Retrospective analysis of the utilisation of DNA analyses in the identification of human remains at Salt River Mortuary (Cape Town, South Africa)

By

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KMBSOP002

SUBMITTED TO THE UNIVERSITY OF CAPE TOWN

In partial fulfilment of the requirements for the degree.

MPhil (Biomedical Forensic Science)

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UNIVERSITY OF CAPE TOWN

Date of submission: February 2024

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Abstract

Post-mortem human identification is crucial for medico-legal investigations and for social justice. Unfortunately, many people remain unidentified, particularly in developing countries. The use of forensic DNA profiling is a reliable method for human identification and was legislated in South Africa in January 2015. However, the use and success of DNA as an identification tool at Salt River Mortuary (SRM) in South Africa are unknown. Medico-legal case files were reviewed from all 3696 cases admitted in 2015, to evaluate the use of DNA in identifying human remains at SRM immediately after the implementation of the 'DNA Act'. While 213 (5.76 %) cases were admitted in 2015 without an alleged identity, 221 individuals had no confirmed identity following post-mortem and identification attempts. DNA samples (for identification and/or investigative purposes) were taken in a total of 490 cases, yet concerningly, these samples represented many people with a confirmed identity, and not all individuals without an (alleged) identity. Of the 221 unidentified human remains, only 62 (28 %) were afforded DNA analysis, suggesting an underutilisation of DNA analysis requests. This observation highlights a potential missed opportunity to leverage DNA technology more comprehensively in cases where conventional identification methods prove insufficient. Further, DNA results were only obtained for 64 cases (13.06 %) with results from 426 cases still outstanding seven years later. Where reports were available, identification via familial matching was successful in 95.31 % of cases (n = 61/64), leading to a success rate of 12.45 % (n = 61/490) for DNA as an identification tool. This poor success rate in 2015 could be attributed to several factors including: inadequate sampling post-mortem possibly due to unclear guidelines about which state authority was responsible for sampling, the low chances of a match on the National Forensic DNA Database due to its infancy (and thus containing few reference DNA profiles), next-of-kin not providing reference samples due to lack of awareness or fear of authorities, or inadequate infrastructure or access to resources. This study highlights the need for intentional and consistent sampling of unidentified human remains and calls for larger efforts to encourage next-of-kin to provide reference samples to increase the chances of identification.

Acknowledgements

I would like to express my sincere gratitude to all those who have supported and guided me throughout the journey of completing this minor dissertation.

First and foremost, I am deeply thankful to my supervisors, Kate Reid and Laura Royle, for their invaluable guidance, unwavering support, and constructive feedback. Their expertise and encouragement have been instrumental in shaping the direction and quality of this research.

I extend my appreciation to the faculty and staff at the University of Cape Town for providing a conducive academic environment and resources essential for the successful completion of this dissertation.

I am grateful to my friends and family for their constant encouragement, understanding, and patience during this demanding period. Their emotional support has been a source of strength, motivating me to persevere in the face of challenges.

I would also like to express my heartfelt appreciation to my mother, whose unwavering belief in my abilities and tireless encouragement played an indispensable role in shaping my academic journey. Her guidance, wisdom, and unconditional support have been a constant source of inspiration, propelling me toward my goals. Her sacrifices and dedication have laid the foundation for my success, and I am eternally grateful for her love and guidance.

Special thanks to the National Research Foundation for their financial support, which has enabled me to pursue this research and contribute to the academic community.

This minor dissertation would not have been possible without the collective support of these individuals and institutions. Thank you for being an integral part of this academic endeavour.

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List of abbreviations

Abbreviation	Meaning
=	Equals sign
%	Percentage
ANOVA	Analysis of Variance
BI	Notification of death/stillbirth
CPA	Criminal Procedures Act
DNA	Deoxyribonucleic acid
DVI	Disaster victim identification
E.G	For example
FPS	Forensic Pathology Service
HREC	Human Research Ethics Committee
LCRC	Local Criminal Record Centre
LODOX	Low dosage X-ray
MSO	Microsoft Office
n	Total number of cases
NCRB	National Crime Record Bureau
NDNAD	National DNA Database
NFDD	National Forensic DNA Database
PCR	Polymerase chain reaction
PM	Post-mortem
SA	South Africa
SAPS	South African Police Service
SRM	Salt River Mortuary
STR	Short tandem repeat
SUD	Sudden unexpected death
UK	United Kingdom
USA	United States of America
VIC	Victim Identification Centre
WCG	Western Cape Government

Chapter 1: Introduction

1.1 Background

Forensic human identification is the process of confirming the name and identity of a deceased individual who has died due to unnatural causes. Globally, medico-legal investigators are responsible for this process as part of their legal obligation [1]. Not only is it required by law to determine the identity of an individual, but this process also acknowledges that all people have the right to an identity, both in life and after death [2,3].

Human identification, in a medico-legal context, involves primary and secondary methods, which involve comparing ante-mortem and post-mortem data [4]. Primary methods of identification include the analysis of the friction ridges of fingerprints (i.e., fingerprint analysis), and visual recognition, through the analysis of external facial features [4]. Secondary methods, include scientific means of identification such as comparative deoxyribonucleic acid (DNA) analysis, dental analysis, post-mortem radiology, and forensic anthropology [4,5]. Supplementary methods involve the use of secondary identifiers such as tattoos, birthmarks and scars to support other methods of identification [4]. All of these techniques may be used in the identification process, but due to technological advances, establishment of national databases and its discriminatory power, DNA is considered the gold-standard method of identification [6]. However, the decision of which method to use is case-specific and depends on the preservation of the body, the quality of accessible ante-mortem data, and the availability of scientific personnel [4].

When an unnatural death occurs, it is required by South African law that a post-mortem investigation is carried out by Forensic Pathology Services (FPS) [2]. This is to determine the cause of the death and assist in the identification of the deceased [2]. Even though identification is the responsibility of the South African Police Services (SAPS), the identification process must be facilitated by the FPS as custodians of the bodies [7]. Several legislations and protocols have been implemented in South Africa to guide the death investigation and assist with identifying unidentified human remains [2,7,8] (e.g., the Victim Identification Centre (VIC) and National Forensic DNA Database (NFDD) [7].

1.2 Post-mortem investigation and unidentified bodies

In some countries, the manner of death is determined during the post-mortem investigation, however in South Africa, this is determined by a magistrate in a court of law. The purpose of a post-mortem investigation in South Africa serves three primary goals: (1) determination of the cause of death; (2) collection of forensic evidence and (3) to establish the identity of the

deceased [1]. Despite the availability of numerous identification methods, several bodies remain unidentified globally each year [3].

Out of 50 million deaths in the United States of America (USA), 10 748 (0.02 %) bodies remained unidentified between 1979 and 2004 [9,10]. According to a report released by the Bureau of Justice Statistics in 2018, there were 11 380 unidentified remains registered across the USA [10]. Migration, homelessness, poor socioeconomic circumstance, and a lack of standardisation in the recording and reporting of unidentified remains are hypothesised to contribute to the number of unidentified bodies in the USA [9,11,12]. In 2007, the National Missing and Unidentified Persons System (NamUS) was established but only became operational in 2009 [13]. NamUS is a national information repository and resource centre for missing and unidentified person cases across the USA. It consists of two interconnected databases; one holds information on people who are missing, both foreign and domestic nationals, and the other holds information on unidentified human remains discovered in the United States [13]. This database provides law enforcement officers, medical examiners, and the general public access to information to aid in the identification of unidentified bodies and solving missing person cases [13]. Almost 2300 cases involving unknown people that were submitted to the NamUS database in the middle of 2016 have since been recognised [13].

Over a 6-year period (2003 – 2009), the Department of Forensic Medicine and Pathology of the University Hospital R. Poincaré in Garches, France reported 217 unidentified bodies out of a total of 2 384 cases (10.2 %) [14]. In major European cities such as Milano, Italy, the percentage of human remains admitted to the mortuary with no identity amounted to 3.24 % (726) over 25 years [15]. A study conducted by Cattaneo *et al.* (20l0) reported that many European countries either do not have the official data on unidentified bodies or could only provide partial information on the matter [16]. This was attributed to the absence of laws enacted to regulate the handling and subsequent recording of unidentified human remains. Therefore, this presented a challenge in tracking unidentified bodies and the compilation of information required to assist in the identification process [16,17].

The situation in developing countries is concerning, with a significantly higher number of unidentified bodies reported when compared to the developed countries discussed above [18]. According to Reid *et al.* (2020), the extent of the burden of unidentified bodies correlates to, however, is not limited to, the country's socioeconomic status [19]. Contributing factors include the lack of access to resources such as general healthcare which increases the number of deaths

from preventable diseases that are admitted to mortuaries, consequently depleting resources and burdening medico-legal mortuaries [20,21]. Individuals from low socioeconomic backgrounds are frequently unable to obtain dental and medical care [22]. Thus, the likelihood of obtaining ante-mortem data that will serve as comparative data is decreased, further hindering the possibility of identification.

According to the Indian National Crime Record Bureau (NCRB), there were 108 628 unidentified bodies reported between 2013 and 2015 [13]. In New Delhi alone, 15 % (n = 21 900) of the overall autopsy caseload in these districts pertained to unidentified human remains [13]. The high number of unidentified bodies in India can be attributed to several factors, including the country's economic status as a developing nation, overpopulation, and a large number of homeless people without relatives or partners [14,15]. This makes it challenging for police officials to establish the identity of individuals whose bodies are found without any identification documentation [16]. Unlike other countries, there are no existing identification portals for unidentified human remains in India [14]. In 2019, "The DNA Technology (Use and Application) Regulation Bill," was formulated to help with the identification of human remains by developing a Forensic DNA database. However, as of 2023, no national guidelines exist despite the introduction of the Bill in 2019 [13].

1.3 Unidentified bodies in South Africa

In South Africa, the number of unidentified bodies throughout the country has not been empirically assessed on a national level. However, three studies have investigated this at Salt River Mortuary (SRM) in Cape Town, the Pretoria Medico-legal Laboratory, and the Johannesburg Forensic Pathology Services medico-legal mortuary [4,23,24]. Each year, between 3 000 and 4 000 bodies are received at these medico-legal mortuaries, making them some of the busiest in the country [4,23,24]. The Pretoria Medico-legal Laboratory reports an average of 9 % (2 253 – 2 461 bodies) of unidentified and unclaimed bodies (range of 7 – 10 %) each year [23]. A similar percentage, 9.2 % (2 904 – 3 886 bodies) of unidentified bodies in SRM has been observed (range of 7.7 % – 11.5 %) [24]. Whereas, in the Johannesburg Forensic Pathology Services medico-legal mortuary, 8.1 % of all cases admitted were of unidentified bodies [4].

In South Africa, it is required by law that identification is to be completed by the next-of-kin in possession of their original identity document and that of the deceased [8]. Despite this, it is suspected that approximately 40 % of South Africans lack identity documents due to not being

registered at the South African Department of Home Affairs [18]. The presence of unidentified bodies in medico-legal facilities throughout South Africa remains a common concern despite the implementation of standardised protocols. In most cases, the number of unidentified bodies is often a reflection of the population density and catchment area dynamics serviced by the medico-legal facility [4]. In the Western Cape Province, there are a total of 16 forensic pathology service centres, and SRM is one of two M6 medico-legal mortuaries that cater to the western metropole of Cape Town [8]. This region has a catchment area of approximately 4.6 million people. By comparison, Gauteng province, which is South Africa's most populated province with a population of around 16 million people, has only 11 forensic pathology service centres [4]. Out of these 11 forensic pathology service centres, only two centres serve the greater Pretoria region, which has a catchment area of approximately 2.7 million people.

Metropolitan areas like Pretoria and Cape Town draw both domestic and international migrants looking for better employment options and economic prospects [4,19]. A large number of these migrants are undocumented residents of the city and/or homeless who complicate the identification process due to the absence of legal identification documents and/or people to visually confirm identity where possible. As a result, this places a strain on the resources of medico-legal facilities.

1.4 Methods of identification

1.4.1 Recommended timeline for human identification in SA

The Regulations Regarding the Rendering of Forensic Pathology Services provide an approximate timeline for the process of human identification at medico-legal mortuaries in South Africa (Figure 1.1) [8]. If the body remains unidentified after 30 days from admission and all efforts towards identification have been made, the body becomes the responsibility of the State [8]. Herein, the local authority will be responsible for the arrangement of a pauper burial. If the body is legally identified after 30 days by the family or next-of-kin, it becomes the family's responsibility or next-of-kin to arrange burial [8]. In some cases, however, the family or next-of-kin may opt for a pauper burial due to financial constraints [18].

