2000 (n=14707)

An analysis of HIV spread across Region A shows an urban/rural divide. There were 14707 cases. There were 12798 missing cases (see Appendix 22). The majority of the 12798 missing cases are from the NMM. Since the type of area information is based on the census of 1996, new areas, especially in urban regions, are thus excluded from the data set as mass urbanisation continued well after 1994. The general assumption is that HIV is a rural phenomenon and that poor women from these areas are the most infected. Although truck drivers make regular stops in rural towns, to and from the Metropole, and other parts of southern Africa, the HIV infection rate is nevertheless low in comparison to the NMM (see also Fig. 4.20). However, the same cannot be said of truck drivers as more than half who were tested outside major urban areas, were HIV positive (UNAIDS/WHO, 2004:2).

It has not been possible to compare this data with the rest of the NMM as comparable data was not provided by the censuses.

Figure 4.24: HIV transmission modes in Region A

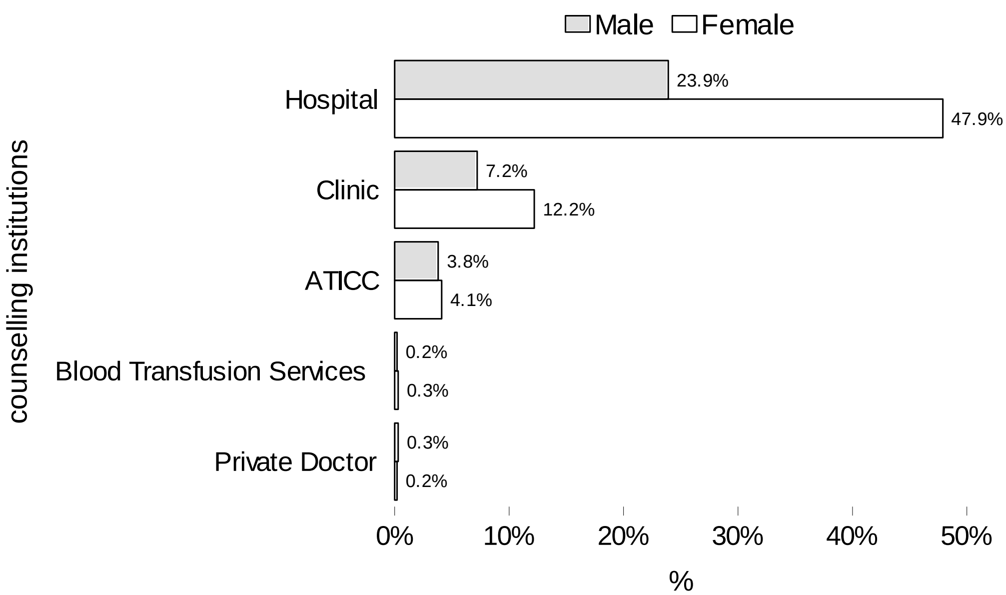


Source: Nelson Mandela Metropole ATICC, 2000 (N=20058)

When analysis was done to observe how HIV was transmitted in the NMM, it was found that the primary mode was heterosexual. There were 20058 cases and there were 7447 missing cases (see Appendix 25). From Figure 4.24, one can deduce that the NMM is experiencing a HIV-2 transmission pattern, as is the case in southern Africa as a whole (Garbus, 2002:24). Whereas haemophiliac and bisexual/homosexual transmissions were dominant in the 1980s, the pattern had reversed entirely (Bloor, 1995a:10; Karim, 1998:16). However, the reduction in HIV-1 prevalence in young adults may further indicate associated declines in HIV-1 incidence, which may not be true as migration and other factors impact on the data. This trend needs further investigation.

A significant observation was the rape transmission mode. Although the rape percentage is inconsequential when compared to the heterosexual mode, one should bear in mind that not all rape cases are officially reported and that rape is on the increase (Vogelman & Lewis, 1999:1). Also, men are raping young females for the virgin-cure (Kaya, 1999:16).

Figure 4.25: Percentage of males and females at counselling institutions



Source: Nelson Mandela Metropole ATICC, 2000 (n=2369)

There were 2369 HIV infected persons who attended counselling institutions. There were 25136 missing cases. Statistics generated through cross-tabulation between gender and the counselling institutions show that females made more use of the services than males (see Appendix 26). In the public hospitals and clinics, twice as many females than males sought counselling services, but at other institutions there were no significant differences as the number of patients was too low. What was notable is that the number of males and females were approximately equal at ATICC. The ATICC services perhaps offered professional confidentiality or patients were immediately offered counselling services. The data confirm that males are in denial and are reluctant to be tested.

The chi-square generated the probability, p= 0.000. There was a significant association between gender and counselling institutions (see Appendix 26).

Speed of HIV in Region A

Barnett and Whiteside (2002:51) have argued that the speed of the pandemic can be assessed by the basic “reproductive rate” R_0. When $R_0=1$, the epidemic is maintained—every person who dies, infects one other person. When $R_0>1$, each person infects more than one other person and the number of HIV incidences then rises. However, when $R_0<1$, the number of incidences decrease and the epidemic disappears.

Table 4.5: The reproductive rate, R_0 per annum in Region A

Year	HIV+ numbers	AIDS deaths	Balance of survivors	Reproductive rate (R_0)
1988				
1989	30	5	25	
1990	70	9	61	2.8
1991	190	19	171	3.114
1992	430	57	373	2.5146
1993	750	74	676	2.0107
1994	1534	140	1394	2.2692
1995	2621	197	2424	1.8802
1996	3703	230	3473	1.5276
1997	5234	414	4820	1.5071
1998	5800	511	5289	1.2033
1999	6444	862	5582	1.2184
2000	6837	1021	5816	1.2248
2001	7537	1200	6337	1.2959
2002	7976 (December 2002)	1400 (September 2002)	6576	1.2586
Total	49156	6139	43017	1.8326

Source: Nelson Mandela Metropole ATICC, 2002 (N=49156)

Table 4.5 shows that the R_0 has decreased from $R_0=3.114$ in 1991 to $R_0=1.2586$ in 2002, with an average rate of $R_0=1.8326$ (see also Appendix 14). However, at the start of the HIV epidemic in 1991, the R_0 is high because of the power of exponential growth, that is, a few HIV carriers who infect many. As the epidemic grows, the exponential power diminishes as infected people die of AIDS. This may imply that the pandemic is slowing down in the Nelson Mandela Metropole with fewer people being infected, not all infected people are tested or behavioural changes had occurred. However, the HIV pandemic has been increasing by 11% each year in the NMM (Van Donk, 2002a:1).

An important factor that can influence the R_0 is that the AIDS deaths reduce the number of people in the total HIV pool. In addition, the NMM ATICC had informed the researcher that data is received from the same diagnostic institutions each year, and that there are many others that do not forward their HIV medical records on to ATICC (personal communication with NMM ATICC, September 2004). This implies that HIV is underreported in the Metropole. On the other hand, the R_0 is not a reliable indicator of how fast the pandemic is spreading in the population because there are many people who are unaware that they are infected or they are in denial. Also, voluntary testing at ANC clinics since 1998 has meant that fewer women are inclined to be tested. These trends would impact on the R_0 value negatively.

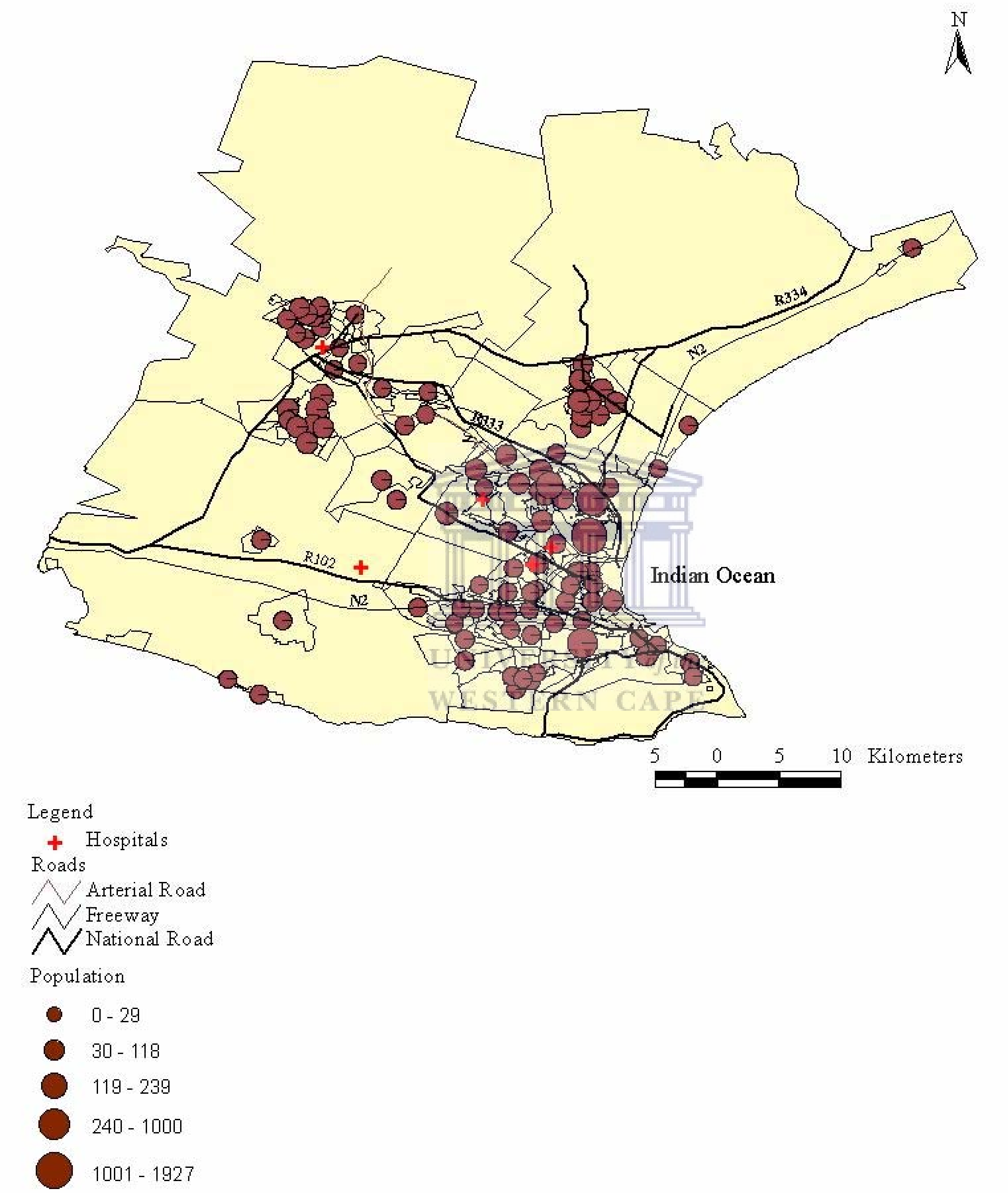
GIS analyses in the Nelson Mandela Metropole

Below is a base map of the NMM, indicating the main suburbs and roads. From Swartkops in the north down to New Brighton in the south, suburbs such as Kwazakhele, Zwide, Soweto-on-Sea, Veeplaas, Kwadwesi, Govan Mbeki and Missionvale are situated within the two surrounding regions (see Fig. 4.26). Bethelsdorp is situated to the west of the salt pan.

Figure 4.26: Map of the NMM showing the suburbs

Source: www.sa-venues.com

Figure 4.27: People living with HIV in the Nelson Mandela Metropole (January 1991-April 2000)



Source: Nelson Mandela Metropole ATICC, 2000

GIS mapping of the HIV pandemic brings forth patterns in the infection and spread, which may have been overlooked by conventional statistical analysis.

Figure 4.27 depicts the spatial distribution of people living with HIV in the Nelson Mandela Metropole. The spatial variables, the longitudinal and latitudinal variables were available for 21322 case-level data in the NMM. Each circle pinpoints the location and number of HIV infected people, either in the suburb of residence or the diagnostic institution. The high concentration of regional clustering is evident from the map: HIV is an urban phenomenon in the NMM. Areas outside the urban locality of the Metropole have remarkably low concentration of HIV infected people. In absolute numbers, more HIV-infected people may be living in densely populated areas than in sparsely populated areas, but in relative terms, (HIV-infected people as percentage of the total population) this might not be the case. It is apparent that high-density living conditions with poor socio-economic background lead to the propagation of HIV and other diseases. Even so, as HIV is primarily a sexually transmitted disease, people living in affluent suburbs are also at risk of infection. People living in the Central Business District (CBD) to the East of the NMM and the previously White-only residential areas in the South and South-West are also infected with HIV as the data population reflected 28.3% of the HIV positive people had street addresses or lived in flats (see Fig. 4.15). Only one area in the South showed a high level of HIV infection and it raises suspicions whether unique vectors exist in the vicinity.

