PREGNANCY RELATED MATERNAL DEATHS AT SALT RIVER FORENSIC PATHOLOGY LABORATORY

A 5 year retrospective study of the epidemiological data and spectrum of pathology and disease in all pregnancy related deaths at Salt River Forensic Pathology Laboratory irrespective of the cause of death.

MINOR DISSERTATION FOR THE PARTIAL FULLFILLMENT OF DEGREE, MASTERS OF MEDICINE IN FORENSIC PATHOLOGY

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APRIL 2014
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1. DECLARATION

I, AKMAL KHAN, HEREBY DECLARE THAT, I KNOW THE MEANING OF PLAGIARISM AND THAT THE WORK ON WHICH THIS DISSERATION IS BASED IS MY ORIGINAL WORK (EXCEPT WHERE ACKNOWLEDGEMENTS INDICATES OTHERWISE), AND THAT NEITHER THE WHOLE WORK OR ANY PART OF IT HAS BEEN, IS BEING, OR IS TO BE SUBMITTED FOR ANOTHER DEGREE IN THIS OR ANY OTHER UNIVERSITY. I EMPOWER THE UNIVERSITY TO REPORODUCE THIS WORK FOR THE PURPOSES OF RESEARCH EITHER IN ITS ENTIRETY OR ANY PORTIONS OF THE CONTENTS IN ANY MANNER WHATSOVER.

SIGNATURE OF PRINCIPAL AUTHOR AND INVESTIGATOR:

Signed by candidate

DATE:

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2. ACKNOWLEDGMENTS

1. STEFAN COETZEE: To my loving partner and spouse, thanks for all the support and understanding during this process.

2. JUNE MEHL (divisional secretary): Thanks for the assistance and co-ordination of this research and dissertation. Furthermore thanks for the friendship and support for the duration of my studies at the division.

3. DR GAVIN KIRK (Head of Clinical Unit, division of Forensic Medicine): Thanks for the supervision and assistance with this research project.

4. OMAR GALANT (Administrative Officer in the division of Forensic Medicine): Thanks for providing me with support and assistance in the use of the office autopsy database and with the location of case files for my research project.

5. PROF LJ MARTIN, DR IJ MOLEFE AND DR IH ALLI: Thanks for the advice and encouragement through the years at the division.

3. DEFINITIONS AND ABBREVIATIONS

AIDS: Acquired immunodeficiency syndrome

ARV: Anti-retroviral therapy

Cause of death or COD: refers to the primary medical cause of death which will be described as the disease or injury which initiated the train of morbid events leading directly to death.

DFMUCT: Division of Forensic Medicine, University of Cape Town

Early post-partum death or Early PP: refers to a death within the first seven (7) days following termination of pregnancy.

Gravidity: refers to the number of pregnancies experienced by a woman, whether complete or incomplete; includes miscarriages, abortions and ectopic pregnancies.

HIV: Human immunodeficiency virus

ICD-10: International classification of disease, tenth revision

Inquest Act: refers to Act No. 58 of 1959 which provides for the holding of inquests in cases of death or alleged death apparently occurring from other than natural causes and for matters incidental thereto.

Late post-partum death or Late PP: refers to a death between seven (7) days to forty two (42) days following termination of pregnancy.

Manner of death: refers to the root cause that initiated the events and answers the questions as to how and why these events occurred; who or what initiated the events and was the death caused by the victim, another person, an unfortunate occurrence (accidental) or Mother Nature.

MOU: Maternity Outpatient Unit

Other than natural deaths or unnatural deaths: refers to deaths from (as per rules and regulations taken from the National Health Act No.61 of 2003 with regards to forensic medico-legal services in South Africa) -

- Application of force, direct or indirect and its resultant complications.
- Due to the effects of any chemical or toxic substance, drug or electrical effect.
- Any death where another person by a negligent act or omission can be held responsible for the death.
- Any death occurring while the deceased was under the influence of a local or general anaesthetic (see procedure related death).
- Where death is sudden and unexpected or explained.

Parity: refers to the number of times a woman has given birth, whether alive or dead infant.

PM: refers to post-mortem examination

Procedure related death: refers to deaths defined by the Health Professions Amendment Act, No. 29 of 2007 which states that the death of a person undergoing or as a result of a procedure of a therapeutic, diagnostic or palliative nature or of which any aspect of such a procedure has been a contributory cause shall not be deemed to be a death from natural causes.

RTA: Road traffic accident

Research number: Number allocated by primary investigator to each case identified from the file perusal beginning at 001.

Suspected clinical cause of death: refers to the suspected cause of death provided by the clinicians attending to the individual whilst in hospital based on their clinical findings.

First (1st) Trimester or 1st T: refers to the first thirteen (13) weeks of pregnancy.

Second (2nd) Trimester or 2nd T: refers to the gestation period between thirteen (13) and twenty six (26) weeks.

Third (3rd) Trimester or 3rd T: refers to the gestation period after twenty six (26) weeks till delivery of the foetus.

UNFPA: The United Nations Population Fund

UNICEF: The United Nations Children's Fund

WHO: World Health Organization

4. ABSTRACT:

Introduction: Death of women whilst pregnant and in the post-partum period is a huge burden of disease in South Africa. All confidential enquiries and research into pregnancy related deaths in South Africa have focused on examining the cases based on the WHO definition of maternal death and have excluded deaths from incidental or accidental causes. Pregnancy related deaths due to suicide, homicide and accidental causes have predominantly only been studied in first world countries. There is minimal data available for developing countries like South Africa.

Methods: A retrospective quantitative and qualitative review of all pregnancy related maternal deaths admitted to the Salt River Forensic Pathology Laboratory between 1 January 2008 and 31 December 2012 was performed. All females that were reported to be pregnant or within forty two (42) days of termination of pregnancy, irrespective of the duration, site of pregnancy, cause of death or manner of death were included in the research study group.

Results: 114 cases of pregnancy related deaths were identified for the five (5) year period with the most number of cases seen in 2008 (n=27). There was a peak of cases in the months of June (12.3%) and in April (11.4%). 62% of the deaths occurred in the ethnic African population group. The age of the women ranged from 17 years to 44 years with a mean of 28.3 years. The greatest number of deaths were seen in the 30-34 year age group (27%). The greatest number of deaths occurred in the early post-partum period (30%) and the 3rd trimester (25%) respectively. The greatest number of deaths occurred at home (n=32) and at tertiary level hospitals (n=31). 48% of the deaths were determined to be of natural causes, with 17% due to homicide, 11% due to accidental events, 7% due to suicide, 5% due to other unnatural causes and in 12% of cases the manner of death could not be ascertained following autopsy examination. The most common causes of natural deaths encountered were due to the consequences of gestational hypertension and eclampsia (n= 8), closely followed by pneumonia and cardiac pathology (n=7). Homicide deaths made up the greatest number of death in the other than natural category with 19 cases. 58% of homicide deaths were due to sharp force trauma to

the body and 42% of the homicide deaths were as a consequence of intimate partner violence. 8 deaths were found to be as a result from suicide. 75% of the suicide deaths were attributed to suspected drug overdoses and toxin ingestion. 12 deaths were from accidental causes which included road traffic accident and deaths from exposure to fires. 9 deaths were found to be as a result of adverse effects or complications following medical treatment or procedure. There was 28% discrepancy observed when comparing suspected clinical cause of death with the post-mortem cause of death.

Conclusion: More than half of the cases encountered in the study died of other than natural causes which would indicate that there is a great need for further research and investigation into pregnancy related deaths from accidental and incidental causes in the South African context. The study highlights the violent homicidal death in pregnancy and the prevalence of intimate partner violence in pregnancy. Furthermore, the study highlights the value of information that can be retrieved from a complete post-mortem examination and recommends that the national confidential enquiry team include pathologists in their working team. The primary investigator further recommends that the method of paper review of maternal death cases in South Africa be reviewed as the primary method of evaluation.

5. INTRODUCTION AND BACKGROUND:

A. The increase in maternal deaths in South Africa becoming a problem of great concern.

Deaths in women whilst pregnant and in the first forty-two (42) days following delivery remain a major problem in South Africa. According to the Saving Mothers 2005-2007, fourth report on confidential enquiries into maternal deaths in South Africa, a total of 4077 maternal deaths were reported for the triennium, which is an increase from the previous trienniums of 2002-2004, which reported 3406 deaths and 1999-2001 which reported 2490 deaths[1,2,3]. Numerous recommendations were made by the confidential enquiry committee in respect of management protocols for obstetric emergencies, education of health staff and patients and to improve the screening of HIV/AIDS related diseases and conditions. However despite these recommendations and strategies, a further increase was reported in the fifth report for the triennium of 2008-2010 of 4867 deaths[4]. These increases are thought to be due to better reporting combined with an actual increase. The focus of these confidential enquiries is to identify various medical pregnancy related conditions and categories that are of increased risk of dying during pregnancy at the different levels of care within South Africa. These enquiries are performed to assist the state with planning and implementing of relevant and worthwhile screening, detecting and management protocols to reduce the number of maternal deaths and address the difficulties encountered at different levels of service within the country[1]. The enquiries also allow for early detection of new trends and patterns of disease, an example being the increase in number of maternal deaths as a consequence of non-pregnancy related infections and AIDS related illnesses as an emerging major cause of death over the last nine (9) years[1,2,3,4].

According to estimates developed by WHO, UNICEF and UNFPA, released in 2000, South Africa had a maternal mortality rate of 230 deaths per 100,000 live births which is very high when compared to first world and industrialized countries, but similar figures are seen in other developing countries like Brazil (260 per 100,000 live births) and India (540 per 100,000 live births)[5,6,7]. There is much confusion about

the maternal mortality rate in South Africa with estimates varying from between 150 deaths per 100000 live births (South African Demographic and Health Survey) to 181-382 per 100000 live births (Graham and Newell) to 578 per 100000 live births (2001 census estimates)[8,9,10]. According to WHO 2010 estimates a maternal mortality rate of approximately 300 per 100 000 live births has been published for South Africa[5]. The confidential enquiry into maternal deaths in South Africa is not a demographic or epidemiological survey and thus cannot report a maternal mortality rate in its enquiry. In rural areas of South Africa, most maternal deaths occur outside of health institutions and may not be reported to the local authorities. Thus many of the calculations are estimations. The lack of reliability into the happenings outside of medical facilities makes the interpretation of these maternal mortality rates extremely complicated. In the fifth confidential enquiry into maternal deaths for the triennium 2008-2010, an institution or facility maternal mortality rate is given which was reported to be 176.22 per 100 000 live births[4]. South Africa's maternal mortality rates continue to increase each year despite improvements in education of health staff and allocation of various resources.

B. Definition dilemmas

Pregnancy-related maternal deaths can be regarded as the death of a woman resulting from or related to her own pregnancy and/or post-partum condition. According to the WHO, maternal mortality is defined as the death of a woman during pregnancy, childbirth or within 42 days of termination of pregnancy or pueperium, irrespective of the duration and site of pregnancy, from any cause related to the pregnancy or its management but not from accidental or incidental causes[5]. Thus, the WHO definition does not focus on deaths from external forces. This definition also excludes deaths occurring during or following assisted reproductive technologies where pregnancy has not occurred. ICD-10 defines pregnancy related deaths as the death of a woman while pregnant or within 42 days of termination of pregnancy irrespective of the cause of death[11]. ICD-10 further goes on to include a new category of late maternal death which includes deaths after 42 days but within one (1) year of termination of pregnancy[11]. The reason for the inclusion of a late maternal death is due to improved technology and advancements in medicine that

could possibly prolong life but the initiating factor remains related to the pregnancy. However, these cases of late maternal death are difficult to recognize or identify.

According to ICD-10, maternal deaths should be divided into direct obstetric deaths and indirect obstetric deaths[12,13]. This is the same classification that is used for the Saving Mothers confidential enquiry performed in South Africa[1,2,3,4]. Direct obstetric deaths are those resulting from obstetric complications of pregnancy, from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above. Indirect obstetric deaths are those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes but was aggravated by physiologic effects of pregnancy[12,13].

The problem with these definitions is that cases of maternal death that don't fit into these definitions fail to reach the attention of the desired parties and go unrecognized. The discrepancy in the WHO and ICD-10 definition also makes identification of cases more complex. The third, fourth and fifth confidential enquiries done in South Africa have included co-incidental deaths in their total number of cases, which reported 110 cases in the triennium of 2002-2004, 118 cases in the triennium of 2005-2007 and 99 cases in triennium of 2008-2010[4].

Deaths from accidental and incidental (unnatural) causes have historically been excluded from the WHO classification and calculation of the maternal mortality rate. Should these cases of accidental and incidental deaths be included, it would increase the rate of maternal mortality in all countries. Some may argue that the initiating factor for these cases may not be related to health care or does not affect the health care system and thus should not be used in calculation of the maternal mortality rate. It is for this reason that accidental and incidental deaths have gone unrecognized and unresearched by the health community at large. It is unknown whether in South Africa, suicidal deaths originating from depression or psychosis in pregnancy are included in the maternal mortality numbers. Depression or psychosis during pregnancy and in the post-partum period has been well documented in literature and it can be argued that certain psychological changes seen in women are related to the physiological effects of pregnancy and therefore should also be

included in the maternal mortality numbers[14]. It can also be argued that those individuals with pre-existing psychosis and depression, which are in a stable condition prior to pregnancy, their condition may be exacerbated by the physiological effects of pregnancy or as a result of medication changes to prevent teratogenicity, placing these individuals at increased risk of death by suicide. Social factors impacting many women in South Africa affect their decisions during the pregnancy which may result in the consumption of products to terminate their pregnancy with resultant fatal complications. Homicidal deaths resulting from an unplanned or unwanted pregnancy also go unrecognized by this definition. These deaths may not seem to affect health care directly but they do exist and attempts should also be made to prevent them. One would argue that even cases afflicted by external forces also affects the health system directly as these cases also present themselves at emergency care and casualty units. Traumatic injuries whether intentional or accidental requires a higher level of care as the physiological effects of pregnancy may result in increased bleeding or the stress of the traumatic event could precipitate early delivery of an immature infant or result in a pregnancy loss. This would indicate to me that protocols should also be in place for the improvement of care in traumatic pregnancy related deaths similar to those developed for obstetric emergencies in South Africa. Thus, with the current WHO terminology used in South Africa, no provisions are being made to reduce the numbers of deaths due to external forces and to provide education regarding these types of deaths in our country.

C. Violence and abuse in pregnancy

Abuse and violence against women has been well documented in South Africa and remains a huge public health problem. It is this very abuse that can be associated with unwanted and unplanned pregnancies[15,16]. In many instances the abuse and violence is usually inflicted by the intimate partner. Abuse in pregnancy has been associated with depression and substance abuse and in some studies, it is also associated with slightly low birth weight infants[17,18]. In the United States, domestic abuse by intimate partners is associated with increased numbers of homicides during pregnancy and in the post-partum period. In some instances, the domestic violence and abuse starts during the pregnancy or the severity of the violence and

abuse increases during pregnancy[18]. There have been studies that also document a protective period from domestic violence in a small proportion of women during pregnancy[17,18]. This phenomenon of violence and abuse during and after a pregnancy is not fully understood and is thought to be associated with cultural and ethnic norms as violence and homicide deaths in the United States is more common amongst the ethnic African American and Hispanic communities compared to the ethnic white communities[17].

A North American review of multiple studies showed a prevalence of violence in pregnancy ranging from 0.9% and 20.1% with the majority of studies showing averages between 3.9% and 8.3%[15,16,17]. In other studies performed in industrialized countries like Australia, Sweden, Switzerland and the United Kingdom, the prevalence rates range from 3.4% to 11%[16]. Higher rates of prevalence have been reported in developing countries with the highest levels seen in Egypt (31.5%), India (21 to 28%) and Saudi Arabia (21%)[17]. Research in the United States and in developing countries has shown that women from poor economic backgrounds or in low income groups are most at risk for violence and abuse[18].

With significant reductions in maternal mortality rates seen in some countries around the world due to the efforts of many organizations, especially like the WHO, deaths due to accidental or incidental causes has started to become the leading cause of death in pregnancy especially in first world and industrialized countries. Thus many countries have begun research into deaths from accidental or incidental causes to accurately assess the situation and implement programmes to reduce deaths from these causes.

South Africa has an overall female homicide rate of 24.7 deaths per 100 000 which is more than six (6) times greater than the world average of 4.0 deaths per 100 000 female population[19]. Of these female homicide deaths, 8.8 deaths per 100 000 occur as a result of intimate partner violence thus making pregnancy, a particular vulnerable at risk period[20]. There has been no comprehensive study into external factors like intimate partner violence in pregnancy within South Africa.

D. Identification of cases

Cases of maternal deaths are difficult to identify as it requires the staff involved in the management to report these cases to their local authority. Furthermore, information regarding the pregnancy, the woman involved and management provided to her; needs to be provided to the local authority to facilitate enquiry into the matter.

Cases are also identified by two (2) methods in South Africa. Firstly, when a death occurs at a facility, a maternal death notification form needs to be filled in and sent to the relevant government representative within seven (7) days of the death[4]. The death will then be reported to the national committee for confidential enquiry[4]. The second method used to identify cases is from the death notification form sent to the Department of Home Affairs. There is an item on page 1 of 1 that asks if the individual had been pregnant or if termination of pregnancy took place 42 days prior to death. The quality of the statistics of maternal deaths in South Africa lies in the hands of the medical personnel working at different levels of care. As mentioned earlier, deaths occurring in rural areas, most of which may occur outside of health institutions may go unreported or little and poor information regarding these deaths are provided to the relevant authorities. Therefore, it is widely thought that the numbers reported by the National confidential enquiry committee may actually be an under-estimate of the problem at hand.

These problems faced by government and enquiry groups make accurate assessment of the problem even more complex and the need to improve the identification system of maternal deaths in South Africa more evident. Many efforts have been made by government and enquiry groups in to increase awareness of reporting maternal death cases and their efforts can be seen by the improved quality of information seen in the confidential enquiry reports[1,2,3,4]. It is vital the medical staff at all levels of care understand the importance of reporting maternal deaths to their local governmental representative. This also includes forensic pathologists who encounter incidental maternal death cases at their respective mortuaries.

E. The importance of these rates and the allocation of resources

Maternal mortality estimates or rates may seem unproductive and useless; however it provides vital information for the care of women within a health care system. It also allows the health care system to identify problems within the society or community and allows for adequate resources to be present for good health. Health according to the WHO definition of 1946 is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity[5].

Thus resources should also be allocated to prevent deaths from external forces or related to psychological conditions as well and not for disease prevention only. Pregnancy provides an opportunity for women to gain vital health educational information from health staff and this information should not only be about HIV and sexually transmitted diseases but should also include information about depression and domestic violence. Currently ante-natal education programs do not necessarily focus on the issues and dilemmas of depression and domestic violence during the pregnancy period.

It allows the local authorities and government to assess the standard of care within each region. It can also be used to assess improvements or declines in health within a specific district or region over a specific period of time. Thus it is vitally important that these statistics are accurate and appropriately describe the actual situation being experienced by women in the South African context. It further highlights the importance of good reporting from all levels of care to ensure resources are allocated where it is needed most.

F. Forensic and academic autopsies

An autopsy performed in a maternal death can provide vital information to support the clinical data provided by the medical team or identify discrepancies in the clinical data provided. It allows for the determination of an accurate cause of death and also addresses the issues of substandard care and incorrect diagnoses. A recent necropsy study published in the Lancet showed the presence of clinical discrepancies of up to 15% of cases when compared with necropsy results[21]. Most

maternal death cases are not autopsied by a department of forensic pathology or anatomical pathology. Most cases have a so-called “verbal” or “paper” autopsy based on the clinical data obtained from the various institutions[22]. Only cases related to the Inquest Act and Procedure Related deaths are autopsied in the forensic pathology laboratories around South Africa. Cases autopsied by anatomical pathology departments are usually on an academic basis and need to be referred by the attending medical team. Thus the reported diagnosis and clinical data provided to the confidential enquiry team is based mainly on paper review and is more a suspected clinical cause of death rather than a definitive histopathological cause of death. Does this type of enquiry actually help our country? Are services and resources being provided for suspected conditions and causes of death? Does the poor reporting and in some cases little clinical data received, allow the members of the confidential enquiry team to confidently come to accurate answers of the problems at hand? Is there a need to advocate for the mandatory performance of autopsies on all maternal deaths in South Africa irrespective of the cause of death?

6. RESEARCH MOTIVATION, AIMS AND OBJECTIVES

There has been no research data, study or enquiry into pregnancy related maternal death irrespective of the cause of death performed in South Africa. It is not publically known how many women die from external forces during pregnancy and in the post-partum period. It is the belief of the author that the data collected in this study could be used to stimulate further research and enquiry into maternal deaths due to external forces in South Africa.

It is also the belief of the author that the information and data collected can be used to educate the mothers of the nation and to prevent accidental and incidental deaths as well as deaths from direct and indirect obstetric causes.

The study will serve to categorize the deaths seen at a forensic pathology laboratory into natural deaths and other than natural deaths as per definitions laid out in the Inquest Act. The study will further categorize the deaths into different fields which include homicides, suicides and accidental deaths to assess where preventative measures need to be targeted. The data collected can be used by the relevant authorities to implement strategic health plans at different levels of care which may include as an example, supportive and counselling services at antenatal clinics and maternal outpatient units.

The author also plans to highlight the wealth of pathological data that can be attained from a medico-legal post-mortem which can be used to support clinical data or identify discrepancies in clinical data and diagnoses that can be used by the confidential enquiry team. This will further improve the quality of data in these enquiries and further improve the health care system that we provide to the women within this country.

To use the data attained from the study to possibly advocate for the inclusion of pathologists and/or forensic pathologists in the confidential enquiry panel into maternal deaths in South Africa to further facilitate better understanding of the pathological reports provided.

To evaluate from the data collected whether there is a need to advocate for the compulsory performance of autopsies, histopathological examination and associated appropriate ancillary investigations, in order to facilitate accurate establishment of cause of death in all deaths of pregnant women in South Africa.

7. STUDY DESIGN:

The research study performed was a retrospective quantitative and qualitative review of all maternal deaths, as per the ICD-10 definition, admitted to the Salt River Forensic Pathology Laboratory between 1 January 2008 and 31 December 2012.