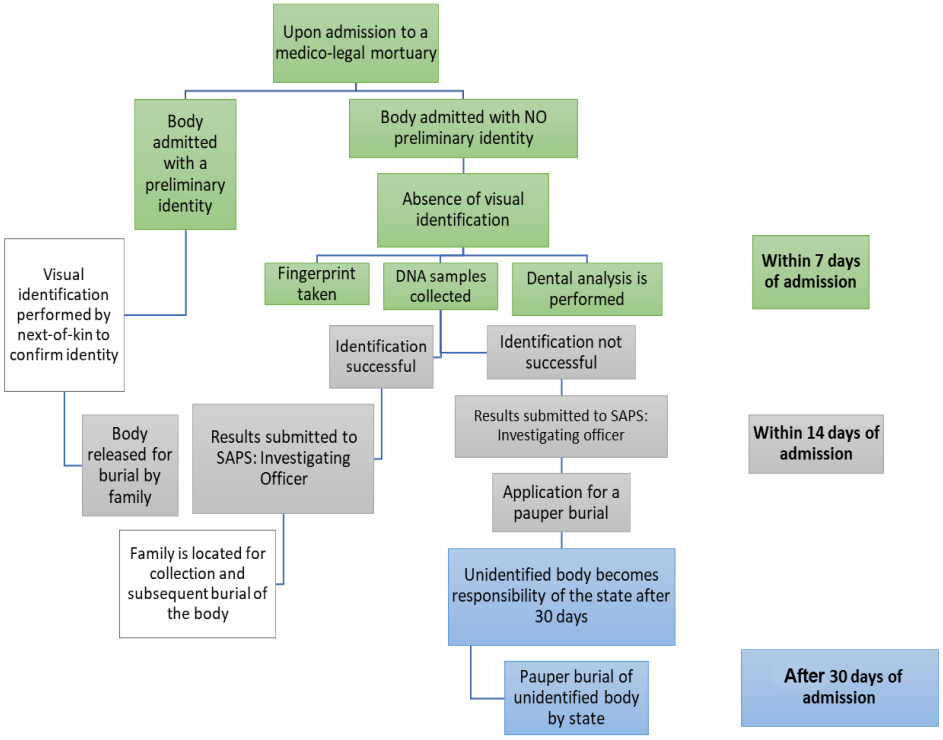

Figure 1.1: The process of post-mortem human identification at medico-legal laboratory facilities in South Africa.

1.4.2 Visual recognition

Visual recognition is a method of identification implemented under the circumstance that there is an insubstantial level of trauma to the facial structure and no or minimal post-mortem changes (i.e., decomposition) to the face [25]. This is performed by the next-of-kin or legal guardian of the deceased who must present both their identity document as well as that of the deceased [8]. Without a valid identity document, identification of the deceased cannot be permitted [8].

Visual identification is also said to have a certain level of subjectivity [25,26]. Despite the popularity of visual identification among researchers, Caplova *et al.* (2018) concluded that opinions about its reliability vary, even when describing visual identification as the simplest form of identification [25]. In the review, it was stated that visual identification has commonly been used for identifying the living, but little research has been carried out about its reliability and applicability in a post-mortem setting, [25]. Therefore, visual identification should be supported by matching ante-mortem data with information collected during the autopsy [5,21].

1.4.3 Fingerprint analysis

Following attempts at visual identification, scientific methods of identification can be implemented [8]. These methods are requested by the medical practitioner (FPS) and are

typically referred to external agencies and stakeholders such as SAPS or private laboratories [23]. The legislation further states that, if a body remains unidentified after seven days of admission, fingerprints need to be collected and the body stored under the appropriate conditions [8]. Fingerprint analysis involves the detailed examination of the friction ridge impression created by the raised papillary ridges on the surface of fingertips [28].

The collected fingerprint is sent to the Local Criminal Record Centre (LCRC) or the Victim Identification Centre (VIC), where an attempt is made to establish the identity of the deceased by comparatively analysing it with that of known offenders in their system [23]. If no identity is established, the fingerprints are sent to the Department of Home Affairs at which the probability of obtaining a match is higher [4,23]. Fingerprint records for the majority of the South African population should exist with the Department of Home Affairs, as all persons are required to provide a fingerprint when applying for identity documents (from the age of 16 years), passports and driver's licences [4], however it is reported that approximated 40 % of South African citizens are undocumented [24].

The results obtained from the fingerprint analysis are then submitted to the medico-legal mortuary, as either no identity could be established by the LCRC or the Department of Home Affairs or no identity could be ascertained [23]. In the case of identification, the Investigating Officer in charge of the case will receive the results and have the responsibility of locating the family of the deceased for the collection/disposal of the remains [23]. However, if the family of the deceased cannot be located within 14 days of receiving the result, an application for a pauper burial is submitted [19,23].

1.4.4 DNA analysis

Should these methods prove unsuccessful in determining identity, biological samples may also be collected by appropriately trained personnel for DNA analysis [8]. These samples are collected after a post-mortem examination or during the procedure and stored in the facility's refrigerator until they can be submitted to the state's Forensic Science Laboratory or a private laboratory (e.g., Unistel Medical Laboratory) for analysis [8].

For DNA analysis to be used for forensic human identification, an appropriate biological sample is required and a forensic DNA profile of the unknown individual needs to be established and matched to either a reference DNA profile from the known individual, or partially matched to a blood relative's DNA profile [5]. This is referred to as comparative DNA

analysis, and kinship analysis respectively (Figure 1.2) [29]. The use of forensic DNA profiling in human identification requires the analysis of short tandem repeats (STRs) that consists of a core repeat motif (2-8 base pairs) [30]. The number of times the core repeat motif repeats itself is highly variable amongst individuals which forms the basis of its high discrimination power when analysed for identification purposes (Figure 1.2) [5]. However, if there is no next-of-kin suspected or known, the DNA profile may be explored against national databases such as the National Forensic DNA Database (NFDD) of [7].

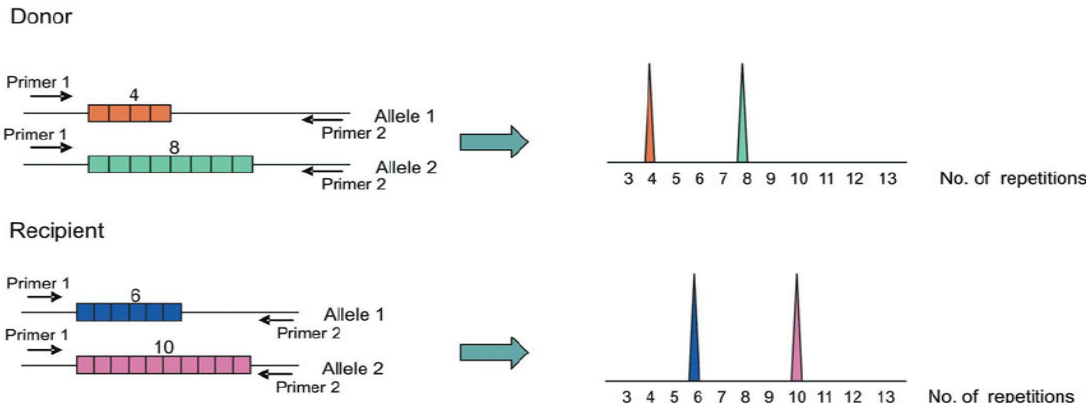

Figure 1.2: Principles of STR analysis. STRs loci are made up of repetitive sequences of 2-7 bp. The donor has 4 and 8 repetitions, whereas the recipient has 6 and 10 repetitions. (Image obtained from [31]*).*

1.4.5 Other methods of identification

Post-mortem dental analysis is conducted in parallel with the collection of biological samples for DNA analysis [23]. Basic odontological descriptions are recorded and photographed. These include simple descriptions of dental features that can be reported by the next-of-kin [1,2]. Using this morphological analysis of the teeth, one may be able to estimate the demographic characteristics of the deceased (e.g., age and biological sex) [32], however, they cannot be reliably used to identify a particular individual on their own. In order to reliably identify a deceased individual using forensic odontology, post-mortem dental records such as dental modifications (e.g., tooth extractions), impression marks and tooth morphology need to be compared to existing ante-mortem dental records [33]. However, unlike fingerprints and DNA profiles, ante-mortem dental records are not always kept in a centralised database [34]. Furthermore, many South African citizens do not have dental work done due to their low socioeconomic status, so dental records are commonly unavailable [4].

Forensic anthropology is another method that can be employed to assist in the identification of unidentified bodies. This method involves estimating the biological profile, including biological sex, age, stature, and population affinity [35]. This can be done through morphological and metric analysis of the bones. These morphometric analyses have known error rates and rely on accurate and updated reference data from the background population [35]. Forensic anthropology can also assess trauma, pathology, or unique features on the bones to determine the presence of operations or diseases [36]. The information obtained can either narrow the search of missing persons or contribute to positive identifications by directly comparing the post-mortem data (e.g., orthopaedic implant) to ante-mortem data (e.g., serial number) [36].

Forensic radiology is another method of identification commonly employed in mass disasters and is becoming a routine forensic practice globally for identification [37]. A LODOX Xmplar-dr (Lodox Systems, SA) is used to scan the entire body in order to find any internal characteristics that might help with identification (such as implants and healed fractures) [4]. Since the technique is non-invasive, it is receiving support in an effort to lessen the use of some of the above-described invasive methods for autopsy and identification [38].

1.5 Recommended post-mortem samples that can be collected for forensic DNA profiling

The South African legislation is clear on who is allowed to collect samples from living individuals, and usually, the samples obtained are non-invasive such as buccal swabs [7]. However, in a post-mortem context, femoral blood is the gold standard sample globally, but sample of choice directly depends on case context as well as the sample types validated in the local forensic DNA laboratory [40]. Femoral blood (3 ml) is required for analysis [42]. However, this is not always available, particularly if a body is decomposed, skeletonised, or burnt [43]. Each case is different and poses unique challenges and the sample type collected needs to be evaluated on a case-by-case basis (Table 1.1).

Table 1.1: Recommended sample type for DNA analysis for different physical conditions of body preservation.

Condition of the body	Recommended samples to collect
Not decomposed, whole body [43–45]	• Blood • buccal swabs • Soft tissue • Nails and/or nail clippings
Not decomposed, mutilated body [43–45]	• Blood and • deep red muscle tissue (~1.0 g) • Nails and/or nail clippings • Buccal swabs
Decomposed, whole body [43,45]	• Nails and/or nail clippings
Decomposed, fragmented body [43,44,46]	• Any available bones or teeth • Nails and/or nail clippings
Severely burnt bodies [43,47–49]	• Any of the samples mentioned above • Swab from the inside of the urinary bladder
Skeletonised body	• Cancellous bone, petrous bone and/or teeth without fillings (preferably teeth with intact roots if present)
Immersed, complete body [50]	• Nails and/or nail clippings • Cancellous or petrous bone and/or • Teeth

1.6 Forensic DNA profiling and DNA database: statutory framework

Forensic DNA analysis remains one of the most effective methods for identifying unidentified human remains [51]. DNA analysis can produce robust statistical evidence linking the unidentified deceased with a close family member or the deceased's ante-mortem samples, sufficient to prove the identity of the deceased [43]. Over the past few years, DNA database capabilities have advanced significantly due to the implementation of legislative protocols and regulations.

In 1998, the Criminal Procedures Act 51 of 1977 (CPA) established the framework for the use of DNA profiling and repositories in South Africa [52]. This occurred three years after the first DNA database was established in the United Kingdom (UK), which remains the world's oldest and largest forensic DNA database [52,53]. Although the legislation altered the use of DNA evidence in South Africa, it was not without limitations, leading to the introduction of the Criminal Law (Forensic Procedures) Amendment Bill in 2008 [52]. The Criminal Law

(Forensic Procedures) Amendment Bill laid the legal foundation for the establishment of the National Forensic DNA Database (NFDD) in 2009 which serves multiple purposes, one of which is, the identification of missing persons and unidentified human remains [23]. Both protocols regulated the collection of invasive biological samples from living individuals suspected of a crime by trained medical personnel upon given consent by the individual.

The lack of consent to collect biological samples for DNA profiling was one of the factors contributing to the stagnant growth of the NFDD. However, the DNA Act, formally known as the Criminal Law (Forensic Procedures) Amendment Act 37 of 2013, was promulgated in 2015 to address this issue [7]. The DNA Act, as colloquially known within South Africa, mandated the collection of DNA samples from a larger group of living individuals without the need for consent. This allowed the NFDD to expand, and comparative searches became possible [7]. Therefore, DNA profiles generated from unidentified human remains can be comparatively searched against all profiles stored within the database, increasing the probability of obtaining a match [7].

In contrast to the relatively slow growth of the NFDD, the UK's National DNA Database (NDNAD) has experienced rapid expansion [54]. Established in 1995, the NDNAD's exponential growth was facilitated by the Criminal Justice and Public Order Act, which authorized police officials to collect DNA samples from individuals accused of a recordable offence [53]. The NDNAD now contains over 3 million DNA profiles, making it the largest forensic DNA database in the world [53]. In comparison, the NFDD has only approximately 413,000 profiles, representing a small fraction of the NDNAD's size [55].

Currently, there is no centralised database for DNA profiles in India, with DNA evidence being collected and analysed by individual laboratories. However, the DNA Technology (Use and Application) Regulation Bill, 2019 aims to regulate the use and application of DNA technology for establishing the identity of individuals, including victims, offenders, suspects, and missing persons [56]. The Bill provides for the establishment of a National DNA Data Bank and several Regional DNA Data Banks, although it has not yet been passed into law [56].

