CAPE HIGHER EDUCATION CONSORTIUM (CHEC) / WESTERN CAPE GOVERNMENT (WCG)

JOINT RESEACH PROGRAMME

CHEC-WCG JOINT TASK TEAM (JTT) RESEARCH GRANTS 2019

PROJECT PROGRESS REPORT

31st JANUARY 2020

PROJECT TITLE

PROFILING FIRE-RELATED FATALITIES IN THE WESTERN CAPE, SOUTH AFRICA: A MULTIDISCIPLINARY AND COLLABORAIVE APPROACH TO BURN MORTALITY PREVENTION

PSG 3 | INCREASE WELLNESS, SAFETY, AND TACKLE SOCIAL ILLS

RESEARCHER:

MS BRONWEN DAVIES

DIVISION OF FORENSIC MEDICINE AND TOXICOLOGY
DEPARTMENT OF PATHOLOGY
FACULTY OF HEALTH SCIENCES
UNIVERITY OF CAPE TOWN
T | +27 (0) 21 406 6026
E | bronwen.davies@uct.ac.za

WCG PARTNER:

MS VONITA THOMPSON

FORENSIC PATHOLOGY SERVICE AND IOA
DEPARTMENT OF HEALTH
WESTERN CAPE GOVERNMENT
T | +27 (0) 21 928 1501
E | vonita.thompson@westerncape.gov.za

ABSTRACT

This project aims to distinguish the nature, characteristics and prevalence of fire-related fatalities within the Western Cape, so as to support the development of multi-disciplinary and evidence-based prevention/intervention strategies for the reduction of fire/burn mortality in the province. By addressing the prevention of fire deaths in human settlements – a critical and neglected focus area for communities - this project aligns with the Provincial Strategic Goals (PSG): 'Increase Wellness, Safety, and Tackle Social Ills' of the Provincial Strategic Plan 2014-2019, which speaks to both housing sustainability and community health and safety. In addition, it also relates to the role and outcomes of Western Cape Government (WCG) Disaster Management strategies in fire prevention.

Through this study, the UCT-WCG collaboration will provide evidence-based contributions to understanding the aetiology and characteristics of fire-related deaths, and specifically in assessing the role and relevance of toxicological analyses in these cases. Insight into the role of alcohol and other drug intoxication in unnatural death is important in understanding risk factors involved in preventable deaths in WC. These interpretations may contribute to public and development, community safety, substance abuse education and intervention strategies (PSG1), and aiding in ways to develop sustainable living environments, and improving disaster management (PSG4). Given the large extent of this research project, and due to the fund limitation of the CHEC-WCG JTT Research Grant 2019, only two (2) initial components were covered by this funding. The researchers will seek additional research funding for the completion of the entire project and for development of a routine platform for monitoring of alcohol, inhalation toxicity and drugs in fire deaths in WC.

The first component of this project was a systematic review entitled: "The role of alcohol and other drug toxicity in fire-related incidents in Africa". The aim of this review was to create a platform of current research on intoxication in victims fire-related incidents on which to build using the WC mortuary data on fire deaths. Data synthesis for included articles is almost complete, and the researchers are finalising the findings for manuscript submission. The second component was a retrospective review entitled: "A retrospective investigation in fire-related deaths in the Western Cape, 2006-2018". This component has been split into two sub-components, one solely dedicated to the Salt River mortuary (SRM) facility – one of the busiest mortuaries in Cape Town - and one for the other mortuaries collated together. This separation stems from obtaining much more detailed autopsy and investigative records for SRM, thereby permitting an expansion of the investigation into fire deaths. The data for the rest of the other 15 WC mortuaries were obtained from Forensic Pathology Service routinely collected data. Collecting information on WC unnatural death cases presented to be considerably challenging as there are 16 mortuaries with an annual case load of >11,000 cases in the WC. Towards the earlier years, the availability of electronic case files is minimal and it has taken time for the researchers to track down information. This retrospective review is thus currently still at this phase for four remaining mortuaries after which all data collection will be concluded and the manuscripts finalised.

INTRODUCTION

The World Health Organization (WHO) estimates that over 265,000 people die from fire-related burn (flame burn) injuries annually, however this is disproportionally concentrated in low- and middle-income countries (LMICs). South Africa, a developing country, has a complex burden of injury associated with fires, particularly given the large number of at-risk populations that have risen from socio-economic, educational and residential disparities across the country. The knowledge surrounding the true nature and characteristics of, and risk factors associated with, both fires and their victims in South Africa is limited. Collaborative targeted research is thus imperative to evaluate current attempts to curb fires fatalities and strategise and optimise evidence-based interventions for fire-related injury and death prevention locally.