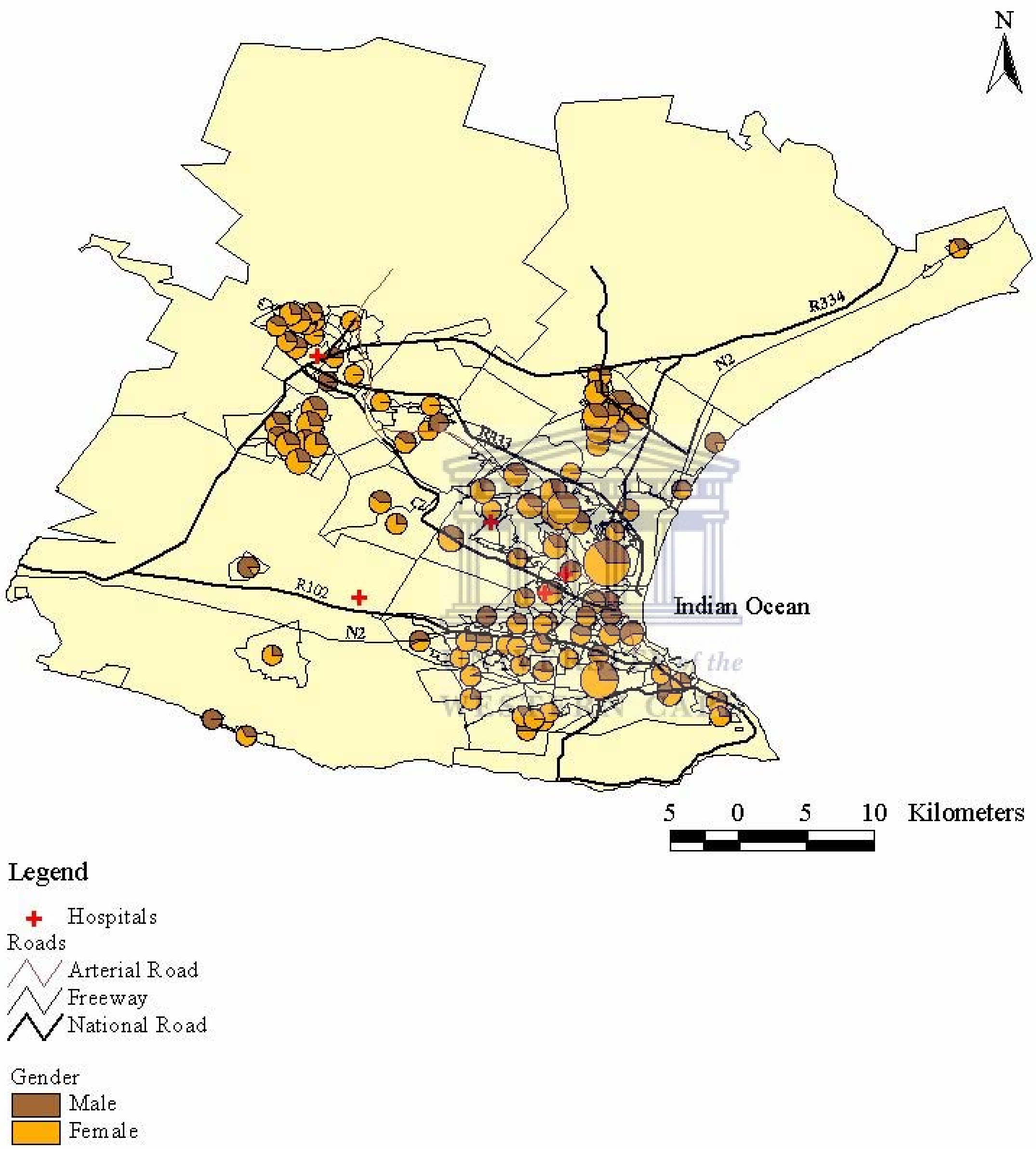
The spread of HIV is not as significant in the suburbs of the NMM that are situated to the South-West of the Metropole in contrast to the suburbs that are situated in the North-East. As the South-Western suburbs were previously set aside for the European population, they have maintained this ethnic profile as the majority of the population are too poor to move into integrated areas as they cannot afford municipal rates on properties and other related costs and services (Christopher, 2000:7). Therefore, it may appear as if HIV is a disease of the poor.

The suburbs of Uitenhage also reflect the HIV concentration in the urban area. Kwanobuhle, a suburb adjacent to and situated to the south of Uitenhage, displays fairly high concentration of HIV. Uitenhage, like Port Elizabeth, has a huge motor vehicle industry and the town receives traffic from two directions: the north and the south (see Fig. 2.5). New Brighton, Kwazakhele and Motherwell in the North-East of the NMM, exhibit a similar profile as Kwanobuhle, that is, they are situated near industrial areas. Therefore, the NMM strongly confirms the hypothesis that the presence of both commercial activity and good transport infrastructure are excellent conduits in the spread of HIV.

As the majority of people were tested at public health facilities, the suburbs, in which public hospitals and clinics were located, show a large concentration of people living with HIV. The public health institutions are situated in or near the highly populated suburbs and it is within these suburbs that the informal settlements have sprung up. It could be that people come into the urban Metropole and locate themselves permanently in informal settlements which are near public health facilities, such as hospitals and clinics, for easy access to treatment (health facilities may be under-resourced in the rural towns). People also migrate from areas of familiarity to areas other than their own (usually rural to urban) to be tested to safe-guard their identities.

Poor people are not the only socio-economic group that is infected by HIV. It is evident that HIV infection is present in all the suburbs of the NMM, but in varying scale. However, there is a large concentration of HIV in the informal settlements and the suburbs that border the main transport routes as HIV is not spread evenly in the informal settlements. It seems that as the distance of a suburb from the main arterial route increases, the HIV infection rate decreases. For example, the suburbs in Bethelsdorp that are situated in the west between the R333 and R102 highways and those suburbs that are not in the proximity of industrial zones, show low HIV infection. This trend indicates that variables such as truck drivers and commercial sex workers who ply their trade on the main transport routes are important role players (vectors) in the spread of HIV. The analysis of the GIS map (Fig. 4.27) shows that HIV is not spread evenly across the Metropole. Therefore, provincial prevalence rates generalised by the ANC protocols are not good indicators of the HIV spread.

Figure 4.28: Gender of people living with HIV in the Nelson Mandela Metropole (January 1991 to April 2000)



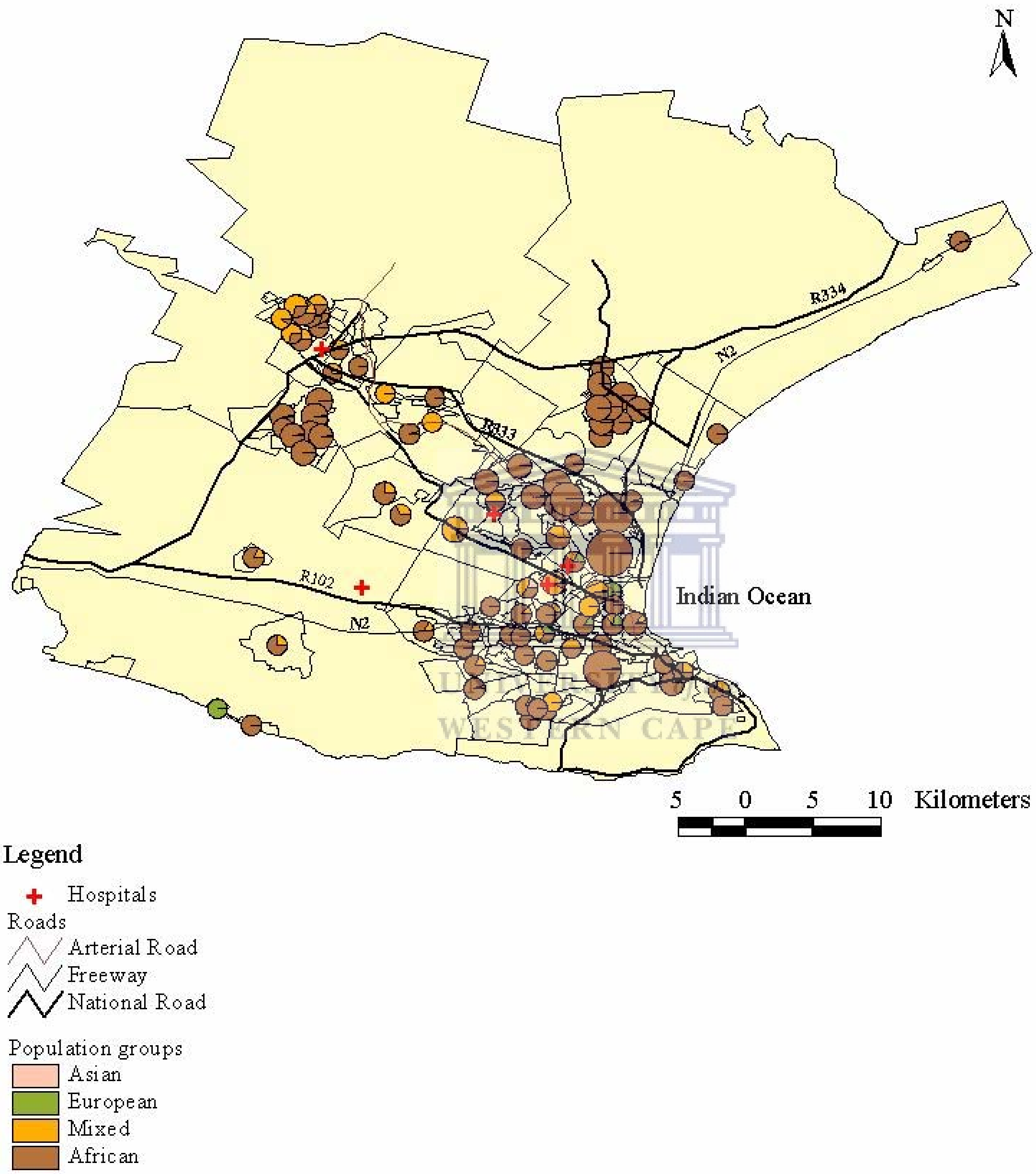
Source: Nelson Mandela Metropole ATICC, 2000

More females than males are infected in the Metropole, a pattern that is consistent with the ANC protocol, the ASSA model and the NMHSRC study. This gender profile is observed across all the suburbs and the pattern is especially distinctive in suburbs inhabited by low socio-economic communities (see Fig. 4.28).

In most of the suburbs, the female infection rate was approximately 65% to the male infection rate of 35%. There were districts in Port Elizabeth and Uitenhage which deviated from this pattern and reflected ratios that were approximately equal. In the CBD areas of Port Elizabeth and Uitenhage, there were more males than females who were infected. Also, there were more males infected in the rural surround of the NMM, but the numbers were small. Thus, the gender ratio showed that not all the suburbs have the same pattern of infection. The UNAIDS (2004) report states that young women are the most vulnerable to infection. The gender ratio is less pronounced in the predominantly Mixed and White suburbs. The map also depicts that the population living in the wealthy suburbs near the national roads (e.g. below the R102) have low HIV gender ratios. The differences in the gender ratio between communities that live in informal settlements and the wealthy suburbs demonstrate that the Jaipur paradigm does affect poor females profoundly. Social cohesion is a factor that is absent in poor communities who live in informal settlements in South Africa and people who migrate in and out of an area make themselves vulnerable to diseases such as HIV as the NMHSRC had reported that the transient nature of township life is conducive to the spread of HIV.

In addition, the gender ratio is the most skewed in the high-density areas because females from poorer communities make more use of public health facilities and, thus, their health status is recorded which is in contrast to females from the higher socio-economic communities who make use of private health facilities. However, this disparity alone does not explain the differential gender ratio, fully. Other factors that play roles in the skewed gender ratio are cultural practices and the poor socio-economic status of females from the previously disadvantaged communities. These women also have to contend with patriarchy, violence and rape as very few can defend themselves physically and economically.

Figure 4.29: Population groups living with HIV in the Nelson Mandela Metropole (January 1991 to April 2000)



Source: Nelson Mandela Metropole ATICC, 2000

In the South African context, HIV infection by population group is a sensitive issue. Since living space in the designated areas allocated to the various population groups has still retained its pre-1994 racial profile, it has been easier to analyse the impact of HIV on the different population groups.