Each country has a unique legislative framework surrounding the retention and destruction of DNA profiles in their forensic DNA databases. In South Africa, DNA profiles stored within the following indices: (i) crime scene, (ii) elimination and (iii) convicted offenders which are stored indefinitely; whereas profiles stored in the (iv) arrestee index must be deleted if they are exonerated or the charges are dismissed [7]. Those stored in the Investigative index are

retained until the purpose of the profile has been served [7]. This is similar to the DNA Technology (use and application) Regulation Bill, 2019 in India [57]. However, there is no regulation regarding how long DNA profiles may be retained in the database [56]. Whereas, in the UK, DNA profiles, of individuals, arrested of a recordable crime are stored indefinitely, regardless of whether the individual is subsequently convicted [53].

Overall, while there are similarities and differences between the legislative frameworks governing the regulation, implementation and use of biological samples for DNA analysis in human identification in South Africa, India and the UK, they all share a common goal of ensuring the appropriate, ethical and efficient use of DNA analysis. In South Africa, the DNA Act has been an important step forward in regulating the use of DNA profiling for the identification of unidentified human remains, however, ongoing efforts are needed to address the remaining challenges hindering the growth and use of efficient use of these identification tool.

1.6.1 Limitations of forensic DNA profiling in post-mortem human identification

Forensic DNA profiling is an invaluable tool in post-mortem human identification, offering high levels of accuracy and reliability [39]. However, several limitations must be acknowledged. Firstly, DNA degradation can occur post-mortem due to environmental factors such as temperature, humidity, and microbial activity, leading to fragmentation and loss of genetic material [39]. This degradation can compromise the quality and quantity of DNA available for analysis, potentially hindering identification efforts. Additionally, DNA profiles obtained from post-mortem samples may be affected by the presence of inhibitors or contaminants, further complicating analysis and interpretation [5]. Traditional methods of analysis such as STR profiling may be of limited value in such cases, especially when dealing with degraded DNA samples [40]. However, despite these challenges, the introduction of novel techniques and technologies into the criminal justice system offers promising solutions [40,41]. These advancements enable the analysis of challenging samples, overcoming some of the limitations associated with traditional methods. Therefore, while acknowledging the constraints of traditional forensic DNA analysis, the integration of innovative approaches offers hope for enhancing the efficacy and reliability of post-mortem human identification efforts.

1.7 Rationale

Identifying human remains is a crucial component of a post-mortem investigation. Unidentified human remains present a challenge from a criminal, civil, administrative, and ethical standpoint [17]. Despite the number of human identification methods available, previous research found that 9.2 % of cases admitted to SRM are unidentified [19]. Given the burden of unidentified bodies, the utilisation of DNA analysis in human identification has become an area of focus. Unfortunately, the implementation of DNA analysis in human identification in developing countries is often hindered by a lack of funding, resources, expertise, and time.

Legislative changes, following the promulgation of The Criminal Law (Forensic Procedures) Amendment Act No. 37 of 2013, made DNA analysis more valued, due to the establishment of a National Forensic DNA Database [7]. Before this, forensic DNA analysis was not legally defined in South Africa, nor did the South African law have a database that regulated DNA evidence. The DNA Act stipulated what reference sample types can be obtained, as well as provided timeframes for forensic DNA analysis to be carried out. However, it is unknown, whether the implementation of this Act influenced the collection and analysis of samples of unidentified human remains at Salt River Mortuary.

Consequently, the proposed research study aimed to evaluate the frequency at which DNA analyses were requested and employed in the process of human identification at the Salt River Mortuary in the year the DNA Act was promulgated (2015). This study formed part of a larger ongoing umbrella study that is investigating human identification holistically from 2015-2022. The data collected in this study focused on the use of DNA as a tool for post-mortem human identification, to assess if it was being used to its potential and if there were any limitations with sample types collected. The data collected in this study would form baseline data, from which trends could be analysed in the umbrella study. These combined results are intended to recommend improved and standardised procedures for human identification, that are practical and feasible.

Finally, as part of service delivery, the data generated for unidentified bodies in this study will form the foundation for an unidentified person's database at Salt River Mortuary. This will aid in the future searching of unidentified human remains and provide reference information to which future information brought forward from the next-of-kin or close family member can be compared too. This is of particular importance due to some individuals only being identified months or years later. The database will not form part of the data presented in this study;

however, it will be handed over to Salt River Mortuary for internal use to assist in the future identification of deceased individuals.

1.8 Aims and objectives

1.8.1 Aim

To evaluate the use of DNA analyses in identifying deceased individuals at Salt River Mortuary from 1 January 2015 to 31 December 2015.

1.8.2 Objectives

- Investigate the success rate of DNA profiling as an identification tool in 2015.
- Identify the sample types collected and explore associated trends with the DNA profiling output and successful identification for each sample type.
- Investigate key turnaround times of DNA analysis request and performance, in relation to the timeline of admission to the release of the body.
- Investigate the demographic profiles and circumstances of death of cases admitted to Salt River Mortuary in 2015.

Chapter 2: Methodology

2.1 Study design

This study involved the retrospective review of all medico-legal case reports relating to cases admitted to SRM (Cape Town, South Africa) between 1 January 2015 and 31 December 2015. SRM serves the western metropole of Cape Town, with a population of ~ 4.8 million. It is one of two M6 mortuaries in the western cape, meaning it is affiliated with a tertiary academic centre and receives above 3 000 cases per year. All cases from 2015 were included, there were no exclusion criteria, however any non-human remains were excluded from further analysis.

This study obtained institutional approval from the Human Research Ethics Committee (HREC REF: 221/2022) (Appendix J) and is a sub-study of an ongoing project since 2021 (HREC REF: 136/2021). Approval to access data from SRM Forensic Pathology Service database was approved by the Clinical Head of the Division of Forensic Medicine and Toxicology and the head of Forensic Pathology Services (FPS), Western Cape Government (WCG).

2.2 Research procedure

Every decedent admitted to the mortuary is assigned a case number, which is used to link all relevant case documents together into a medico-legal case file. The medico-legal case files comprise of a number of documents generated by the forensic pathologist, mortuary admission, and scene documentation issued by the South African Police Service (SAPS) and the investigating officer. The medico-legal documents reviewed included the following, (i) Questionnaire for the identification of a deceased, (ii) Forensic Pathology Services Identification Statement (FPS 008), (iii) Forensic Pathology Services Notification to claim and remove the body (FPS 012), (iv) Report on a medico-legal post-mortem examination, (v) FPS 002 document, (vi) Notification of death/stillbirth (BI-1663 form), (vii) Acknowledge of receipt (FPS 013 form) (Appendix B – H).

The post-mortem examination reports were written in terms of section 212 (4), Criminal Procedure Act 51 of 1977, which documents findings from the autopsy performed by the medical practitioner. The post-mortem reports provide additional information on the type of sample collected for DNA analysis if implemented. The case files reviewed also included the BI-1663 form, which must be completed when notifying home affairs of a death. To confirm that fingerprints would be possible to obtain if needed, the BI-1663 form was reviewed to note

if fingerprints were present. The FPS002 and acknowledgement of receipt form, both of which need to be completed by the forensic officer and investigating officer, contain dates relevant to the study.

From the documents explained above, variables were obtained to gather information on the frequency and nature of identification methods utilised at SRM. The data collection was divided into five main sections: Generic data, Demographics, Case information, Relevant dates, and Methods of identification. Sub-variables within these categories are summarised in Appendix A. When scanned copies of the documents were not available on the online Livelink, hard copy case reports were consulted. Following this, where documents remained missing, unavailable, or incomplete – data collection terms such as 'unknown', 'not available' or missing were recorded.

2.3 Inclusion and exclusion criteria

All cases from 2015 were included in the study and were used to directly address objective 1 and 4. A subset of these cases was used to address objective 2 and 3 with the following inclusion and exclusion criteria:

2.3.1 Inclusion criteria

- All cases admitted to salt river mortuary in 2015 without a presumptive identity.
- Cases where DNA analysis was utilised for the purpose of identification at salt river mortuary in 2015.
- Cases where DNA analysis contributed to the confirmed identification of the bodies.
- Cases that had samples collected for the purpose identification through DNA analysis.

2.3.2 Exclusion criteria

- All case admitted to salt river mortuary in 2015 with a presumptive identity.
- Cases where DNA analysis was not utilised in the identification of human remains at Salt River Mortuary.
- Cases where data or documentation related to DNA analysis are unavailable for review.
- Cases where DNA analysis did not contribute to the final identification of the bodies.
- Cases involving non-human remains.

2.4 Data management

The data collection process utilised a Microsoft Excel spreadsheet (Microsoft 365 (Version 2301 California, United States of America). To ensure accurate data capture, the spreadsheet

employed data validation techniques. Data were managed according to the data management plan (Appendix I) to ensure confidentiality and privacy of the data. Regular data backups were performed onto a password-encrypted USB drive, which was stored securely at the University of Cape Town.

2.5 Statistical analysis

Descriptive statistical analysis (mean, median, mode, standard deviation) was carried out using Microsoft® Excel® for Microsoft 365 (Version 2301 California, United States of America) to summarise and organise the data, enabling the determination of the data's central tendency. The categorisation of the data aligned with legal definitions, encompassing variables such as 'manner of death', 'cause of death', and 'admission status' categories. Additionally, Microsoft® Excel® was utilised for timeframe analysis, allowing for the examination of patterns and trends in the temporal distribution of cases admitted to Salt River Mortuary.

Furthermore, demographic profiling of all cases admitted to Salt River Mortuary was conducted using Microsoft® Excel®. This involved the systematic analysis of demographic variables such as age and biological sex. Microsoft® Excel® also served the additional purpose of data visualisation, facilitating a more comprehensive understanding of the dataset by creating visual representations.

Subsequently, an investigation into potential significant associations among the assessed categorical variables was conducted using the Chi-Square test in IBM SPSS Statistics (Version 28.0.1.1 (15)), at a significance level of $\alpha = 0.05$.

Chapter 3 Results

3.1 Overview

In 2015, SRM conducted 3 696 medico-legal death investigations. The majority of these cases were biologically male (n = 2 824, 76.41 %). In 10 cases (0.27 %), the sex was undetermined due to severe physical injuries or incomplete or missing documentation. The age range of the decedents spanned from 0 to 102 years, with the most prevalent age group falling between 21 years and 50 years (figure 3.1).

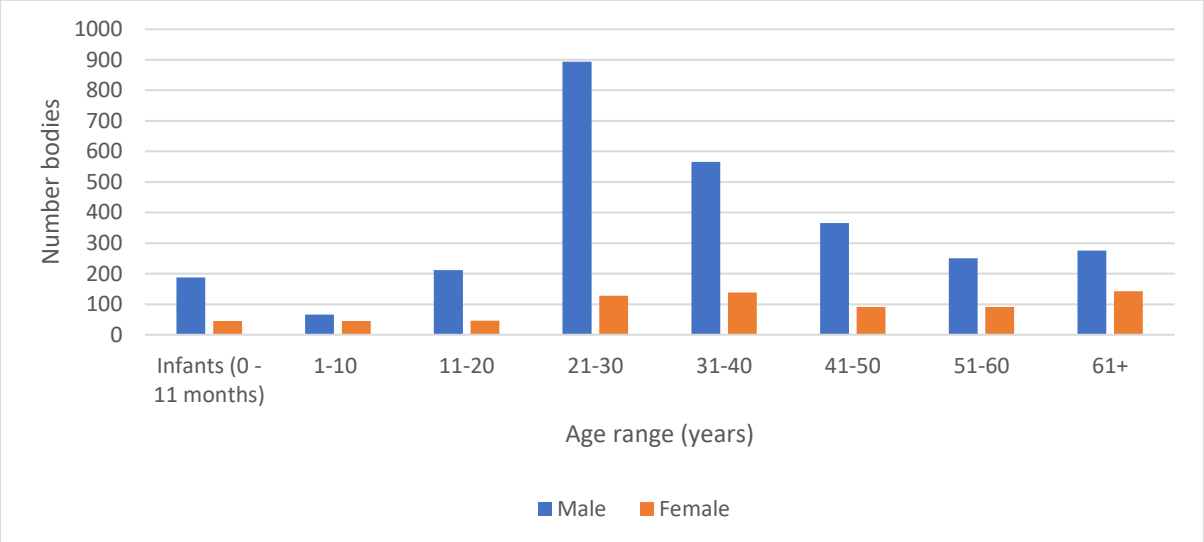

Figure 3.1 The distribution of admissions to SRM in 2015, categorised by biological sex and age group, ranging from infants (0 to 11 months) to adults aged 61 and above.

Most bodies were admitted due to external trauma (n = 1 923/3696, 52.03 %), followed by sudden unexpected death (SUD) (n = 1 104/3696, 29.87 %). Undetermined (n = 12, 0.32 %), denoted cases where identification attempts were inconclusive or insufficient, while "unknown" (n = 6, 0.16 %) pertains to cases where the body's identity is entirely unknown, typically due to a lack of initial information, as seen in severely disfigured bodies (Figure 3.2).

Within the total admissions, 144/3696 cases (3.90 %) exhibited signs of physical damage that would affect visual recognition. This category constituted 79/3696 cases of decomposition (2.14 %), 59/3696 cases with burning (1.60 %), and five skeletonised remains (0.14 %). Additionally, there was a singular instance (0.03 %) involving mutilated human remains.