The consequences of fire burn injuries are multi-faceted, affecting numerous sectors and individuals physically, socially and economically. Depending on the extent and severity of the fire, other indirect costs such as lost wages and long-term treatment of physical and emotional trauma, also contribute to the socioeconomic impact of fires. In South Africa, where rural migration to larger urban cities has led to the proliferation of informal settlements; fires occurring in these areas often result in wide-spread loss of homes and life. The overcrowded spaces, together with the highly combustible

materials with which informal housing is constructed, pose high risks for expansive fires in these areas, which in addition to loss of personal property, may result in injury and/or loss of life.

Physical flame burn injury is inclusive of both pathological skin injuries, and injury related to the inhalation of the combustion products in smoke, which vary depending on the material burned. Fires generate the production of a variety of toxic gases, such as carbon monoxide (CO) and hydrogen cyanide (HCN). These toxic combustion products of internal constituents of buildings and/or furnishings are usually inhaled by a victim and may contribute to their injury and/or death. In addition, intoxication from drugs and/or alcohol may also impair judgement, increase response time to get to safety or alert others, and reduce consciousness, which may increase the risk of death in a fire. Toxicological results from the victim of a fire may therefore provide essential information concerning the contribution of toxic gas inhalation and/or drugs and alcohol intoxication to death.

RATIONALE

Burn injury prevention strategies require insight into the epidemiological characteristics of fires and the populations at risk. There is a scarcity of published data on the epidemiology of fire burn fatalities in low- to middle-income countries, such as South Africa. Research that accurately and comprehensively describes the magnitude, risk and nature of fire-burn mortality in South Africa is limited, yet could inform on key vulnerable populations and risk factors and guide strategic evidence-based interventions and improved death prevention strategies. The Western Cape Government is working on strategies for 'Fire and Burn Injury Prevention' to understand the aetiology of these injuries and develop interventions to reduce the prevalence of injury in the Western Cape. These strategies are aimed at developing evidence-based interventions involving a number of departments and stakeholders thus supporting a multi-disciplinary approach to this complex injury aetiology.

In medico-legal death investigation, the use of evidence obtained at the death scene and the individual's history, together with autopsy and toxicological findings should be interpreted holistically to come to a final determination of cause and manner of death. Fire-related fatalities are no exception. Investigating drugs and alcohol, or toxic gases within a decedent together may aid in eliciting key risk factors that need to be better managed and addressed. FPS manage autopsy and death scene investigations within unnatural death. However, there is a recent movement to strengthen their internal toxicological services. Historic information concerning these deaths, together with international best practise guidelines, put the FPS/UCT integration in a prime position of optimising future services associated with investigating these deaths. It also allows for the development of a platform for routine data collection, analysis and reporting of fire deaths and their associated toxicological findings on at least an annual basis. This would provide ongoing support for fire prevention services to monitor their interventions. As most fires are associated with CO toxicity if the person is alive, it is important to gain a better understanding the role of this gas together with other combustion products, in local fire deaths. If inhalation toxicity is highly prevalent and deemed to significantly contribute to death in WC, then strategies that reduce toxic gas inhalation (e.g. CO monitors) need to be targeted for intervention.

PROJECT RESEARCH QUESTIONS, AIMS, AND OBJECTIVES

This research project focuses on fire-related fatalities in the Western Cape Province of South Africa. It investigates both retrospectively and prospectively, the characteristics of such death cases, including the role of substances (alcohol and other drugs) as well as inhalation toxicity to death. Given that this entire research project is relatively large and due to the fund limitation of this funding call, only the two primary aims could be covered by this current funding. The researchers will seek additional research funding for the completion of the entire project. Through this CHEC-WCG JTT Research Grant 2019, the research questions, aims, and objectives of this study were as follows:

Table 1: Project research questions, aims, and objectives covered by the CHEC-WCG JTT Research Grant 2019.

Research Questions	Aims	Objectives
i. What is the prevalence and incidence of fire-related fatalities in the Western Cape (2006-2018)?	• To distinguish the prevalence and characteristic of fire-related fatalities in Western Cape between 2006 and 2018 (13-year period).	· To conduct a retrospective investigation/analysis of post-mortem (autopsy) reports and ancillary investigative documents pertaining to fire-related fatalities received at all Western Cape mortuaries (2006-2018).
ii. What are the high-risk factors, population groups and geographical locations for fatal fire incidents in the Western Cape?		· To conduct demographic and circumstantial data analysis to distinguish at-risk populations and locations (to include age, sex, location of death, circumstances surrounding death, suspected cause of fire, role of drugs and/or alcohol);
iii. What are the key pathological findings in those who die in fire-related events?	• To investigate the role and associations of toxic combustion products (such as CO and HCN) in victims of fatal fires.	· To assess key post-mortem findings, such as pattern and extent of burning (mild (0-20%), moderate (21-50%), heavy (>50%) and other pathological findings (e.g. respiratory soot and hyperaemic lines) at autopsy;
iv. What were the contributions of substances such as alcohol and drugs to fire deaths (2006-2018)?		· To assess available National Forensic Chemistry Laboratory toxicology reports, to include interpretation of COHb results for contribution of CO inhalation to death, and of alcohol and or/drugs to death.