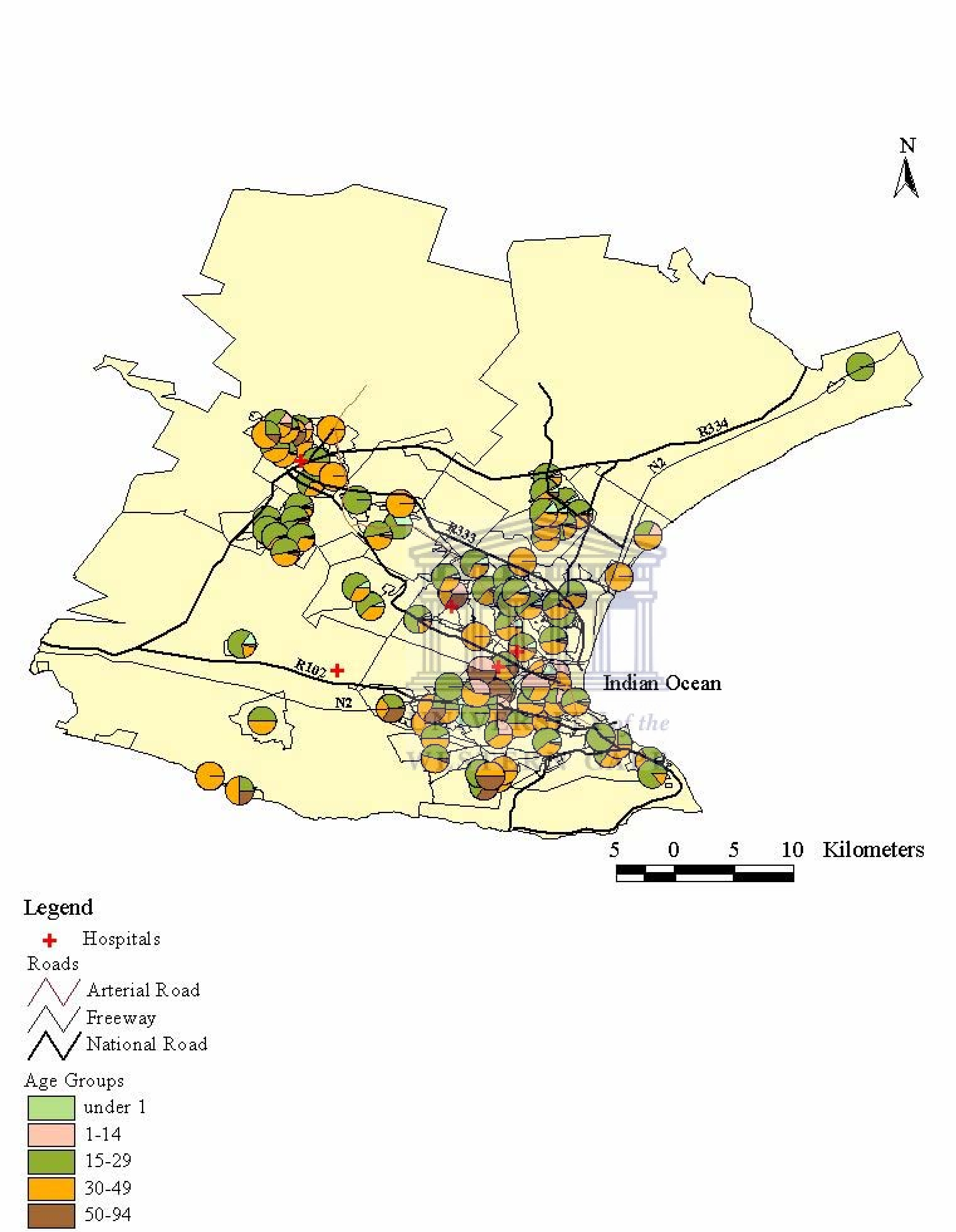
From the above map (Fig. 4.29), it is clear that the African population are at the receiving end of the HIV pandemic. African communities on both sides of the Uitenhage highway are highly infected with HIV. In the North-Eastern suburbs, which are predominantly African, HIV infections are high. The Walmer suburb is the only suburb which has a high HIV infection rate in the South. This pattern raises suspicions of whether unique proximal vectors exist in the vicinity of this suburb.

Although the African group was an established group in Port Elizabeth since the nineteenth century, the HIV/AIDS pandemic has affected them more than the other population groups in the NMM. At this point, we may affirm that the African population group had experienced much upheaval in their communities with factors such as in and out-migration and the proliferation of informal settlements in and around the townships which had retarded social cohesion in the previously stable African population group.

The Mixed group who live predominantly in the suburbs in the South and South-West of the NMM, are spread across the Metropole, in the CBD and Uitenhage. Mixed group communities are also infected but to a lesser extent than the African group. It is evident that more Mixed people are infected who live near the highways than those who live further from the highways. Their HIV infection rate is indicative of a community that had not experienced the same effects of the Jaipur Paradigm as had the African group. As Christopher (1988:5) had stated that many had lived in mixed residential areas since the nineteenth century and although the majority were relocated in the pre-Apartheid and Apartheid era, they had remained a relatively stable population. A significant observation was the HIV infection rate among the Mixed group in the North-West and central Uitenhage which showed larger clustering among this population group than Port Elizabeth.

The European and Asian groups do not feature significantly in the GIS map as their HIV infection rates are low. It is significant that to the North of the R102, communities are highly infected but to the South, the Mixed group is infected to a lesser degree. The significant differences in HIV infection among the population groups reflect the differences in sexual and cultural behaviour and socio-economic conditions in the respective communities.

Figure 4.30: HIV carriers in the Nelson Mandela Metropole per age group (January 1991 to April 2000)



Source: Nelson Mandela Metropole ATICC, 2000

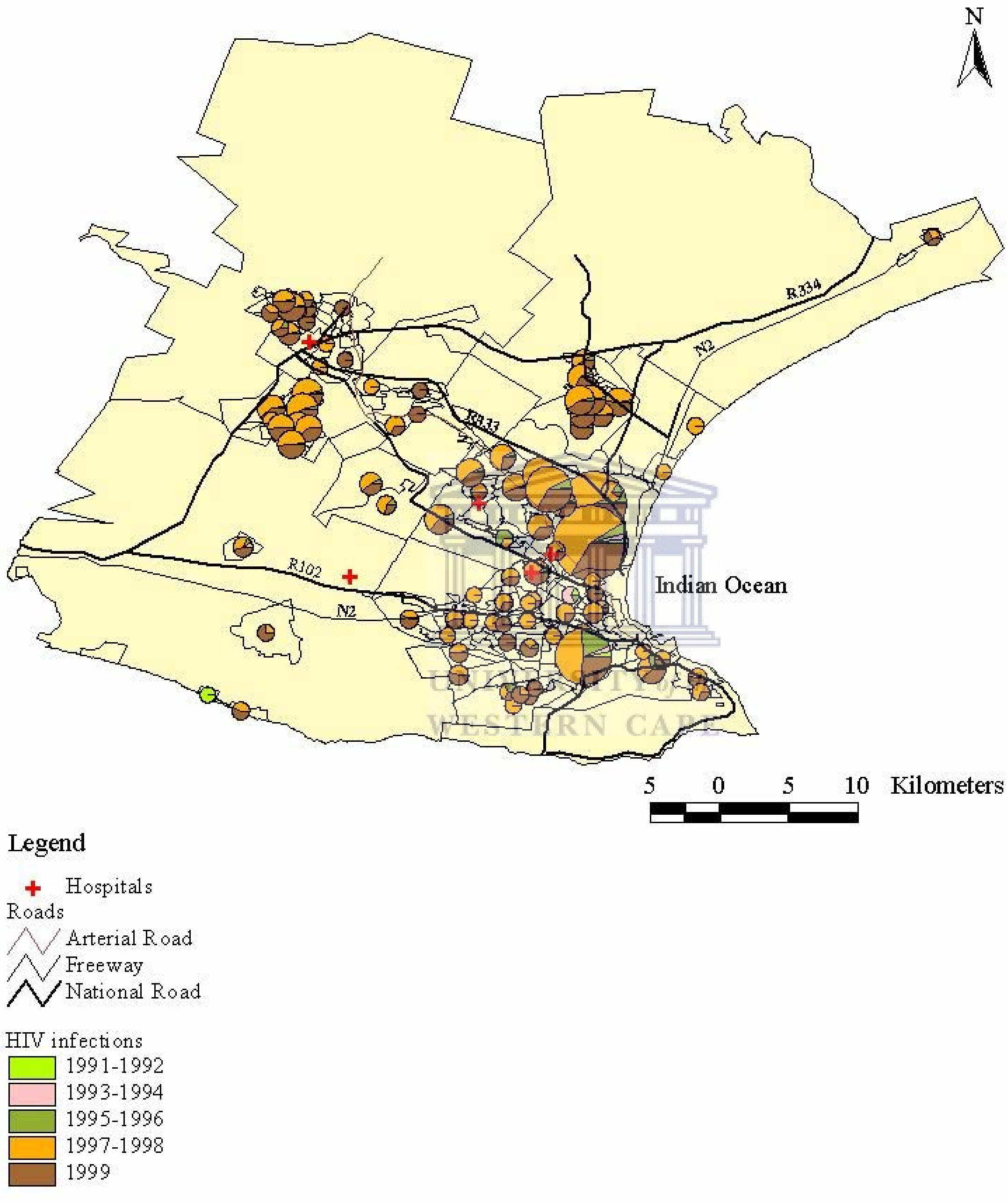
Figure 4.30 shows the spatial distribution of HIV carriers per age group. The GIS age group analysis shows how and where the different HIV age cohorts are situated in the NMM. The less than one year age group shows a significant infection rate, but mainly in the North-East of the Metropole. In the central and southern part of the NMM with the exception of the Walmer suburb, the less than one year age group infection rate was not significantly large. Again, this represents strong evidence of poor socio-economic conditions under which poor women live.

The less than one year age group age group infection is high in most informal settlements which may impact negatively on the NMM population for the future. The 15-29 year age group has the highest number of HIV carriers in all the areas as this age group is the most sexually active group. As with the over 60 year age groups, the 1-14 year age group displays the least infection rates. Thus, GIS analysis not only reflects the age and gender statistics but also the geographical position of these variables in the various suburbs.

Statistical analysis showed low infection rates for the 1-14 year age group. However, the GIS map shows that infection rates were high in the CBD area and the areas to the west of the CBD. The pattern suggests that the CBD area may offer anonymity to teenagers who indulge in sexual activities.

The 15-29 and the 30-49 year age groups were the most representative across the Metropole. In the north of Uitenhage, there were an equal number of HIV infections in the 30-49 year age group and the 15-29 year age group. This pattern was discernible across the Metropole. The over 50 year age group was more visible in the CBD and central Port Elizabeth as was the presence of the 1-14 year age group which is a unique feature. Do individuals in the older age group seek out teen partners? In the central city, at least, the association seems likely since anonymity is well guaranteed.

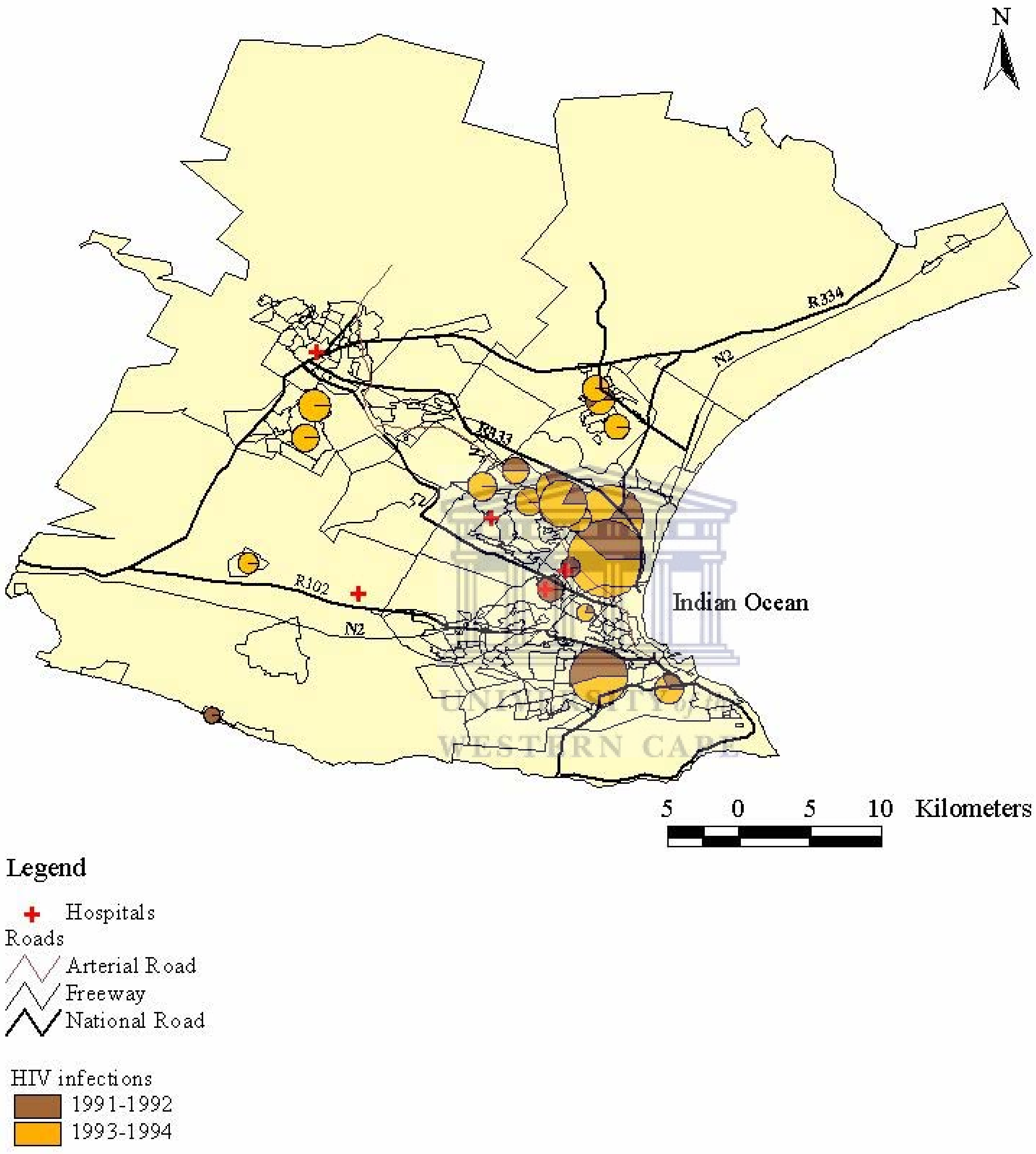
Figure 4.31: HIV infection over time (1991 to 1999)