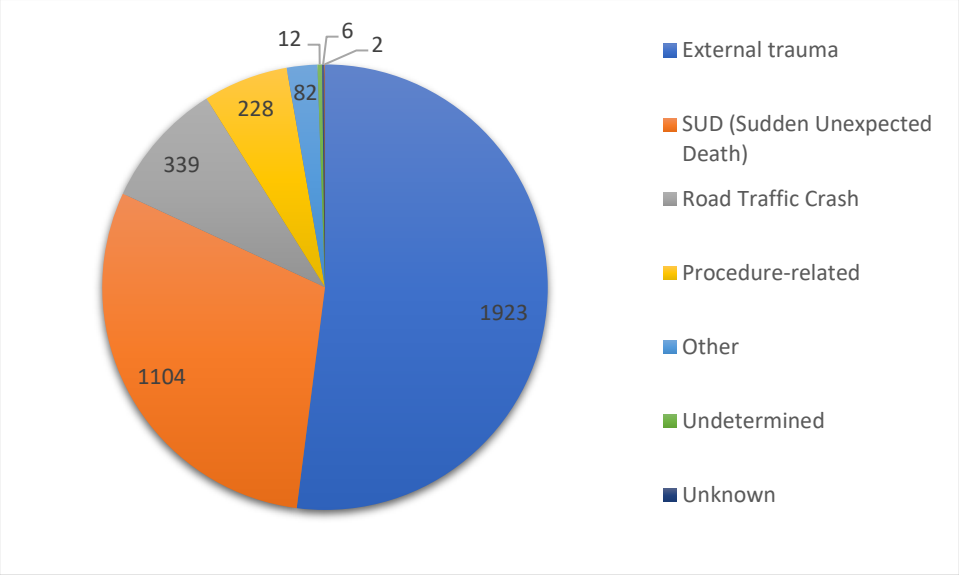

Figure 3.2 Distribution of bodies admitted to SRM in 2015 according to admission category.

Out of the 3 696 cases reviewed in 2015, 3 483 (94.24 %) were admitted with a presumptive identity, leaving 213 (5.76 %) cases without any presumptive identity. Among the cases with a presumptive identity, 2 015 were visually identified before undergoing post-mortem examination, while the remaining 1 468 cases could not be identified visually before post-mortem examination. Within the subset of cases admitted without a presumptive identity, only 24 were successfully identified through visual recognition prior to post-mortem examination. Consequently, a total of 1 657 cases had no confirmed identity at the time of post-mortem examination (Figure 3.3). More than three quarters of these cases were biologically male between the ages of 21 years and 30 years (n = 1272/1657, 76.77 %).

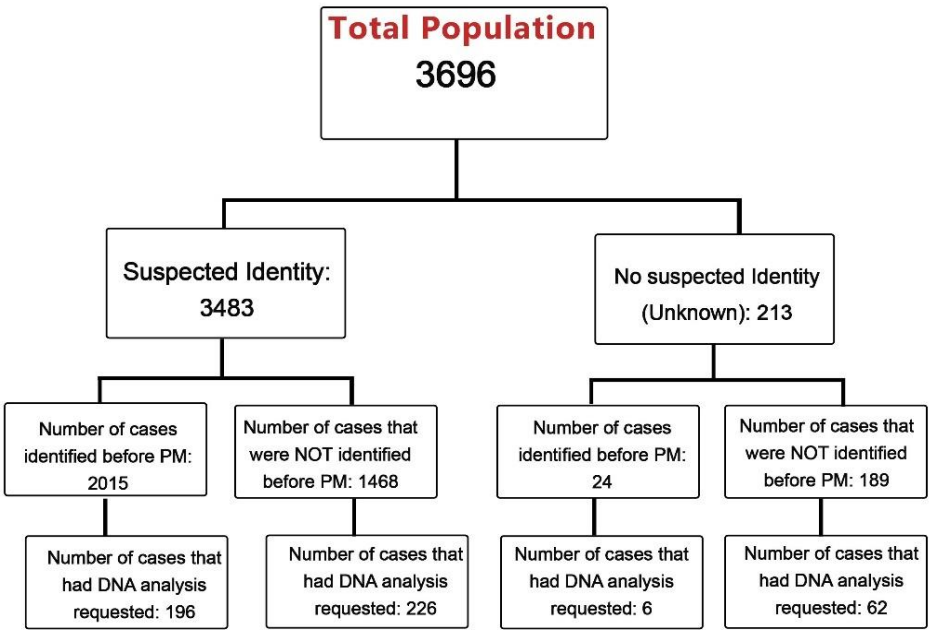

Figure 3.3 A schematic diagram of the identification status of bodies admitted to SRM during 2015, with 'Post-mortem' abbreviated as 'PM' and 'Presumptive identity', referring to bodies admitted with a presumed identity.

Following all scientific analysis and based off reports obtained, a further 79 (85.97 %) and 61 (95.31 %) cases were identified through fingerprint analysis and forensic DNA evaluation respectively. Forensic anthropology was utilised in seven cases for the establishment of post-mortem interval. A portion of the cases (n = 65, 1.76 %) had their identity confirmed or determined through visual or scientific means, however the next-of-kin were unable to or did not make arrangements to collect the remains – these individuals thus represent the 'unclaimed remains' population at SRM during 2015. Therefore, regardless of whether an individual was admitted with a presumptive identity or not, a total of 221 individuals remained unidentified in 2015.

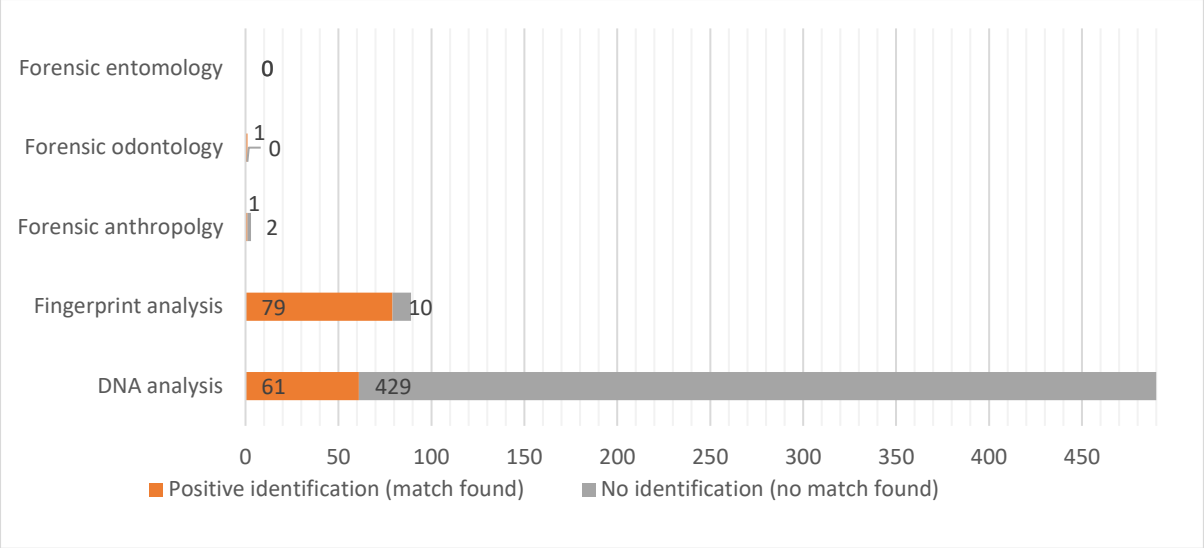

Figure 3.4 The types of identification methods implemented at SRM in 2015 along with the outcomes of each method applied, excluding visual identification.

3.2 Analysis of DNA sample types and outcomes in cases requesting DNA analysis

Samples for DNA analyses were obtained in 490/3696 (13.26 %) cases overall (Figure 3.3). The majority of these cases were from individuals who were admitted with a presumptive identity (n = 422/490; 86.12 %), with 196/490 cases having had their identity visually confirmed prior to post-mortem examination. Of the individuals who had no presumptive identity at admission (n = 213/3696), DNA was obtained from 68 cases, wherein six had been visually identified prior to post-mortem examination. The preferred sample for DNA analysis was blood spots, constituting the majority with 378/490 cases (77.14 %). Whole blood samples were obtained from 86/490 cases (17.55 %) (Figure 3.5).

Within the collected samples, bloodspot samples exhibited the highest success rate, with 50 out of 378 yielding full DNA profiles. Blood samples, though fewer in number, also provided viable DNA profiles, with 5 out of 86 samples yielding complete DNA profiles (Figure 3.5)

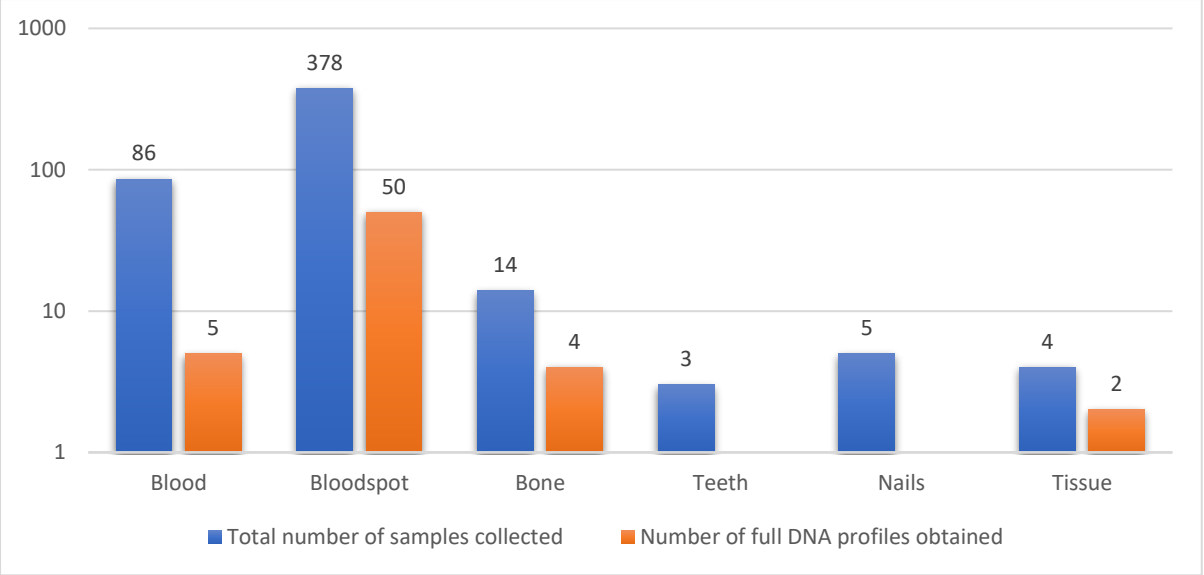

Figure 3.5 The number and success rate of biological samples collected by Forensic Pathologist for DNA analysis in 2015.

Of the cases that collected samples for DNA analysis (n = 490/3696, 13.26 %), results were obtained from a total of 64 cases (n = 64/490, 13.06 %). Complete DNA profiles were obtained in 61 cases (n = 61/490, 12.45 %), 48 of these cases were of bodies admitted with a presumptive identity. The remaining thirteen belonged to bodies admitted without a presumptive identity. In one case, the DNA profile did not yield a match, two cases failed to produce any DNA profiles and the results of 426 cases were unknown (Table 3.1) and (Figure 3.5).

Table 3.1 This summary table provides an overview of DNA analysis requests and results.

DNA analysis	**Value**
Total cases with DNA requested	490
Cases with DNA results received	64
Turnaround time for results (range)	0 to 471 days
Full DNA profiles obtained	61
Identified cases (with full DNA profile)	48
Unidentified cases (with full DNA profile)	13
No DNA match	1
Failed DNA profiles	2
Unknown DNA results	426
Success rate of DNA for the purpose of identification	48/490 = 9.8 %

3.2.1 *Statistical assessment of sample type influence on DNA profiling efficacy*

To ascertain the correlation between the collected sample types and the efficacy of DNA profiling outcomes, a Chi-Square test was executed utilising IBM SPSS Statistics (Version 28.0.1.1 (15)) The analysis yielded a p-value of .000, indicating a departure from the null hypothesis of independence. This implies a statistically significant relationship between the types of samples and the observed patterns in DNA profiling output (Figure 3.6).

Further exploration of this relationship reveals that certain sample types exhibit higher success rates in yielding full DNA profiles compared to others. Specifically, bloodspot samples displayed the highest success rate, with 50 out of 378 samples yielding complete DNA profiles. Conversely, bone, teeth, and nails samples exhibited lower success rates, with only 4 out of 14 bone samples yielding usable profiles (Figure 3.5). These findings underscore a correlation between the type of biological sample collected and the efficacy of DNA profiling outcomes, with blood and bloodspot samples demonstrating higher success rates compared to bone, teeth, and nails samples.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1183113.031[a]	24	.000
Likelihood Ratio	8517.598	24	.000
N of Valid Cases	1045369		

a. 29 cells (82.9%) have expected count less than 5. The minimum expected count is .00.