PROJECT PROGRESS & FINDINGS TO DATE

This multi-disciplinary research study involves comprehensive and evidence-based retrospective and prospective approaches to investigating fire-related fatalities in the Western Cape Province of South Africa. The CHEC-WCG JTT Research Grant 2019 covered the following initially proposed research activities:

Task 1: Systematic Review on the Global Prevalence of Fire-Related Deaths and the Role of Toxicity in Death

Initial Task Overview

A systematic review is a reliable source of evidence to guide best practices and service providers with regards to health and safety. In order to understand the aetiology of fire-related deaths, a systematic review of the literature will be undertaken to (a) explore the demographics and characteristics of fire-related deaths, (b) identify the mechanisms of injury, (c) identify the mechanisms and relationships of risk factors (such as the role of drugs and alcohol) to the incident, (d) investigate the prevalence of fire-related deaths globally, and finally (e) identify the toxicological testing involved in inhalation toxicity and the role it plays in determining cause and manner of death. Gaps in knowledge will be identified, and the role of focused research and effective interventions will be highlighted.

Research Modifications

It was decided that the investigation of fire-related incidents would be targeted over that of a global scale. The reason behind this was to create a platform of insight into the literature and work that has been done in this area within Africa. No such review exists, particularly one that investigates the role of intoxication in these events. It was decided to include both clinical and forensic articles and therefore investigate flame burns within both living and the deceased. It was initially hypothesised that there would be a limited availability of data concerning toxicological testing in fire deaths, which is a core component of the subsequent retrospective analysis.

Research Approach

The steps in the systematic review process involved: (a) formulating a review question/objective; (b) providing a framework for inclusion and exclusion criteria; (c) formulating a comprehensive search strategy; (d) assessing each

articles validity through critical appraisal; (e) synthesising data (including sub-group analysis), and (f) interpreting and presenting review findings.

Research Methodology

Table 2: Research methods used in the systematic review component of the research project.

Steps		Details
(a)	**Review Question:**	What is the role of alcohol and other drug toxicity in fire-related incidents in Africa?
(b)	**Inclusion/Exclusion Framework**:	· Population: *Africa* · Exposure/Setting: *Fire, Burn* · Mechanism of Action: *Smoke, Injury* · Risk Factors: *Alcohol, Drugs, Substances* · Outcomes: *Victim, Morbidity, Mortality*
(c)	**Search Strategy:** ▪ Search terms: ▪ Databases searched: **25** ▪ Primary searches: ▪ Secondary searches: ▪ Tertiary searches:	 See *Appendix 1A*. PubMed, Medline, Web of Science, Scopus, Cochrane, Cinahl, ISI Web of Knowledge, Clinical Key, BMJ Best Practice, EbscoHost, Africa-Wide Information/Academic Search Premier, WorldCat, OCLC FirstSearch, WorldCat Dissertations and Theses, Proquest, Current and Completed Research, DATAD Online, Navtech, Union Catalogue of Theses and Dissertations, SACat, AfricaCat, Sabinet Reference, SA ePublications, SciElo, ScienceDirect. **32** primary articles (see *Appendix 1B*). **15** secondary articles (see *Appendix 1B*). **3** tertiary articles (see *Appendix 1B*).
(d)	**Critical Appraisal:** ▪ Tool used: ▪ Included studies: **43**	 An adapted version of the AXIS (Appraisal tool for Cross-Sectional Studies) tool was utilised (see *Appendix 1C)*. Characteristics of included studies in the systematic review (see *Appendix 1D*).
(e)	**Data Synthesis:** ▪ Synthesis pointers:	 Formulating synthesis information from the included articles based on the research question and outcomes.
(f)	**Interpretation:** ▪ Findings:	 Presenting research findings in a manuscript format for dissemination.