All females that were reported to be pregnant or within 42 days of termination of pregnancy irrespective of the duration, site of pregnancy, cause of death or manner of death were included in the research study group. Late maternal deaths according to the ICD-10 classification of between 43 days and within a year of termination of pregnancy were not included in the current research study.

8. METHODOLOGY:

The research data was collected by the primary investigator after receiving approval from the UCT Ethics Committee (see Appendix A for Approval Letter) from the 19 September 2013 to the 24 September 2013 by using access to the Office autopsy database (database located on G: hard drive in the DFMUCT). This database contained the lists and information of all the cases autopsied at Salt River Forensic Pathology Laboratory over the period being researched which was collated by the pathologists working within the DFMUCT. Further to this, a cross check of cases was performed using the Salt River Forensic Pathology Index of cases located on G: hard drive in the DFMUCT which was collated by the Forensic Officers Mortuary Management system at Salt River Forensic Pathology Laboratory. Proxy consent for access to this database and for consent to the information present within the case files located in the archives was provided by the chief specialist and head of the Division of Forensic Medicine at the University of Cape Town, Professor LJ Martin (see Appendix B for proxy consent letter).

The study subjects were selected from the office autopsy database using two (2) filtering fields of search. The first search word used was “female” in the gender category to identify all female cases done over the research period. Then the second search filter was the “age” category applied to all the female cases identified from the first filter to identify all the women in the maternal or reproductive age group. A widened age filter of 10 to 50 years was used to prevent missing any possible case where the age may have been incorrectly recorded or stated on the database and to contend with late birth registration which is not an uncommon occurrence within the country.

All subjects that were identified from the office autopsy data were captured on a Data Capture Sheet with the unique post-mortem death register number as temporary reference (see Appendix C for an example of Data Capture Sheet). Each subject’s file was then removed from the archive and perusal through the file was performed to identify if the subject was either pregnant at the time of death or within forty two (42) days after termination of the pregnancy to qualify for the research study. Once a case or subject had been identified to be fitting within our research study group, the case was allocated a unique research study number starting from 001. Then the data collection sheet designed by the primary investigator (see Appendix D for Data Collection Sheet) was used to extract the relevant research data from the case file.

The data collection sheet looked to collect data with regards to the date of death, age and race of individual, death related to the pregnancy and post-partum period, site of death, parity and gravidity, number of foetus, prenatal care, HIV status, suspected clinical cause of death, manner of death and post-mortem cause of death. These data questions contained a list of variables or categories that the individual could fit into. Other variables unique to autopsies were also included within the study such as alcohol levels, toxicology analyses and histopathological examination and results. All the data was recorded on the data collection sheet and kept as hard copies.

The data was then transferred from the hard copy data collection sheet onto a Microsoft ® Office 2007 excel spreadsheet with the uniquely assigned research

number as reference. The data was rechecked by myself to ensure that the information had been accurately transferred. The data within the spreadsheet was further analysed using unique formulas and statistical tests present in the Microsoft ® Office software, 2007 edition. The post-mortem death register numbers used to initially identify the cases were not transferred into the excel spreadsheet to maintain anonymity. The post-mortem death register numbers were not included in the data collection sheet.

Review of the medico-legal information contained within the files was performed by myself as the primary investigator within the DFMUCT. All relevant files and documentation were signed out of the archives as per prescribed rules within the DFMUCT. Once the data had been collected, the case files were immediately returned to the archives as per prescribed rules within the DFMUCT. Missing case files were acquired with assistance from the administrative officer Mr. Omar Galant and divisional secretary Ms. June Mehl in October and November 2013.

All information encountered within the files and the data that was transferred into the excel spreadsheet was treated as confidential. The personal identifying details, like the name and identification number of the deceased were not included into the data collection sheets or excel spreadsheet. This confidentiality was maintained throughout the research period and during the write up of the dissertation. This confidentiality and anonymity will be further maintained should the research be published in the future.

There were no risks encountered during the identification and collection of the research data.

In many cases, there was no definitive information about pregnancy recorded in case files and these cases were excluded from the research study. There were post-mortem reports that reported the genital organs as “not examined” or left blank in the report and these cases were also excluded from the research study. Cases with causes or manner of death recorded as “undetermined” were included in the study group and categorized accordingly. The reason for this was to also identify and highlight the reasons for the causes and manner of death being recorded so.

There was no official funding of the research study. The basic costs of stationery and computer equipment and software were paid for by the primary investigator.

There was no official recruitment of staff for the case identification and data collection process. The administration officer at DFMUCT, Mr. Omar Galant assisted with the location of some case files that were absent, otherwise the majority of case files were identified by the primary investigator. The collection of the data was performed in its entirety by the primary investigator.

The analysis of the data present on the excel spreadsheet was performed with the use of formulas of the Microsoft ® Office excel software which was performed by the primary investigator. Checking, assistance and guidance with this was also provided by the supervisor Dr Gavin Kirk. Furthermore, statistical tests in the form of paired T-tests and Chi-Square tests were applied to the numerical and categorical data collected. A Chi-Square critical value comparisons to $p = 0.05$ and $p = 0.01$ were applied to the categorical data collected to assess for significance.

9. RESULTS:

A. General findings

There were 14878 autopsies performed at Salt River Forensic Pathology Laboratory during the five (5) year research period from 1 January 2008 to 31 December 2012. There were 1803 cases identified for perusal from the search filtering process of the Office Autopsy database and the Salt River Forensic Pathology index located on the G: Hard drive in the DFMUCT. On the perusal of these 1803 cases from the archives, 114 cases were identified to qualify for the study. Thus, the incidence of pregnancy related deaths comprised of 0.77% of all autopsies performed at Salt River Forensic Pathology Laboratory. 30 cases had no descriptions of the genitalia (left blank) or recorded the internal genitalia as "not examined" and could not be adequately assessed for the study. These 30 cases were excluded from the research study.

Of the 114 cases identified; 27 cases were from 2008, 25 cases from 2009, 20 cases from 2010, 22 cases from 2011 and 20 cases from 2012; see CHART 1. Of the 114 cases, 55 cases (48%) were assessed by the attending pathologist to be of natural causes and 59 cases (52%) were grouped into the other than natural cause's category. The highest number of other than natural deaths was seen in 2008 with 18 cases and the lowest number of other than natural deaths was seen in 2010 with seven (7) cases, see CHART 1.

The variance seen in the distribution of cases between 2008 and 2012 had a Chi-Square value of 1.65 which would indicate a p value greater than 0.05 (Chi-Square critical value for p = 0.05 was 9.487). The variance seen in the distribution of natural cases compared to other than natural cases had a p value of 0.7 using paired statistical T Tests. Thus the variability in the distribution of deaths was not significant.

The monthly distribution of the cases showed peaks in April with 13 cases (11.4%) and in June 14 cases (12.3%). The quietest month was November with five (5) cases (4.4%). The variance in the distribution of cases over the months of the year had a Chi-Square value of 9.02 which corresponds with a p value greater than 0.05 (Chi-

Square Critical value for p = 0.05 was 19.675). Thus the distribution of these deaths could be due to co-incidence.

CHART 1: Yearly distribution of pregnancy related deaths

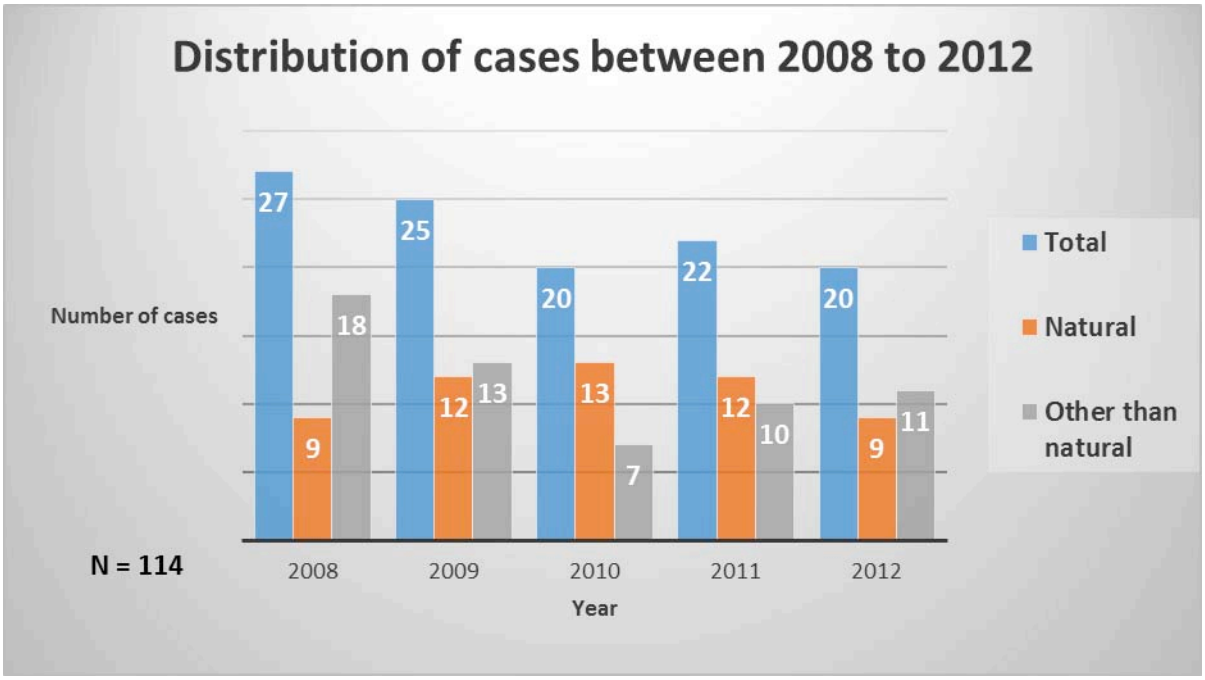
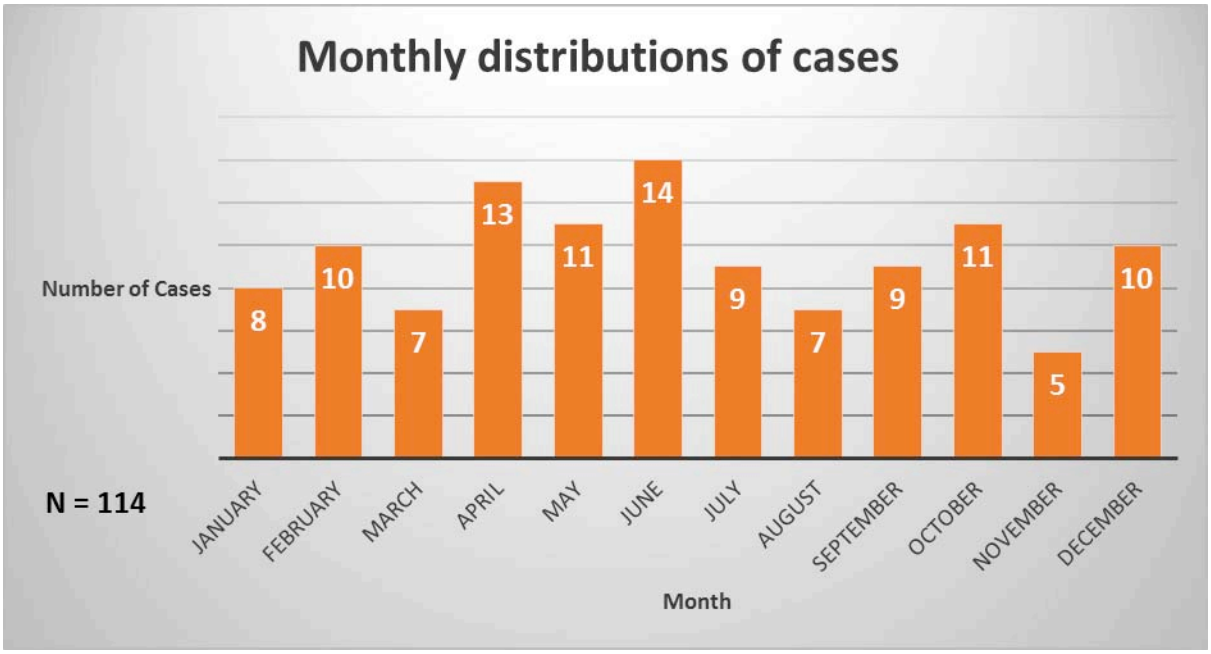
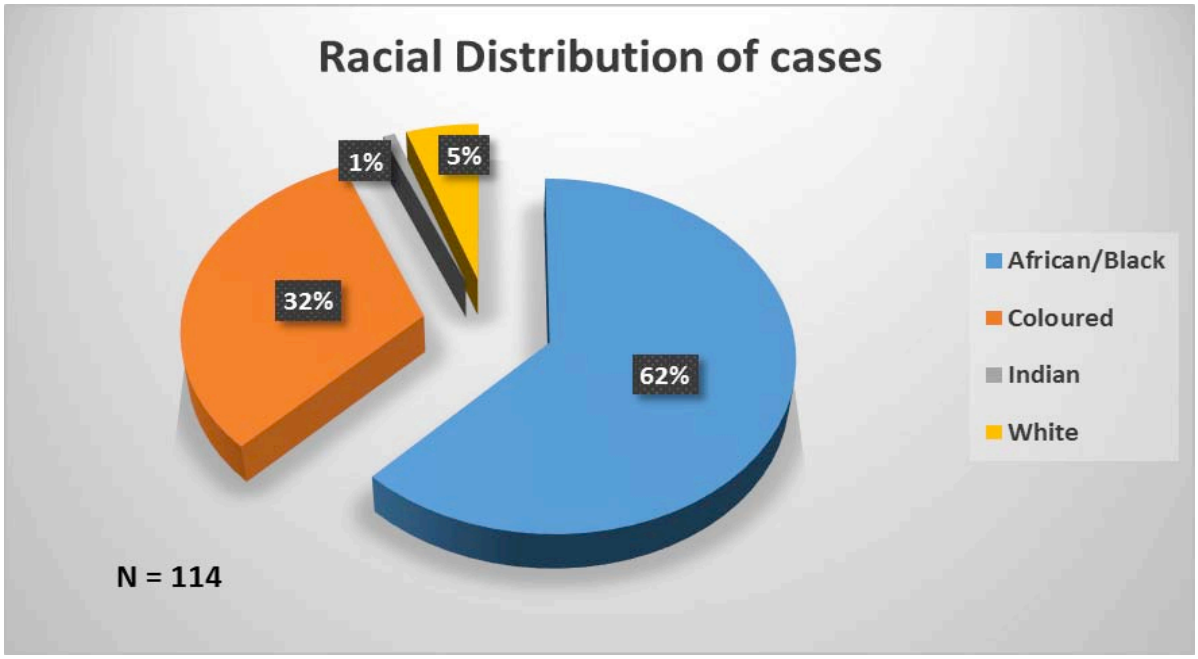


CHART 2: Monthly distribution of pregnancy related deaths



The racial profile or ethnic breakdown of the research study group comprised of 71 African/Black individuals (62%), 36 Coloured individuals (32%), 6 White individuals (5%) and one (1) Indian individual (1%); see CHART 3. The variance seen in the distribution of cases amongst the different ethnic groups when compared to the racial breakdown of the Western Cape province show a Chi-Square value of 50.31 which corresponded to a p value less than 0.01 (Chi-Square Critical value for p = 0.01 was 11.34), therefore making the reported increased maternal deaths seen in the African/Black population significant. Please note that the racial breakdown for the Cape metropolitan region was not used as reliable statistics for this region could not be acquired.

CHART 3: Racial distribution of pregnancy related deaths

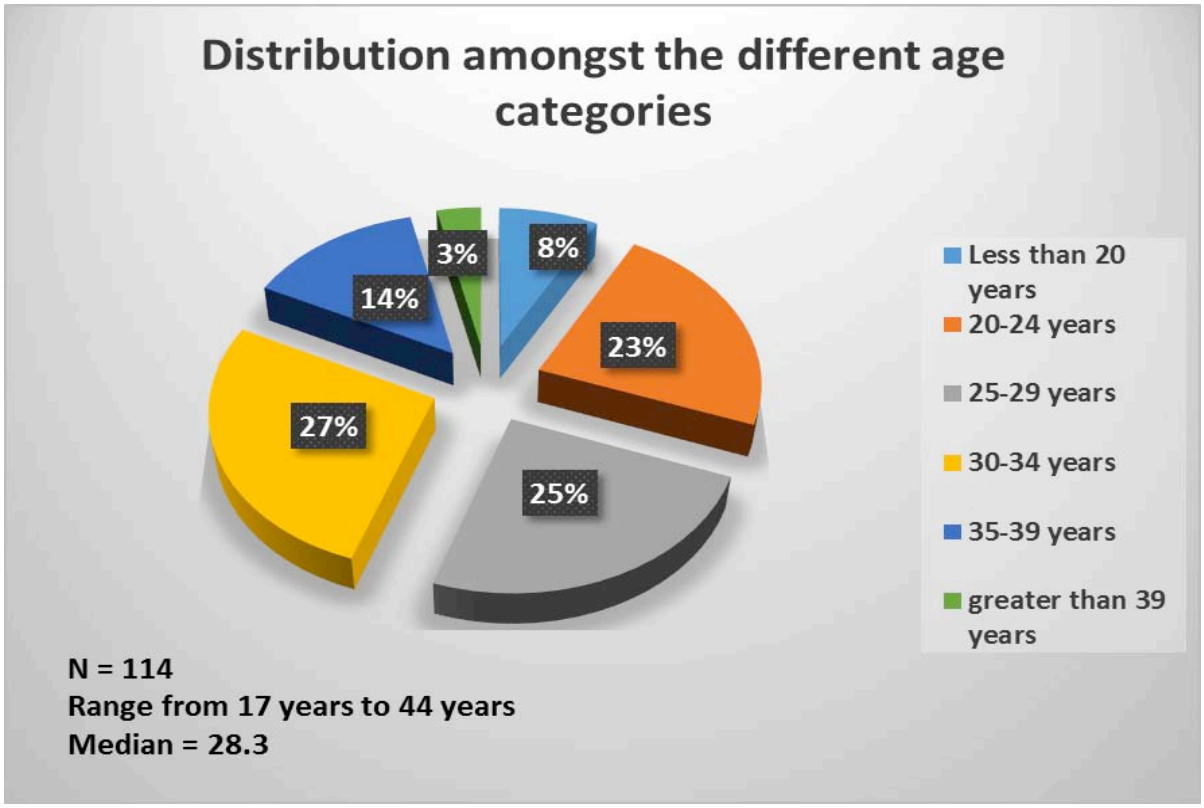


The youngest individual in the study was 17 years old and the oldest individual in the study was 44 years old with a mean age of 28.3 years. The age groups were further categorized into different groups in order to target specific at risk groups. These categories were less than 20 years, 20 to 24 years, 25 to 29 years, 30 to 34 years, 35 to 39 years and greater than 39 years old. There were nine (9) cases (8%) identified in the less than 20 years age group, 26 cases (23%) in the 20 to 24 years age group, 28 cases (25%) in the 25 to 29 years age group, 31 cases (27%) in the

30 to 34 years age group, 16 cases (14%) in the 35 to 39 years age group and four (4) cases (3%) in the greater than 39 years age group. The highest number of the cases was seen in the 30 to 34 years age group which would indicate that the older reproductive age are more at risk of maternal death. See CHART 4.

The variance in distribution of cases amongst the different age categories when compared to the national general pregnancy population distribution showed a Chi-Square value of 8.15 which corresponds with a p value greater than 0.05 (Chi-Square Critical value for p = 0.05 was 11.07). Thus the variance seen is not statistically significant.

CHART 4: Distribution of pregnancy related death amongst the different age categories



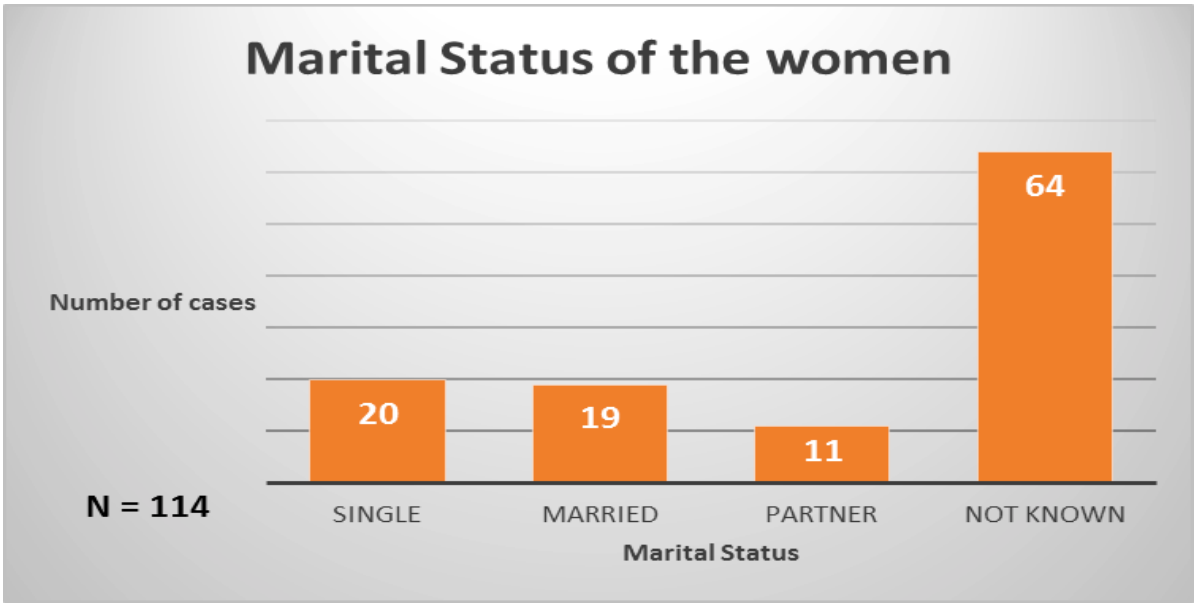
Out of the 114 cases, six (6) deaths occurred in the first pregnancy (primigravid), nine (9) deaths in the second pregnancy, three (3) in the third pregnancy, eight (8) in the fourth pregnancy, one (1) in the fifth and two (2) deaths occurred in individuals in their sixth or more pregnancy. A total of 23 cases were seen in multigravid females.