Source: Nelson Mandela Metropole ATICC, 2000

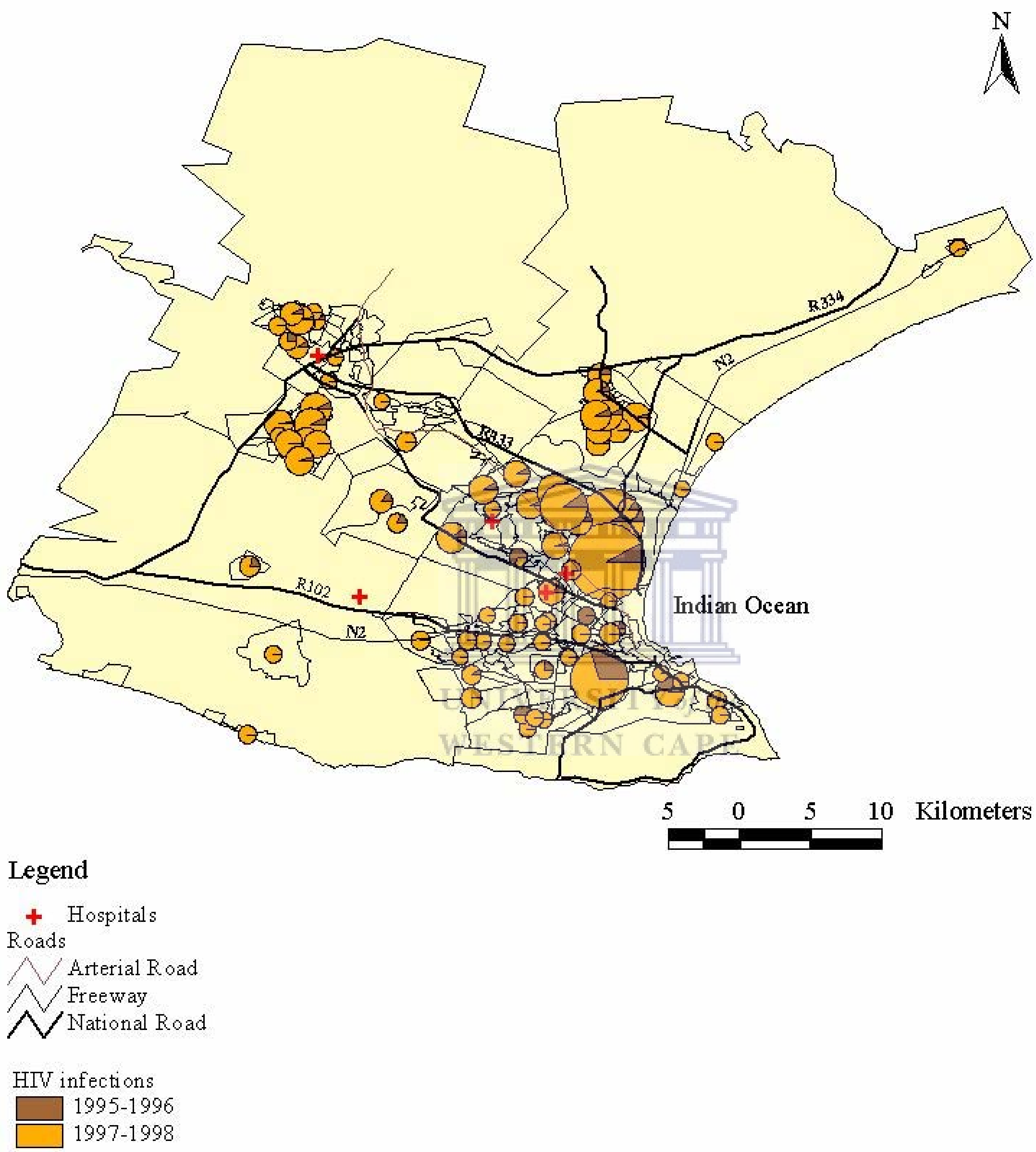
The above figure (4.31) depicts the HIV infection from 1991 to 1999. The researcher would have preferred to use histograms as this mode is the most appropriate to use to show population or infection increases, but the data was visibly clustered. Therefore, pie-charts were used to show the increases over periods of time. From 1991-1992, the HIV infection numbers were insignificant across the Metropole, although the exponential growth of the epidemic was the highest in the first two years (see Table 4.4). From 1995-1996, the HIV infection rate was climbing steadily and was visibly more than the periods, 1991-1992 to 1993-1994. The 1995-1996 period shows the most significant increases in the some of the South and the North-Eastern suburbs. However, the 1997-1998 period shows rapid increases across the entire Metropole. This is in contrast to the national DoH's assertion that the pandemic had stabilised in this period.

Figure 4.32: GIS map of people living with HIV in the NMM (1991-1992 to 1993-1994)



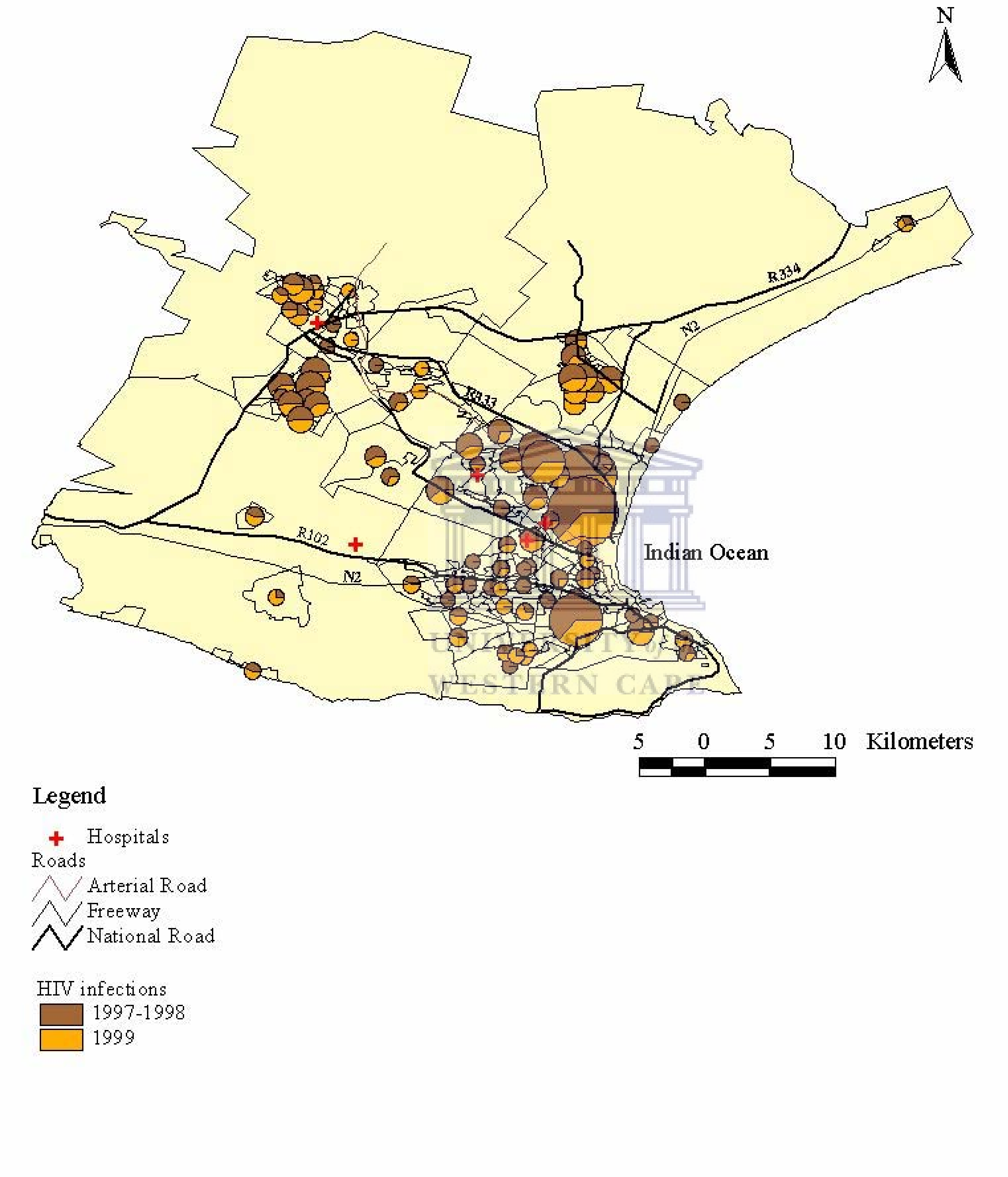
Source: Nelson Mandela Metropole ATICC, 2000

Figure 4.33: GIS map of people living with HIV in the NMM (1995-1996 to1997-1998)



Source: Nelson Mandela Metropole ATICC, 2000

Figure 4.34: GIS map of people living with HIV in the NMM (1997-1998 to 1999)



Source: Nelson Mandela Metropole ATICC, 2000

The three GIS maps, (figures 4.32, 4.33 and 4.34) show how the pandemic had progressed year on year in the NMM.

Figure 4.32 represents the spatial distribution and spread of HIV in the NMM in the period 1991-1994. From the map, it is observed that HIV spread is not significant over the NMM in the first four years of recording HIV data in the North-Eastern suburbs–the only significant record is in the public health institutions north and south of the R333 national road. To the north of the R333, the suburbs displayed marginal prevalence rates in 1993-1994 period. In the central business district, there is a balanced presence of HIV. In the south of the Metropole, most of the suburbs to the west and of the national road were HIV-free zones. The escalation in the 1993-1994 period is significant as it shows how proximal vectors impact on the spread of HIV. For example, one suburb is situated near a military base and borders the national road. Informal settlements are present within the Walmer magisterial district. Thus, an interaction of the Jaipur paradigm, truck stops and a military base gives an excellent interpretation of how HIV has spread initially in the NMM. A person could, therefore, conclude that military bases and highways are powerful vectors in the spread of HIV as Jochelson (2001:15) and Shell (2000a:13-14) have affirmed.

The 1995-1996 to 1997-1998 periods show significant but variable increases in HIV incidences in the NMM (see Fig. 4.33). The map shows that as from 1995, HIV was prevalent across the entire NMM. For example, in 1996 the biggest increase is recorded in the central business district, some significant increase in the North-Eastern suburbs, north-west Uitenhage and a suburb in the south of Port Elizabeth (see also Table 4.5). These increases in HIV could have been owing to massive in-migration into the NMM after the 1994 general elections as well as enhanced recording of HIV infections from the different health institutions.

Again, the pandemic has shown remarkable growth in the 1997-1998 to 1999 periods which saw more significant increases in HIV incidences across the Metropole (see Fig. 4.34). As the year 1999 is a single year when the comparison was made with the preceding period, 1997-1998, the year 1999 showed increases that are highly significant. In northern Uitenhage, Kwanobuhle, Motherwell and the South-West suburbs of Port Elizabeth show approximate increases for both the period 1997-1998 and the year 1999. This reveals that the HIV infections had doubled in one year in certain areas of the NMM.

By 1996, HIV has spread right across the Metropole. Collectively, the maps show that HIV infections was the most prevalent in suburbs bordering national roads, near public health institutions and military bases. The roles of highways and military bases have already been discussed and public health institutions are places where the majority of HIV infections are recorded (see Fig. 4.17). In addition, the maps reflect that suburbs that were situated further from the highways and military bases, recorded the least HIV infection rates. Previously, HIV was prevalent among the white gay communities and then became predominant among the heterosexual communities. However, as the pandemic matured, new trends became visible as HIV established itself in all suburbs of the NMM. The NMHSRC survey reported that both wealthy and poor Africans are at risk (Shisana & Simbayi, 2002:62-63). The NMM data strongly confirm this.

Conclusion

Analysis using conventional statistical and graphical methodology has generated new knowledge of the spatial distribution and spread of HIV in the NMM. GIS technology has shown the role of vectors in the spread of HIV that conventional methods could not reveal. GIS has demonstrated that it is an advanced technology that can give information on the spread of HIV across a metropole as it had done by exposing the role of vectors in the spread of HIV. In addition, GIS had confirmed the spread of HIV according to age, gender and population groups across the NMM.

The GIS analysis on gender clearly shows that the spatial distribution of the female and male HIV infection rates across are not even in the NMM. Male denial plays a huge role in the skewed gender ratio as they do not wish to be tested. Also, the age group mapping revealed the possible association between the different age groups in certain areas of the Metropole.

Chapter Five

Discussion

Discussion

Introduction

This chapter discusses the main trends, patterns and connections that have emerged from the research. The analysis into the spatial distribution and spread of HIV/AIDS in the NMM from 1991 to 2000 unearthed new results about the spatial distribution and spread using both conventional statistical analysis and GIS technology. The aim of the study was to provide factual information about the epidemiology of HIV in terms of prevalence rates, proximal vectors and the effects that the pandemic would have on the demographic profile of the NMM.