Conclusions

A total of 42 articles met the selection criteria of this systematic review and were included for data synthesis. Based on the introduction section of the articles, 25 articles had a focus on burns, with 18 articles purely investigating burns and 7 articles investigating burn as one of many types of injuries. The remaining 17 articles did not establish contextual background to tackle burn-related research, and instead they provided background on general injury, violence and injuries, and/or burdens of disease. Most of the articles were aetiological studies [57% (n=24)], whereas only 10% (n=4) were prevalence/incidence studies, and 33% (n=14) were investigating both aspects. All included studies were descriptive in nature with a cross-sectional study design using a primary or secondary data. Studies that met our inclusion criteria for investigating the relationship of interest involved African populations from only 12 nations out of all 54 countries in Africa. Most of them were South African studies (n=26), followed by Kenya. Only one or two studies were conducted in the remaining population of Egypt, Malawi, Namibia, Swaziland, Uganda, Zambia, Zimbabwe, Ghana, Tunisia, and Tanzania. While this may not indicate the scope of literature associated with burn injuries in Africa, it does illustrate that there are limited publications that mention alcohol or drugs within burn research. This is likely due to the challenges associated with developing and maintaining effective toxicological services within a resource constrained environment – where trauma rates are very high.

All the included articles appropriately described their sample population which represented their research population of interest. Most involved individuals of all ages, with a few looking especially at adults or children. It appeared to be easier and more convenient to utilise secondary data for investigating the role of toxicity in fire-related incidents, as

shown in our systematic review, with 15 (36%) and 27 (64%) articles using primary and secondary data, respectively. The sample size of the sample populations varied between 12 and 59,935 subjects, with an average of 4,604 study participants. Interestingly, only 16 included studies had evidence of missing data in their article, which speaks to the quality of their data source used as well as the reliability of the original research paper produced.

Only 8 (19%) of the articles indicated that toxicological testing occurred using some analytical technique. Instead most articles provided toxicological data of a qualitative nature (alcohol: n=27, 64%; other drugs: n=12, 28%) such as through questionnaires on an individual's use of alcohol or other drugs. Ethanol was quantitated in blood or another biological specimen in 11 articles. These were largely reports on analytical results that were not performed by the researchers. CO, a key combustion product in fires, and measured in the form of carboxyhaemoglobin, was only reported in 2 articles. This further supports either limitations in service provision or results that are not published. Inhalational injury, which can include the presence of smoke and burns in the airways, was only reported in 10 papers. This however, is an important factor to monitor, especially in the deceased, where the presence of soot may indicate the individual was alive within the fire. Statistical analyses were reported within 38 (90%) articles, ranging from descriptive statistics (means, medians, counts and percentages) to more complex statistical analyses such as incident rates, odds ratios, p-values, and multivariate statistical regression on various patient variables.

Most articles (n=37,88%) presented a detailed overview of the case characteristics (injury details), including victim demographics (age, and sex), and location and temporal details. Comprehensive burn injury data was recorded in 39 articles (93%), with specific data relating to fire burns was reported in 24 articles (57%). The prevalence of alcohol or drug use or detection was reported for most sample populations (n=33, 78%), however, a lot of these data were based off of self-reported use, which can be unreliable and may underestimate the problem. This is evidenced by only a single study providing a statistical significant finding between alcohol and/or drugs and burn injury. This lack of quantitative data illustrates the challenges associated with understanding the true role of alcohol or drug intoxication and flame burn injury. It was identified that some of this gap could be targeted through the retrospective analysis of the mortuary data in the second component of this project. A few more studies (n=12, 28%) did however, suggest a relationship between intoxication and burn injury. These suggested that alcohol consumption (and intoxication) may increase the risk of exposure to fire and injury. In many instances, drug and alcohol data was presented for a group of injuries, of which burns was one, and it was not possible to associated the alcohol or drugs to burns injury only.

Most authors recognised limitations of their studies within the manuscripts (n=26,62%) , which included the use of self-reported alcohol and drug use data, limited routinely collected data, limited sample size numbers and lack of statistical power. Very few manuscripts identified a source of funding (n=10, 24%). This clearly illustrates a need for strengthened funding opportunities to support burn-injury prevention and especially to investigate the role of toxicity in these patients or decedents. Another key issue noted was that only 50% of the articles indicated that some form of ethical approval was obtained. Given that the majority of studies dealt with human subjects (whether living or deceased), it would be expected that ethical approval to conduct the study is obtained – even if on retrospective case reports. This is especially the case in medicolegal death cases, where information may have legal consequences and anonymity is of essence.

The manuscript output for this research component is in draft form. The researchers are currently concluding the final analyses of the synthesis items and the surrounding discussion. This article will be submitted for publication within the next few weeks so as to conclude this component of the overarching study.