In 85 cases (75%), there was no information recorded in the case files about the parity or gravidity of the deceased.

94 cases (82%) out of the 114 cases were related to a singleton pregnancy and four (4) cases were related to twin pregnancies. Six (6) cases were described as other which were miscarriages where the clinical team were unable to determine the number of foetuses present. 9 cases did not have any information about the number of foetuses present.

The marital statuses of the deceased women were also documented. 20 of the cases were in single women, 19 cases were in married women and 11 cases were in women with committed partners. 64 of the cases (56%) had no information with regard to the marital status of the women recorded in the case files. See CHART 5.

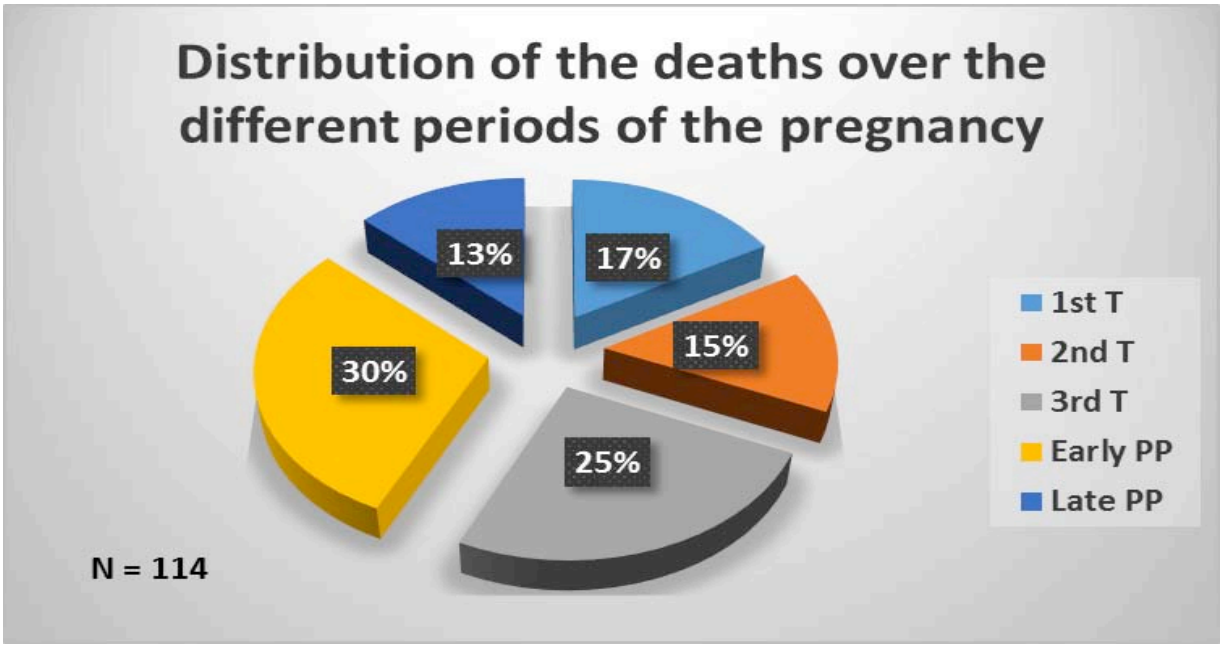
CHART 5: Marital status of the pregnancy related deaths



The pregnancy and post-partum period were divided into different categories, namely first trimester, second trimester, third trimester, early post-partum period and late post-partum period (refer to definitions, pages 5-6 for the exact days or weeks used). There were 19 cases (17%) in the first trimester, 17 cases (15%) in the second trimester, 29 cases (25%) in the third trimester, 34 cases (30%) in the early

post-partum period and 15 cases (13%) in the late post-partum period. The highest number of cases were seen in the early post-partum period. See CHART 6.

CHART 6: Distributions of pregnancy related deaths amongst the different categories of the pregnancy and post-partum periods



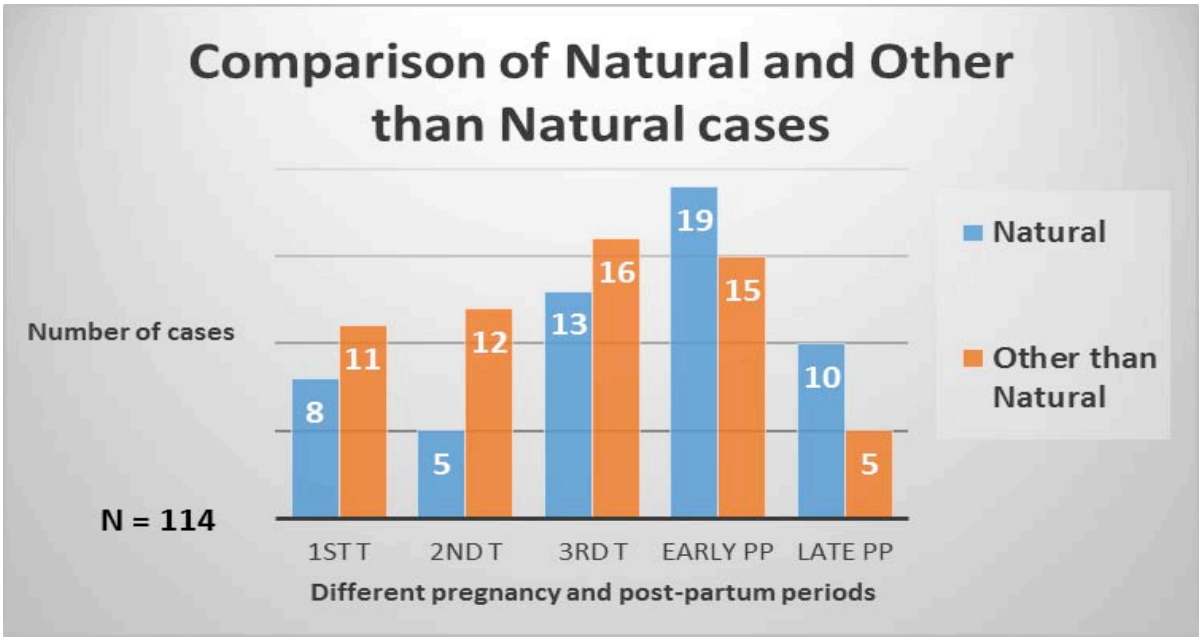
The variance in distribution of cases amongst the different categories for the pregnancy and post-partum period showed a Chi-Square value of 11.81 which corresponds with a p value between 0.01 and 0.05 (Chi-Square Critical value for p = 0.05 was 9.48 and p = 0.01 was 13.27), thus making the distribution significant.

The comparison between natural deaths and other than natural deaths showed that natural deaths were more prominent in the post-partum period compared to other than natural deaths in the current study. It also showed that other than natural deaths were more prominent during the pregnancy period compared to natural deaths in the current study. See CHART 7.

The site of all deaths was recorded to assess which sites are most at risk for pregnancy related deaths. Only information regarding the place of death was recorded and scene of initial injury was not taken into account in this research study. In 32 cases (28.1%), the death occurred at home, four (4) cases (3.5%) occurred

whilst being transported to hospital in the ambulance, nine (9) cases (7.9%) occurred at an MOU or day hospital level facility, five (5) cases (4.4%) occurred at a district hospital level facility, 13 cases (11.4%) occurred at a secondary hospital level facility, 31 cases (26.3%) occurred at a tertiary hospital level facility, nine (9) cases (7.9%) occurred at privately owned or managed hospital facility and 11 cases (9.6%) occurred at other locations outside of the home, ambulance or hospital facilities like the roads or within a car. See CHART 8.

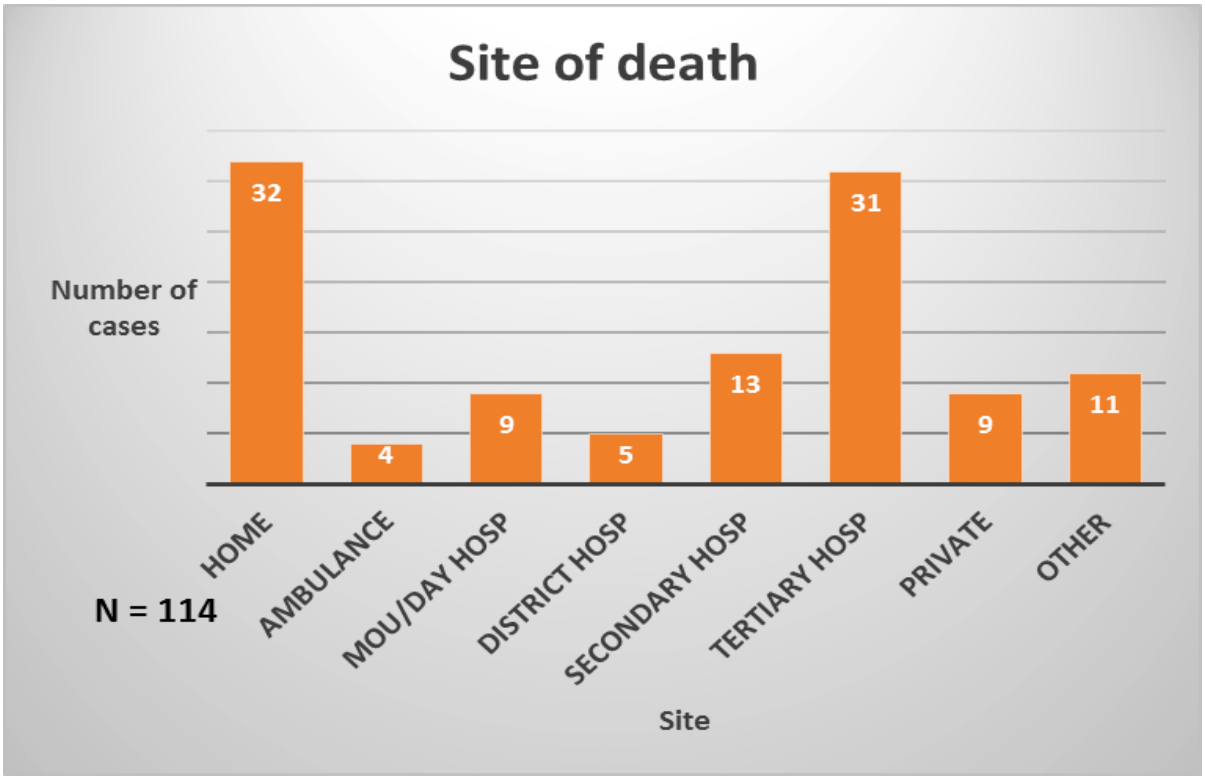
CHART 7: Comparison of natural and other than natural case distribution amongst the categories of the pregnancy and post-partum periods



There was no major difference in the variance of cases with regards to site of death when comparing natural with other than natural deaths. See CHART 9.

Of the 114 cases, 27 of them received pre-natal care and 15 cases did not receive any pre-natal care prior to death. In 72 cases (63%), there was no information recorded in the case files regarding pre-natal care.

CHART 8: Distribution of pregnancy related death amongst the sites of death

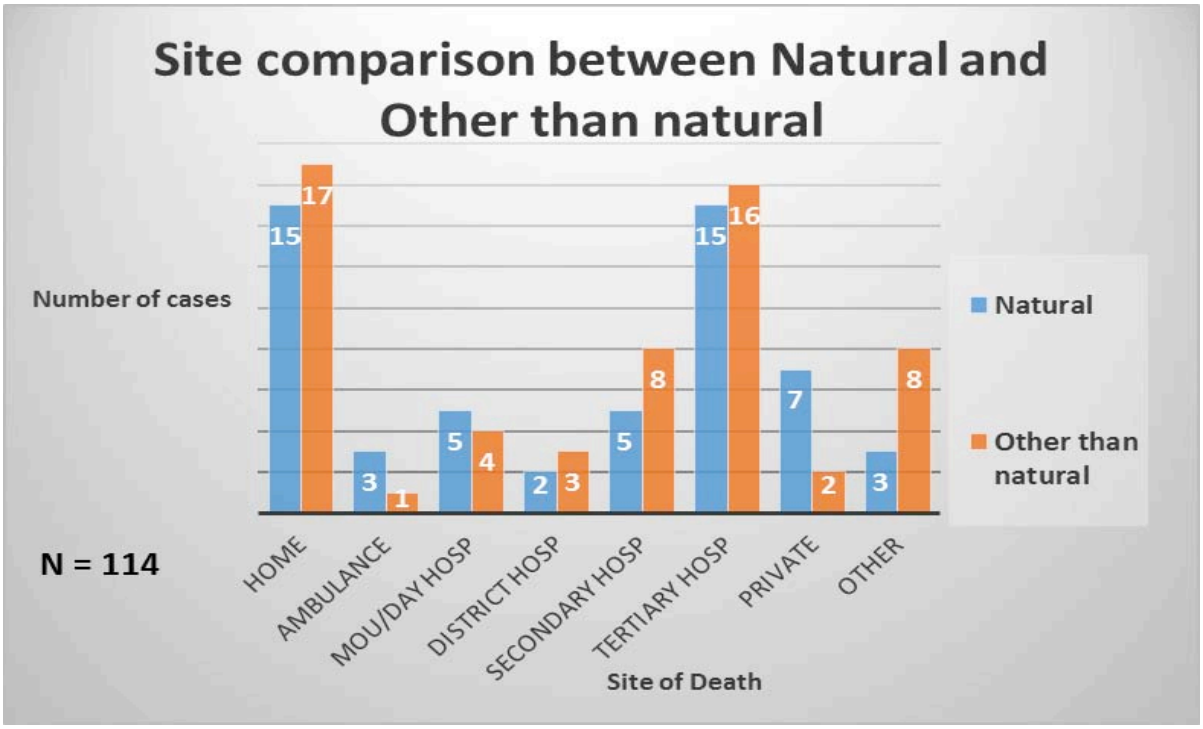


The HIV status of the deceased was known in 21 of the cases (18%). 17 cases (15%) were reported to have a positive status and four (4) cases (3%) were reported to have a negative status. In 93 of the cases (82%), the HIV status of the individual was either not recorded in the case files or not known. Of the 17 positive statuses, four (4) individuals had CD4 counts less than 200, seven (7) individuals had CD4 counts between 200 and 500 and in six (6) individuals the CD4 count was not known or not recorded within the case file. Of the 17 cases, seven (7) individuals were known to be on anti-retroviral treatment, six (6) individuals were recorded as not on anti-retroviral treatment and in four (4) of the individuals it was not known if they were on anti-retroviral treatment.

In all cases, the alleged manner of death was assessed by the attending pathologists for the cases following completion of the post-mortem or autopsy examination. The manner of death was divided into natural and other than natural categories. The other than natural category was further divided into suicide, homicide, accidental, undetermined and un-natural (other). In total, there were eight (8) suicide related

deaths (7%), 19 (16.7%) homicide related deaths, 55 (48.2%) natural deaths, 12 (10.5%) accidental deaths, 14 (12.3%) cases reported the manner of death as undetermined, and six (6) cases (5.3%) were classified into the category of un-natural other. See CHART 10.

CHART 9: The site comparison between natural and other than natural cases



In the category of other than natural which is comprised of the cases due to external forces had a total of 59 cases (52% of all cases), of which homicide deaths had the highest number of cases with 19 cases (32% of other than natural cases). See CHART 11.

CHART 10: Distribution of pregnancy related deaths with regard to the manner of death

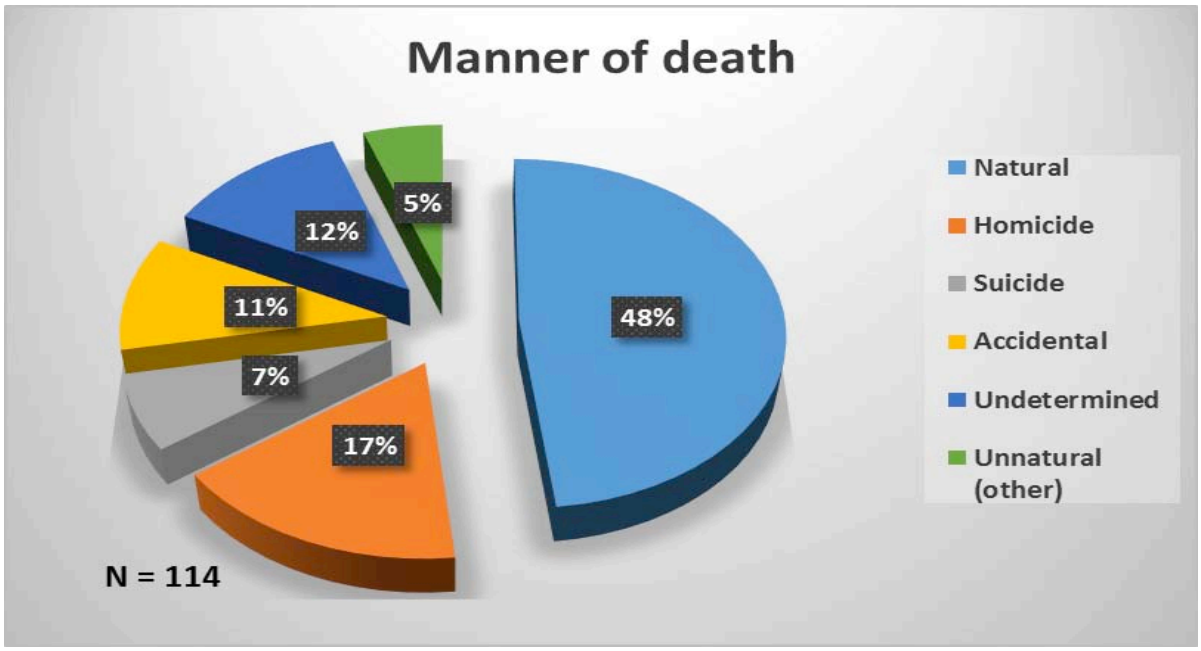
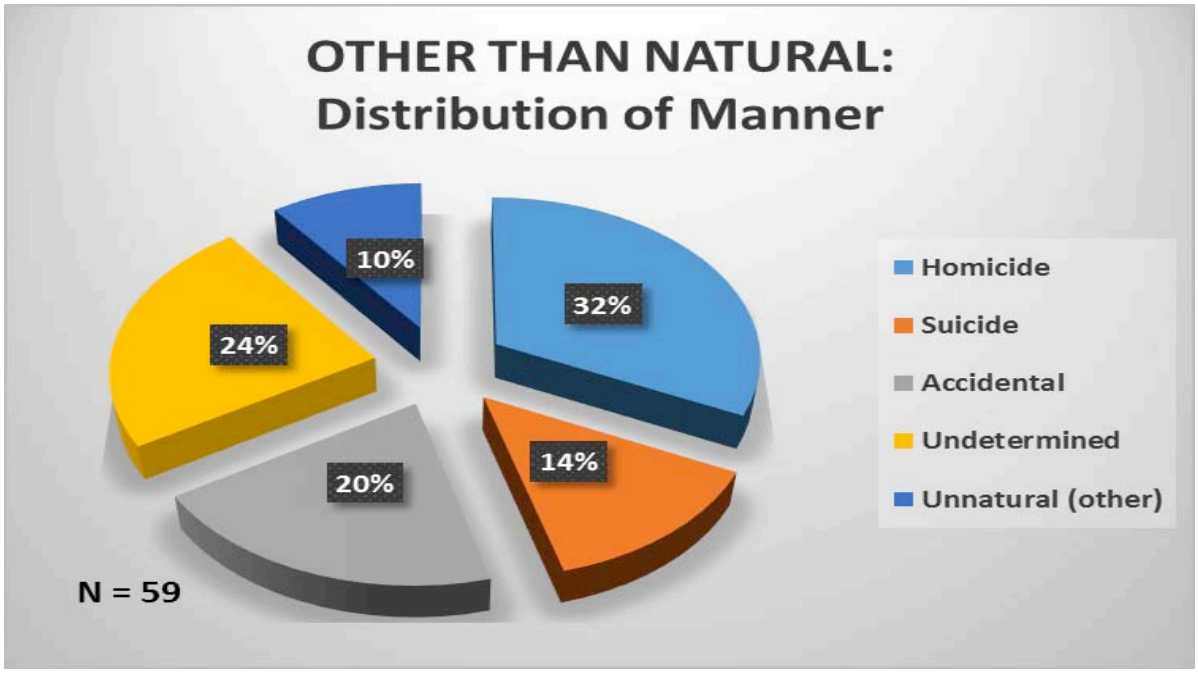


CHART 11: Distribution of pregnancy related deaths with regard to manner of death in the category of other than natural



B. Natural deaths

There were 55 cases categorized as deaths due to natural causes. The conditions or diseases that contributed to the death were categorized into different groups. In some cases, more than one condition or disease was noted to have contributed to and caused death. The most common conditions encountered were gestational hypertension and eclampsia with 8 cases; pneumonia, pulmonary thrombo-embolic disease and cardiac pathology with 7 cases each. Other conditions encountered included HIV and AIDS related conditions, tuberculosis, other embolic disease, sepsis, antepartum and post-partum haemorrhage, ectopic pregnancy, lung pathology (other than pneumonia) and aortic dissection or aneurysm with rupture. There is a category labelled as other with 8 cases which included miscellaneous conditions encountered during the perusal of case files. See TABLE 1 and TABLE 2.

The average age of the women who died of natural causes was 30.09 years which is almost 2 years older than the average age of pregnancy related deaths at the facility. There were 2 cases seen in the less than 20 years category, 10 cases in the 20 to 24 years category, 12 cases in the 25 to 29 years category, 16 cases in the 30 to 34 years category, 14 cases in the 35 to 39 years category and 1 case in the greater than 39 years category. The variance in the distribution of cases when compared to the national general pregnancy population taken from the fifth Saving Mother's report, shows a Chi-Square value of 23.27 which corresponds with a p value less than 0.01 (Chi-Square Critical value for p = 0.01 was 15.086). This therefore makes the distribution of the cases significant. See CHART 12.