An analysis of the gender profile in the NMM shows that there are more females than males who are HIV positive. This finding is the same for all the other surveillance protocols, studies and projections such as the ANC, NMHSRC and ASSA. However, this pattern was not observed across all the age groups and population groups as the gender variable cannot be examined in isolation, as age and population groupings influenced the outcome of the study, and as Williams *et al.* have argued that age-specific incidence of infection is the most sensitive marker of transmission (2000:299). For instance, the gender ratio was approximately equal in the less than one year age group, 1-4, 5-9 and 10-14 year age groups as these age groups are assumed to be sexually inactive. However, researchers argue that girls are physically vulnerable to sexual violence (Kaya, 1999:40) and child rape is prevalent in South Africa (Shilumani, 2004:1). HIV positive infections, for the less than one year age group, were largely from vertical transmission, which is, mother-to-child infection, and is responsible for up to 30% of mortality rate in this age group (Barnett & Whiteside, 2002:169). From the 15-19 year age group to the 35-39 year age group, the gender infection rates were not comparative as female infection rates were significantly higher than males. The study showed that the bulk of HIV infection was in the 25-29 year age groups for both males and females although there were twice as many females infected than males in this age group and in the 20-24 year age group there were eight females to every male who was infected. This summary shows that males are inadequately recorded in the health system as males' admission to hospitals and clinics were mainly for TB and trauma (Ramdas & Zunga, 2004:6). Also, the high infection rates in these age groups are indicative that predominantly the reproductive members of the population are infected and that HIV is transmitted primarily through heterosexual relationships (see Fig. 4.24).

Since 1998, when voluntary testing came in to being, the national DoH (2000:2) stated that HIV infection was falling, but it could be argued that many young women declined to take a test and features such as mortality and migration impacts on HIV incidences in the less than 24 year age group and HIV-1 transmission patterns. As with young males, females outside the child-bearing age groups are also not tested (DoH, 2000:4; Shisana & Simbayi, 2002:1). Vogelman and Lewis (1999:1) state that the higher sex ratio can be attributed to regional and social causes such as those espoused by Whiteside and others who have argued that the Jaipur paradigm contributes towards an interpretation of high HIV infection rates in communities that are exposed to low social cohesion (Whiteside *et al.,* 1999:1-3). This is the case in South African cities such as the NMM, as people migrate to urban areas to access better job opportunities and health services, but the majority do not have the social or financial capital to succeed (Bekker, 1999:218-223; Cross & Webb, 1999:17). Also, the gender dimension in HIV transmission is not probed by Whiteside's Jaipur paradigm.

It was significant that when the male HIV infection rate per age was analysed, the gender ratio progressively decreased as HIV positive males moved up the age group hierarchy. There are two possible explanations for this gender ratio decline—either the females who were infected in initial age groups and had subsequently moved up into the higher age groups showed a high mortality rate without ARV treatment or the male HIV status were recorded well as they made increasingly use of health facilities when they became laid up with opportunistic diseases such as TB (Lehohla, 2002:6; Ramdas & Zunga, 2004:6). Thus, it can be concluded that the majority of HIV positive males were not captured in the initial stages of infection.

In the same manner, since 1998, when voluntary testing was introduced, the DoH stated that HIV infection was falling (2000:2), but it can be argued that many young women may have declined to take a test as they were now asked whether they wish to be tested or not. As males were excluded from the ANC sampling, females outside the child-bearing age groups were also not tested (DoH, 2000:4; Shisana & Simbayi, 2002:1) and in the case of the NMHSRC study, both males and females in the under two age group and people from high risk areas were excluded from the study sample (Shisana & Simbayi, 2002:31-32). Clearly, the South African national HIV surveillance protocols have failed to capture HIV prevalence rates across gender and age in a representative way.

Consequently, when attendance by males and females at both public and private diagnostic institutions were analysed, it was found that the HIV status of more females than males was captured in public health institutions (see Tables 4.3 and 4.4). The reason was that females from poorer socio-economic backgrounds made more use of the public health facilities according to the ATICC data set as well as the NMHSRC study, and the European population group tended to make less use of public health facilities (DoH, 2000:4-5). Furthermore, the ANC protocol had stated that more than 80% of poor people make use of public health facilities and that 80% of poor women attend the ANCs (DoH, 2000:4-5). In contrast, males and females were equally represented in private health institutions. This pattern strongly suggested that males from all population groups were not captured efficiently in the public health system, but were captured well in the private health system as they made application for mortgage loans, life assurances and medical aids (see Table 4.4). It is evident from the analysis that HIV was not prevalent only in the poorer communities, but was present in the middle-class too, as they have larger disposable incomes, for example, individuals such as teachers (Shell & Zeitlin, 2000:8). There was a significant association between gender and diagnostic health institutions (see Tables 4.3 and 4.4). The chi-square analysis, therefore, rejects the null hypothesis and accepts the alternate hypothesis that there is an association between gender and diagnostic institutions.

When HIV/AIDS among the various population groups was examined, the analysis showed that great variation existed among the different cultural groups, which was also the conclusion of the ANC protocol and the NMHSRC study (see Table 4.1). However, the ATICC data set established that 90% of those infected with HIV were Africans in comparison to the NMHSRC study, which reflected a figure of under 80%. In addition, the NMHSRC study cited higher prevalence rates for the European and Asian groups (Shisana & Simbayi, 2002:101). However, the NMHSRC study was based on relatively small sample sizes for the different population groups (cf. Shisana & Simbayi, 2002:13-14). The NMHSRC study contended that the HIV prevalence rates among the different population groups could be attributed to social and behavioural determinants (Shisana & Simbayi, 2002:101). An analysis of the gender ratio in the different population groups reflected more females than males who were HIV positive in the African and the Mixed groups, in contrast to more males than females in the European and Asian groups. The differences in the gender ratio is an indication that the Jaipur paradigm has a strong influence in the NMM since huge socio-economic disparity exists among the various population groups, as Airhihenbuwa and Webster (2004:4) have contended that in Africa culture plays a big role in the health of a community. To this end, the historical demography of the NMM showed that at the beginning of the twentieth century, the African population was an established middle-class entity, but the proliferation of informal settlements after 1948 created unfavourable socio-economic conditions (Christopher, 2000:6). Abel's "woman power index" analysis shows further that females are the most affected by the Jaipur paradigm (2005:46). Historically, the African population adapted in the urban area, but the continuous pressure for them to shift to new living space compromised many people's living standards (Christopher 1988:12). The chi-square analysis, therefore, rejects the null hypothesis and accepts the alternate hypothesis that great overall variation exists between gender and the population groups in the NMM.

Attendance at HIV counselling institutions gave an indication of the number of males and females seeking counselling services. Females, as was the case when attendance at public health institutions was analysed, made more use of counselling services which further confirms male denial. The chi-square analysis, therefore, rejects the null hypothesis and accepts the alternate hypothesis that there is an association between gender and counselling institutions.

The proximal vectors were many and varied in the NMM. Analysis of educational institutions, the military, prisons and truck stops could not be made statistically as the frequencies within these institutions were not always available and in nearly all cases non-existent as only the prisons had data on HIV/AIDS. However, the HIV infection rates in the suburbs near the vectors gave an indication the impact the said vectors had on the spread of HIV. Using conventional statistical methods in each suburb furnished the frequency of HIV in the suburbs of the NMM. The most marked vector was the army base in the south of the NMM. Initially, the military had been implicated in the spread of HIV among the local population in the NMM, as a UNAIDS study had reported that military personnel had disposable income which was usually spent on commercial sex workers (UNAIDS, 1998). Historically, the Eastern Cape population had been infected with diseases by the military since the nineteenth century (Jochelson, 2001:15; van Heyningen, 1984:84; Phillips, 1990:22-167). It was observed that the Walmer magisterial district had the highest HIV prevalence in the NMM as it was situated near a military base (PE ATICC, 2000; Shell, 1999:37). The total number of army personnel infected was 179 and these were early cases (see Table 4.1). There are three army bases in the Eastern Cape, namely, Port Elizabeth, Grahamstown and Umtata. The Port Elizabeth army base is situated near Walmer Township which had 786 HIV carriers. There may be a reward-induced reciprocal relationship between the residents of the township and the army personnel. Statisticians have argued that between 25% and 40% of the army is infected (Heinecken, 2001:110).

A geographical analysis in Region A shows that the incidence of HIV positives is emerging from the North-East. Suburbs that lie on the North-West of the arterial road to Uitenhage show fewer incidences of HIV. According to the NMHSRC study, the Free State province has the highest HIV prevalence in South Africa (14.7%) (Shisana & Simbayi, 2002:46) and the district of Graaf-Reinet in Region A that borders the Free

State, had 218 incidences. There is a also a huge military base, Tempi, outside Bloemfontein which would account for the high prevalence rates in the Free State, but the traffic from the North also contributes to the spread of the virus, not only in that province, but also in the towns of Region A. There is no migration from the west since the Western Cape is one of the main target areas for out-migration from the rural areas of the Eastern Cape (Bekker, 1999:220). The main vectors are within the Eastern Cape, but many HIV carriers may have been diagnosed elsewhere. The ATICC data does not have this information. Also, areas where there are no clinics and hospitals, there are unlikely to be any reported cases. Since there are few ANCs in the rural areas, HIV cases are not captured efficiently or at all. An examination of the data set reflects low incidence in the rural towns (see Fig.4.20).

The population groups that are infected the most are from the North-East suburbs. Average incidence of the epidemic obscures the deep and wide penetration of the current epidemic clustered in certain well-defined socio-economic neighbourhoods and communities, most markedly in the old and new informal settlements. There is evidence that migration has an effect on the overall impact in the region. The taxi industry has changed the speed and mode of travel (Gould, 2004:35). This has impacted on migration patterns. The results show that the epidemic is growing fastest in the informal settlements and the largest numbers of the HIV-infected had street addresses (see Fig. 4.15). The absolute number of HIV cases within suburbs reveals further evidence of a North-East vector. The huge Truckers' Inn on the N2 national road is a popularly suspected site of infection. In 2003, the official opening of South Africa's sixth roadside clinic took place at the Truckers' Inn in Wells Estate, regarded as an HIV/AIDS hot spot (*Daily Dispatch*, 11 February 2003).

The HIV positive prison population in Region A stands at 330 carriers. We do not know what % this number constitutes of the total prison population. Goyer (2003) had argued that prisoners are 5 to 10 times more likely to be HIV positive than the general population and she estimates that the prevalence rate in prisons to be 41.5%. A prison population is a catchment area for infection of new inmates and they in turn, on release can infect the general population. Thus, a reciprocal relationship exists between the prison and the general population. The prison figures reflect that prison populations follow the same density pattern as the populations in informal settlements.

There are 1017 HIV carriers who are related to each other, that is, in some households more than one member is HIV positive (see Fig. 4.12). This phenomenon needs further investigation.

From the GIS maps, a North-East vector was evident. Another vector may be the army base in the south because the area adjacent to it was the only area in the south that had a large concentration of HIV carriers. There were also HIV carriers in the army base. From the maps, it was also evident that the suburbs near the highways were infected more than suburbs that were situated further from it. It seemed that the HIV infection rate decreased as the distance increased from the national arterial roads.

When the population growth in the NMM was examined between the national censuses, 1996 and 2001, it was found that the growth rate was not substantial. In certain age groups, a negative growth was observed. The negative growth could mean that either HIV/AIDS has a greater effect on infant mortality or that HIV is affecting the fertility in young women or it could be a combination of both. From 1996 to 2001, the population had grown by 0.95% **(**see Appendix 2). The most striking impact was the correlation between the HIV infection rates in the 0-4 year age group and the 5-14 year age group and the corresponding negative growth rates in these age groups (Census 1996 to Census 2001) (see Appendix 2). The pandemic affected both male and female age cohorts in these age groups. Sex ratios were maintained from 1996 to 2001, which may imply that males are dying at the same rate as females.

Both the NMHSRC study and the ASSA 2002 study stated that since the advent of the HIV/AIDS pandemic, mortality rates were higher in the 15-49 year age groups in South Africa. Although the mortality sample in the NMM ATICC data is small, it nevertheless reflected the trend of the NMHSRC survey and the ASSA model.

The spread regarding the prevalence rates in the NMM was not compatible to the annual DoH's antenatal clinic surveillance protocols, the findings which were used to make inferences to the whole EC. In the EC, the ANC data that were collected from the seven district regions were averaged out to arrive at a single rate. In 2002 and 2003, the ANC prevalence rates for the Nelson Mandela Metropole were the highest (see Appendix 3). Generalisation of the prevalence rates thus compromises effective spending at the local level.

The GIS technique has highlighted some observations that ordinary research could not detect, that is, the spatial distribution of the infection against the proximal vectors. The GIS analysis could also detect the following: the relationship between the infected population groups and where they were located in the NMM; the relationship between the age/gender of the infected and their location; the relationship between the year and the location to show how fast the pandemic had grown in the respective locations. In summary, GIS is a technique that highlighted relationships between variables and the place of location which other analyses were not able to do.

From the data it is evident that the HIV spread has not been uniform throughout the Nelson Mandela Metropole and its rural surrounds. The research has shown that population density influences the rate of HIV infections as more people were infected in the urban region of the NMM. Clusters could be observed along the national highways in the North-East direction of the EC that borders Free State Province and Lesotho and to the Nelson Mandela Metropole in the South. Rural towns that bordered the main highways and arterial roads had more people infected than towns and villages which were situated away from the main highways. The same pattern of infection was observed in the urban suburbs: the HIV infection rate was inversely proportional to the distance from the main trucking routes. This pattern was found to be present in the data set population upon which this research is based.