Recommendations for Follow-Up Action:

The review illustrated that our hypothesis that there is limited available published data concerning drug and alcohol intoxication in victims of flame burn, especially as it relates to analytical quantitative toxicological data, upon which one can draw stronger conclusions about the role of intoxication in the event. This can be strengthened, especially within operational forensic service, whereby periodic updates of reports on case-loads and toxicity findings would be of benefit to emergency and disaster management services (amongst others). This also illustrates the gap associated with drug and alcohol analysis in trauma units. There is limited data concerning the extent of the availability of these type of analyses in the continent. These would provide quantitative data upon which toxicologists can interpret. This may not be operationally or economically feasible in the South African context, however, further it does provide an opportunity

for future research in trauma or hospital units managing burn patients, where samples could be collected for alcohol and drug screen. This becomes even more important when there are insurance or legal implications of the burn injury and event.

Supporting and improving funding and research associated with toxicity and injuries in South Africa and Africa should be higher in priority. It was illustrated that only few studies received funding for the projects presented. This has historically been a challenge, particularly in toxicological research where there is a strong foundation of quantitative analytical data to work with from the sample population.

One means of combatting this dearth of data is to produce periodic reports within WCG operational services (such as FPS), on the case load findings update. This is a goal within the larger context of this project, particularly as FPS moves forward in developing their own internal toxicological service. Continuous reporting on toxicological findings in fatalities or other medicolegal cases has shown to be of great use internationally. These data are very important in identifying trends and also monitoring particular risks within the communities – such as the opioid crisis within the United States. Provision of mortality data with toxicological findings would be of help to policy makers and other entities (such as disaster management) to monitor the risks and outcome trends but also monitor the implementation of strategies (such as the installation of smoke or CO detectors within informal settlements. In order to continue these kinds of evidence-based research and reporting within an operational environment, the role of funding becomes vital.

The results indicated that there was very limited published data concerning the role of inhalation toxicity and injury in Africa. Internationally, articles concerning different COHb and even HCN concentrations in deceased individuals abound. These are two very key pyrolysis products that should be monitored within fire injuries, and particularly deaths. Historically, there is no data concerning cyanide in decedents in Africa. This again provides an opportunity to investigate further, especially within the FPS operational environment, where analyses can be optimised for the unnatural death population. This is also important in the local environment where informal settlements are made out of a wide number of materials. If cyanide or other fumes can incapacitate a person before they can get out of a house, then it is essential to determine how that could be better managed and prevented (e.g. CO and HCN detectors). The investigation into cyanide in fire deaths in Cape Town, is one component of this larger project that is still being worked on.

One of the biggest challenges in this kind of research is the availability of primary data, as well as not being able to carry out controlled experimental investigations. Most of the articles were descriptive in nature and based off of secondary data, which limited the ability to draw inferences from the data or ascribe causation. This is a challenge, particularly within post-mortem research.

Task 2. Retrospective Investigation of Fire-Related Deaths in the Western Cape (2006-2018)

Task Overview

A cross-sectional analysis of all Western Cape fatalities associated with fire burn injury and/or inhalation toxicity with carbon monoxide, a key toxic combustion products produced in fires, was conducted. Western Cape is one of nine provinces within SA, and houses over 5.8 million inhabitants (approximately 10% of South Africa's population). There are currently 16 mortuaries (previously 17) across the province that render death investigation services as part of the WCG Forensic Pathology Service (FPS), which moved out of SAPS and was established in 2006 within the WCG Department of Health (DoH). Mortuaries were transferred to DoH at different times though, with Salt River mortuary being first in 2006. The retrospective component of the study included post-mortem case reviews and subsequent data collection from all FPS mortuaries in the WC from 2006 to 2018.

Research Approach

To obtain a detailed profile of retrospective fire burn death cases, the following steps were required: (a) identifying the data sources, evaluating their strengths and weaknesses, and assessing the sources for accuracy and completion; (b) devising a data extraction instrument by setting up a controlled-access data repository (database) for data collection and deciding which variables are to be extracted; (c) extracting the desired data effectively and systematically from the

sources in accordance with the instrument devised and the criteria/definitions agreed upon beforehand; (d) coding the extracted data, recording the various agreed terminologies, enumerating the operation definitions for the coding process, and assessing the coded data for any discrepancies; (e) analysing the data statistically using an appropriate statistical software program and suitable statistical methods. Analyses can range in complexity from simple semi-quantitative measures for qualitative data to hierarchical multivariate analyses. Finally, (f) disseminating research findings in a peer-reviewed journal publication to expand the scientific evidence base as required.

Research Methodology

Table 3: Research methods used in the retrospective component of the research project including challenges encountered.