Of the 55 cases encountered in the natural deaths category, eight (8) cases occurred in the 1st trimester, five (5) cases in the second trimester, 13 cases in the 3rd trimester, 19 cases in the early post-partum period and ten (10) cases in the late post-partum period. The variance in the distribution of cases amongst the different categories showed a Chi-Square value of 12.11 which corresponds with a p value between 0.01 and 0.05 (Chi-Square Critical value for p = 0.05 was 9.48 and p = 0.01 was 13.27). This therefore makes the variance in distribution significant. See CHART 13.

TABLE 1: List of diseases and conditions that caused or contributed to natural pregnancy related deaths.

Number of cases	Conditions
8 cases (15%)	Gestational hypertension and eclampsia
7 cases (13%)	Pneumonia (not including pulmonary tuberculosis), pulmonary thrombo-embolic disease, cardiac pathology
3 cases (6%)	HIV related conditions, sepsis, lung pathology (other than pneumonia), Aortic dissection/aneurysm with rupture and Tuberculosis
2 cases (4%)	post-partum haemorrhage and ectopic pregnancies
1 case (2%)	Other embolic disease, ante-partum haemorrhage, uterine rupture

TABLE 2: List of miscellaneous conditions and disease encountered causing and contributing to natural pregnancy related deaths

List of miscellaneous conditions encountered
Intracerebral haemorrhage
Thrombotic thrombocytopaenic purpura
Acute appendicitis
Peritonitis
Meningitis

Of the 55 natural deaths encountered, 36 cases were seen in the ethnic African/Black population, 15 cases in the Coloured population and four (4) cases in the White population. No cases were seen in the Indian population group. This would indicate that the ethnic African/Black population group are more at risk for maternal death than the other population groups. The distribution of cases amongst the different population groups when compared to the population group breakdown for the Western Cape Province taken from the stats SA estimates shows a Chi-Square

value of 23.27 which corresponds with a p value less than 0.01 (Chi-Square Critical value for p = 0.01 was 11.34). See CHART 14.

CHART 12: Natural deaths, distribution amongst the age categories

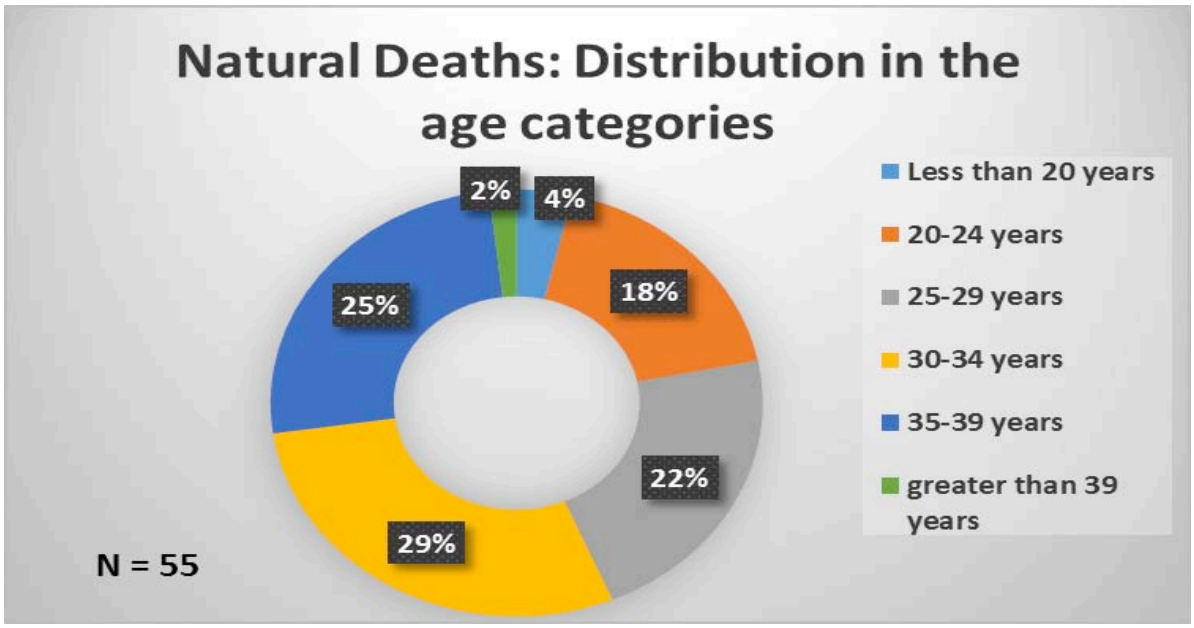


CHART 13: Natural death distribution amongst the pregnancy and post-partum period categories

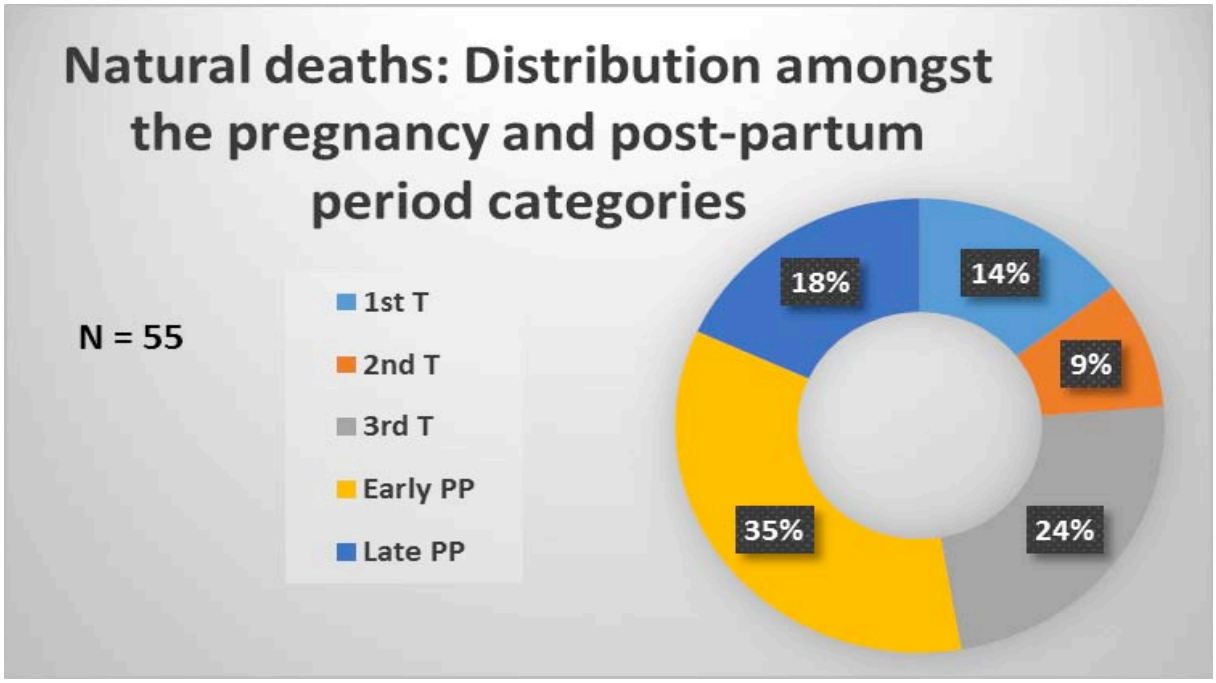
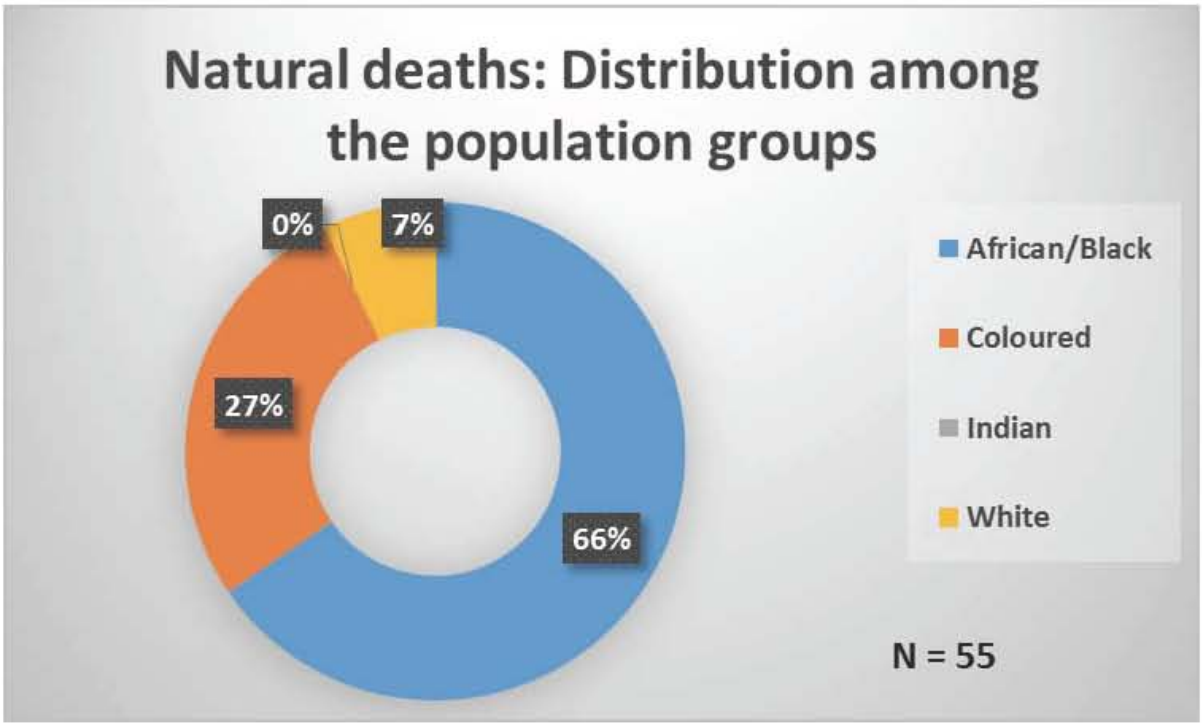


CHART 14: Natural deaths, distribution among the population groups



C. Other than natural deaths:

1. Suicide:

In the category of other than natural, there were eight (8) deaths that could be definitively categorized to be due to suicides based on evidence provided by the investigating officer such as suicide notes or suicidal mobile texts. These suicide deaths were further categorized according to the method used. Six (6) cases (75%) were related to drug overdoses or ingestion of toxins whilst two (2) cases (25%) committed suicide by ligature hanging. Out of the eight (8) suicide deaths, four (4) cases (50%) occurred during the 1st trimester whilst one (1) case (12.5%) each occurred in the 2nd trimester, 3rd trimester, early post-partum and late post-partum periods respectively. Four (4) cases (50%) occurred in the African/Black ethnic population group whilst a further four (4) cases (50%) were seen in the Coloured population group. No suicide deaths were seen amongst the White and Indian ethnic populations. The suicide deaths were also categorized according to the different age groups involved. Four (4) cases (50%) of the cases were seen in the less than 20 year age group, with one (1) case (12.5%) seen in the 20 to 24 year age group, two (2) cases (25%) seen in the 25 to 29 year age group, one (1) case (12.5%) in the 30 to 34 year age group and no cases were seen above 35 years. The p values for the population groups, pregnancy and post-partum period categories and age categories were all greater than 0.05 which would indicate that they were not statistically significant.

In the six (6) cases that were found to be related to drug overdoses or toxin ingestion, specimens for toxicology analyses were taken either at the presenting medical facility of or by the attending pathologist, and in some cases both. In two (2) of the cases (33%), a positive toxicology result was received from the forensic chemistry laboratory. In four (4) of the cases (67%), the toxicology results are still pending.

See TABLE 3 for summary of findings in suicide pregnancy related deaths.

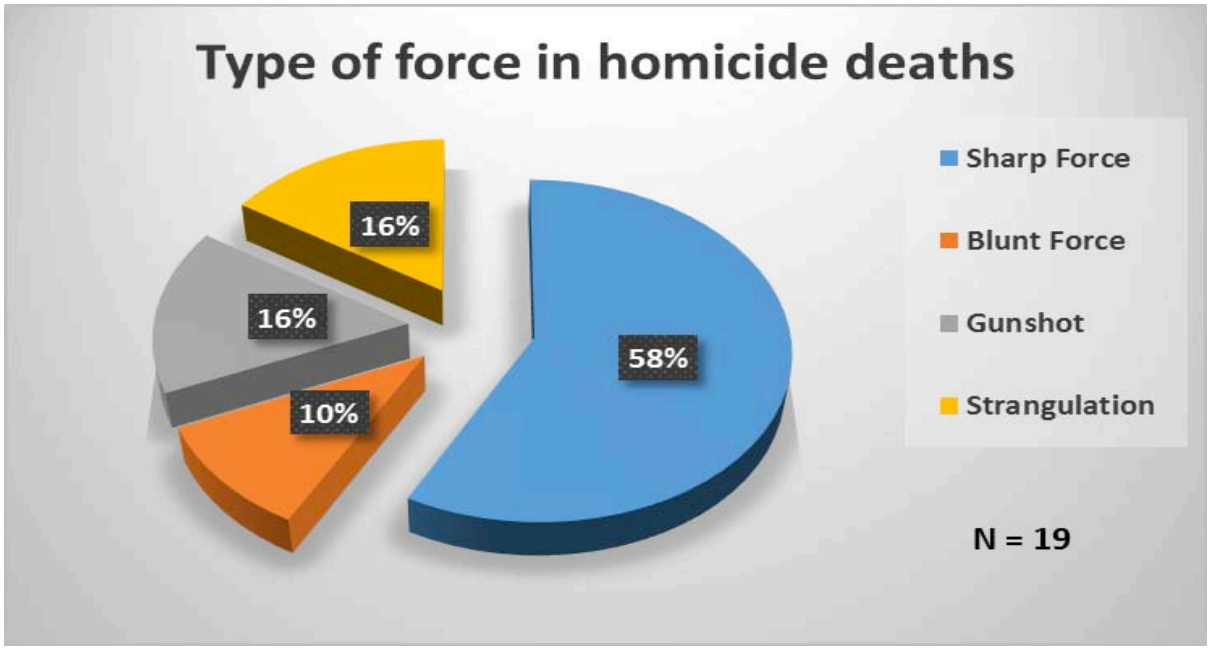
TABLE 3: Suicide pregnancy related deaths breakdown

Categories	Number of Cases
Method of Death	**Total = 8**
Drugs or toxins	6
Hanging	2
Pregnancy or post-partum period	**Total = 8**
1st trimester	4
2nd trimester	1
3rd trimester	1
Early Post-partum	1
Late Post-partum	1
Race	**Total = 8**
African/Black	4
Coloured	4
White	0
Indian	0
Age categories	**Total = 8**
Less than 20 years	4
20 to 24 years	1
25 to 29 years	2
30 to 34 years	1
35 to 39 years	0
Greater than 39 years	0

2. Homicide:

A total of 19 homicide deaths were identified for the study period. The homicide deaths were categorized further by the type of force or trauma used, the regions of the body that were injured and the alleged suspect inflicting the trauma on the subject. Of the 19 homicide cases, 11 cases (58%) died from sharp force trauma, two (2) cases (11%) died as a result of blunt force trauma, three (3) cases (16%) died as a result of firearm injuries and three (3) cases (16%) died as a result of strangulation (manual and ligature compression of the neck). See CHART 15.

CHART 15: Type of force used in homicide pregnancy related deaths

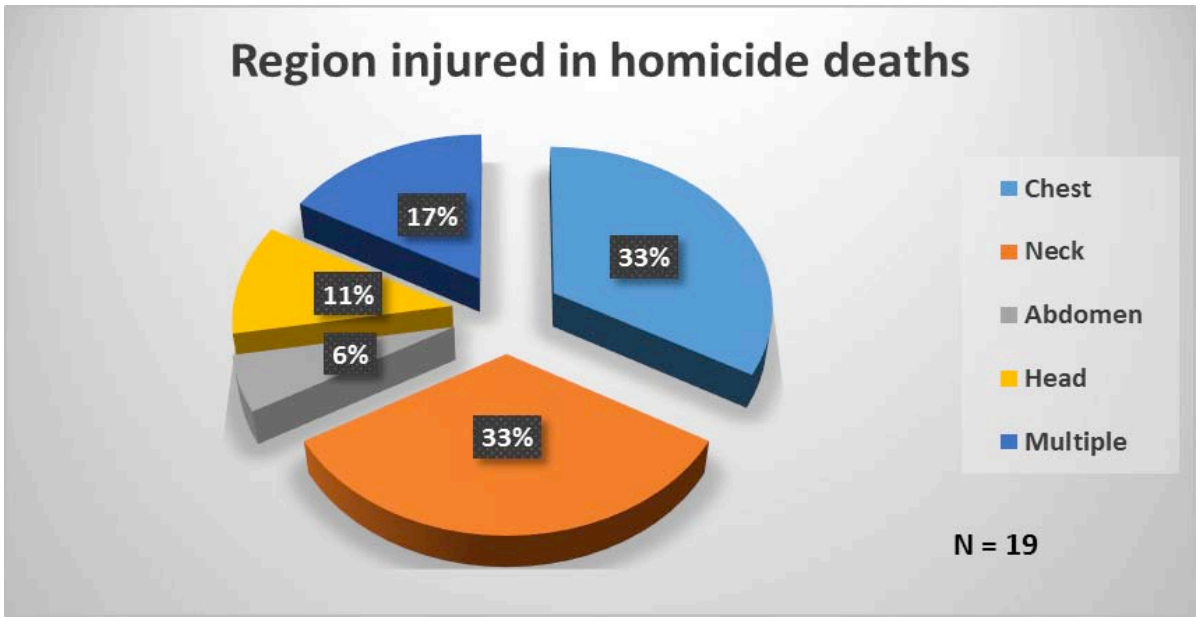


Of the 19 cases, six (6) deaths resulted from injuries to the chest (31.6%), a further six (6) deaths resulted from injuries to the neck (31.6%), one (1) death resulted from injuries to the abdomen (5.3%), two (2) deaths resulted from injuries to the head (10.5%) and three (3) deaths had injuries involving multiple regions of the body (15.8%). See CHART 16.

Of the 19 homicide cases, eight (8) of the women were allegedly murdered by their boyfriends or husbands (intimate partner) which corresponds to 42.1% of the cases and 11 were killed by other people (strangers) or it is not known who murdered them

which corresponds to 57.9% of the cases. See CHART 17. The precise reasons for the intimate partner murdering of the pregnant females was not present in the case files examined. An examination of court proceedings for these cases was not performed in this research study.

CHART 16: Regional distribution of injuries in homicide pregnancy related deaths

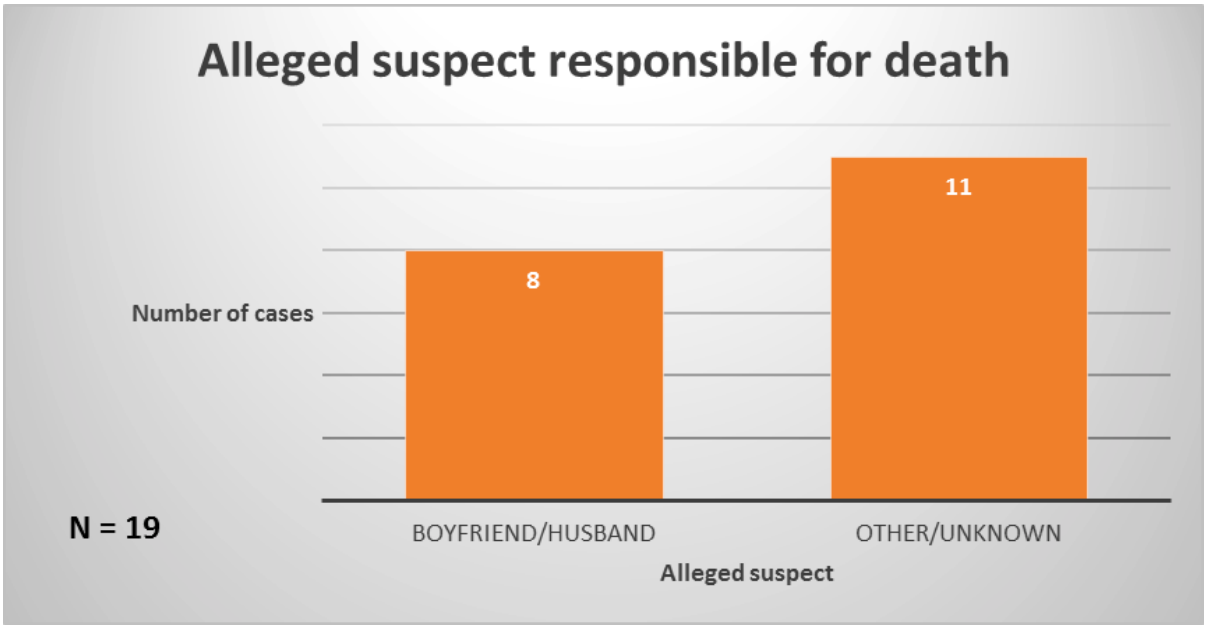


Of the 19 homicide deaths, three (3) deaths (16%) occurred in the 1st trimester, seven (7) deaths (37%) occurred in the 2nd trimester, six (6) deaths (32%) occurring in the 3rd trimester, two (2) deaths (11%) in the early post-partum and one (1) death (5%) in the late post-partum period. See CHART 18. The variance in the distribution of cases among the pregnancy and post-partum period categories showed a Chi-Square value of 11.94 which corresponds with a p value between 0.01 and 0.05 (Chi-Square Critical value for p= 0.05 was 9.48 and p = 0.01 was 13.27). The most dangerous period for homicidal deaths was the 2nd and 3rd trimesters which is statistically significant.

11 of the cases (57%) were in women of ethnic African/black population group and eight (8) of the cases (43%) were in the in the Coloured population group. No cases were found to be in the ethnic White and Indian population groups. The variance in

the distribution among the different population groups showed a Chi-Square value of 2.20 which correspond with a p value greater than 0.05 (Chi-Square Critical value for p = 0.05 was 7.80).