Figure 3.6 Chi-Square Test Results for Association between Sample Types and DNA Profiling Outcomes

3.2.2 Examination of DNA analysis timelines: investigating key time points from admission to body release in 2015 DNA analyses – a comparison between SAPS and Unistel

In the year 2015, DNA tests were requested for 490 cases, however, reports were only obtained from 64 (13.06 %) cases, with a turnaround time ranging from 0 to 471 days (25.89 days). Based on the records available at the time of data collection, three reports indicated that the samples were forwarded to SAPS for analysis, a process that spanned from 0 to 581 days (162 days) to complete. In contrast, 61 samples were directed to the private laboratory, Unistel, for analysis, with an average request-to-analysis time of (0 – 256 days) 19.16 days. The information regarding the outcomes of the remaining 426 cases were unknown during the data collection period of this study(Figure 3.7).

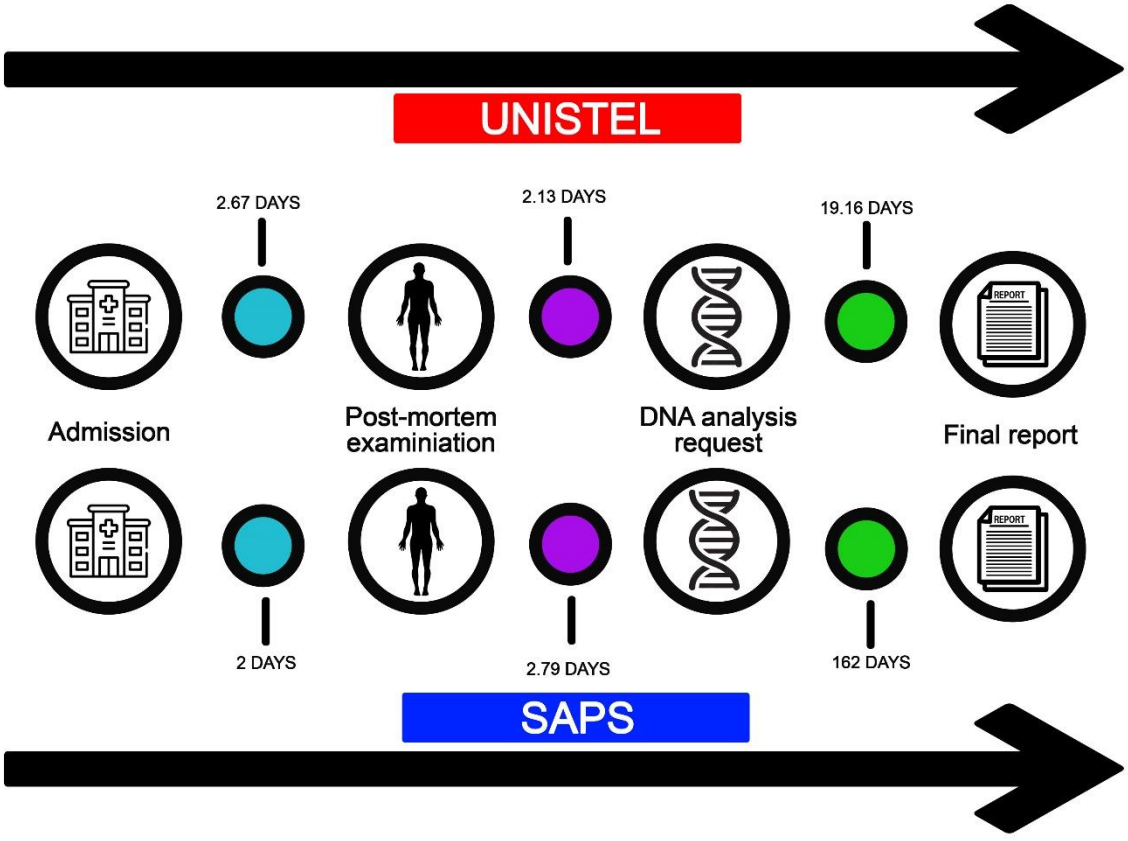

Figure 3.7 Comparison of DNA Analysis Report Turnaround Times Between Unistel and SAPS from time of admission to forensic facility

Chapter 4: Discussion

Overview: The challenge of identifying unidentified bodies

The process of identifying unknown bodies is often a complex undertaking, particularly when there is no presumptive identity of the deceased, no known next-of-kin, or when the body is not visually recognisable [15]. In the current study 5.76 % (n = 213) of cases admitted to SRM lacked a presumptive identity (Figure 3.3). Despite the implementation of identification methods, 5.98 % (n = 221/3696) of cases remained unidentified in 2015. It is noteworthy that these percentages are lower than those reported in previous research conducted at SRM, where 10.89 % (n = 363) of cases were unidentified for the year 2015 [24]. Factors contributing to this disparity could include the current study's benefit from a 5-year interval, allowing for the collection of a larger volume of reports. This suggests that additional documents, previously inaccessible, might now be obtainable or have been made available for scrutiny in the present investigation.

In response to the challenge of unidentified bodies, the Human Decedent Identification Unit (ID unit) was established in 2016 by the University of the Witwatersrand's Department of Forensic Medicine and Pathology [4]. Collaborating with the International Committee of the Red Cross, the Gauteng Southern Cluster Forensic Pathology Services, and the Victim Identification Centre, this initiative aims to conduct secondary identification procedures on unidentified bodies [4]. Unidentified bodies accounted for 8.1 % (n = 693) of total annual admissions at the Johannesburg Forensic Pathology Services medico-legal mortuary between January 2018 and July 2020. Of these, 385 bodies were processed by the ID unit, and 22.6 % of the bodies (n = 87) were subsequently identified, with only one case (1.1 %) being identified using DNA analysis [4].

4.1.1 Gender disparity and age distribution in unidentified bodies at SRM 2015

The proportion of unidentified male individuals (n = 154, 69.68 %) was slightly lower than the overall admission rate of 76.41 % in SRM for the year 2015. This male predominance aligns with previous findings in a study conducted at the Pretoria Medico-Legal Laboratory, which reported that approximately 80 % of the total caseload of unidentified bodies was male [23]. Similar sex disparities were observed in developed countries like the USA, where males comprised 80.6 % of the unidentified population [9]. Research suggests that males are more likely to engage in high-risk activities, such as drug use and criminal behaviour, increasing the chances of their remains being found in remote or isolated areas [23,58]. Additionally, many

males migrate from their hometowns to cities in search of better opportunities and economic prospects [4]

However, a notable finding was the significant proportion of individuals between the ages of 21 to 30 years among the unidentified population, making up 29.59 % (n = 416/1406). This trend contrasts with findings from a previous study conducted in SRM, where the predominant age group was 30 – 40 years (27.44%) [24]. This pattern of higher involvement of adults in the unidentified population was also observed in studies conducted in New Delhi, India, and the USA, where the most common age groups in the unidentified population were 30 – 40 years (31.02 %) and 18 – 37 years (46.60 %), respectively [9,59].

Timeframe analysis of identification processes at SRM in 2015

When a body is brought to a medico-legal facility, a post-mortem examination must be carried out promptly to determine the cause of death and other contributing factors [7]. On average, the examinations for bodies with a presumptive identity took approximately 3.15 days, while those without took approximately 3.47 days. The marginal increase in waiting time may be ascribed to the potential delay in the arrival of the deceased's families at the mortuary for the purpose of identifying the body. This finding is consistent with a previous study conducted at SRM, in which the average time that elapsed between the date of admission to an autopsy was 3.80 days [24].

At SRM, visual recognition is typically used as the primary method of identifying bodies, with 93.24 % of cases admitted in 2015 identified visually by a next-of-kin or close family member. If visual identification is not possible or unsuccessful, scientific methods can be implemented to assist in the identification of the body [8].

Where fingerprint analysis was used (n = 92), 79 bodies (or 85.97 %) were identified successfully using this method, which took an average of 32.28 days (Figure 3.4). This is similar to the Johannesburg Forensic Pathology Services medico-legal mortuary findings, where fingerprint analysis was the most successful method of identification at 98.9 % [4]. However, there was a notable difference in the time it took to complete fingerprint analysis at SRM (32.28 days) compared to the Pretoria medico-legal laboratory (approximately 14 days) [23]. A plausible explanation for this divergence may stem from potential communication gaps among the key departments involved in the identification process—SAPS, the Department of Home Affairs, and FPS. The likely absence of effective communication and collaboration

could have resulted in delays in sending and receiving information between these departments, extending the overall duration of the identification process.

4.2.1 DNA analysis in post-mortem human identification

In this study, DNA analysis was requested in 490 cases (Figure 3.4), and an increase in requests was observed in December (Appendix K[1]). Nevertheless, only 68/490 (13.88 %) cases clearly articulated the intended purpose of the DNA analysis for identification, leaving the reasons for DNA analysis in the remaining 419 cases unclear. This lack of clarity underscores the imperative for a more standardised and transparent reporting approach regarding the precise objectives of DNA analysis [9]. Such an approach could serve to enhance resource allocation and prioritise identification endeavours [57].

The study reveals a DNA analysis success rate of 9.80 % (48 out of 490 cases). This relatively low success rate can be attributed to several factors. One prominent factor is the lack of clear objectives for DNA analysis outlined by forensic pathologists in their reports. This ambiguity has led to difficulties in interpreting the results. Additionally, failed DNA profiles constitute another significant challenge. The quality of DNA profiles can be compromised due to the type of sample collected (figure 3.6). Moreover, instances of no match results are not uncommon, primarily stemming from the absence of family members for comparative DNA analysis. This lack of familial involvement in sample collection poses a substantial hurdle in achieving successful DNA matches [58,60].

The absence of family members during the collection of appropriate samples for comparative DNA analysis raises concerns on multiple fronts. One major concern is the fear these family members may harbour, particularly if they are illegal migrants [61]. The apprehension of potential deportation may deter them from participating in the identification process [62]. Another fear is the possibility of criminal prosecution, as their profiles would be scrutinised against the database [63]. This ethical dilemma further complicates the identification process.

Furthermore, the study sheds light on a poignant issue where family members might not be aware of the passing of their loved ones [58,64]. This lack of awareness might be attributed to assumptions of the missing status, adding another layer of complexity to the challenges faced in achieving comprehensive and accurate DNA analysis results [57]. To enhance the effectiveness of DNA analysis in forensic cases, authorities need to ensure that appropriate

samples are collected from the bodies that require identification, collaborations with private labs needs to be fosters too.

4.2.2 DNA sample collection

The proportion of cases in which samples were collected for DNA testing in this study stood at only 13.26 %, this is a significant decrease from the percentage reported in a previous study conducted at SRM over an eight-year period (23.5 %) [24]. The implementation of the Criminal Law (Forensic Procedures) Amendment Act 37 of 2013, which became effective in January 2015, was expected to result in an increase in DNA analysis requests soon after [65]. However, it is noteworthy that while samples were retained for DNA analysis in this study, information regarding the outcomes of the analysis was unavailable in 426 cases, mirroring a similar finding reported in a prior study [24]. Moreover, while the law came into effect in January 2015, it is likely that the practical resources necessary for its implementation in forensic facilities were only made available later, and thus a true increase in DNA sampling may only be seen in subsequent years.

Comprehending the outcomes of DNA analysis is essential for assessing the success rate and identifying areas requiring improvement. It is important to acknowledge that SAPS is not obligated to submit the results of DNA analysis, as the responsibility for identification lies solely with SAPS, not FPS [7]. SAPS is limited to conveying information on whether the body has been identified or not, facilitating FPS in the release process [7]. This raises a significant concern because, lacking detailed reports on the results, FPS faces challenges in evaluating the quality of collected samples and determining their adequacy for generating meaningful results. This information is especially important for Forensic Pathologist, when collecting samples for DNA analysis. This underscores the need for a collaborative approach to streamline communication and ensure that relevant information is shared seamlessly between SAPS and FPS for more effective and informed decision-making processes.

The collection of DNA samples from bodies that had already been visually identified (n = 202, 9.91 %) represents a significant misallocation of resources (Figure 3.3). Yet, a striking 1 369 cases that had not undergone visual identification prior to post-mortem examination had no samples collected for DNA analysis (Figure 3.3). Of particular significance, within this latter group, 121 bodies were subsequently released for a pauper burial, which refers to a burial or funeral service provided for individuals who were unable to afford the cost of a traditional burial. This practice effectively eliminates any opportunity for future sample collection or analysis. As a result, it highlights a potential area where resources could be more effectively

utilised, given the limited utility of collecting DNA samples from bodies that had already been visually identified, especially when such resources could be redirected to cases where identification remains more challenging and pressing.

It is a legal requirement to collect samples for downstream scientific analysis after 7 days of admission if standard means of identification are unsuccessful [8]. However, delays in the collection and proper storage of samples can negatively impact downstream DNA analysis [66]. Given that the average time between admission and autopsy was approximately 72 hours in the current study, it can be assumed that any delay in the final reporting was unlikely to be primarily attributed to post-mortem DNA degradation as a result of an increased post-mortem interval [67]. The average time (3 days) was notably shorter compared to that observed in an Indian mortuary (10 – 15 days) and was similar to the findings of a study carried out in the Pretoria Medico-Legal Mortuary (1 – 2 days) [23,59].