Step	Details	
(a)	**Data Sources:** post-mortem/autopsy reports, ancillary toxicological investigative result reports, FPS death scene documentation, FPS Livelink Enterprise Content Management (ECM) system (see *Appendix 2A*).	
(b)	**Extraction Instrument**: restricted-access fire/burn database was created containing the following variables – study case identification, demographic, death scene, post-mortem/autopsy, and toxicological data. This includes mortuary, year, sex, age, ethnicity, hospital admission and duration, date of death, scene and area of incident, scene paraphernalia, and circumstance of death, alleged manner of death, method of death, cause of death, extent of burn injury, post-mortem morphological characteristics, and toxicological results (see *Appendix 2B*).	
(c)	**Data Collection:** extracting the necessary information from all 17 mortuaries has shown to be extremely challenging. To date, data extraction is complete for 13 out of 17 mortuaries (76.5%) for the years 2006 to 2018. As noted in the previous progress report, due to unforeseen collection difficulties, the scope of the study objectives was segregated, with the most comprehensive (addressing all four objectives) data collected solely for the Salt River mortuary and less comprehensive (addressing only two objectives) data for the remaining 16 mortuaries. *Note: The process of gathering data for the remaining 4 mortuaries is still ongoing.*	
	· Salt River Mortuary (SRM) data (see *Appendix 2C*)	· Other mortuaries data (Beaufort West, George, Knysna, Laingsburg, Malmesbury, Mossel Bay, Oudtshoorn, Paarl, Riversdale, Stellenbosch, Tygerberg, Wolseley, Swellendam, Vredendal, Vredenburg, and Worcester) (see *Appendix 2D).*
(e)	**Coding:** coding the extracted data, recoding the various agreed terminologies, enumerating the operation definitions for the coding process, and assessing the coded data for any discrepancies.	
(f)	**Analysis:** analysing the data statistically using an appropriate statistical software program and suitable statistical methods – analyses can range in complexity from simple semi-quantitative measures for qualitative data to hierarchical multivariate analyses.	
(g)	**Interpretation/Presentation:** disseminating research findings in peer-reviewed journal publications to expand the scientific evidence base.	

As indicated in table 3, the data made available had to be triaged in analysis. While FPS was largely initiated within the DoH in 2006, it proved very difficult to obtain the important data from 2006-2010, as there was limited digitisation and recording of routine case data. However, the researchers had access to all the archived case files for Salt River mortuary (the academic mortuary associated with UCT), and hence it was decided to do a full analysis of SRM cases (the busiest mortuary in WC) from 2006 – 2018, and a limited scope analysis of the other mortuaries from 2010-2018. As stated in table 3 (data collection), this component of the project is still underway. The amount of data available and the time taken to extract and collate the data has taken a lot of time. It also became noticeable that there were a lot of COHb and blood alcohol reports for cases that can't be located. The researchers are currently trying to source these both at the National laboratory and within the docket archives of the mortuary. It is the goal of the researchers to conclude the remaining analyses and manuscript draft writing for submission within February 2020. The remainder of the budget available (indicated below), will go toward publication costs and research assistant fees.

Conclusions

All the Western Cape Province state mortuaries (16 current facilities) lack optimised mortality surveillance systems, including scientific and factual databases for proper, reliable and accurate running operations (Appendix 2A). Routine data is recorded (case numbers, cause of death, whether toxicological testing was requested), but in the author's

experience this data has been observed to have flaws and not always match with the autopsy reports or case file data. The inputting of that data into the databases therefore seems to be problematic. Historically, there has also been a very poor system of receipt and control of toxicological reports and data from the national laboratories. This makes retrospective investigations of toxicological data challenging within our context. It is the hope that with the development of FPS scientific services, that this internal documentation and reporting system can be optimised – not only for operational purposes but for reporting and research means. Within this study however, secondary data was used for most the mortuaries, which was intrinsically incomplete but still highly essential to informed decision making with respect to institutional public health actions and interventions. Complete data were collected at the Salt River facility as the researchers' institution is in partnership. In fact, more fire deaths occurred at the Salt River mortuary, being one of the two largest WC mortuary facilities, compared to other facilities. The researchers are still awaiting for some mortuary records to be provided in order to complete the retrospective component of this study. The lack of comprehensive document control and digitisation has made this component of the project challenging.