CHART 17: Alleged suspect responsible for the homicide pregnancy related death



The distribution of homicide cases amongst the different age categories found one (1) case (5%) in the less than 20 years age group with seven (7) cases (37%) in the 20 to 24 years age group, five (5) cases (26%) in the 25 to 29 years age group, five (5) cases (26%) in the 30 to 34 years age group, one (1) case (5%) in the 35 to 39 age group and no cases in the greater than 39 years age group. The average age of the women who suffered homicide deaths was 26.05 years which is two (2) years younger than the average age of the pregnancy related deaths encountered at the facility. See CHART 19. The variance in the distribution of cases among the different age categories when compared with the national general pregnancy population showed a Chi-Square test value of 3.87 which corresponds with a p value greater than 3.87 (Chi-Square critical value for p = 0.05 was 11.07).

CHART 18: Homicidal deaths, distribution among the pregnancy and post-partum period categories

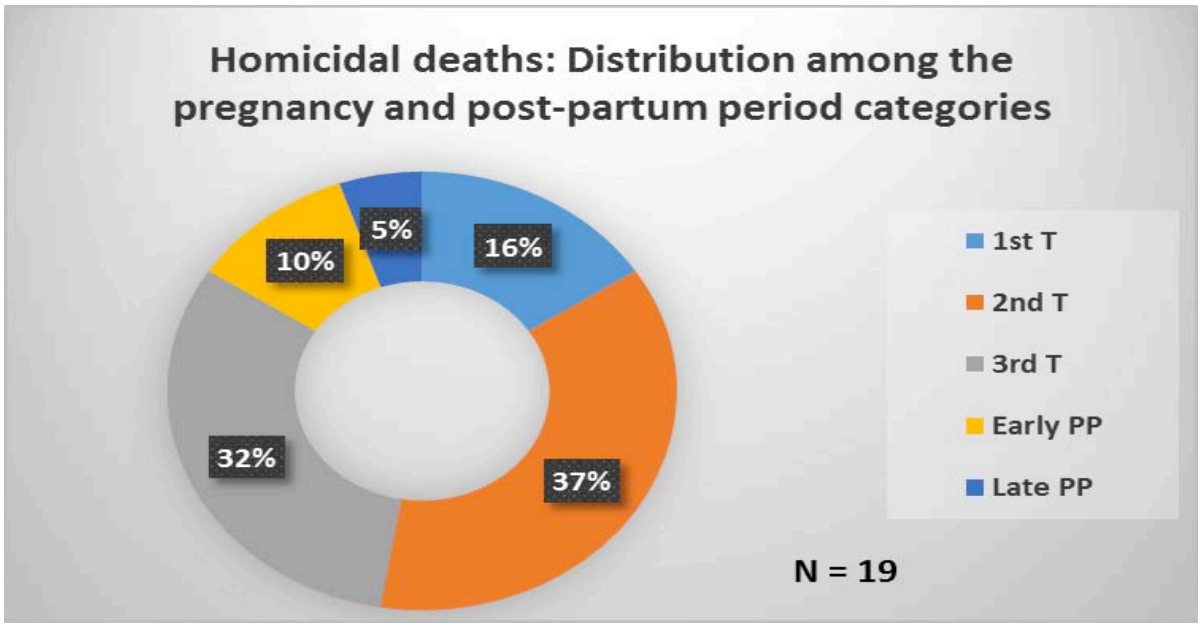
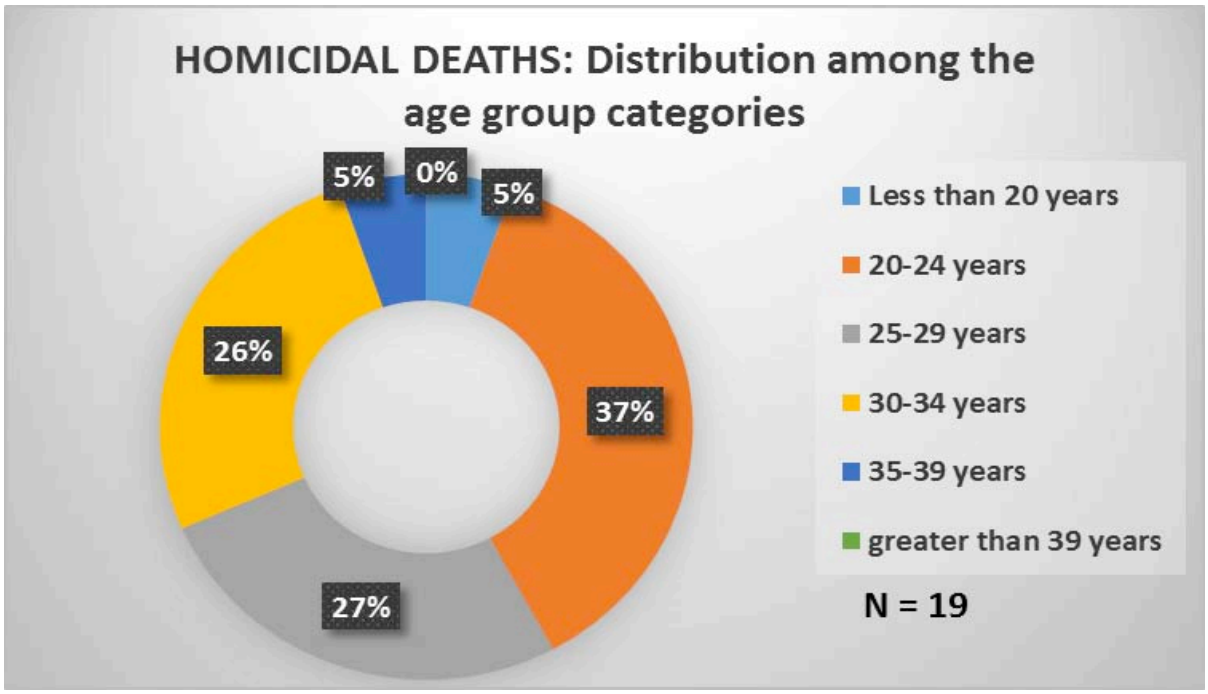


CHART 19: Homicidal deaths, distribution of deaths among the age group categories



See TABLE 4 for summary of homicide death findings.

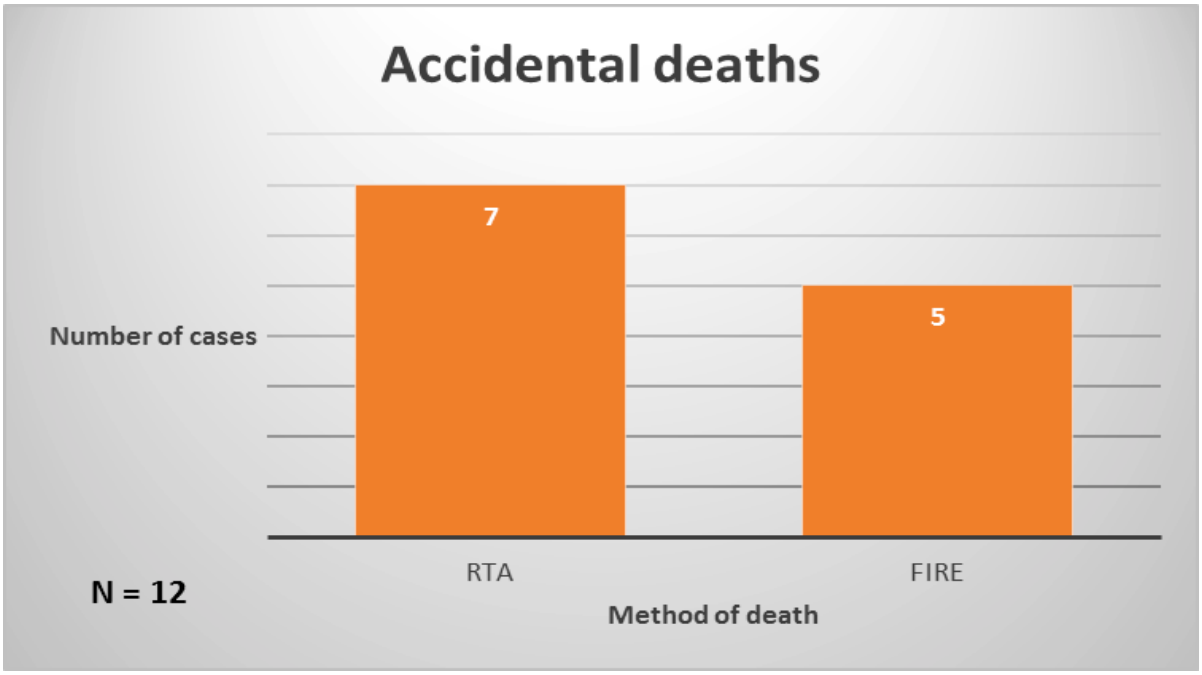
TABLE 4: Homicide pregnancy related deaths breakdown

Categories	Number of Cases
Method/Type of Force	**Total = 19**
Sharp	11
Blunt	2
Firearm	3
Strangulation	3
Pregnancy or post-partum period	**Total = 19**
1st trimester	3
2nd trimester	7
3rd trimester	6
Early Post-partum	2
Late Post-partum	1
Race	**Total = 19**
African/Black	11
Coloured	8
White	0
Indian	0
Age categories	**Total = 19**
Less than 20 years	1
20 to 24 years	7
25 to 29 years	5
30 to 34 years	5
35 to 39 years	1
Greater than 39 years	0

3. Accidental

Of the 12 cases of accidental deaths encountered in the study, the type of accidents encountered fell into two (2) categories, those that died as a result of RTA or as a result of fires to dwelling or buildings. Seven (7) cases (58.3%) where related to RTA and five 5 cases (41.6%) were related to fires. See CHART 20. Of the seven (7) cases involved in RTA, five (5) cases (71.4%) were as passengers or car occupants and two (2) cases (28.6%) were pedestrians. See CHART 21. Blood alcohol levels were performed in four (4) of the cases involved in RTA with only one (1) case reporting a positive level of 0.05g/100ml. Blood alcohol levels were performed in four (4) of the cases involved in fires with two (2) cases reporting positive levels of 0.17g/100ml and 0.11g/100ml respectively. Carbon monoxide (carboxyhaemoglobin) levels were performed on three (3) of the cases involved in fires. The levels encountered were 36%, 4% and 23% respectively.

CHART 20: Distribution of accidental pregnancy related deaths



Of the 12 cases, four (4) deaths (33%) occured in the 1st trimester, three (3) deaths (25%) in the 2nd trimester and five (5) deaths (42%) in the 3rd trimester with no cases reported in the post-partum period. Four (4) cases (33%) were seen in the 20 to 24

year age group, 25 to 29 year age group and 30 to 34 year age group each. There were no cases seen in the less than 20 years age group, 35 to 39 years age goup and in the great than 35 years age group. There were six (6) cases (50%) seen in the ethnic African/Black population, four (4) cases (33%) in the Coloured population and two (2) cases (17%) in the White population group. No cases were seen in the Indian population group. The Chi-Square tests performed on the population groups, age groups and pregnancy and post-partum period categories corresponded with p values greater than 0.05 which indicated that the variance in the distribution was not statistically significant.

See TABLE 5 for summary of accidental death findings.

CHART 21: Distribution of RTA related pregnancy related deaths.

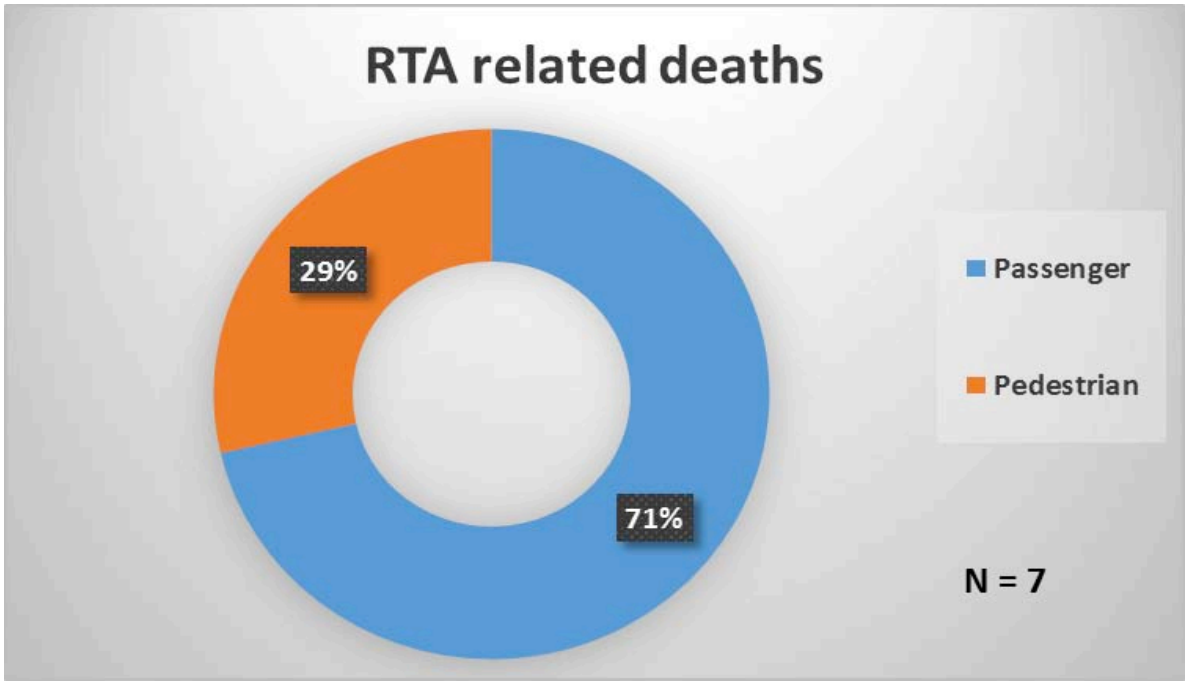


TABLE 5: Accidental pregnancy related deaths breakdown

Categories	Number of Cases
Method of death	**Total = 12**
RTA Passenger	5
RTA Pedestrian	2
Fires	5
Pregnancy or post-partum period	**Total = 12**
1st trimester	4
2nd trimester	3
3rd trimester	5
Early Post-partum	0
Late Post-partum	0
Race	**Total = 12**
African/Black	6
Coloured	4
White	2
Indian	0
Age categories	**Total = 12**
Less than 20 years	0
20 to 24 years	4
25 to 29 years	4
30 to 34 years	4
35 to 39 years	0
Greater than 39 years	0

4. Undetermined

There were 14 cases in which following completion of the post-mortem examination, the manner of death could not be immediately determined by the attending pathologist. The manner of death for these cases was recorded as undetermined.

Six (6) of these cases were referred for medico-legal examination as the death was related to a medical procedure or medical treatment. Of these six (6) cases, three (3) deaths are thought to have resulted from a complication or adverse affect of the medical procedure or medical treatment. However they remain recorded as undetermined, pending an open inquest court enquiry. The other 3 deaths are thought to most likely be due to natural causes, but also remain recorded as undetermined, pending the acquisition of complete clinical notes to exclude any specific events in hospital that may have contributed to the death.

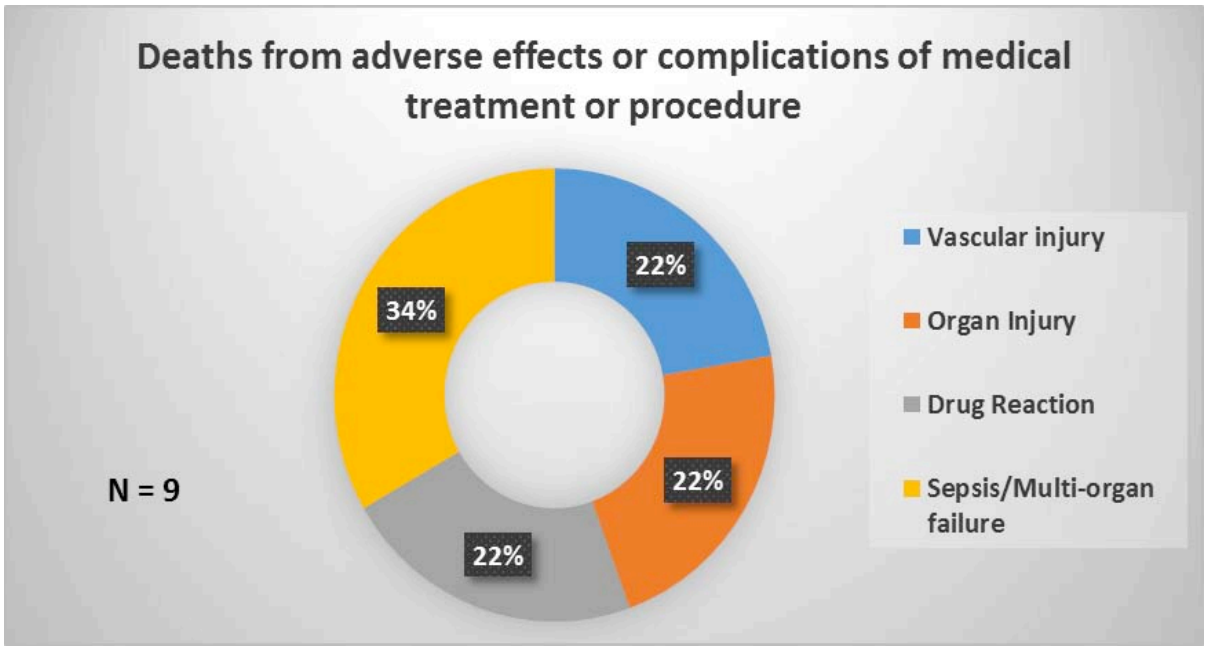
Eight (8) of the cases were referred as sudden unexpected and unexplained deaths for medico-legal examination. Of these, three (3) cases are thought to be related to toxin ingestion but where the toxicology results remain outstanding. The circumstances surrounding these deaths are not fully understood and thus could not definitively be classified under suicide deaths either. The other five (5) cases were determined to be as a result of natural disease following histological examination, however remain recorded as undetermined pending drug screen results and statements from the family.

In all of the cases where the manner of death was deemed to be undetermined by the attending pathologist; tissue specimens were retained for histopathological examination, specimens were retained for drug screen or full toxicology analysis and blood alcohol specimens were taken. Ancillary investigations like mast cell tryptase and blood cultures were performed on selected cases based on the circumstantial history provided.

5. Unnatural (other)

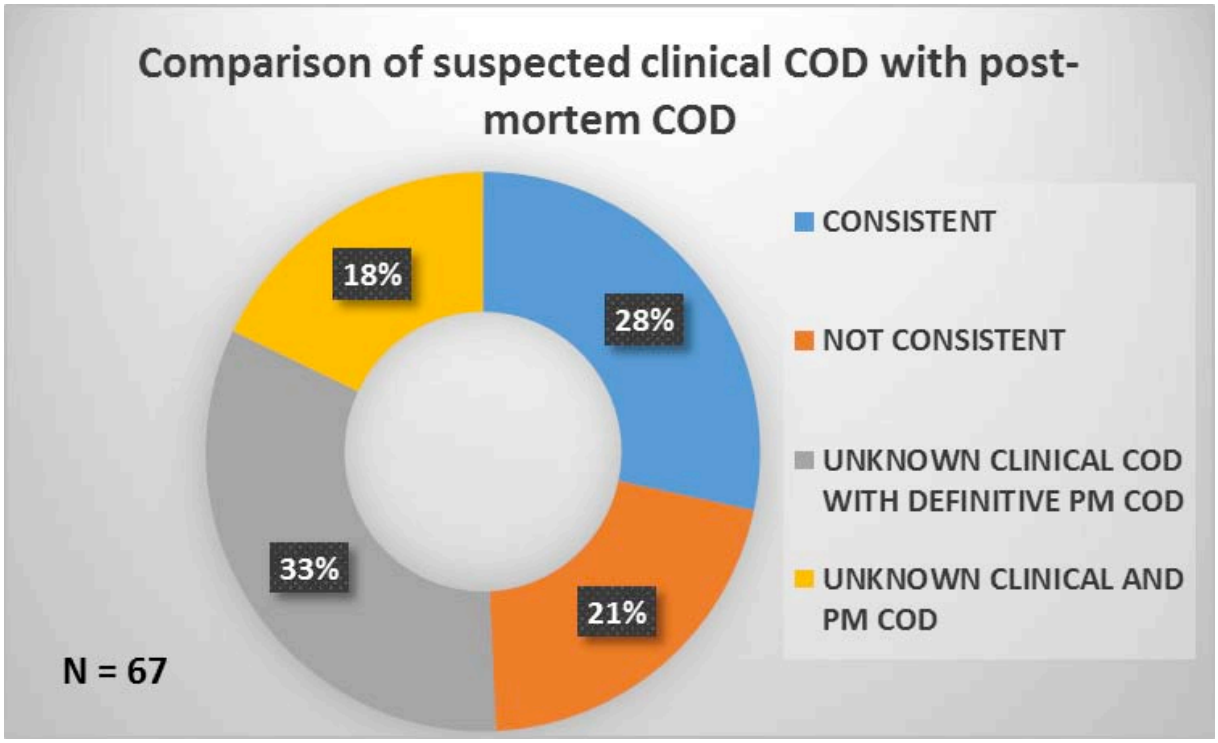
There were six (6) cases which were classified into the category of unnatural (other). These cases were determined by the attending pathologist to be as a result of adverse effects or as a direct complication of the medical treatment or medical procedure performed. In total, also accounting for the cases that were initially labelled as undetermined but awaiting open inquest, there were nine (9) cases that died as a result of complications or adverse effects of a medical procedure or medical treatment. Two (2) cases (22%) were as a result of vascular injury during the procedure that was further complicated by coagulopathy. Two (2) cases (22%) were as a result of complications following organ injury during the performance of the medical procedure. Three (3) cases (33%) resulted from sepsis and multi-organ failure following the medical procedure. All of these three (3) cases of sepsis were related to suspected poor performance of an evacuation of the uterus procedure during the 1st trimester of pregnancy. Two (2) cases (22%) were as a result of adverse drug reactions. See CHART 22.