The selection of an appropriate sample type for collection depends on the circumstances of the body and the available storage conditions in the medico-legal mortuary or forensic science laboratory (SAPS) [29,51]. The most commonly collected post-mortem sample for human identification was dried blood spots on FTA cards (n = 57, 81.43 %) (Figure 3.5). This method of collection and storage provides a significant advantage for DNA analysis, as the samples can be stored at room temperature (between 21 °C and 26 °C) with low humidity [68]. This has significant value in overburdened or backlogged facilities for several reasons. Firstly, the ease of storage at room temperature reduces the strain on limited refrigeration resources, allowing for more efficient use of available space in facilities dealing with a high volume of cases. Additionally, the simplicity of storage conditions minimises the need for equipment, making this method more accessible and cost-effective, especially in resource-constrained environments. Lastly, the prolonged stability of FTA card samples allows for delayed processing [69], which can be advantageous in situations where there are delays in analysis or a backlog of cases, providing flexibility in managing the workflow of forensic laboratories.

4.2.3 DNA analysis outcome

It is noteworthy that in cases where results were obtained (n = 64/490), 61 cases (95.31 %) were from a private laboratory, which had a notably faster turnaround time of approximately 25.86 days (figure 3.7). In contrast, samples submitted to the Forensic Science Laboratory at SAPS resulted in either partial or no DNA profiles and had a much longer turnaround time of approximately 162 days. The discrepancy in turnaround times can be largely attributed to the operational context of the Forensic Science Laboratory at SAPS. This laboratory is tasked with

conducting pivotal scientific investigations, encompassing DNA testing, which are essential for supporting criminal investigations and facilitating prosecutions [70]. Consequently, the significant backlog of cases from 2015, coupled with workload demands and resource constraints, likely played a role in causing the delays in processing times.

In South Africa, the NFDD stores DNA profiles from various sources, including convicted offenders, arrestees, and missing persons [71]. DNA profiles obtained from unidentified human remains are compared to the profiles stored in designated indices in the NFDD to identify potential matches [7,71]. In countries like the UK and the USA, it is clearly stated that the DNA profiles of unidentified bodies are compared against all profiles in the database, regardless of the category in which they are stored [13,53]. In alignment with these international practices, South Africa has adopted a similar strategy, ensuring that the DNA profiles of unidentified bodies undergo thorough comparison against the entirety of the available database, thus enhancing the effectiveness of the identification process and increasing the chances of successful matches.[7,72]. This context and practice are reflected in the current study, where DNA profiles generated by SAPS were compared to existing profiles within the NFDD. One ethical concern worth noting is that DNA profiles obtained from family members are subjected to searches against all profiles stored within the NFDD. This practice may pose a hindrance for family members who fear potential criminal prosecution, acting as a deterrent that discourages their willingness to come forward and contribute to the identification process. However, it is crucial to recognize that the NFDD, like any database, requires continuous development to align with evolving technological and procedural standards. A model akin to the NamUS database [73], where ongoing enhancements and refinements are integral, could serve as a blueprint for optimizing the NFDD's functionality and ensuring its relevance in advancing forensic identification practices.

In 2015, 84.62 % (n = 187) of the unidentified bodies at SRM were well-preserved, while the remaining 15.38 % (n = 34) were beyond physical recognition. In contrast, in Milan, Italy, only 68.30 % (n = 496) of the unidentified population were well-preserved, and the remaining 31.70 % (n = 230) were in different states of poor preservation [15]. This discrepancy could be attributed to the fewer number of unidentified bodies reported in developed countries in the first instance. Once followed up with, scientific means of identification, which are more abundant and available in developed facilities, the likelihood of a body remaining unidentified is possibly due to physical factors preventing identification versus the access to resources to

do so [74]. This indicates that the state of preservation is more likely the reason for unidentified human remains in developed countries compared to developing countries.

This inference gains further support when examining the specific success rates of DNA analysis in the current study. Notably, bloodspot samples emerged as the most reliable for human identification, with 47 cases yielding positive matches according to available reports at the time of investigation. On the other hand, tissue samples exhibited the least favourable outcomes, with only two cases resulting in positive identifications. This nuanced analysis underscores the intricate interplay between preservation status, the efficacy of DNA analysis, and the identification process. The higher success rates in developed facilities likely stem from more abundant resources and advanced techniques, emphasising that the probability of a body remaining unidentified in these regions is more likely linked to the physical condition preventing identification rather than limitations in available resources. This underscores the importance of considering the multifaceted dynamics influencing the identification of unidentified human remains in developed compared to developing countries.

Limitations and recommendations

The limitations and recommendations are based on the data collected in this study in 2015. It is noted that some of these limitations and recommendations may have already been addressed and/or implemented, and thus, this data should be used in conjunction with later data to determine how the changes have improved the process.

Incomplete or missing documents posed a challenge to the present study, affecting not just the unidentified population but all cases admitted to SRM in 2015. This issue may have arisen from human error or inadequate record-keeping systems, but as far as possible, this hurdle was overcome by utilising multiple sources such as the Forensic Pathology Services online database and hard copy records. The lack of records made it hard to obtain vital information about the unidentified population, including DNA analysis for identification purposes. The outcomes of 86.94 % (n = 426/490) of cases requiring DNA testing was unknow due to the absence of records, as for cases with no match, SAPS do not standardly give reports back to FPS. This leads to incomplete or biased data analysis.

To address these challenges, standardisation of documentation and reports is essential to minimise the potential for unclear language. Furthermore, quality checks should be conducted by SAPS and FPS to ensure that the documentation process is followed accurately and consistently, and final reports are timely uploaded to the forensic pathology Live Link database.

Regular reviews of the documentation process can also highlight any gaps or issues that need to be addressed to improve the overall quality of the data collected regarding deceased individuals.

This study also highlighted the under-utilisation of scientific methods of identification, such as DNA analysis, The lack of utilisation of scientific methods can be attributed to several factors, including the lack of awareness among investigators on the availability of these resources, and the value they may add [59]. Furthermore, the study revealed a significant gap in follow-up procedures to determine the success or failure of DNA analysis in cases where it was requested, highlighting a critical aspect of the investigative process that demands attention and improvement.

To address this issue, there needs to be increased awareness and training for investigators and forensic specialists on the benefits and applications of scientific identification methods [59]. This can be achieved through regular training programs, conferences, and workshops focusing on the latest forensic science advancements and techniques. There is also a critical need for the establishment of systematic tracking mechanisms within investigative processes. This involves creating protocols that ensure regular and comprehensive follow-up on the outcomes of DNA analyses, documenting whether they led to successful identifications or not. Introducing standardised reporting practices would further contribute to maintaining a thorough record of the effectiveness of DNA analysis in different cases. Additionally, establishing a centralised database to record and share the outcomes of DNA analyses can serve as a valuable resource for future investigations. This database could be designed to store anonymized information, maintaining confidentiality while providing a comprehensive repository of cases, their respective outcomes, and any challenges encountered.

The research outcomes also emphasise the value of synergy between private stakeholders and forensic pathology laboratories in employing DNA analysis for human identification [4,23,24]. With the backlog of cases requiring processing in forensic pathology laboratories, the possibility of obtaining timely results is significantly reduced. However, the involvement of private stakeholders can help alleviate this issue by providing support and resources to expedite the identification process. Private laboratories can provide additional capacity for DNA analysis, helping to reduce the backlog of cases waiting to be processed by forensic pathology laboratories. Moreover, private stakeholders can offer expertise in areas such as information

management, logistics, and quality control, helping to streamline and improve the identification process. Further research is needed to evaluate the potential benefits of this collaboration.

Conclusion

In conclusion, the challenge of unidentified bodies, constituting 5.98 % of cases at the Salt River Mortuary in 2015, poses significant difficulties not only within South Africa but also on a global scale. The limited success of DNA analysis, yielding favourable results in only 1.65 % of the population requiring identification, highlights a notable underutilisation of this identification tool at SRM in 2015.

Despite the optimism associated with the enactment of the ‘DNA Act’ in 2015, its positive impact was not immediately evident in that year. Therefore, this data contributes to the 'pre-NFDD' baseline, acknowledging that DNA utilisation did not exhibit an overwhelmingly positive outcome. Recognising negative or sub-optimal outcomes as valuable underscores the importance of continued efforts to enhance the effectiveness of identification tools for addressing the persistent challenge of unidentified bodies. This study has brought to light the intricate factors contributing to the problem, emphasising the pressing need for a multifaceted approach. Addressing these challenges requires a comprehensive strategy that encompasses the enhancement of documentation and reporting standards, as well as the promotion of awareness and utilisation of scientific identification methods.

Moreover, fostering collaboration between public and private stakeholders is pivotal in optimising the identification process. By implementing these recommendations, post-mortem human identification can be improved and provide social justice to the families and communities affected by these distressing cases, both in South Africa and worldwide. The insights gleaned from this study contribute to a broader understanding of the complexities involved in addressing unidentified bodies, laying the groundwork for future initiatives aimed at refining and advancing identification practices globally.

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Appendices

Appendix A: Diagrammatic representation of variables collected

Green variables to be collected for all cases, purple variables to be collected where visual identification was performed before the autopsy, blue variables to be collected where visual identification was performed after the autopsy, and grey variables to be collected where no visual identification was performed before autopsy and red variables to be collected where DNA analysis was requested.

Variable	Description	Collection conditions
Green variables	- Date of death - Date of death declaration - Date of admission - Date of post-mortem - Date of release - Admission category – cause of death - Type of burial (i.e., state, private, pauper) - Condition of body5	Collected for all cases
Purple variables	- Visual identification – before autopsy (Y/N) - Secondary identifier - Date of visual identification - Identifier's relation to deceased	Collected where visual identification was performed before autopsy
Blue variables	- Visual identification – after autopsy - Secondary identifiers - Date of visual identification	Collected where visual identification was performed after autopsy
Grey variables	- Fingerprint obtained (Y/N) – if yes – date - Odontology (Y/N) – if yes – date - Anthropology (Y/N) – if yes – date - Radiology (Y/N) - Type of sample collected - Date of sample collection - Date and type of analysis performed - Date results were obtained	Collected where no visual identification was performed

	- nature of results	
Red variables	- DNA analysis requested (Y/N) – if yes – date - Date DNA analysis performed - Type of sample collected and processed - Date results were obtained - Outcome of results	Collected where DNA analysis was requested

Appendix B: Questionnaire for the identification of a deceased

QUESTIONNAIRE FOR THE IDENTIFICATION OF A DECEASED

WC/11/ _____/15

Person Identifying Deceased / Next of Kin

1. Full Names :
2. Surname :
3. ID / Passport Number:
4. Relationship to Deceased:
5. Cell Number :
6. Home Tel. Number:
7. Address :
8. Work Address: Code
9. Work Tel. Number:

Details of Deceased

1. Actual Name :
2. Surname :
3. ID / Passport Number:
4. Age :
5. Marital Status :
6. Occupation :
7. Place of Birth :
8. Residential address: Code

Appendix C: Forensic Pathology Services identification statement (FPS 008 form)

Departement van Gesondheid
Department of Health
iSebe lezeMpilo

FORENSIC PATHOLOGY SERVICES

IDENTIFICATION STATEMENT

DR:
Full Names and Surname:
Identity Number:
Residential Address:

Work Address:

Cell phone: Tel (Home): Tel (Work):

Declare under Oath in English:

On 2015-05-18 at 11:17 I went to the Forensic Pathology Laboratory, Salt River FPS, where the body of a Female marked DRNr: was pointed out to me by / which I identified to , as being that of

Further particulars of the deceased are as follows:

Identity / Passport Number:

Place of Birth:

Marital Status:

Relationship to deceased:

Residential Address:

N.A The contents of this declaration are true to the best of my knowledge and belief. I am aware that should it be submitted as evidence and I know that something appears therein which I know to be false or believe not to be true, I could be liable for prosecution.
1. I know and understand the contents of this declaration.
2. I have no / ~~have~~ objection to taking the prescribed oath.
3. I consider / ~~do not consider~~ the prescribed oath binding on my conscience.

Date: **2015-05-18** Time: **11:17**

Signature / thumbprint of deponent

N.A I David Peter Hoogbaard certify that the above statement was taken down by myself and that the deponent has acknowledged that ~~he~~ / she knows and understands the contents hereof. This statement was sworn to before me and the deponents signature was placed hereon in my presence.

Date: **2015-05-18** Time: **11:17**

Commissioner of Oaths: Ex Officio
Department of Health
Forensic Pathology Laboratory: Salt River FPS

Appendix D: Forensic Pathology Services notification to claim and remove the body (FPS 012)

Departement van Gesondheid
Department of Health
iSebe lezeMpilo

FORENSIC PATHOLOGY SERVICES

Date:

The Manager
Forensic Pathology Laboratory: Salt River FPS
Department of Health
Western Cape

To

NOTIFICATION TO CLAIM AND REMOVE BODY

You are hereby notified that the body of must kindly be removed as soon as possible from the Forensic Pathology Laboratory. Should the body not be claimed and removed within 48 hours (Saturdays, Sundays & Public Holidays excluded) of it being ready for removal, storage fees (at the rate of R186 per day) will be charged, payable to the Forensic Pathology Service.