Of the data collected for the Salt River mortuary, there were more fire-related deaths in the year 2018 and 2017. The least amount of such fatalities occurred in 2009. From 2006 to 2018, there were a total of 1382 fire-related deaths. Most fire-related victims (n=1152, 83%) were not admitted to hospital suggesting that such cases are rarely attended to prior to fatality. This is usually due to severity of the burns. Common areas for fire incidents included residential property (formal and informal), correctional services, farm, fore station, industrial and construction area, medical centre, outdoors, railway, residential institution, transportation area, sports and athletics area, and in a vehicle. The number of individuals involved in the fire incidents varied from 1 person to 8 individuals. Based on the available information, the suggested circumstances of death were mostly accidental (n=844), homicidal (n=135), and suicidal (n=18). However, 382 fire cases are currently not finalised pending ancillary toxicological testing results to confirm suspected cause of death. Of those tested for toxicity, 745 cases had positive blood alcohol concentration (BAC) levels, and 814 tested positive for carbon monoxide (CO) analysis. The researchers are to investigate these BAC and COHb concentrations more closely so as to identify possible associations and risk factors such as age, temporal factors and sex amongst others. A deeper investigation of the actual concentration levels will be important to determine the role that these may have played in the individual's death.

Recommendations for Follow-Up Action

As mentioned previously, there is a movement within FPS to internalise scientific services within its own operations so as to better account for and control the work and output. This is particularly the case for post-mortem toxicology work, which involves the routine collection and analysis of specimens for ethanol (alcohol), drugs and other chemicals. Providing such a comprehensive review of burn fatalities has not previously been reported in South Africa. This provides a picture of the nature and trends of fire deaths – and of importance the role of toxicological investigations in these cases. It will also frame the recommendations concerning the type of testing that should be routinely performed in these cases – especially ethanol and COHb.

This project will also go further to start investigating HCN within fire deaths in WC to determine whether that is an intoxicant that should be monitored routinely. By putting this groundwork together, it sets the platform to monitor these cases routinely within the WC and to provide period reporting on the case variables and particularly any risk factors such as intoxication. This will provide evidence-based support to strengthen the FPS/UCT scientific collaborations and hopefully with that – the funding to produce these important reports.

The analysis of this data should also provide insight into areas of intervention targeting, particularly in terms of areas at risk of fire deaths, and the vulnerable populations. In addition, this also provides a platform on which to review the implementation of smoke detectors in informal settlements by disaster management. One may not be able to determine causation, but there may be altered trends in deaths in a certain area following the implementation of those systems. Depending on the concentrations of COHb, there may also be suggestion to try move to install CO detectors as well. Guidelines on safe use of fire in the household, especially with regards to an individual being intoxicated should be devised based on the BAC results in the report.

The post-mortem data is based on the extreme outcome – that is death. It should illustrate the gap within clinical data, concerning drug/alcohol intoxication in individuals who survive flame burns. A study involving key Burns Units, where blood for drugs and alcohol screening is made available and obtained from an injured person following consent approval, would be of interest in comparing to the post-mortem data.

Recommendations for best practise or improved document management efficiency will also be submitted to FPS management for review.

BUDGET

Kindly adhere to below description of budget line items			
Each and every budget ITEM should be **motivated** in such a way that it **justifies** the amount/s requested. Budget items must be fully described and aligned with the project work-plan provided in Section 3 above.			
	Description of budget line item	**Amount**	**Spent**
a.	**One (1) 12-month project research assistant time at R 90/hr as per UCT's 2018 HR rate under "assistance-mode" (http://www.hr.uct.ac.za/hr/benefits/remuneration/rates):** The research assistant will work part-time (20 hours per week or 80 hours per month) on this project under the supervision of the project coordinator and report directly to the principal investigator. The duties include conducting research activities, collecting data/information such as filtering through databases, extracting information, hardcopy autopsy reports sifting, synthesizing data/findings, reporting/analysis results, and write-up.	R 86 400	R 74 000
b.	**Administrative supplies for research activities:** Stationary (e.g. pens, clipboards, files, sticky notes, and staples), photocopying, printing and printer consumables, and airtime for telephonic communications.	R 1,000	R 1000
c.	**A 16 GB USB Flash:** For access-controlled data storage and management. The USB will be used to store all data related to this research project and will remain in the vicinity of the principal investigator's office at all times.	R 100	R 100
d.	**Transportation costs to/from the Salt River, Tygerberg, and other rural mortuaries mortuary facility:** For the research team to travel to the Salt River Forensic Pathology Mortuary, R 50.00 two-way as per Uber rates, for data and/or sample collection. Trips to the mortuary are expected during the data collection of the study's retrospective component to retrieve post-mortem and ancillary reports dated from 2006. The researchers estimate a maximum of 10 trips back and forth to the mortuary during the study period. R100 is assigned for a trip to Stellenbosch for which 10 trips are planned. R200 is required to visit Paarl/Worcester or other rural mortuaries for which 1 trip is planned for each.	R 2,500	R 1000
e.	**Publication costs:** For the production and publication of two (2) peer-reviewed articles. The researchers would ideally publish open-access which comes at specific fees (e.g. the South African Medical Journal (SAMJ) charges R 5000 per article for open-access publication).	R 10 000	-
f.	**UCT Faculty of Health Science Finance Levy (waived)**	R 0.00[1]	R 0.00[1]
	TOTAL	**R 100 000**	**R 76 100**