CHART 22: Deaths from adverse effects or complications of medical treatment or procedure



Of the 114 cases encountered in the study, 67 cases died in hospital at various different levels of care. These cases were referred for medico-legal post-mortem examination. In all cases that were referred for medico-legal examination, clinical details are provided by the attending physicians. A suspected clinical cause of death is provided by the attending physicians. In 19 cases (28%), the suspected clinical cause of death was consistent or similar with the post-mortem cause of death. In 14 cases (21%), the suspected clinical cause of death was not consistent or similar to the post-mortem cause of death. In 22 cases (33%), the suspected clinical cause of death was stated as "unknown" or was not provided; however post-mortem examination was able to establish a definitive cause of death. In the remaining 12 cases (18%), the post-mortem cause of death was stated as "under investigation" or "undetermined" as there are results that are still pending like toxicology or complete clinical notes.

CHART 23: The comparison of suspected clinical cause of death with the post-mortem cause of death



10. DISCUSSION:

Research studies into pregnancy related deaths at forensic pathology laboratories have not been performed before in South Africa and thus there is minimal to no data about pregnancy related deaths occurring from accidental and incidental causes (external forces). Research into pregnancy related deaths from accidental and incidental causes has been predominantly performed in first world countries and a handful of developing countries. Thus most references are from first world or industrialized countries. Almost all of the these studies focused either on natural deaths or deaths due to external forces and did not look at the natural and other than natural deaths together. Due to the structure of the laws in South Africa, namely the Inquest Act and Health Professions Amendment Act, Forensic Pathology laboratories in South Africa see a selection of natural deaths and deaths from unnatural causes which makes comparisons with first world countries complex and difficult.

According the 2013 mid-year population estimates published by STATS SA, there are approximately 52.9 million people living in South Africa with 27.1 million of those being of the female gender (51%)[23]. Of the 52.9 million people in South Africa, six million (11.4%) of the population reside in the Western Cape Province; of which 1.75 million (29%) of these are female in the age group between 10 and 49 years[23]. The Saving Mothers 2008 to 2010 Fifth Report on Confidential Enquiries into Maternal Deaths in South Africa highlighted that the Western Cape province had one of the best facility maternal mortality death rate of 77.6 per 100 000 live births and the Cape Metropolitan district having a facility maternal mortality rate of 80.8 per 100 000 live births when compared to other provinces in South Africa[4]. The Western Cape Province maternal deaths make up only 5% of all maternal deaths in South Africa[4]. The Cape Metropolitan district accounts for approximately 72% of all cases in the Western Cape Province as per data received from the Western Cape Department of Health[34]. Thus the mortality rate in the Western Cape Province is much less when compared with the rest of the country. Thus the maternal mortality rate seen in the Western Cape Province are closer to the rates seen in industrialized and first world countries. Therefore, deaths from accidental and incidental causes

are of increased importance as a possible leading cause of death in the Western Cape Province compared to other provinces in South Africa. Thus, studies into maternal death in the Western Cape Province provides an ideal opportunity to highlight the unnatural deaths in comparison with natural deaths.

A 15 year retrospective review performed by Christiansen and Collins of all forensic autopsy cases from the Medical University of South Carolina only identified ten (10) pregnancy related cases of which only one (1) accidental death due to a pedestrian motor vehicle accident was reported[24]. A similar, 22 year retrospective study performed by Prahlow et al of all case files from the Dallas County Medical Examiner's office identified a total of 45 cases of pregnancy related deaths; however this study did not look at suicide deaths or deaths from external forces[25]. A 24 year retrospective study performed in Finland by Gissler et al identified 212 observed pregnancy associated deaths due to external causes which included deaths up to 1 year following delivery in the entire country[26]. In this study, which conducted a five (5) year retrospective study in a single forensic pathology centre; identified 114 pregnancy related deaths. One would consider this a significant number of cases identified. Of importance is that more than half of the deaths were due to other than natural causes.

The 114 cases identified corresponded with an incidence of 0.77% of pregnancy related death cases encountered at the facility which is 7 to 8 times more than the incidence encountered at the Dallas County Medical Examiner's office facility in Prahlow et al study[25].

In the current study, pregnancy related deaths were relatively equally distributed over the five years of the study period with the most number of cases seen in the 2008 with a slow decline in the numbers up to 2012. This would indicate that there was a slight improvement in maternal health over the period studied or more informed medical staff feel confident enough to sign out cases without referral to Forensic Pathology Services. Of interest was that the greatest number of deaths were encountered in the months of June and April with the quietest month being November. The reason for the peaks and troughs in the distribution of cases over the different months is not fully understood. It may be co-incidental or may be related to

vacation times. Statistical tests showed that the variance in the distribution was not significant.

The racial distribution of the cases showed that the majority of the individuals were from the ethnic African/Black and Coloured population groups. These population groups are mainly of the low income group in the Western Cape Province. Thus, are income levels and ethnicity associated with increased risk of maternal deaths? Similar phenomena are seen in studies performed in the United States were ethnic African Americans are more at risk of pregnancy related deaths when compared with the white population group[25,27].

The age of the women ranged from 17 years to 44 years with a mean age of 28.3 years. The greatest number of cases were seen in 30-34 year age group followed by the 25-29 year age group which is quite different to the studies performed in the United States that showed most of the pregnancy related deaths occurred in the less than 20 year age group and the 20-24 year age group[27]. This would indicate that the older age groups in the Western Cape Province are more at risk compared to those in the United States. Of note was that a slighter younger mean age of 26.05 years was seen in the other than natural deaths group when compared to the natural deaths group which had a mean age of 30.09 years.

The current study could not fully assess whether primigravid women were more at risk than multigravid women as 74% of the case files did not record the parity and gravidity of the deceased. Similar problems were encountered with the marital status and prenatal care; where 56% of the cases having no record of the marital status in their case files and 63% of the cases had no recording whether any prenatal care was received prior to death. Prenatal care and the support from a caring husband or partner can contribute to the improved well being of women during the pregnancy and the post-partum period. Studies in the United States showed that women who had not received pre-natal care had a maternal mortality rate three times more than those who had initiated pre-natal care in the first trimester[27]. Further studies and research is required to evaluate the importance of initiating early prenatal care and maternal mortality rates in South Africa.

The distribution of deaths over the various periods along the journey of a pregnant female found that the greatest number of deaths occurred in the early post-partum phase with 30% and in the 3rd trimester with 25%. The current study showed that variance in distribution was statistically significant. This may partly be due to clinicians attempting to terminate the pregnancy as soon as possible during emergency situations to save both infant and/or mother. The female later dies in the post-partum period following consequences of the emergency obstetric condition.

The current study found that the greatest number of deaths occurred either at home or at tertiary level facilities. When considering that a large number of deaths occurred at the tertiary level facilities; this would indicate that a good transport and referral system is in place within the province which allows the most complicated and difficult cases to arrive at the tertiary facility where the subject can receive the best treatment by the most qualified and experienced staff in the province. On the other hand when considering the number of deaths occurring at home; it is quite alarming that many women are being found dead or are dying at home without recognizing that they are ill. This would indicate that both dangerous signs and symptoms are being missed by the pregnant females and/or there is a lack of education or understanding of dangerous situations for themselves.

In 18% of the cases encountered in the current study, the HIV status of the subject was known, of which 15% of all cases had a positive result. According to STATS SA, 17.4% of women in their reproductive age group are HIV positive[23]. Even though we found similar numbers in the subjects of the current study, this may be an under estimate as 82% of the subjects did not have any information about their HIV status. This may indicate that there is still a large proportion of women who are not getting screened for HIV/AIDS during the pregnancy period. This is in contrast to the findings of the fifth Saving Mothers confidential report for the triennium 2008-2010 which reported 21% of the women that died had either unknown HIV statuses or they had declined testing[4]. It may be more probably that the Forensic pathology services or related medical staff did not include the information in the documents of the case file. A study performed by Myer et al on the impact of anti-retroviral therapy on the incidence of pregnancy among HIV-infected women in Sub-Saharan Africa, found

that women of younger age, low educational background and higher CD4 counts were more likely to fall pregnant whilst already knowing their positive HIV status[28]. This indicates that being HIV positive and being on anti-retroviral therapy does not impact pregnancy prevention. The risk of fatal complications in HIV pregnant females is higher than non-pregnant females which has been demonstrated by the deaths reported in the Saving Mothers reports[1,2,3,4]. Thus education of HIV positive patients whom are or are not on anti-retroviral therapy regarding the risks of fatal complications if they were to fall pregnant is of vital importance. However, this education needs to be co-ordinated into anti-retroviral therapy programmes across the country. The study performed by Myer et al also indicates that women on anti-retroviral are more likely to fall pregnant than HIV positive women not on anti-retroviral therapy[28]. This indicates that the women may feel that being on anti-retroviral therapy protects them and their babies from fatal complications during pregnancy.

Amongst the natural causes of death, gestational hypertension and eclampsia followed closely by pneumonia, pulmonary thrombo-embolic disease and cardiac pathology contributed to the most deaths encountered at Salt River Forensic Pathology laboratory. In the study performed by Christiansen and Collins, pulmonary thrombo-embolism, pre-eclampsia and pulmonary complications were the commonest causes of death whilst the commonest causes of death encountered by the Prahlow et al study were amniotic fluid embolism, artery/aneurysm dissection/rupture, ruptured ectopic pregnancy and pulmonary embolism[24,25]. A surprising finding was that a rare condition like amniotic fluid embolism was the commonest condition encountered in the Prahlow et al study. Our study did not have a single case of amniotic fluid embolism. Otherwise two (2) of the common causes encountered in our study, pulmonary thrombo-embolism and gestational hypertension were similar to those encountered in the American studies. Both these conditions are very preventable. An article by Professor J Moodley on maternal deaths due to hypertensive disorders in pregnancy, indicates that deaths from hypertensive disease in pregnancy can be reduced by four important methods[29]. Those being promotion of antenatal care and the instituting of a recall system for defaulters, instituting regional centers with regional obstetricians to provide high level

care, the continuous professional education of health care professionals on guidelines of clinical management and educating and informing the general public on the complications associated with pre-eclampsia/eclampsia syndrome[29]. Pulmonary thrombo-embolism is a preventable condition with simple interventions like increasing mobility during the pregnancy and after delivery and the institution of compression stockings for those at high risk. The fifth Saving Mothers confidential enquiry report also recognized these two conditions as important causes of maternal deaths and provides comprehensive management plans to prevent deaths from these conditions[4]. Two of the other major natural causes of death encountered in the current study; pneumonia and cardiac pathology were different to those seen in the American studies. Not surprisingly, very few of the natural deaths were attributed to AIDS related illness in the current study which is in contrast to the Saving Mother confidential enquiry reports as many of these deaths would not qualify for referral to Forensic Pathology services in terms of the Inquest Act[1,2,3,4]. No AIDS related illnesses were reported as causes of deaths in the American based studies. Of note, miscellaneous conditions like intracerebral haemorrhage, meningitis, peritonitis and acute appendicitis was not encountered in the American studies. This serves to indicate that the natural pathology experienced in our research group was different to those experienced in the American study groups with a few similarities. Thus our approach to prevention of these conditions and diseases needs to be different to those of first world countries.

In the category of other than natural, homicide deaths were the most common type of death experienced with suicide deaths being the least common. This is completely different to the study done in Finland which found the most common death type in the suicide category and the least common in the homicide category[26]. The American study showed homicides to be the leading cause of death consistent with the current study[27]. This begs the argument that ethnicity plays a major part as to how different cultures regard pregnancy. The majority of the research group in the Finland study comprised of ethnic white population whilst the majority of homicide deaths encountered in the American study were ethnic African American population group[26,27]. This coincides with the findings of the current study which showed that all homicide deaths occurred in the ethnic African and Coloured population groups and

no deaths were seen in the Indian and White population groups. In both of the studies, American and Finnish, the most number of homicide deaths were seen in the less than 20 year age group and the 15 to 24 year age group respectively[26,27]. In the current study, the greatest number of homicide deaths was also seen in a younger age group but it was more in the 20 to 24 year age group with many cases also seen in the 25 to 29 year age group and the 30 to 34 year age group. This shows an average age that is slightly higher than the averages seen in the Finnish and American studies[26,27]. A contrasting finding was that 56% of the homicide deaths in the American study were due to firearm related injuries whilst 58% of the homicide deaths in the current study were due to sharp force injuries[27]. Another contrasting finding was that only 20.6% of the homicide deaths in the American study occurred whilst still pregnant (undelivered) and only 3.8% of pregnancy related deaths from external causes in the Finland study occurred whilst still pregnant, which differs from our study where 84% of the homicide deaths occurred whilst still pregnant[26,27]. This indicates a much higher incidence of fatal violence during pregnancy in the Western Cape Province and a lack of concern for the unborn infant when compared to industrialized countries.

Suicide deaths during pregnancy and in the post-partum period have been well documented in the literature, however levels of suicide are actually lower during pregnancy and post-partum period when compared to non-pregnant females[14]. An article published by the Institute of Mental Health in the United States which reviewed suicidality in pregnancy reported suicide deaths ranging from 9 to 20% of deaths due to external forces[14]. The studies performed in the United States and in the United Kingdom showed higher rates of suicide among the younger population especially teenagers[14]. The study performed in Finland showed that suicide deaths comprised more than 50% of deaths due to external forces with the majority of the deaths occurring in the 35 to 49 year age group[26]. The study in Finland also found the leading risk factor was the post-partum period after an induced abortion in all age groups[26]. In the current study, suicide deaths encompassed 14% of the cases in the other than natural death category and 8% of cases overall which is similar to what is being seen in the United States and United Kingdom. The methods used comprised of drug and toxin ingestion and hanging which is slightly different to the reports from

the United States which reports the use of violent methods to commit suicide[14]. 50% of the cases encountered in our study occurred in the 1st trimester making early parts of pregnancy the most risky period for suicide which is in contrast to suicide deaths in the Finland where almost 100% of the cases occurred in the post-partum period[26]. Also 50% of cases occurred in the less than 20 year age group which is similar to the findings of the studies performed in the United States and United Kingdom and in contrast to the suicide deaths in Finland[14,26].

Accidental or unintentional deaths seen in our study comprised of 20% of other than natural deaths and 11% of all cases. They consisted of deaths from road traffic accidents and fires. In the study performed in Finland, approximately 40% of the cases were due to unintentional injuries, thus the numbers seen in our study is less than that experienced in Finland[26]. Of note, a study performed in New Mexico, United States reported a high number of pregnancy related deaths occurring in motor vehicle accidents[30]. The current study also encountered deaths from road traffic accidents which comprised of seven (7) cases over five years. The New Mexican study identified 33 cases over a ten year retrospective study[30]. Also accidental deaths from motor vehicles accidents accounted for 70% of deaths related to external forces in the New Mexico study[30]. The study done in New Mexico emphasized the importance for the use of seat belts and encouraged efforts to educate the community about safe vehicle travelling practices[30]. The lower case numbers seen in our study could be attributed to constant “Arrive Alive” public health campaigns in South Africa. In contrast, a large number of road accident fatalities are still seen in South Africa, which would indicate that South African families take more precautions when travelling with a pregnant female.

There were nine (9) cases in our study that were thought to be directly related to adverse effects or complications of medical treatment or medical procedure. The complications included vascular injuries, organ injuries, adverse drug reactions and septic complications from the medical procedure. Of note, all the septic complications were directly related to the medical procedure performed. The procedure encountered in all three (3) of those cases were due to a poorly performed evacuation of uterus procedure. A recent randomised controlled study

performed by Warriner et al, published in the Lancet, showed an increased complication rate among manual vacuum extractions performed by midwifes as compared to manual vacuum extractions performed by qualified doctors in South Africa[31]. As to which health personnel (midwife or doctor) performed these evacuations was not recorded in the case files.

The current study highlighted that 21% of the cases which had suspected clinical causes of death from referring medical facilities completely differed from the cause of death found after post-mortem examination. This is similar to a study performed by Sonderegger-Iseli which shows discrepancies of 15% between clinical diagnoses as compared to post-mortem diagnoses[21]. Also of importance was that in 33% of the cases where the attending medical team could not definitively establish a cause of death, a cause of death could be definitively established following post-mortem examination. The current method of evaluation of maternal deaths in developing countries is via verbal autopsies or paper autopsies[22]. Taking into account that one fifth of clinical diagnoses were different to post-mortem diagnoses, one could dispute the value of this method of evaluation of maternal deaths. Even with increased financial contributions and improved guideline development within our country, there has not been a significant decline in the number of maternal deaths in South Africa. The current situation in South Africa would indicate that the country will not make the Millennium Development Goal Five by 2015[32]. It is the opinion of the primary investigator and author that we need to re-assess the method of evaluation of maternal deaths in South Africa which has also been echoed by the other prominent researchers in the fields recognising that the verbal autopsies do not provide the answers and solutions to the maternal mortality crisis[33].

11. LIMITATIONS and PROBLEMS ENCOUNTERED IN THE PERFOMANCE OF THE STUDY:

Firstly, similar studies on other than natural maternal death investigation in South Africa were not performed before thus making the set up of the study very complex. Studies performed in first world nations were used as a guideline even though their notification systems and data methods differed from those of South Africa.

All natural maternal deaths are not autopsied at Forensic Pathology services, thus only a selection of natural deaths referred in terms of the Inquest Act and procedure related deaths are seen in the current study. The results seen in the Natural deaths category are only representative of mortuary and does not reflect the situation seen at medical facilities.

This study was performed in a single forensic pathology laboratory centre located in a single city within the large Western Cape Province. One could argue that it does not completely represent the picture that may be present in the province or within South Africa. The aim of the study was actually to highlight deaths from external forces within the province and country and where better to perform such a study than in the busiest facility in the province which saw approximately 3000 cases per year during the research period.

This study gathered data from reviewed case files which included information provided from the attending clinicians, investigating police officers and reports provided by the pathologists. No contact was made with the family members of the deceased and thus vital information and parameters like marital status, pre-natal care and history of domestic violence which were not recorded in the case files could not be accurately assessed in this study. This would indicate that follow up studies may need to be considered including interviews with deceased's family.

A major problem encountered in the study was misplaced case files or files that were not signed out via the rules within DFMUCT. It was only with the assistance of the administration officer who searched for case files that all suspected cases could be

assessed. This impresses the importance of maintaining exemplary archiving rules in order to facilitate efficient collection of data that is representative of the situation.

A further problem encountered in the analysis of the results was the comparison of racial distribution of cases with the racial breakdown within the drainage region of Salt River Forensic Pathology Laboratory. There was no reliable racial breakdown data for this region thus racial breakdown for the Western Cape Province was used. These racial breakdowns affect the calculation of the p-value in all the different sections in the results.

A major limitation and difficulty encountered in the study was the absence of toxicology reports. This is due to the huge backlog of cases at the forensic chemistry laboratories within the country. As cases with possible causes of death were awaiting these results for completion of the case, many cases encountered in the study were still recorded as “under investigation” or “undetermined”. It is important that the backlog situation that is currently being seen in Forensic Chemistry laboratories needs to be urgently attended to.

Lastly, when interpretation of results was performed, difficulties were encountered on comparison of results with other studies which were performed in first world countries as there are differences in population sizes, number of deaths and research study structure. Reliable data from developing countries to compare the results with were not available in the literature.

12. VALUES OF THE STUDY:

This research study highlights maternal deaths from other than natural causes which has never been explored before in South Africa. It provides the research fraternity with a starting point in exploring different forms of research with regards to pregnancy related deaths in South Africa.

Furthermore this research study highlighted the unique context of problems faced by pregnant females within our country. It is very important that we remember to research maternal deaths with the knowledge of common conditions and disease that are present in the variety of ethnic South African population groups.

The study showed the importance of post-mortem examination by independent pathologists and advocated that their contribution to the understanding of maternal deaths is vital in the process of reducing maternal deaths.

Now that deaths from suicide, homicide and accidental causes have been brought to the attention of the public health community; prevention and educational programmes can be introduced into the antenatal programme within the province. It would also impress the importance of possibly including an element of social services into the antenatal programme especially in the low income groups.

The study further highlights homicide deaths from intimate partner violence within the study group during pregnancy which is a major public problem within our society. The primary investigator feels that these deaths should be completely prevented or eradicated from our community. For this to occur, efforts are required from not only medical personnel but also committed and determined policing service in domestic violence cases as well as active social services programmes. It highlights the need for further education of the community on the dangers of intimate partner violence both in pregnancy and in non-pregnant females.

13. CONCLUSION with RECOMMENDATIONS:

It is quite evident from this study how important post-mortem examination is and that histopathological examination combined with toxicology analyses can provide more accurate answers as to the mechanism and clinical pathological correlation of the maternal deaths. Pathologists performing autopsies in South Africa are not directly part of the attending medical team and thus can provide a more objective opinion of the events that occurred based on the pathology seen at autopsy. Non-pathologists may make an argument that pathologists are not obstetricians and therefore may not be able to assess the situation with the same knowledge and experience that an obstetrician has. It is for this reason that the primary researcher recommends that pathologists should be included in the assessing confidential enquiry team and should be provided the opportunity to comment on the maternal health model in the country.

This study highlights how unique the South African situation is and how it contrasts and differs from industrialized and first world countries. It is the opinion of the primary investigator that national research into other than natural deaths in pregnancy take place to assess the magnitude of the problem.

The research study highlighted the high number of homicidal deaths during pregnancy, of which intimate partner violence was a major factor in those deaths. Deaths due to suicidal causes were seen to a lesser degree. Thus it is vitally important that education of issues around domestic violence and depression in pregnancy be also included in the ante-natal program. One may also find the need to include social workers and psychologists into a multi-disciplinary management team during the pregnancy period. Thus providing comprehensive care to the pregnant females and decrease deaths from external forces in South Africa.

South Africa has a high maternal mortality rate which is thought to be an underestimate due to poor reporting from rural districts. Accurate numbers of deaths due to external forces are also lacking. Furthermore, confidential enquiries are performed primarily by paper review which may also not provided all the answers. Compulsory post-mortem examination by anatomical and forensic pathologists in all

maternal death cases would assist in providing accurate information on the fatal conditions and diseases placing pregnant women at risk in South Africa, and should be seriously considered.

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[The data provided to me in reference item 34 has not been published yet. The data will be included in the sixth saving mothers confidential report into maternal deaths in South Africa.]