If the body is not claimed and removed within thirty (30) days after notification, it may be buried as a pauper. You are further notified that the property of the deceased (has been / has not been) handed over, to the next of kin.

Please be advised that if the property has not been removed, you need to instruct your undertaker to remove the property when removing the body.

If the property has not been removed after thirty (30) days of notification the property may be destroyed. (Due to Occupational Health and Safety Regulations.)

AUTHORITY TO HAND OVER BODY

You are hereby notified that the body of is to be handed over to the holder of an original copy of this form.

Undertaker / Authorised person

Forensic Officer

2015/05/18

Date Stamp

Appendix E: Report on a medico-legal post-mortem examination

Western Cape Government
Health

DIRECTORATE: FORENSIC PATHOLOGY SERVICE
REFERENCE: FORM FPS 007 WC LL
ENQUIRIES: 021-4066412

REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF HEALTH : PROVINCE OF THE WESTERN CAPE

REPORT ON A MEDICO-LEGAL POST-MORTEM EXAMINATION

WC
Nyanga SAPS

To the Magistrate of Cape Town.

AFFIDAVIT IN TERMS OF SECTION 212(4), ACT 51 OF 1977 (SAP 378)

I,

state under oath:

1. I am in the service of the Province of the Western Cape as a Senior Specialist in Forensic Pathology and Senior Lecturer of the Department of Forensic Medicine stationed at the Medical Faculty of the University of Cape Town.

2. On the 4th of February 2015 at 08h00, a body bag was pointed out to me by Forensic Pathology Officer of the Salt River Forensic Pathology Laboratory. The bag was marked WC . The body bag contained the body of a black adult male with an ankle tag which was marked WC The estimated age of the decedent was 24 years. The body was certified as dead as informed on 1 February 2015 at 02h45.

3. I conducted a post-mortem examination on the said body and recorded my findings which facts I ascertained by means of an examination requiring skill in anatomy and pathology.

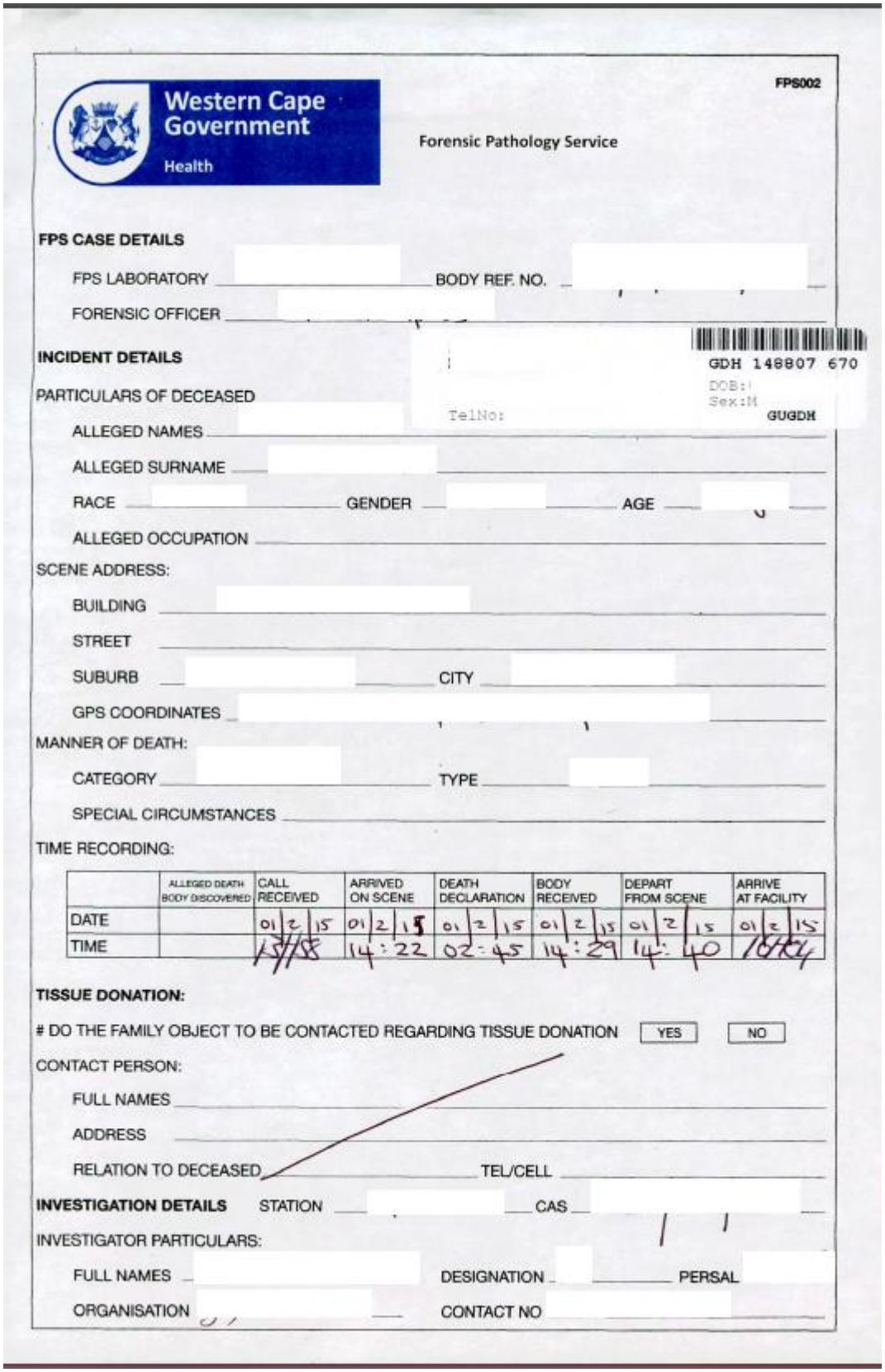
4. The chief post-mortem findings made by me on this body were:

   4.1. The body of a black adult male.
   4.2. There is a single fatal gunshot wound from the face into the head as described in the report.
   4.3. A spent bullet point is retrieved from the brain.
   4.4. Very extensive aspiration of blood into the lungs.

5. That, as a result of my observations, a schedule of which follows, I concluded that the cause/causes of death was/were:
   A gunshot wound to the head.

1

Appendix F: FPS 002 document



FPS002

Western Cape Government
Health

Forensic Pathology Service

FPS CASE DETAILS

FPS LABORATORY _____ BODY REF. NO. _____

FORENSIC OFFICER _____

INCIDENT DETAILS

GDH 148807 670
DOB:
Sex:M
GUGDH

PARTICULARS OF DECEASED

TelNo:

ALLEGED NAMES _____

ALLEGED SURNAME _____

RACE _____ GENDER _____ AGE _____

ALLEGED OCCUPATION _____

SCENE ADDRESS:

BUILDING _____

STREET _____

SUBURB _____ CITY _____

GPS COORDINATES _____

MANNER OF DEATH:

CATEGORY _____ TYPE _____

SPECIAL CIRCUMSTANCES _____

TIME RECORDING:

	ALLEGED DEATH / BODY DISCOVERED	CALL RECEIVED	ARRIVED ON SCENE	DEATH DECLARATION	BODY RECEIVED	DEPART FROM SCENE	ARRIVE AT FACILITY
DATE		01/2/15	01/2/15	01/2/15	01/2/15	01/2/15	01/2/15
TIME		13/58	14:22	02:45	14:29	14:40	16:24

TISSUE DONATION:

DO THE FAMILY OBJECT TO BE CONTACTED REGARDING TISSUE DONATION [YES] [NO]

CONTACT PERSON:

FULL NAMES _____

ADDRESS _____

RELATION TO DECEASED _____ TEL/CELL _____

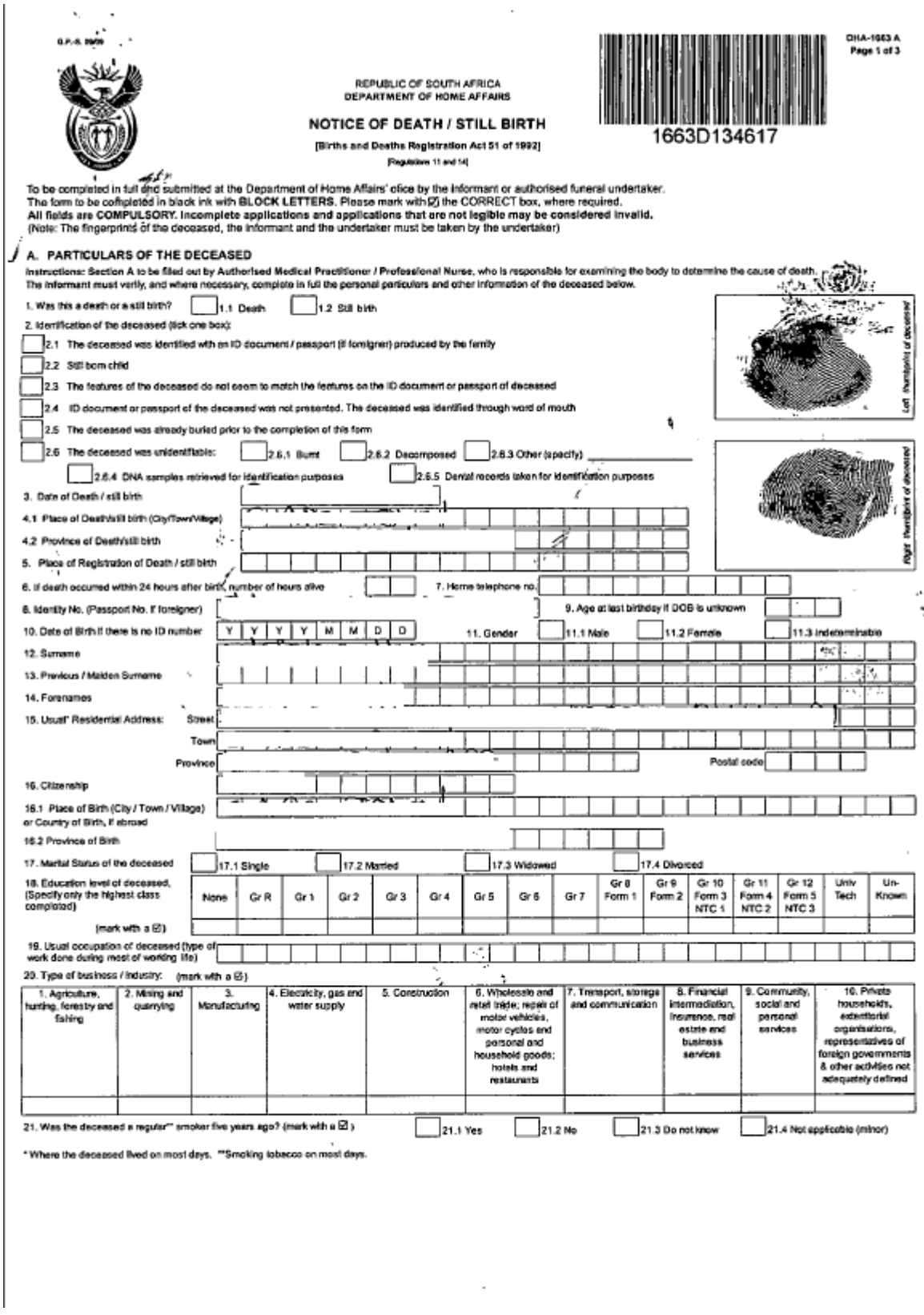
INVESTIGATION DETAILS STATION _____ CAS _____

INVESTIGATOR PARTICULARS:

FULL NAMES _____ DESIGNATION _____ PERSAL _____

ORGANISATION _____ CONTACT NO _____

Appendix G: Notification of death/stillbirth (BI-1663 form)



DHA-1663 A
Page 1 of 3

REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF HOME AFFAIRS

NOTICE OF DEATH / STILL BIRTH

[Births and Deaths Registration Act 51 of 1992]
[Regulations 11 and 14]

1663D134617

To be completed in full and submitted at the Department of Home Affairs' office by the informant or authorised funeral undertaker.
The form to be completed in black ink with **BLOCK LETTERS**. Please mark with ☑ the CORRECT box, where required.
All fields are COMPULSORY. Incomplete applications and applications that are not legible may be considered invalid.
(Note: The fingerprints of the deceased, the informant and the undertaker must be taken by the undertaker)

A. PARTICULARS OF THE DECEASED

Instructions: Section A to be filled out by Authorised Medical Practitioner / Professional Nurse, who is responsible for examining the body to determine the cause of death. The informant must verify, and where necessary, complete in full the personal particulars and other information of the deceased below.