The GIS maps reflected several HIV clusters in the Metropole. All, but one was situated in the North-East direction of a main road. Hence, prevalence rates differed at the suburban level, and perhaps differed even at the street and household levels. However, analysis could not be done at this level as the information was not available.

Conclusion

The research has unearthed new information on the epidemiology of HIV/AIDS pandemic in the NMM. The information should direct local government departments to spend their budget in a constructive and efficient manner so that adequate support in terms of ARV and social grants reach the previously disadvantaged communities in the NMM and its rural surrounds.

From the data, it was evident that prevalence rates at the magisterial district levels in Region A were not the same as the research conducted by the ANC surveillance protocols, the NMHSRC study and the ASSA models. It was also evident that even at the suburban level, the prevalence rates differed from that of the rates at the regional and magisterial levels.

Chapter Six

Conclusions and recommendations

Conclusions and recommendations

The need for a statistical research approach is well recognised in epidemiology and public health. In the case of the HIV/AIDS pandemic, the responses to quell the spread have become the principle public health policy in South Africa. But, as the pandemic had unfolded, many hidden variables that impinge on the spread have come to the fore. Conventional statistical methods and mathematical modelling have been unable to decipher the direction of the spread and vectors in a geographical setting. The use of GIS as a tool, for this researcher at least, has brought to light new ways of thinking about the pandemic.

The various surveillance protocols in South Africa had failed to establish an accurate epidemiology of HIV/AIDS on the national, provincial or local municipal levels. The statistical analysis together with GIS technology in the NMM showed that case-level data was the best in terms of analysing the spread.

The principle findings suggest the presence of high HIV clustering within the NMM, the wealthiest city, in the wealthiest health region of the EC, but in the poorest province of South Africa. The HIV/AIDS data from Region A shows that the pandemic is not only among the poor, but also the middle-class. The NMM had unique internal vectors such as high density areas, a wealthy population, truck stops and military bases. Moreover, it seems that the pandemic had a negative impact on the growth rate of the population in terms of numbers.

The research exposed some of the gaps that exist in the study and suggests possible areas for further studies. For instance, gaps exist in the investigation of clans within households who are HIV positive. As a consequence, this may be a major hidden cluster, which health authorities should target to bring down the level of HIV infection. Another important finding was the differences in the gender ratio when attendance at both the public and private health institutions were analysed as it was found that the gender ratio was not the same at any two types of institution. This demonstrated that males make less use of public health facilities. Also, among the various population groups, an interesting pattern emerged: there were more females than males infected in the African and the Mixed groups in contrast to more males than females in the European and Asian groups. Attendance at counselling institutions reflected more females than males. Collectively, these findings strongly suggest male denial and the refusal to be tested.

Just as healthcare was used to perpetuate race and class segregation in the formative years of Port Elizabeth, this pattern is still evident in the twenty-first century in the NMM as the majority of the African population is still living in segregated areas as many are too poor to move into integrated areas. Since the establishment of Algoa Bay in the nineteenth century, Africans have experienced quarantine and continuous removals to residential areas outside the city in the name of public health through the sanitation syndrome. Now, the NMM is experiencing an HIV epidemic, which is mainly among the African population, but the majority cannot afford or access anti-retroviral drugs from the private health sector. Although race cannot be used as a justification to remove HIV positive people physically from their geographic environment, the reality is that as ART is not accessible by the poor, it is reminiscent of the conditions that prevailed in PE for the past two centuries. As the national DoH has a limited roll-out plan for ART nationally, this treatment is only available to a few in the public health sector.

HIV/AIDS prevention policies have failed to bring down the incidence of HIV. The policies do not address the feminisation of poverty, the entrenched racism, an unjust health care system and the growing economic inequalities resulting from the system of capitalism. Therefore, poor urban women are increasingly burdened by HIV/AIDS in the NMM. Whereas previously, race and class were used to segregate people, in the era of HIV/AIDS, wealth and class are the reasons for segregation in the NMM and other cities in South Africa.

Policy implications and recommendations

a. The shortcoming in the present surveillance protocols needs to be addressed so that the role of males in the spread of HIV can be ascertained. A surveillance protocol that tests all trauma patients at hospitals and clinics would capture HIV prevalence among males more efficiently;

b. Policy makers should look at the North-East vectors to minimise their cumulative effect on the Metropole;
c. Proximal vectors such as prison and army personnel should be targeted for behaviour modification, and not only truck stops;
d. National and provincial models that project the HIV/AIDS spread should exercise caution when these models are applied to specific regions and municipalities;
e. Males should be socialised at an early age to respect females and to undergo testing and counselling;
f. Innovative HIV awareness campaigns should be maintained at all times;
g. There are studies that look at the urban and rural divide, but this study examines the public health and private health domains, which reflect contrasting gender ratios. Perhaps policymakers should look at the role of middleclass males in spreading HIV and that perhaps HIV/AIDS is not spread by the poor but by males that have extra money to afford another sex partner, but that especially poor females are affected by the behaviour of these males, and
h. Educating people, especially young people, to adopt responsible and low-risk sexual behaviour in the struggle for an HIV/AIDS-free society.

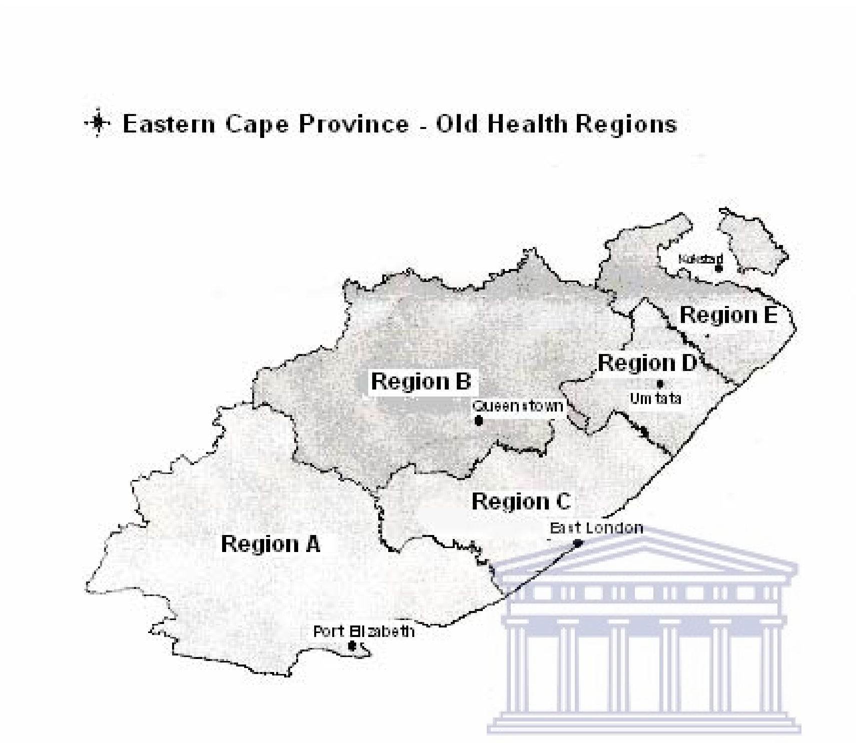
The research has questioned the limitations of the existing surveillance protocols as these do not model proximal vectors and the related variables in their assumptions as both the Nelson Mandela Metropole ATICC analysis and the Carletonville study have shown that regional vectors impact on the spread and that prevalence rates differ from national and provincial rates.

It seems that the Jaipur paradigm, cultural practices, gender inequality, the proximal vectors and in-and-out-migration, collectively are key forces impacting on the spread of HIV/AIDS in the NMM. Local government departments in the NMM should work together vigorously to stem the tide of the spread by implementing ARV roll-out plan for all communities but at the same time encouraging social and economic enlistment in communities to encourage equality between the genders and population groups.

Appendices

Appendix 1

Map showing the Old Eastern Cape Boundaries during the transition period (1999-2000)



Source: DoH, 2004: EC HIV and syphilis Antenatal Sero-Surveillance in the EC, 2003

Appendix 2

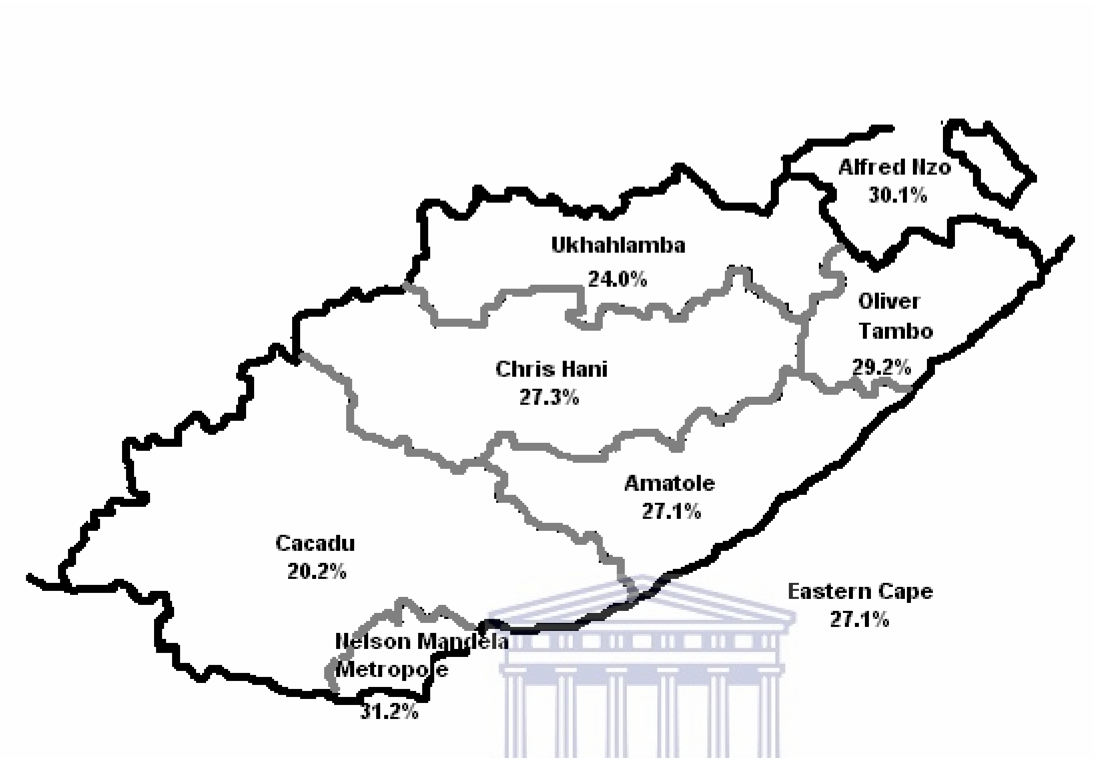
Population size of the Nelson Mandela Metropole by gender and age group (1996 and 2001)

Gender	Age group	1996 Census	2001 Census
Male	0-4	42584	38780
	5-14	93979	93366
	15-34	175614	182298
	35-64	127986	145073
	Over 65	18867	20314
Female	0-4	41765	38449
	5-14	94676	92645
	15-34	189235	192655
	35-64	145623	169546
	Over 65	28985	32652
Total		959314	1005778

Sources: Census 1996; Census 2001 (Stats SA, 2004)

Appendix 3

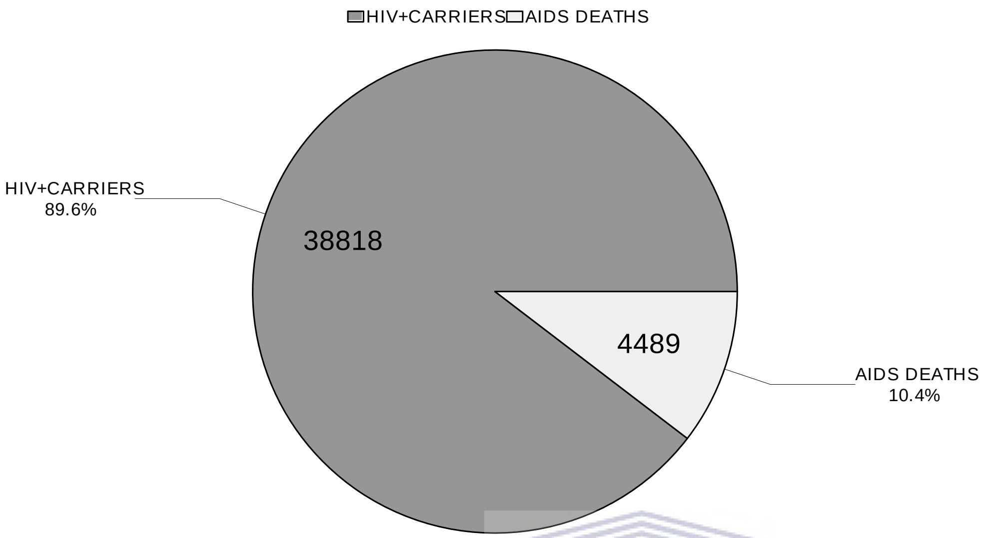
HIV prevalence rates in the seven district councils of the EC, 2002



Source: DoH, 2003b: EC HIV and syphilis Antenatal Sero-Surveillance in the EC, 2003

Appendix 4

HIV/AIDS aggregated data in Region A (1989 – 2001)