15. APPENDIX:

Appendix A: Ethics Approval

Appendix B: Proxy consent from the head of the Division of Forensic Medicine, University of Cape Town

Appendix C: Data Capture Sheet (example)

Appendix D: Data Collection Sheet designed by primary investigator

Appendix E: Research Spreadsheet

Appendix A

HREC Ref 562/2013

UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/research/humanethics/forms

17 September 2013

HREC REF: 562/2013

Dr A Khan
c/o Dr G Kirk
Forensic Medicine
Falmouth Building

Dear Dr Khan

PROJECT TITLE: PREGNANCY-RELATED MATERNAL DEATHS AT SALT RIVER FORENSIC PATHOLOGYLABORATORY, A 5 YEAR RETROSPECTIVE STUDY OF THE EPIDEMIOLOGICAL DATA AND SPECTRUM OF PATHOLOGY AND DISEASE IN ALL PREGNANCY RELATED DEATHS AT SALT RIVER FORENSIC PATHOLOGY LABORATORY IRRESPECTIVE OF THE CASUE OF DEATH

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30th September 2014

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical

s.thomas

Appendix B

Division of Forensic Medicine

Professor Lorna J Martin

P O Box 13914, Mowbray, 7705
Faculty of Health Sciences, Falmouth Building, Entrance 3, Level 1
Tel: +27 (0) 21 406 6412/6110 Fax: +27 (0) 21 448 1249
E-mail: lornaj.martin@uct.ac.za
Internet: www.forensicmedicine.uct.ac.za

5 August 2013

I, Lorna Jean Martin, hereby grant permission for **Dr Akmal Khan** to have access to archived records, and to use the Forensic Medicine office autopsy database for research relating to his M Med dissertation, with the following provisions –

1) that all identifiable patient information remains confidential
2) that only the principle investigator and research assistant have access to the raw data
3) that, for analysis purposes, research numbers are assigned to each case which have been de-linked from the raw data.

Lorna J Martin
Professor,& Head of Clinical Department

Appendix C

Data Capture Sheet (Example)

Year: 2012

WC 11 number (from filtered search)	Allocated Research Number
13	No
21	No
33	No
56	No
57	No
61	No
68	No
72	No
82	No
92	No
96	No
114	001
119	No
125	No
145	No
156	No
157	No
169	No
171	No
195	No
205	No
206	No
207	No
217	No
218	No
226	No
230	No
237	No
240	No
253	No
263	No
275	No
282	No
285	No
314	No
315	No
322	No
325	No

331	No
352	No
357	No
363	No
386	No
391	No
392	No
408	No
409	No
418	No
422	No
469	No
478	No
486	No
490	No
492	No
496	No
498	No
513	No
514	No
517	No
520	No
533	No
542	No
543	002
548	No
549	No
554	No
558	No
559	No
565	No
569	No
580	No
582	No
587	No
592	No
595	No
607	No
612	No
616	No
625	No
672	No

677	No
679	No
695	No
703	No
711	No
712	No
713	No
714	No
715	No
716	No
722	No
726	No
730	No
734	No
747	No
759	No
761	No
763	No
768	No
769	No
785	No
787	No
789	No
815	No
849	No
867	No
869	No
874	No
885	No
889	No
918	No
919	No
933	No
947	No
999	No
1000	No
1019	No
1046	No
1051	No
1055	No
1065	No
1075	No

1080	No
1091	No
1093	No
1101	No
1105	No
1106	No
1119	No
1120	No
1134	No
1137	No
1140	No
1147	No
1152	No
1166	No
1188	No
1191	No
1193	No
1200	No
1203	No
1204	No
1208	No
1218	No
1226	No
1231	No
1239	No
1246	No
1260	No
1262	No
1272	No
1277	No
1286	No
1298	No
1302	No
1304	No
1322	No
1324	No
1329	No
1332	No
1335	No
1344	No
1348	No
1349	No

1350	No
1356	No
1388	No
1391	No
1394	No
1397	No
1405	No
1408	No
1460	No
1463	No
1472	No
1491	No
1499	No
1509	No
1511	No
1513	No
1532	No
1552	No
1554	No
1564	No
1569	No
1579	No
1606	No
1620	No
1647	No
1667	No
1676	No
1678	No
1680	No
1713	No
1718	No
1727	No
1730	No
1738	No
1742	No
1745	No
1756	No
1768	No
1772	No
1773	No
1775	No
1777	No

1780	No
1784	No
1788	No
1790	No
1793	No
1810	No
1827	No
1829	No
1830	No
1841	003
1842	No
1866	No
1868	No
1881	No
1884	No
1889	No
1899	No
1901	No
1905	No
1928	No
1949	No
1958	No
1971	No
1984	No
1998	No
2002	No
2028	No
2029	No
2031	No
2057	No
2064	No
2073	No
2108	No
2120	No
2140	No
2152	No
2157	No
2167	No
2171	No
2180	No
2198	No
2202	No

2207	No
2209	No
2227	004
2243	No
2251	No
2264	No
2266	No
2294	No
2296	No
2300	No
2304	No
2319	No
2320	No
2322	No
2336	No
2343	No
2382	No
2385	No
2395	No
2419	No
2424	No
2426	No
2427	No
2432	No
2436	No
2437	No
2444	No
2477	No
2481	No
2497	No
2510	No
2511	No
2525	No
2530	No
2532	No
2551	No
2569	No
2573	No
2580	No
2581	No
2599	No
2605	No

2611	No
2613	No
2615	No
2622	No
2634	No
2637	No
2639	No
2642	No
2649	No
2655	No
2657	No
2676	No
2678	005
2684	No
2693	No
2697	No
2708	No
2710	No
2712	No
2714	No
2720	No
2736	No
2740	No
2741	No
2770	No
2772	No
2783	No
2785	No
2798	No
2807	No
2819	No
2838	No
2841	No
2843	No
2848	No
2854	No
2855	No
2856	No
2866	No
2867	No
2892	No
2895	No

2898	No
2903	No
2924	No
2949	No
2950	No
2957	No
2966	No
2982	No
2991	No
2997	No
3014	No
3024	No
3026	No
3031	No

Appendix D

Pregnancy related maternal deaths at Salt River Forensic Pathology Laboratory

Data Collection sheet

No.	Category of interest	Options:	Answer:
1	Research study number:	(001 to 999)	
2	Date of death:	yyyy/mm/dd	
3	Age:	In years	
4	Race:	Asian/Indian/African/White/Coloured	
5	Parity:	Number/not known	
6	Gravidity	Number/not known	
7	Number of fetuses:	Number/not known	
8	Marital status:	Single/ Married/ committed partner/ not known	
9	Death occurred during:	$1^{st}/2^{nd}/3^{rd}$/early post-partum/late post-partum	
10	Site of death: (Name of medical center if applicable)	At home/ In ambulance/ MOU/ district hospital/ secondary hospital/ tertiary hospital	
11	If at medical center, please provide suspected cause of death based on clinical data:	Cause of death/ unknown cause of death/ not at medical center	
12	Pre-natal care:	Yes/ No/ not known	
13	HIV status:	Positive/ Negative/ Not known	
14	If answer positive in 13, CD4 count:	>500/200-500/<200/Not known	
15	If answer positive in 13, On ARV treatment:	Yes/No/ Awaiting/Not known	
16	Related to TOP:	Yes / No	
17	If yes in 16, which institution	Recognized institution/Illegal TOP	
18	Cause of death (after autopsy examination):		
19	Manner of death:	Suicide/Homicide/Accident/Natural/Undetermined	
20	Involved in RTA:	Yes/No	
21	If yes to 20,	Driver/Passenger/Pedestrian	
22	Was blood alcohol level taken:	Yes/ No/ Not applicable	

Appendix D

23	If yes to 22, Blood alcohol level	Give actual level	
24	Was any specimens taken for toxicology analysis	Yes/No/Not applicable	
25	If yes to 24, results of toxicology	Positive result/ Negative Result/still awaiting results	
26	Any other significant findings from autopsy report:	Found during perusal through the document and at autopsy	
27	Relevant histopathological findings:	Found during perusal through the histopathology report/ histology not taken	

Data Collection Form designed by Dr. Akmal Khan

Appendix E

Appendix E: Research data spreadsheet

For ease of reference, please refer to attached CD for digital copy of spreadsheet.

Research Number	Year of Death	Month of Death	Day of Death	Age	Race	Parity
1	2012	1	12	19	African/Black	Not known
2	2012	1	29	30	African/Black	Not known
3	2012	2	20	26	African/Black	Not known
4	2012	2	25	24	African/Black	1
5	2012	3	31	30	African/Black	Not known
6	2012	4	14	38	Coloured	6
7	2012	5	2	28	Coloured	Not known
8	2012	5	28	30	African/Black	Not known
9	2012	6	6	31	Coloured	Not known
10	2012	6	15	28	Coloured	1
11	2012	6	16	25	African/Black	Not known
12	2012	6	24	28	Coloured	Not known
13	2012	6	29	28	Coloured	3
14	2012	8	30	28	Coloured	Not known
15	2012	9	21	37	White	Not known
16	2012	10	4	26	Coloured	Not known
17	2012	11	26	39	African/Black	Not known
18	2012	12	8	20	African/Black	Not known
19	2012	12	15	37	Coloured	Not known
20	2011	2	19	23	Coloured	Not known
21	2011	3	2	38	African/Black	Not known
22	2011	4	8	33	African/Black	Not known
23	2011	4	14	37	African/Black	Not known
24	2011	4	15	25	African/Black	Not known

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25	2011	4	18	35	African/Black	6
26	2011	5	4	30	Coloured	Not known
27	2011	6	15	37	Coloured	Not known
28	2011	6	16	29	African/Black	Not known
29	2011	6	21	22	African/Black	Not known
30	2011	7	8	34	African/Black	Not known
31	2011	7	22	19	Coloured	0
32	2011	8	20	24	African/Black	Not known
33	2011	9	9	24	African/Black	Not known
34	2011	9	11	34	Coloured	1
35	2011	10	7	27	White	Not known
36	2011	10	18	21	White	0
37	2011	12	4	32	African/Black	2
38	2011	12	14	33	African/Black	Not known
39	2010	1	2	33	African/Black	3
40	2010	1	13	24	Coloured	Not known
41	2010	1	10	20	African/Black	2
42	2010	3	29	26	African/Black	3
43	2010	4	4	28	Coloured	2
44	2010	4	4	28	African/Black	2
45	2010	4	24	20	African/Black	Not known
46	2010	6	22	25	African/Black	Not known
47	2010	7	17	31	African/Black	Not known
48	2010	7	26	29	African/Black	Not known
49	2010	9	28	33	African/Black	Not known
50	2010	10	9	35	White	Not known
51	2010	10	16	34	African/Black	0
52	2010	10	29	33	African/Black	Not known
53	2010	12	3	35	African/Black	3
54	2010	12	17	36	African/Black	4
55	2009	2	23	22	African/Black	Not known

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56	2009	2	27	30	African/Black	Not known
57	2009	5	9	25	Coloured	Not known
58	2009	9	14	20	African/Black	Not known
59	2009	12	25	26	Coloured	Not known
60	2009	3	25	40	African/Black	Not known
61	2009	4	18	36	White	Not known
62	2009	5	1	30	African/Black	Not known
63	2009	5	18	24	Coloured	Not known
64	2009	5	9	26	African/Black	2
65	2009	5	27	40	African/Black	Not known
66	2009	6	5	31	African/Black	0
67	2009	6	10	32	African/Black	Not known
68	2009	6	29	18	Indian	Not known
69	2009	7	13	28	Coloured	Not known
70	2009	7	19	23	Coloured	Not known
71	2009	7	30	30	African/Black	Not known
72	2009	8	16	37	African/Black	2
73	2009	8	20	29	African/Black	1
74	2009	8	25	17	African/Black	0
75	2009	10	6	32	African/Black	Not known
76	2009	10	8	21	African/Black	Not known
77	2009	11	22	21	Coloured	Not known
78	2009	11	23	27	African/Black	Not known
79	2009	12	15	18	African/Black	1
80	2008	5	25	33	African/Black	Not known
81	2008	4	1	30	African/Black	Not known
82	2008	10	11	17	Coloured	Not known
83	2008	11	2	32	Coloured	Not

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						known	
84	2008	9	5	18	African/Black	Not known	
85	2008	11	3	26	Coloured	Not known	
86	2008	10	12	30	African/Black	Not known	
87	2008	9	17	21	Coloured	Not known	
88	2008	8	25	23	Coloured	Not known	
89	2008	8	5	24	African/Black	Not known	
90	2008	1	1	19	Coloured	Not known	
91	2008	1	13	21	Coloured	Not known	
92	2008	2	11	21	Coloured	Not known	
93	2008	2	24	39	Coloured		0
94	2008	2	26	33	African/Black	Not known	
95	2008	2	27	22	African/Black	Not known	
96	2008	3	19	30	White	Not known	
97	2008	3	23	24	African/Black	Not known	
98	2008	3	26	30	African/Black	Not known	
99	2008	4	13	26	African/Black		2
100	2008	4	18	19	African/Black	Not known	
101	2008	5	27	32	African/Black		4
102	2011	9	1	23	African/Black		1
103	2008	7	8	23	African/Black	Not known	
104	2012	12	13	37	African/Black		3
105	2011	5	11	26	Coloured	Not known	
106	2008	1	6	27	African/Black	Not known	
107	2008	2	17	33	African/Black	Not known	
108	2008	6	9	36	Coloured	Not known	
109	2010	4	29	22	Coloured	Not known	
110	2010	6	6	25	Coloured	Not	

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111	2010	10	4	40	African/Black	Not known 4
112	2011	9	28	44	African/Black	Not known
113	2008	7	13	29	African/Black	Not known
114	2010	12	19	31	Coloured	Not known

Research Number	Gravidity	Number of foetuses	Marital staus	Death occurred	Site of Death
1	Not known	Singleton	Single	3rd T	Home
2	Not known	Singleton	Single	3rd T	Private
3	Not known	Not Known	Single	Early PP	Tertiary
4	2	Singleton	Single	3rd T	Tertiary
5	Not known	Singleton	Single	2nd T	Secondary
6	6	Not Known	Partner	Late PP	Tertiary
7	Not known	Singleton	Single	2nd T	Home
8	Not known	Singleton	Single	3rd T	Home
9	Not known	Singleton	Partner	3rd T	Home
10	2	Singleton	Married	Early PP	Tertiary
11	Not known	Singleton	Partner	3rd T	District Hosp
12	Not known	Singleton	Married	Early PP	Tertiary
13	4	Other	Single	Early PP	Tertiary
14	Not known	Singleton	Single	3rd T	Other
15	Not known	Singleton	Single	Late PP	Private
16	Not known	Singleton	Single	2nd T	Secondary
17	Not known	Not Known	Married	Early PP	Secondary
18	Not known	Singleton	Partner	3rd T	Other
19	Not known	Singleton	Married	2nd T	Home
20	Not known	Singleton	Not known	Early PP	Tertiary
21	Not	Singleton	Single	3rd T	Ambulance

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	known					
22	Not known		Not Known	Not known	Late PP	Tertiary
23	Not known		Singleton	Not known	1st T	Home
24	Not known		Singleton	Not known	3rd T	Home
25		6	Singleton	Single	Early PP	MOU/Day Hosp
26	Not known		Not Known	Single	Late PP	Home
27	Not known		Singleton	Married	Early PP	Home
28	Not known		Singleton	Not known	3rd T	Tertiary
29	Not known		Singleton	Single	3rd T	Home
30	Not known		Singleton	Not known	1st T	Other
31		1	Singleton	Partner	1st T	Home
32	Not known		Singleton	Partner	1st T	Home
33	Not known		Singleton	Not known	2nd T	Other
34		3	Singleton	Married	Early PP	Secondary
35	Not known		Singleton	Married	1st T	Secondary
36		1	Singleton	Single	Early PP	Home
37		2	Singleton	Married	Late PP	Home
38	Not known		Singleton	Single	1st T	Home
39		3	Singleton	Not known	Early PP	Secondary
40	Not known		Singleton	Married	1st T	District Hosp
41		2	Singleton	Not known	Early PP	Tertiary
42		4	Twins	Not known	3rd T	Other
43		2	Singleton	Married	Late PP	Home
44		3	Singleton	Not known	3rd T	Secondary
45	Not known		Singleton	Partner	2nd T	MOU/Day Hosp
46	Not known		Singleton	Not known	3rd T	Tertiary
47	Not known		Not Known	Not known	Early PP	Tertiary
48	Not known		Singleton	Not known	2nd T	District Hosp
49	Not known		Singleton	Married	Late PP	Private
50	Not		Singleton	Married	3rd T	Private

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	known					
51		1	Singleton	Married	3rd T	Home
	Not					
52	known		Singleton	Not known	Early PP	Tertiary
53		4	Singleton	Single	1st T	Tertiary
54		4	Twins	Not known	Early PP	Tertiary
	Not					
55	known		Singleton	Not known	3rd T	Home
	Not					
56	known		Other	Not known	1st T	Secondary
	Not					
57	known		Singleton	Not known	2nd T	Other
	Not					
58	known		Singleton	Partner	2nd T	Other
	Not					
59	known		Singleton	Not known	1st T	Home
	Not					MOU/Day
60	known		Singleton	Married	Early PP	Hosp
	Not					
61	known		Singleton	Not known	Early PP	Private
	Not					
62	known		Singleton	Not known	Late PP	Private
	Not					
63	known		Singleton	Partner	2nd T	Tertiary
64		2	Singleton	Not known	Late PP	Ambulance
	Not					
65	known		Singleton	Not known	3rd T	Other
66		5	Twins	Not known	Early PP	Tertiary
	Not					
67	known		Other	Not known	1st T	Home
	Not					
68	known		Singleton	Not known	3rd T	Home
	Not					
69	known		Singleton	Married	2nd T	Ambulance
	Not					
70	known		Singleton	Not known	3rd T	District Hosp
	Not					
71	known		Singleton	Not known	3rd T	Tertiary
72		2	Singleton	Not known	Early PP	Tertiary
73		1	Singleton	Not known	Early PP	Secondary
74		1	Other	Not known	Early PP	Tertiary
	Not					MOU/Day
75	known		Singleton	Not known	Late PP	Hosp
	Not					
76	known		Not Known	Not known	1st T	Tertiary
	Not					
77	known		Singleton	Not known	2nd T	Secondary
	Not					
78	known		Singleton	Not known	Early PP	Tertiary

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79		1	Singleton	Not known	Late PP	Tertiary
80	Not known		Not Known	Partner	Late PP	Home
81	Not known		Singleton	Not known	1st T	Tertiary
82	Not known		Singleton	Not known	3rd T	Home
83	Not known		Singleton	Partner	1st T	Home
84	Not known		Singleton	Not known	2nd T	Tertiary
85	Not known		Twins	Not known	3rd T	Home
86	Not known		Other	Not known	Early PP	Secondary
87	Not known		Singleton	Not known	Early PP	Home
88	Not known		Singleton	Not known	Late PP	Private
89	Not known		Singleton	Not known	1st T	Home
90	Not known		Singleton	Not known	1st T	Ambulance
91	Not known		Singleton	Not known	Early PP	Home
92	Not known		Singleton	Not known	Early PP	MOU/Day Hosp
93		4	Singleton	Not known	3rd T	District Hosp
94	Not known		Singleton	Not known	3rd T	Tertiary
95	Not known		Other	Not known	Early PP	Secondary
96	Not known		Singleton	Not known	2nd T	Other
97	Not known		Singleton	Not known	Early PP	Tertiary
98	Not known		Singleton	Not known	1st T	Other
99		2	Not Known	Not known	Early PP	Tertiary
100	Not known		Singleton	Not known	1st T	Other
101		4	Singleton	Not known	Early PP	Tertiary
102		2	Singleton	Single	3rd T	MOU/Day Hosp
103	Not known		Singleton	Not known	Early PP	Tertiary
104		4	Singleton	Married	3rd T	MOU/Day Hosp
105	Not known		Singleton	Married	Early PP	Private

Appendix E

106	Not known		Singleton	Not known	1st T	Private
107	Not known		Singleton	Not known	2nd T	Home
108	Not known		Singleton	Married	Late PP	Home
109	Not known		Singleton	Not known	Late PP	MOU/Day Hosp
110	Not known		Singleton	Not known	2nd T	Home
111		4	Singleton	Single	Early PP	MOU/Day Hosp
112	Not known		Singleton	Not known	Early PP	Tertiary
113	Not known		Singleton	Not known	3rd T	Secondary
114	Not known		Singleton	Married	2nd T	Home

Research Number	Medical Center	Medical center COD
1	N/A	N/A
2	Vincent Pallotti	Hypovolaemic shock or Myocardial Contusion
3	Groote Schuur	Not known
4	Groote Schuur	Resp tract infection
5	New Somerset	Hypovolaemic shock/Vessel injury/Head injury
6	Groote Schuur	Cerebral Infarct
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A
10	Groote Schuur	Not given
11	Victoria	Embolus
12	Groote Schuur	Septic Shock post EVAC and Aortic valve repair
13	Groote Schuur	Amniotic Fluid Embolus
14	N/A	N/A
15	UCT and Cape Town Mediclinic	Intra-abdominal sepsis
16	New Somerset	Drug OD and prolonged hypoxia
17	New Somerset	Pulmonary embolus or Amniotic Fluid embolus
18	N/A	N/A
19	N/A	N/A
20	Groote Schuur	Gunshot wound to the abdomen