Left thumbprint of deceased

Right thumbprint of deceased

1. Was this a death or a still birth? ☐ 1.1 Death ☐ 1.2 Still birth

2. Identification of the deceased (tick one box):

☐ 2.1 The deceased was identified with an ID document / passport (if foreigner) produced by the family
☐ 2.2 Still born child
☐ 2.3 The features of the deceased do not seem to match the features on the ID document or passport of deceased
☐ 2.4 ID document or passport of the deceased was not presented. The deceased was identified through word of mouth
☐ 2.5 The deceased was already buried prior to the completion of this form
☐ 2.6 The deceased was unidentifiable: ☐ 2.6.1 Burnt ☐ 2.6.2 Decomposed ☐ 2.6.3 Other (specify) _____
☐ 2.6.4 DNA samples retrieved for identification purposes ☐ 2.6.5 Dental records taken for identification purposes

3. Date of Death / still birth
4.1 Place of Death/still birth (City/Town/Village)
4.2 Province of Death/still birth
5. Place of Registration of Death / still birth
6. If death occurred within 24 hours after birth, number of hours alive
7. Home telephone no.
8. Identity No. (Passport No. if foreigner)
9. Age at last birthday if DOB is unknown
10. Date of Birth if there is no ID number (Y Y Y Y M M D D)
11. Gender ☐ 11.1 Male ☐ 11.2 Female ☐ 11.3 Indeterminable
12. Surname
13. Previous / Maiden Surname
14. Forenames
15. Usual* Residential Address: Street
Town
Province
Postal code
16. Citizenship
16.1 Place of Birth (City / Town / Village) or Country of Birth, if abroad
16.2 Province of Birth
17. Marital Status of the deceased ☐ 17.1 Single ☐ 17.2 Married ☐ 17.3 Widowed ☐ 17.4 Divorced

18. Education level of deceased, (Specify only the highest class completed) (mark with a ☑)

None	Gr R	Gr 1	Gr 2	Gr 3	Gr 4	Gr 5	Gr 6	Gr 7	Gr 8 Form 1	Gr 9 Form 2	Gr 10 Form 3 NTC 1	Gr 11 Form 4 NTC 2	Gr 12 Form 5 NTC 3	Univ Tech	Un-Known

19. Usual occupation of deceased (type of work done during most of working life)

20. Type of business / industry: (mark with a ☑)

1. Agriculture, hunting, forestry and fishing	2. Mining and quarrying	3. Manufacturing	4. Electricity, gas and water supply	5. Construction	6. Wholesale and retail trade; repair of motor vehicles, motor cycles and personal and household goods; hotels and restaurants	7. Transport, storage and communication	8. Financial intermediation, insurance, real estate and business services	9. Community, social and personal services	10. Private households, extraterritorial organisations, representatives of foreign governments & other activities not adequately defined

21. Was the deceased a regular** smoker five years ago? (mark with a ☑) ☐ 21.1 Yes ☐ 21.2 No ☐ 21.3 Do not know ☐ 21.4 Not applicable (minor)

* Where the deceased lived on most days. **Smoking tobacco on most days.

Appendix H: Acknowledgement of receipt (FPS 013 form)

Departement van Gesondheid
Department of Health
iSebe lezeMpilo

FORENSIC PATHOLOGY SERVICES

R **WC/11/0289/15**

ACKNOWLEDGEMENT OF RECEIPT

certify having received the body marked DR , properly cleaned, sutured and prepared for burial from the Forensic athology Laboratory.

ıtended Place of burial: _____

ndertaker removing body:

ndertaker Employee:

ate from when Storage fees are calculated: **2015/02/04 10:58:56**

mount received: **R0**

eceipt Number: **n/a**

ate: **2015-02-04**

ime: **12:26**

Date Stamp

landlane Funeral undertakers/
ndertaker / Authorised person

andall Phillips
orensic Officer (Reception)

orensic Officer (Release Check)

Appendix I: Data management plan

Utilisation of DNA analyses in the process of forensic human identification at Salt River Mortuary (Cape Town, South Africa) - Student Outline DMP

1. General guidelines

PURPOSE OF THIS TEMPLATE - The purpose of the Outline DMP is to indicate your initial plans for how your data will be collected, shared and stored, and to give you a chance to think about these data-focused aspects of the research process. As your begin doing your research, your data process may change, and it is perfectly acceptable to change your data management plan to accommodate the changes in your research process. Indicate below that you understand the purpose of completing this Outline DMP template.

- I understand the Outline DMP template is a projection of my anticipated data management planning requirements and should be updated as my project develops.

This Outline DMP provides details on anticipated data management requirements and will be updated once data collection is underway and if necessary.

2. Authors and supervisors

PROJECT NAME - Replicate the title of your project, dissertation or thesis exactly as it appears in your proposal document.

Utilisation of DNA analyses in the process of forensic human identification at Salt River Mortuary (Cape Town, South Africa)

PERSONAL DETAILS - Indicate the name(s) and student number(s) of the student(s) who will be involved in this project, dissertation or thesis.

Sophy Celine Kambowo
KMBSOP002

SUPERVISOR(S) DETAILS - Indicate who will supervise this project, dissertation or thesis. If you do not yet have a supervisor, leave this section blank.

Principal Investigator: Dr. Laura J. Heathfield
Supervisor:Mrs Kate Reid

3. Data Collection/Generation

COLLECTION OF ORIGINAL DATA - Indicate whether or not you intend to gather/produce original data for your study, and provide a brief description of the kind of data you think you will collect. If you are unsure at this time, indicate what you think you are most likely to collect. If you are not intending to gather or collect your own data, declare that here.

- I intend to collect original data (described below).

Quantitative data will be collected from existing medico-legal autopsy records from Salt River Mortuary. These records are in digitial format and stored on a secure online platform. When the online platform is down or under maintenance, hard copy documentation will be reviewed in accordance with Divisional ethics and confidentiality guidance. The collation of this data into a single access point will constitute original data, as will any data analyses conducted therefrom (excel, R, SPSS, GraphPad). It is anticipated that approximately 3500 case files will be review. The data will be collated into Microsoft Excel, and will be <1GB in size.

USE OF EXISTING DATA - Indicate if you intend to re-use existing data, either from online searches or from datasets provided by your supervisor, lab, or funder. If you are not intending to re-use existing data, declare that here.

- I intend to reuse existing data in my study (described below).

II intend to use data that I will be retrospectively collect from all medico-legal case files at Salt River mortuary over a twelve-month period, between 1 January 2015 and 31 December 2015. The data will be in the form of pre-determined variables like, method of identification, timeline of events, profile of identified vs unidentified individuals and sample collected.

Data will be obtained from existing medico-legal autopsy reports. The data is stored in a secure excel based database or on a secure online database. Secure credentials have been obtained by the supervision team to access these documents, and further approval is being sought for the student. Where needed, hard copy medico-legal documents stored at the repository at UCT will be reviewed in accordance with divisional protocols. All case reports will be kept in a secure locked office and signed out by the division secretary when needed. These credentials will not be distributed to other users, unless listed on the research project. Data will be obtained from the online database through collection of raw data, and no copies of original material will be made. All data will be backed up regularly onto a password secured USB device.

DATA SHARING - Indicate whether or not you are intending to publish your research data. If you are, indicate where you are intending to publish your data and under what licensing conditions, such as Creative Commons. If you are not intending to publish your data, provide reasons and reference the appropriate ethical considerations, commercial applications/patenting ambition, or data re-use agreements that prevent you from publishing your data.

- I intend to share my data (details below).

The metadata generated will be published at the end of the project, in the form of an MPhil minor dissertation. The data will be incorporated into a larger study that is intended to be published in international peer-reviewed research journals. Licensing implemented will follow that of the journal. However, the raw data will not be published, due to the sensitive and confidential nature of the information.

Institutional ethics will be obtained prior to commencing data collection. Data obtained from medico-legal case reports has been approved as part of a larger ongoing research study.

4. Data Storage

ANTICIPATED DATASET SIZE - Indicate the estimated size of your completed dataset, and indicate whether or not you will need to access additional data storage facilities. If such storage is not provided by your unit or department, you may need to factor in the cost of purchasing additional storage space.

- 20GB or less

Data will be collected and stored as Microsoft Excel. It is not anticipated that the data files, and subsequent analyses files will exceed 1GB. Access to additional storage facilities will not be required. Back ups of the data will be on password protected USB devices which are stored in a secure location. Working documents will only be available to the listed project-related personnel (that have ethics approval), and will be required to be viewed on a password protected secure device.

DATA BACKUPS - Indicate how you plan to ensure your data is secure and retrievable in case of errors or hardware failure. Describe what procedures you will put in place to back-up copies of your data and where they will be stored.

- I intend to backup my data using a service provided by UCT (UCT GoogleDrive, UCT OneDrive, Netstorage, ZivaHub etc.).

Data will be collected and stored on the students OneDrive account which is password protected. Data shared with the supervisors and/or collaborators will be through OneDrive or Google Drive. Back-up of data will also be performed onto a password encrpyted USB device or harddrive that will be stored by the Principal Investigator in a safe, secure location. This will ensure that the data files are accessible and secure should the electronic device be damaged or compromised. Passwords will be reguarly updated to reduce risk of compromised security.

5. Data Centre(s)/Repositories

Appendix J: HREC REF: 221/2022 approval letter

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45 E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-submissions@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

21 April 2022

HREC REF: 221/2022

Dr L Heathfield
Division of Forensic Medicine & Toxicology
Entrance 3, Level 1 Falmouth Building- FHS
Email: Laura.heathfield@uct.ac.za
Student: KMBSOP002@myuct.ac.za

Dear Dr Heathfield

PROJECT TITLE : RETROSPECTIVE ANALYSIS OF THE UTILISATION OF DNA ANALYSES IN THE IDENTIFICATION OF HUMAN REMAINS AT SALT RIVER MORTUARY (CAPE TOWN, SOUTH AFRICA)-SUB-STUDY LINKED TO 136/2021
(MPHIL CANDIDATE-MISS SOPHY KAMBOWO)

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

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

This approval is subject to strict adherence to the HREC recommendations regarding research involving human participants during COVID -19, our letter dated 02 February 2022 provides guidance found on our website:
http://www.health.uct.ac.za/fhs/research/humanethics/forms

Approval is granted for one year until the 30 April 2023.

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/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Miss Sophy Kambowo will also be involved in this study.

Please quote the HREC REF 221/2022 in all your correspondence.

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

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938) This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30 04 24
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee		Date Signed	16/3/2023

Note: Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.
Please clarify your plan for research-related activities during COVID-19 lockdown.
Please use the latest form found on our website:
http://www.health.uct.ac.za/fhs/research/humanethics/forms

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	14 March 2023		
HREC REF Number	221/2022	Current Ethics Approval was granted until	30 April 2023
Protocol title	Retrospective analysis of the utilization of DNA analyses in the identification of Human Remains at Salt River Mortuary (cape Town, South Africa) Sub study linked to 136/2021		
Protocol number (If applicable)			
Are there any sub-studies linked to this study?		☐ Yes	✓ No
If yes, could you please provide the HREC Reference number for all sub-studies? **Note:** A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	A/Prof Laura Heathfield		
Department / Office Internal Mail Address	Reception, Division of Forensic Medicine and Toxicology, Falmouth building (entrance 3, level 1), Medical School, Anzio Road, Observatory		

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

HUMAN RESEARCH ETHICS COMMITTEE
16 MAR 2023
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Appendix K: The distribution of cases admitted to SRM in 2015 per month

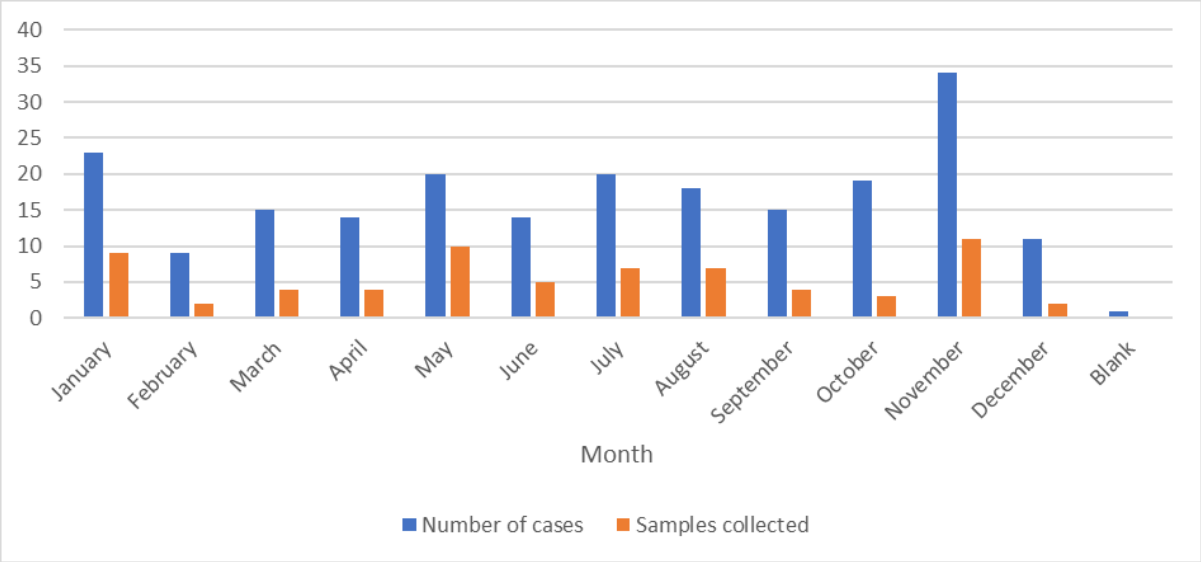


Figure 5 The distribution of cases admitted to SRM in 2015 per month.