Source: NMM ATICC, 2002 (N=43307)

Appendix 5

New HIV infections in the Western Region of the EC by gender and population group, 2001

	African	Coloured	White	Asian	Total	% of total
Male	2232	300	10	2	2544	33.7%
Female	3884	540	2	3	4429	58.9%
Unknown	71	13	0	0	84	1.1%
Sub-total adults	6187	853	12	5	7057	93.7%
Paediatric	438	42	0	0	480	6.3%
Total cases	6625	895	12	5	7537	100%
%of total	88%	12%	0%	0%	100%	

Source: NMM AIDS, Training, Information and Counselling Centre (ATICC), Western Region of the Eastern Cape (2002)

Appendix 6

Number of HIV infected carriers by magisterial districts (1991-2000)

	Frequency	Percent	Valid Percent	Cumulative Percent
		.1	.1	.1
Nelson Mandela mag.dist.	18773	68.3	69.6	69.7
02_UITENHAGE	2549	9.3	9.5	79.2
05_CRADOCK	669	2.4	2.5	81.7
06_HUMANSDORP	832	3.0	3.1	84.8
07_SEAST	378	1.4	1.4	86.2
09_FBEAUFORT	221	.8	.8	87.0
10_KIRKWOOD	487	1.8	1.8	88.8
12_GR	233	.8	.9	89.7
15_MIDDLEBURG	144	.5	.5	90.2
23_HANKEY	175	.6	.6	90.8
24_HO	57	.2	.2	91.0
Joubertina	59	.2	.2	91.3
26_SS	56	.2	.2	91.5
28_JA	44	.2	.2	91.6
29_PE	37	.1	.1	91.8
30_AE	35	.1	.1	91.9
33_VE	21	.1	.1	92.0
34_BF	17	.1	.1	92.0
35_AB	19	.1	.1	92.1
36_AL	86	.3	.3	92.4
47_EL	7	.0	.0	92.5
EC125 Buffalo city	7	.0	.0	92.5
ALBANY-GHT	898	3.3	3.3	95.8
ALBERT	123	.4	.5	96.3
ALIWAL-NORTH	225	.8	.8	97.1
Anon	1	.0	.0	97.1
BARKLY-EAST	122	.4	.5	97.6
BATHURST	300	1.1	1.1	98.7
BIZANA	3	.0	.0	98.7
CAPE TOW	1	.0	.0	98.7
GEORGE	4	.0	.0	98.7
HEWU	1	.0	.0	98.7
JOHANNES	5	.0	.0	98.7
KWAMASHU	2	.0	.0	98.7

	LADY GREY	103	.4	.4	99.1
	MACLEAR	1	.0	.0	99.1
	MOORREES	1	.0	.0	99.1
	MPOFU	4	.0	.0	99.1
	NOUPOORT	56	.2	.2	99.3
	PEDDIE	5	.0	.0	99.4
	POTCHEFS	1	.0	.0	99.4
	PRETORIA	1	.0	.0	99.4
	QUEENSTO	8	.0	.0	99.4
	RIEBEECK	3	.0	.0	99.4
	STEYNSBU	75	.3	.3	99.7
	STEYTLER	1	.0	.0	99.7
	TARKA	59	.2	.2	99.9
	UMTATA	2	.0	.0	99.9
	VICTORIA	13	.0	.0	100.0
	WILLOWMO	6	.0	.0	100.0
	ZIMBABWE	1	.0	.0	100.0
	ZWELITSH	2	.0	.0	100.0
	Total	26970	98.1	100.0	
Missing	Unknown or not stated	535	1.9		
Total		27505	100.0		

Source: NMM ATICC, 2000

Appendix 7

Number of HIV cases by gender and age group (1991-2000)

		Sex of patient		
		Male	Female	Total
5 year age group	90 to 94	1	0	1
	85 to 89	0	1	1
	80 to 85	2	0	2
	75 to 79	5	4	9
	70 to 74	9	8	17
	65 to 69	23	23	46
	60 to 64	54	38	92
	55 to 59	106	107	213
	50 to 54	220	202	422
	45 to 49	424	427	851
	40 to 44	831	806	1637
	35 to 39	1333	1674	3007
	30 to 34	1767	2652	4419
	25 to 29	2568	4351	6919
	20 to 24	1181	3908	5089
	15 to 19	210	1790	2000
	10 to 14	13	83	96
	5 to 9	33	51	84
	1 to 4	151	148	299
	Under 1	924	1207	2131
Total		9855	17480	27335

Source: NMM ATICC, 2000

Appendix 8

Sex of patients infected with HIV, 1991-2000

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	9855	35.8	36.0	36.0
	Female	17491	63.6	64.0	100.0
	Total	27346	99.4	100.0	
Missing	9	159	.6		
Total		27505	100.0		

Source: NMM ATICC, 2000

Appendix 9

Number of HIV infections by year of recording and age group, 1991-2000

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
5 year age group	90 to 94	0	0	0	0	0	0	0	1	0	0	1
	85 to 89	0	0	0	0	0	0	0	0	1	0	1
	80 to 85	0	0	0	0	0	0	0	0	2	0	2
	75 to 79	0	0	0	0	1	0	5	2	1	0	9
	70 to 74	0	0	0	0	0	0	1	7	7	2	17
	65 to 69	0	1	1	0	4	3	11	7	16	3	46
	60 to 64	0	1	1	3	4	12	20	15	29	7	92
	55 to 59	1	0	3	4	11	24	35	52	69	15	214
	50 to 54	5	8	10	11	25	44	70	92	133	25	423
	45 to 49	3	12	21	19	60	105	144	207	234	47	852
	40 to 44	8	14	30	56	91	218	313	374	460	74	1638
	35 to 39	18	44	74	111	257	369	582	692	728	136	3011
	30 to 34	21	56	117	169	359	661	828	970	1071	181	4433
	25 to 29	34	91	150	251	469	797	1600	1602	1724	295	7013
	20 to 24	55	103	170	249	552	671	940	1028	1130	205	5103
	15 to 19	27	44	80	112	233	245	326	382	441	114	2004
	10 to 14	0	1	3	3	13	12	15	24	19	6	96
	5 to 9	0	1	0	2	3	13	17	18	23	7	84
	1 to 4	2	6	6	12	26	47	54	58	68	21	300
	Under 1	16	47	83	230	386	474	272	287	285	63	2143
Total		190	429	749	1232	2494	3695	5233	5818	6441	1201	27482

Source: NMM ATICC, 2000

Appendix 10

Number of HIV infections by population group, 1991-2000

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	African	25465	92.6	92.7	92.7
	Mixed	1801	6.5	6.6	99.2
	Asian	10	.0	.0	99.3
	European	199	.7	.7	100.0
	Total	27475	99.9	100.0	
Missing	Not stated	30	.1		
Total		27505	100.0		

Source: NMM ATICC, 2000

Appendix 11

NMHSRC 2002 overall HIV prevalence by sex and race

Sex and Race	n	HIV positive (%)	95% CI
Total	8428	11.4	10.0-12.7
Male	3772	9.5	8.0-11.1
Female	4656	12.8	10.9-14.6
African	5056	12.9	11.2-14.5
White	701	6.2	3.1-9.2
Coloured	1775	6.1	4.5-7.8
Indian	896	1.6	0-3.4

Source: Shisana and Simbayi (Nelson Mandela Human Sciences Research Council Study of HIV/AIDS), 2002. p. 42.

Appendix 12

Number of HIV infections by population group and year of recording, 1991-2000

		Population Group								Total	
		African		Mixed		Asian		European			
		Count	% of Total	Count	% of Total	Count	% of Total	Count	% of Total	Count	% of Total
ref_yyyy	1991	174	.6%	10	.0%	0	.0%	6	.0%	190	.7%
	1992	398	1.4%	20	.1%	2	.0%	10	.0%	430	1.6%
	1993	700	2.5%	37	.1%	0	.0%	12	.0%	749	2.7%
	1994	1138	4.1%	78	.3%	0	.0%	13	.0%	1229	4.5%
	1995	2336	8.5%	134	.5%	0	.0%	23	.1%	2493	9.1%
	1996	3433	12.5 %	231	.8%	3	.0%	34	.1%	3701	13.5%
	1997	4856	17.7 %	345	1.3%	1	.0%	32	.1%	5234	19.1%
	1998	5401	19.7 %	370	1.3%	2	.0%	35	.1%	5808	21.1%
	1999	5931	21.6 %	474	1.7%	2	.0%	33	.1%	6440	23.4%
	2000	1098	4.0%	102	.4%	0	.0%	1	.0%	1201	4.4%
Total		25465	92.7 %	1801	6.6%	10	.0%	199	.7%	27475	100.0%

Source: NMM ATICC, 2000

Appendix 13

Number of HIV infections by sex and population group, 1991-2000

			Population Group				Total
			African	Mixed	Asian	European	
Sex of patient	Male	Count	9043	640	7	163	9853
		% within Sex of patient	91.8%	6.5%	.1%	1.7%	100.0%
	Female	Count	16292	1153	3	36	17484
		% within Sex of patient	93.2%	6.6%	.0%	.2%	100.0%
Total		Count	25335	1793	10	199	27337
		% within Sex of patient	92.7%	6.6%	.0%	.7%	100.0%

Source: NMM ATICC, 2000

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	188.047(a)	3	.000
Continuity Correction			
Likelihood Ratio	182.879	3	.000
Linear-by-Linear Association	95.720	1	.000
N of Valid Cases	27337		

Appendix 14

HIV carriers and AIDS deaths (1989-2002)

Number of HIV carriers	Year	Number of AIDS deaths
30	1989	5
70	1990	9
190	1991	19
430	1992	57
750	1993	74
1534	1994	140
2621	1995	197
3703	1996	230
5234	1997	414
5800	1998	511
6444	1999	862
6837	2000	1021
7537	2001	1200
6050	2002 (January-September)	700
Total 44868		5189

Source: NMM ATICC, 2002

Appendix 15

Number of HIV infections recorded, 1991-2000

	Frequency	Percent	Valid Percent	Cumulative Percent
1991	190	.7	.7	.7
1992	430	1.6	1.6	2.3
1993	749	2.7	2.7	5.0
1994	1232	4.5	4.5	9.5
1995	2494	9.1	9.1	18.5
1996	3706	13.5	13.5	32.0
1997	5238	19.0	19.0	51.0
1998	5818	21.2	21.2	72.2
1999	6446	23.4	23.4	95.6
2000	1202	4.4	4.4	100.0
Total	27505	100.0	100.0	

Source: NMM ATICC, 2000

Appendix 16

Number of AIDS deaths by sex and year of recording, 1991-2000

		Sex of patient		
		Male	Female	Total
Year of death	1991	8	7	15
	1992	18	38	56
	1993	30	46	76
	1994	50	70	120
	1995	68	109	177
	1996	74	132	206
	1997	112	189	301
	1998	154	221	375
	1999	308	462	770
	2000	35	72	107
Total		857	1346	2203

Source: NMM ATICC, 2000

Appendix 17

AIDS deaths by age group and year of recording, 1991-2000

		Year of death										
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
5 year age group	80 to 85	0	0	0	0	0	0	0	0	1	0	1
	70 to 74	0	0	0	0	0	0	0	0	1	1	2
	65 to 69	0	0	0	1	0	1	4	0	4	0	10
	60 to 64	0	0	0	0	1	2	2	2	2	2	11
	55 to 59	0	0	2	1	2	2	4	7	14	0	32
	50 to 54	0	2	4	5	3	5	6	14	28	2	69
	45 to 49	1	0	5	4	9	5	13	24	45	4	110
	40 to 44	2	3	8	6	10	18	21	41	73	7	189
	35 to 39	3	9	9	16	29	29	42	42	95	12	286
	30 to 34	2	6	16	26	22	37	54	71	136	29	399
	25 to 29	0	7	8	15	33	35	66	71	161	18	414
	20 to 24	3	13	8	20	22	26	30	50	102	15	289
	15 to 19	2	2	2	5	8	3	8	3	22	6	61
	10 to 14	0	0	0	1	0	0	0	3	0	0	4
	5 to 9	0	0	0	0	0	1	2	0	1	0	4
	1 to 4	0	0	2	4	3	2	3	5	6	1	26
	Under 1	2	14	12	16	35	40	46	42	83	11	301
Total		15	56	76	120	177	206	301	375	774	108	2208

Source: NMM ATICC, 2000

Appendix 18

AIDS deaths by population group and year of death recording, 1991-2000

		Population Group				Total
		African	Mixed	Asian	European	
Year of death	1991	13	2	0	0	15
	1992	51	4	1	0	56
	1993	68	6	1	1	76
	1994	104	14	0	2	120
	1995	172	5	0	0	177
	1996	190	15	0	1	206
	1997	279	20	0	2	301
	1998	350	24	0	1	375
	1999	741	31	0	2	774
	2000	102	6	0	0	108
Total		2070	127	2	9	2208

Source: NMM ATICC, 2000

Appendix 19

Relationship of HIV-infected person to head of household

		Frequency	Percent	Valid Percent
	baby son	179	.7	17.6
	baby daughter	208	.8	20.5
	husband	2	.0	.2
	wife	3	.0	.3
	sister	2	.0	.2
	father	46	.2	4.5
	mother	576	2.1	56.6
	59	1	.0	.1
	Total	1017	3.7	100.0
Missing	see crss_ref	355	1.3	
	not stated	26133	95.0	
	Total	26488	96.3	
Total		27505	100.0	