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21	N/A	N/A
22	Groote Schuur	Septic Shock
23	N/A	N/A
24	N/A	N/A
25	K.T.C. Gugulethu	Not given
26	N/A	N/A
27	N/A	N/A
28	Groote Schuur	DIC
29	N/A	N/A
30	N/A	N/A
31	N/A	N/A
32	N/A	N/A
33	N/A	N/A
34	Mowbray Maternity	Amniotic Fluid Embolus
35	New Somerset	Polytrauma
36	N/A	N/A
37	N/A	N/A
38	N/A	N/A
39	New Somerset	DIC secondary to Abruptio placentae
40	Wesfleur	Not given
41	Groote Schuur	Cerebrovascular accident
42	Fire Station	N/A
43	N/A	N/A
44	New Somerset	HIV asc CMO or Pulmonary embolus
45	K.T.C. Gugulethu	Not given
46	Groote Schuur	Septic Shock
47	Groote Schuur	Hypoxia leading to bradycardia and arrest
48	Wesfleur	Not given
49	Vincent Pallotti	Pulmonary thromboembolus
50	Vincent Pallotti	Pulmonary thromboembolus
51	N/A	N/A
52	Groote Schuur	Cerebral oedema
53	Groote Schuur	Pulmonary embolus or intracranial haem
54	Groote Schuur	Amniotic Fluid Embolus/Massive PPH/ Multi-organ failure
55	N/A	N/A
56	GF Jooste	Not given (unsure)
57	Bushes	N/A
58	Streets	N/A
59	N/A	N/A
60	Mitchells Plain	Not given
61	Constantiaberg Medi-clinic	DIC
62	Mitchells Plain Medical Centre	Not given
63	Groote Schuur	Not given

64	N/A	N/A
65	On route to hospital	N/A
66	Groote Schuur	Septic Shock
67	N/A	N/A
68	N/A	N/A
69	N/A	N/A
70	Wesfleur	Not given
71	Groote Schuur	Septic Shock/ARDS/Pulm oedema/ Mitral stenosis
72	Groote Schuur	Not given
73	New Somerset	Resp Failure/ Pulmonary embolus
74	Groote Schuur	Drug OD or Hepatic Failure
75	Mitchells Plain	Not given
76	Groote Schuur	Diffuse brain injury
77	GF Jooste	Not given
78	Groote Schuur	Hypovolaemic Shock
79	Groote Schuur	Not given
80	N/A	N/A
81	Groote Schuur	Sepsis
82	N/A	N/A
83	N/A	N/A
84	Groote Schuur	Not given
85	N/A	N/A
86	GF Jooste	Sepsis
87	N/A	N/A
88	UCT Academic	Not given
89	N/A	N/A
90	N/A	N/A
91	N/A	N/A
92	Mitchells Plain	Not given
93	Wesfleur	Not given
94	Groote Schuur	Not given
95	GF Jooste	Septic Shock
96	Car	N/A
97	Groote Schuur	Sepsis and DIC
98	Streets	N/A
99	Groote Schuur	Pulmonary embolus
100	Car	N/A
101	Groote Schuur	Not given
102	K.T.C. Gugulethu	Not given
103	Groote Schuur	Not given
104	Retreat MOU	Pulmonary oedema secondary to gestational HPT
105	Vincent Pallotti	Not given
106	Tokai Medicross	Not given
107	N/A	N/A
108	N/A	N/A

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109	Hanover Park	Not given
110	N/A	N/A
111	Gugulethu Day Hospital	Not given
112	Groote Schuur	Unknown ? Liver Failure
113	New Somerset	Delayed Hypersensitivity Reaction
114	N/A	N/A

Research Number	Pre-natal care	HIV Status	CD Count	ARV Treatment	Related to TOP	TOP Institute
1	Not known	Not known	N/A	N/A	No	N/A
2	Not known	Not known	N/A	N/A	No	N/A
3	Yes	Not known	N/A	N/A	No	N/A
4	No	Positive	Not Known	Yes	No	N/A
5	Not known	Not known	N/A	N/A	No	N/A
6	No	Positive	Not Known	Not known	No	N/A
7	No	Not known	N/A	N/A	No	N/A
8	Yes	Not known	N/A	N/A	No	N/A
9	Not known	Not known	N/A	N/A	No	N/A
10	Not known	Positive	20	No	No	N/A
11	Not known	Not known	N/A	N/A	No	N/A
12	Not known	Not known	N/A	N/A	Yes	Recognized
13	Yes	Not known	N/A	N/A	Yes	Recognized
14	Not known	Not known	N/A	N/A	No	N/A
15	Yes	Negative	N/A	N/A	No	N/A
16	No	Not known	N/A	N/A	No	N/A
17	Yes	Not known	N/A	N/A	No	N/A
18	Not known	Not known	N/A	N/A	No	N/A
19	Not known	Not known	N/A	N/A	No	N/A
20	Not known	Negative	N/A	N/A	No	N/A
21	Not known	Positive	119	Yes	No	N/A
22	Not known	Positive	222	No	No	N/A
23	Yes	Not known	N/A	N/A	No	N/A
24	Not known	Not known	N/A	N/A	No	N/A
25	Not known	Not known	N/A	N/A	No	N/A
26	Not known	Not known	N/A	N/A	Not known	N/A
27	Yes	Not known	N/A	N/A	No	N/A
28	Not known	Not known	N/A	N/A	No	N/A
29	Not known	Not known	N/A	N/A	No	N/A
30	Not known	Not known	N/A	N/A	No	N/A
31	No	Not known	N/A	N/A	No	N/A
32	Not known	Not known	N/A	N/A	No	N/A
33	Not known	Not known	N/A	N/A	No	N/A
34	Yes	Not known	N/A	N/A	No	N/A
35	Not known	Not known	N/A	N/A	No	N/A

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36	Not known	Not known	N/A	N/A	No	N/A
37	Yes	Not known	N/A	N/A	No	N/A
38	No	Not known	N/A	N/A	No	N/A
39	No	Positive	294	No	No	N/A
40	No	Not known	N/A	N/A	No	N/A
41	No	Not known	N/A	N/A	No	N/A
42	Yes	Not known	N/A	N/A	No	N/A
43	Yes	Not known	N/A	N/A	No	N/A
44	Yes	Positive	34	Yes	No	N/A
45	Not known	Not known	N/A	N/A	No	N/A
46	Not known	Not known	N/A	N/A	No	N/A
47	Not known	Positive	84	No	No	N/A
48	Not known	Not known	N/A	N/A	No	N/A
49	Not known	Positive	Not Known	Yes	No	N/A
50	Yes	Not known	N/A	N/A	No	N/A
51	Yes	Not known	N/A	N/A	No	N/A
52	Not known	Not known	N/A	N/A	Yes	Recognized
53	No	Positive	242	No	No	N/A
54	Yes	Positive	243	Yes	No	N/A
55	Not known	Not known	N/A	N/A	No	N/A
56	No	Not known	N/A	N/A	No	N/A
57	Not known	Not known	N/A	N/A	No	N/A
58	Not known	Not known	N/A	N/A	No	N/A
59	Not known	Not known	N/A	N/A	No	N/A
60	Not known	Not known	N/A	N/A	No	N/A
61	Yes	Not known	N/A	N/A	No	N/A
62	Yes	Positive	Not Known	Yes	No	N/A
63	Not known	Not known	N/A	N/A	No	N/A
64	Yes	Positive	423	Yes	No	N/A
65	Not known	Not known	N/A	N/A	No	N/A
66	Yes	Not known	N/A	N/A	No	N/A
67	No	Not known	N/A	N/A	No	N/A
68	Not known	Not known	N/A	N/A	No	N/A
69	Yes	Not known	N/A	N/A	No	N/A
70	Not known	Not known	N/A	N/A	No	N/A
71	Not known	Negative	N/A	N/A	No	N/A
72	Not known	Not known	N/A	N/A	No	N/A
73	Not known	Positive	284	Not known	No	N/A
74	Not known	Not known	N/A	N/A	No	N/A
75	Yes	Not known	N/A	N/A	No	N/A
76	Not known	Not known	N/A	N/A	No	N/A
77	Not known	Not known	N/A	N/A	No	N/A
78	Not known	Not known	N/A	N/A	No	N/A
79	Yes	Positive	287	No	No	N/A
80	Not known	Not known	N/A	N/A	No	N/A

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81	Not known	Not known	N/A	N/A	No	N/A
82	Not known	Not known	N/A	N/A	No	N/A
83	Not known	Not known	N/A	N/A	No	N/A
84	Not known	Positive	Not Known	Not known	No	N/A
85	Not known	Not known	N/A	N/A	No	N/A
86	Not known	Not known	N/A	N/A	No	N/A
87	Yes	Not known	N/A	N/A	No	N/A
88	Yes	Not known	N/A	N/A	No	N/A
89	Not known	Not known	N/A	N/A	No	N/A
90	Not known	Not known	N/A	N/A	No	N/A
91	Not known	Not known	N/A	N/A	No	N/A
92	Yes	Not known	N/A	N/A	No	N/A
93	Not known	Not known	N/A	N/A	No	N/A
94	Not known	Not known	N/A	N/A	No	N/A
95	Not known	Not known	N/A	N/A	Yes	Recognized
96	Not known	Not known	N/A	N/A	No	N/A
97	No	Not known	N/A	N/A	No	N/A
98	Not known	Not known	N/A	N/A	No	N/A
99	Not known	Not known	N/A	N/A	No	N/A
100	Not known	Not known	N/A	N/A	No	N/A
101	Not known	Not known	N/A	N/A	No	N/A
102	No	Not known	N/A	N/A	No	N/A
103	Not known	Not known	N/A	N/A	No	N/A
104	Yes	Negative	N/A	N/A	No	N/A
105	Yes	Not known	N/A	N/A	No	N/A
106	Not known	Not known	N/A	N/A	No	N/A
107	Not known	Not known	N/A	N/A	No	N/A
108	Not known	Not known	N/A	N/A	No	N/A
109	Not known	Not known	N/A	N/A	No	N/A
110	Not known	Not known	N/A	N/A	No	N/A
111	No	Not known	N/A	N/A	No	N/A
112	Not known	Positive	Not Known	Not known	No	N/A
113	Not known	Not known	N/A	N/A	No	N/A
114	Not known	Not known	N/A	N/A	No	N/A

Research Number	PM COD	Manner of Death
1	Undetermined	Suicide
2	Multiple Injuries	Accidental
3	Complication of procedure	Un-natural (other)
4	Bilateral pneumonias	Natural
5	Stab wound injuries to R subclavian	Homicide
6	Wound Sepsis	Natural
7	Pneumonia on LODOX (No PM performed)	Natural

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8	Complications of Hypertension in Pregnancy (No PM performed)	Natural
9	Stab wound to chest	Homicide
10	HIVAN and pneumonia	Natural
11	Stab wound to chest	Homicide
12	Undetermined	Undetermined
13	Muliple emboli (Trophoblastic and Fibrin)	Natural
14	Manual compression of the neck	Homicide
15	Consistent with sepsis in post-operative setting	Natural
16	Undetermined	Suicide
17	Saddle embolus	Natural
18	Stab wound to chest	Homicide
19	Multiple stab wound injuries to body	Homicide
20	Gunshot wound to the abdomen	Homicide
21	Pulmonary TB and retroviral disease (No PM performed)	Natural
22	Complication of procedure	Un-natural (other)
23	Pulmonary Thromboembolus	Natural
24	Burning and charring	Accidental
25	Post-partum haemorrhage (Atonic uterus)	Natural
26	Undetermined (Most likely OD)	Suicide
27	Ruptured uterus	Natural
28	Eclampsia with Bleeding D/O (No PM performed)	Natural
29	Bronchopneumonia	Natural
30	Embolus (Saddle)	Natural
31	Consistent with hanging	Suicide
32	Smoke inhalation and burns	Accidental
33	Multiple stab wound injuries to body	Homicide
34	Undetermined	Undetermined
35	Blunt abdominal trauma	Accidental
36	Aortic dissection (Possible Marfan's)	Natural
37	Cardiac pathology (No PM performed)	Natural
38	Ruptured ectopic pregnancy (Tubal)	Natural
39	Hypovolaemic Shock secondary to gestational hypertension and DIC	Natural
40	Ruptured ectopic pregnancy (Tubal)	Natural
41	Eclampsia and HELLP syndrome	Natural
42	Undetermined	Undetermined
43	Pulmonary embolus	Natural
44	Advanced retroviral disease	Natural
45	Stab wound to neck	Homicide
46	Undetermined (Most likely OD)	Undetermined
47	Disseminated TB	Natural
48	Stab wound to chest	Homicide
49	Pulmonary Thromboembolus	Natural
50	Intracerebral haemorrhage	Natural
51	Hypertension and Cardiac Failure	Natural

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52	Uterine perforation and rupture following evacuation of uterus	Un-natural (other)
53	Thrombotic thrombocytopaenic pupura	Natural
54	Uterine atony and massive PPH	Natural
55	Ligature compression of neck	Homicide
56	Complications of acute appendicitis	Natural
57	Manual strangulation	Homicide
58	Gunshot wound to the head	Homicide
59	Stab wound to the chest	Homicide
60	Undetermined	Undetermined
61	Pre-eclampsia	Natural
62	Peritonitis	Natural
63	Undeteremined	Undetermined
64	Pneumonia on LODOX (No PM performed)	Natural
65	Hypertension and Cardiac Failure	Natural
66	Undetermined	Undetermined
67	Basal meningitis and empyema	Natural
68	Undetermined	Undetermined
69	Aortic dissection and rupture	Natural
70	Multiple injuries	Accidental
71	Lung pathology in a person with valvular heart dx	Natural
72	ARDS secondary to bronchiolitis	Natural
73	Lung pathology	Natural
74	Under investigation	Suicide
75	Cardiac pathology (No PM performed)	Natural
76	Multiple injuries	Accidental
77	Burn injuries	Accidental
78	Abruptio Placentae	Natural
79	Adverse drug reaction	Un-natural (other)
80	Stab wound to the chest	Homicide
81	Undetermined	Homicide
82	Stab wound to the neck	Homicide
83	Multiple gunshot wounds to the body	Homicide
84	Pneumonia and meningitis (NO PM performed)	Natural
85	Burn injuries	Accidental
86	Undetermined	Undetermined
87	Cardiac pathology	Natural
88	Sepsis	Natural
89	Consistent with Hanging	Suicide
90	Undetermined	Suicide
91	Pulmonary Thromboembolus	Natural
92	Undetermined	Undetermined
93	Cardiac: Mitral stenosis	Natural
94	Multiple injuries	Accidental
95	Multiple organ pathology due to genital sepsis and peritonitis	Un-natural (other)
96	Traumatic asphyxiation	Accidental

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97	Intra-abdominal haemorrhage associated with surgical procedure	Un-natural (other)
98	Blunt force head trauma	Accidental
99	Natural causes	Natural
100	Ruptured aorta	Natural
101	Pre-eclampsia	Natural
102	Eclampsia	Natural
103	Head injuries	Homicide
104	Eclampsia	Natural
105	Natural causes (No PM performed)	Natural
106	Undetermined (Most likely OD)	Suicide
107	Pneumocytis pneumonia	Natural
108	Undetermined	Undetermined
109	Pulmonary thromboembolus (saddle)	Natural
110	Smoke inhalation and burns	Accidental
111	Undetermined	Undetermined
112	Undetermined (Probably Liver Failure)	Undetermined
113	Undetermined	Undetermined
114	Intracranial pathology (Tubercuoloma)	Natural

Research Number	RTA	RTA (2)	Alcohol	Alcohol Level
1	No	N/A	Yes	0.00
2	Yes	Passenger	No	N/A
3	No	N/A	No	N/A
4	No	N/A	No	N/A
5	No	N/A	Yes	0.13
6	No	N/A	No	N/A
7	No	N/A	No	N/A
8	No	N/A	No	N/A
9	No	N/A	Yes	0.11
10	No	N/A	No	N/A
11	No	N/A	Yes	0.21
12	No	N/A	No	N/A
13	No	N/A	No	N/A
14	No	N/A	No	N/A
15	No	N/A	No	N/A
16	No	N/A	No	N/A
17	No	N/A	No	N/A
18	No	N/A	Yes	0.00
19	No	N/A	Yes	Awaiting
20	No	N/A	No	N/A
21	No	N/A	No	N/A
22	No	N/A	No	N/A

23	No	N/A	No	N/A
24	No	N/A	Yes	0.00
25	No	N/A	No	N/A
26	No	N/A	No	N/A
27	No	N/A	No	N/A
28	No	N/A	No	N/A
29	No	N/A	Yes	0.00
30	No	N/A	No	N/A
31	No	N/A	Yes	0.00
32	No	N/A	Yes	0,17
33	No	N/A	Yes	0.00
34	No	N/A	No	N/A
35	Yes	Passenger	Yes	0.05
36	No	N/A	No	N/A
37	No	N/A	No	N/A
38	No	N/A	No	N/A
39	No	N/A	No	N/A
40	No	N/A	No	N/A
41	No	N/A	No	N/A
42	No	N/A	No	N/A
43	No	N/A	No	N/A
44	No	N/A	No	N/A
45	No	N/A	No	N/A
46	No	N/A	No	N/A
47	No	N/A	No	N/A
48	No	N/A	Yes	0.16
49	No	N/A	No	N/A
50	No	N/A	No	N/A
51	No	N/A	No	N/A
52	No	N/A	No	N/A
53	No	N/A	No	N/A
54	No	N/A	No	N/A
55	No	N/A	Yes	0,00
56	No	N/A	No	N/A
57	No	N/A	Yes	0.00
58	No	N/A	Yes	0.00
59	No	N/A	Yes	0.14
60	No	N/A	No	N/A
61	No	N/A	No	N/A
62	No	N/A	No	N/A
63	No	N/A	Yes	0.00
64	No	N/A	No	N/A
65	No	N/A	No	N/A
66	No	N/A	No	N/A
67	No	N/A	No	N/A

68	No	N/A	No	N/A
69	No	N/A	No	N/A
70	Yes	Passenger	No	N/A
71	No	N/A	No	N/A
72	No	N/A	No	N/A
73	No	N/A	No	N/A
74	No	N/A	No	N/A
75	No	N/A	No	N/A
76	Yes	Pedestrian	Yes	0,00
77	No	N/A	Yes	0.11
78	No	N/A	No	N/A
79	No	N/A	No	N/A
80	No	N/A	Yes	0.00
81	No	N/A	No	N/A
82	No	N/A	Yes	0.03
83	No	N/A	Yes	0.00
84	No	N/A	No	N/A
85	No	N/A	Yes	0.00
86	No	N/A	No	N/A
87	No	N/A	No	N/A
88	No	N/A	No	N/A
89	No	N/A	Yes	0.00
90	No	N/A	Yes	0,00
91	No	N/A	No	N/A
92	No	N/A	Yes	0,00
93	No	N/A	No	N/A
94	Yes	Passenger	No	N/A
95	No	N/A	No	N/A
96	Yes	Passenger	Yes	0,00
97	No	N/A	No	N/A
98	Yes	Pedestrian	Yes	0,00
99	No	N/A	No	N/A
100	Yes	Passenger	Yes	0,00
101	No	N/A	No	N/A
102	No	N/A	No	N/A
103	No	N/A	No	N/A
104	No	N/A	No	N/A
105	No	N/A	No	N/A
106	No	N/A	Yes	0,00
107	No	N/A	No	N/A
108	No	N/A	Yes	Awaiting
109	No	N/A	No	N/A
110	No	N/A	No	N/A
111	No	N/A	No	N/A
112	No	N/A	No	N/A

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113	No	N/A	No	N/A
114	No	N/A	No	N/A

Research Number	Tox	Tox Results	Histo taken
1	Yes	Turbifos	Yes
2	No	N/A	No
3	No	N/A	No
4	No	N/A	Yes
5	No	N/A	No
6	No	N/A	Yes
7	No	N/A	No
8	No	N/A	No
9	No	N/A	No
10	No	N/A	Yes
11	No	N/A	Yes
12	No	N/A	Yes
13	No	N/A	Yes
14	Yes	Trace Methaqualone	No
15	No	N/A	Yes
16	No	N/A	Yes
17	No	N/A	No
18	No	N/A	No
19	No	N/A	No
20	No	N/A	No
21	No	N/A	No
22	No	N/A	Yes
23	No	N/A	Yes
24	Yes	CO = 36% sat	No
25	No	N/A	No
26	Yes	Chlorpromazine and orphenadrine found	Yes
27	No	N/A	Yes
28	No	N/A	No
29	No	N/A	Yes
30	No	N/A	No
31	No	N/A	No
32	Yes	CO = 65% sat	No
33	No	N/A	No
34	No	N/A	Yes
35	No	N/A	No
36	No	N/A	Yes
37	No	N/A	No
38	No	N/A	No

39	No	N/A	Yes
40	No	N/A	Yes
41	No	N/A	No
42	Yes	Awaiting	Yes
43	No	N/A	No
44	Yes	Awaiting	Yes
45	No	N/A	No
46	Yes	Awaiting	Yes
47	No	N/A	Yes
48	No	N/A	No
49	No	N/A	No
50	No	N/A	Yes
51	No	N/A	No
52	No	N/A	Yes
53	No	N/A	Yes
54	No	N/A	Yes
55	Yes	No drugs detected	No
56	No	N/A	No
57	No	N/A	No
58	No	N/A	No
59	No	N/A	No
60	No	N/A	Yes
61	No	N/A	Yes
62	No	N/A	Yes
63	No	N/A	Yes
64	No	N/A	No
65	No	N/A	No
66	No	N/A	Yes
67	No	N/A	No
68	Yes	Awaiting	Yes
69	Yes	Awaiting	No
70	No	N/A	No
71	No	N/A	No
72	No	N/A	Yes
73	No	N/A	Yes
74	Yes	Awaiting	Yes
75	No	N/A	No
76	No	N/A	No
77	Yes	CO = 4%	No
78	No	N/A	No
79	No	N/A	Yes
80	No	N/A	No
81	No	N/A	Yes
82	No	N/A	No
83	No	N/A	No

84	No	N/A	No
85	Yes	CO = 23%	No
86	No	N/A	Yes
87	No	N/A	Yes
88	No	N/A	Yes
89	Yes	Awaiting	No
90	Yes	Awaiting	Yes
91	No	N/A	No
92	No	N/A	Yes
93	No	N/A	Yes
94	No	N/A	No
95	No	N/A	Yes
96	No	N/A	No
97	No	N/A	Yes
98	No	N/A	No
99	No	N/A	Yes
100	No	N/A	No
101	No	N/A	No
102	No	N/A	Yes
103	No	N/A	No
104	No	N/A	Yes
105	No	N/A	No
106	Yes	Awaiting	Yes
107	No	N/A	Yes
108	No	N/A	Yes
109	No	N/A	No
110	No	N/A	No
111	No	N/A	Yes
112	No	N/A	Yes
113	No	N/A	Yes
114	No	N/A	Yes