Source: NMM ATICC, 2000

Appendix 20

Number of HIV infections by type of dwelling

		Frequency	Percent	Valid Percent
Valid		15879	57.7	57.7
	99	1	.0	.0
	ACADEMIA	12	.0	.0
	BARRACKS	185	.7	.7
	BUSINESS	53	.2	.2
	CARE_OF	16	.1	.1
	FARM	39	.1	.1
	Flat	57	.2	.2
	HARBOUR	2	.0	.0
	HOSPICE	16	.1	.1
	HOSPITAL	1	.0	.0
	Hostel, SMQ	1	.0	.0
	HOTEL	4	.0	.0
	Prison	368	1.3	1.3
	Location	83	.3	.3
	LUSOMO	1	.0	.0
	MALL	1	.0	.0
	NEPTUNE	1	.0	.0
	NURSERY	1	.0	.0
	PARK	2	.0	.0
	POBOX	38	.1	.1
	SCHOOL	2	.0	.0
	SITE&SER	2576	9.4	9.4
	SMQ	272	1.0	1.0
	SPORTS F	19	.1	.1
	SQUACAP	155	.6	.6
	SQUARE	3	.0	.0
	STELA	1	.0	.0
	Street address	7716	28.1	28.1
	Total	27505	100.0	100.0

Source: NMM ATICC, 2000

Appendix 21

Number of HIV infections by diagnostic institution and sex, 1991-2000

			Sex of patient		
			Male	Female	Total
Diagnostic Institution (a)	HOSPITAL	Count	4940	10559	15499
		% within Diagnostic Institution (a)	31.9%	68.1%	100.0%
	DOCTOR	Count	1046	1275	2321
		% within Diagnostic Institution (a)	45.1%	54.9%	100.0%
	ACADEMIA	Count	3	9	12
		% within Diagnostic Institution (a)	25.0%	75.0%	100.0%
	CLINIC	Count	2397	4698	7095
		% within Diagnostic Institution (a)	33.8%	66.2%	100.0%
	DF_SAP	Count	119	58	177
		% within Diagnostic Institution (a)	67.2%	32.8%	100.0%
	EPBTS	Count	187	174	361
		% within Diagnostic Institution (a)	51.8%	48.2%	100.0%
	INDUSTRY	Count	31	12	43
		% within Diagnostic Institution (a)	72.1%	27.9%	100.0%
	INSURANCE	Count	646	405	1051
		% within Diagnostic Institution (a)	61.5%	38.5%	100.0%
	MOH_DS	Count	40	88	128
		% within Diagnostic Institution (a)	31.3%	68.8%	100.0%
	PRE_EMLOY MENT	Count	43	24	67
		% within Diagnostic Institution (a)	64.2%	35.8%	100.0%
	PRISON	Count	288	45	333
		% within Diagnostic Institution (a)	86.5%	13.5%	100.0%
	SANTA TB	Count	97	128	225

	% within Diagnostic Institution (a)	43.1%	56.9%	100.0%
Total	Count	9837	17475	27312
	% within Diagnostic Institution (a)	36.0%	64.0%	100.0%

Source: NMM ATICC, 2000

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1044.767a	11	.000
Continuity Correction			
Likelihood Ratio	1017.616	11	.000
Linear-by-Linear Association			
N of Valid Cases	27312		

Appendix 22

Number of HIV infections by type of area, 1991-2000

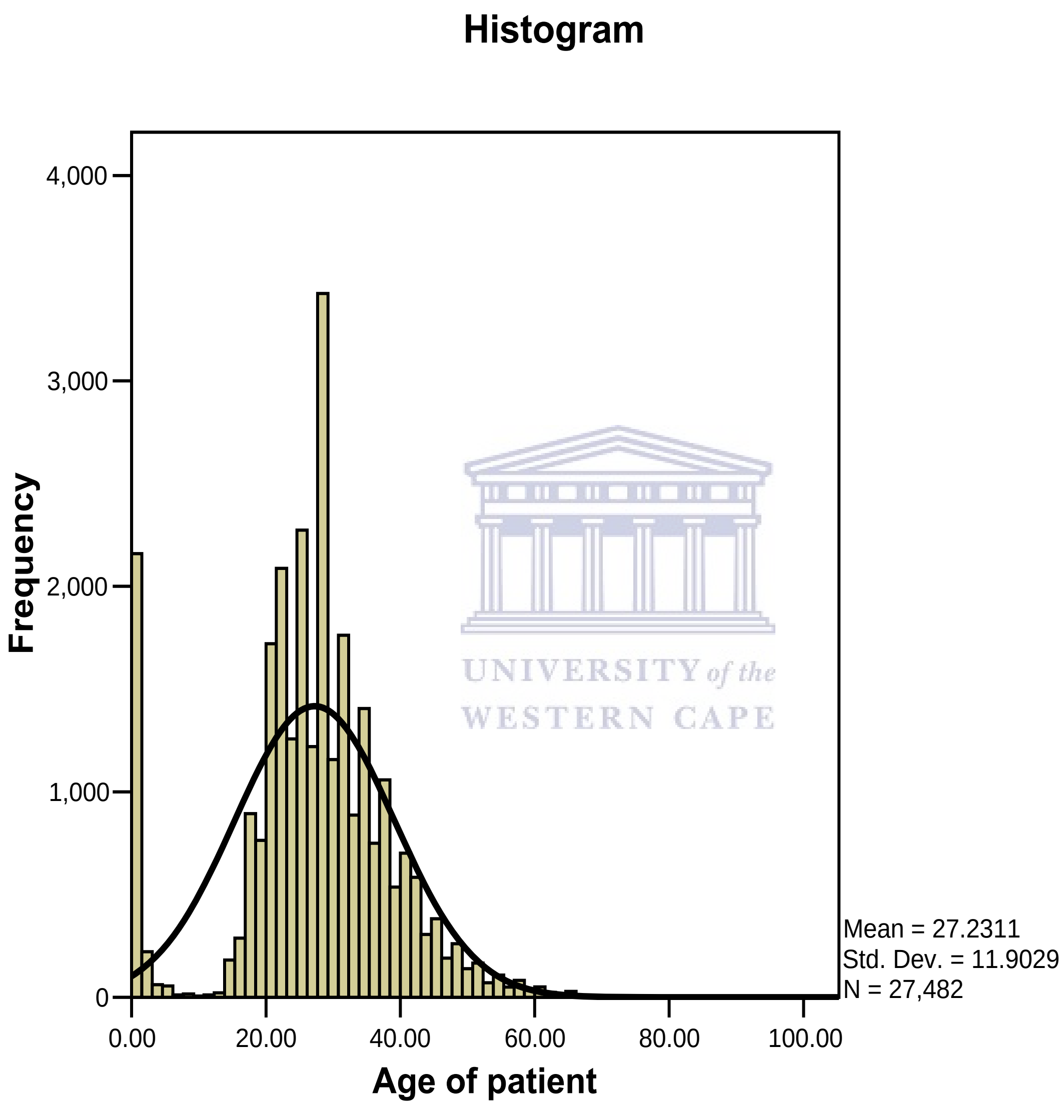
		Frequency	Percent	Valid Percent
Valid		12797	46.5	46.5
	.	1	.0	.0
	Area	390	1.4	1.4
	Settlement	2	.0	.0
	Settlement/Group of huts	1	.0	.0
	Town	1711	6.2	6.2
	Urban_Area(Urban_Area)	12603	45.8	45.8
	Total	27505	100.0	100.0

Source: NMM ATICC, 2000

Appendix 23

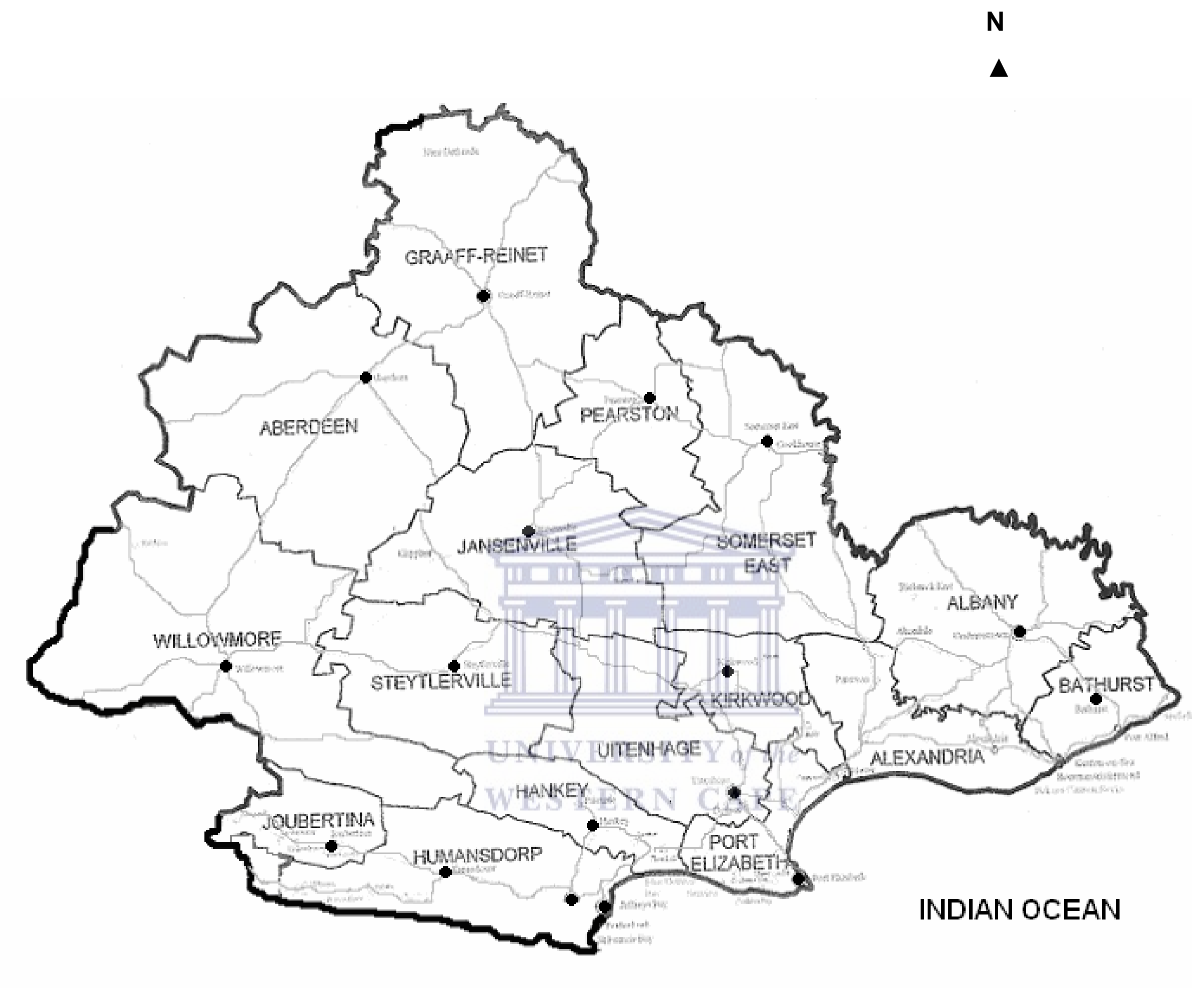
Histogram of the age variable with a normal curve

Source: NMM ATICC, 2000



Appendix 24

The magisterial districts in Region A before demarcation in 2000



Source: Port Elizabeth & Uitenhage Metropole, Socio-Economic Monitor - A Profile of the Metropole for Decision Makers, 2000. page 81

Appendix 25

Transmission patterns of HIV infections, 1991-2000

		Frequency	Percent	Valid Percent
Valid	Missing	7442	27.1	27.1
	Rape	53	.2	.2
	Other	9	.0	.0
	Homosexual	8	.0	.0
	Heterosexual	18348	66.7	66.7
	Haemophilia	1	.0	.0
	Mother to Child Transmission	1627	5.9	5.9
	Bisexual	9	.0	.0
	Anonymous	3	.0	.0
	Total	27500	100.0	100.0
Missing	Unknown	5	.0	
Total		27505	100.0	

Source: NMM ATICC, 2000

Appendix 26

HIV infection by counseling place and sex of patient, 1991-2000

		Sex of patient		Total
		Male	Female	
ATICC	Count	90	98	188
	% of Total	3.8%	4.1%	7.9%
Blood Trans-fusion	Count	4	6	10
	% of Total	.2%	.3%	.4%
Clinic	Count	171	288	459
	% of Total	7.2%	12.2%	19.4%
Hospital	Count	567	1134	1701
	% of Total	23.9%	47.9%	71.8%
Private	Count	7	4	11
	% of Total	.3%	.2%	.5%
Total	Count	839	1530	2369
	% of Total	35.4%	64.6%	100.0%

Source: NMM ATICC, 2000

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.579(a)	4	.000
Continuity Correction			
Likelihood Ratio	19.879	4	.001
Linear-by-Linear Association			
N of Valid Cases	2369		

Appendix 27

Population group compositions, 1996 and 2001

Population group	2001	1996
Africans	592355	538133
Coloured	236160	235992
Indian	11237	11100
White	166026	173548

Source: STATS SA 2004

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