1 As per agreement between UCT and CHEC, the UCT Faculty of Health Science levy is waived for this project.

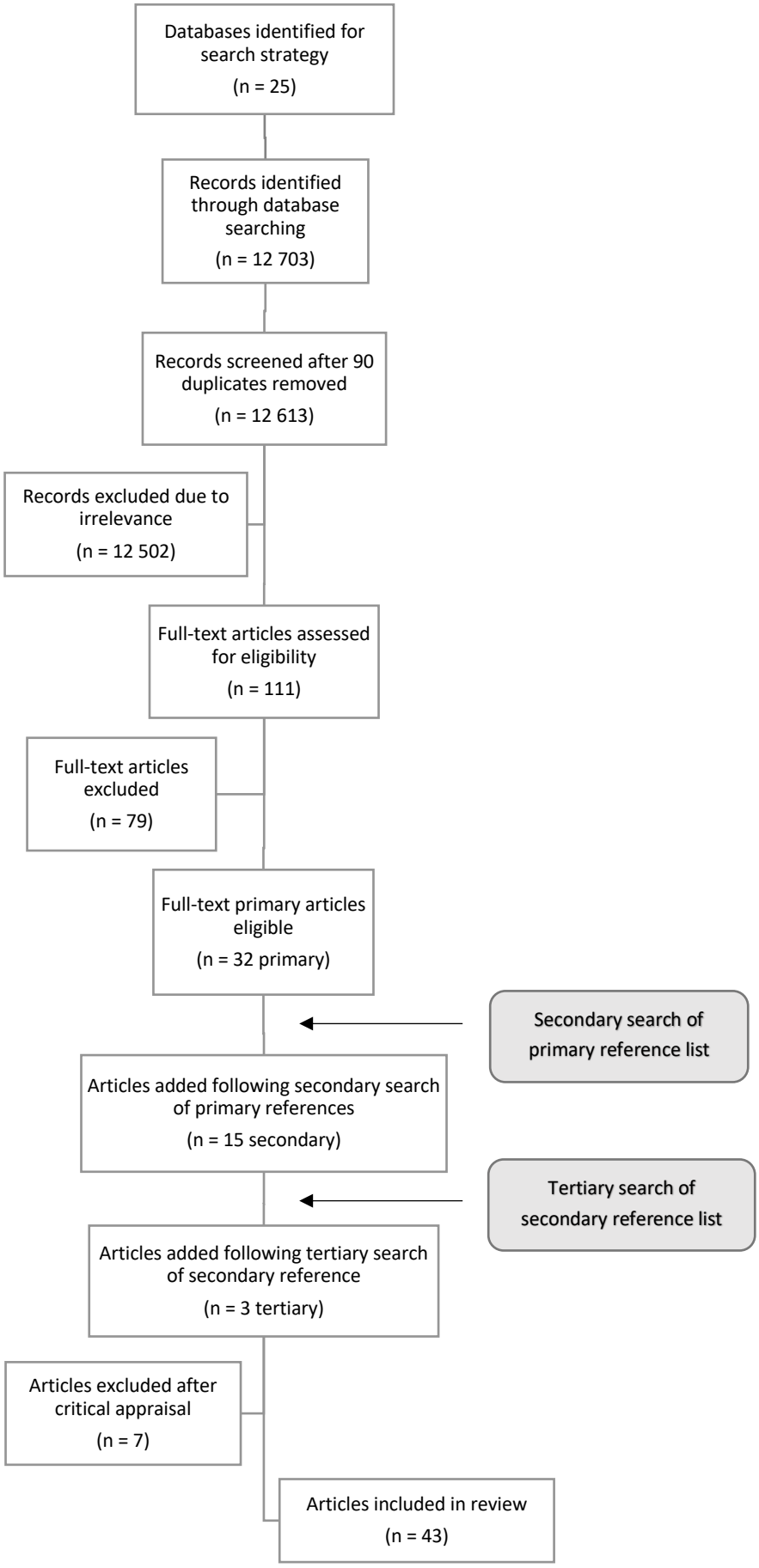
APPENDICES

Appendix 1A: List of search terms used to review evidence as per the systematic review component.

Key Concepts/Criteria	Terms/Keywords
Population	(((Africa[MeSH Terms]) OR Africa) OR Africas) OR Africae)) OR ((African[MeSH Terms]) OR African)) OR (("Africa continent") OR "Africas continent")) OR (("Africa population") OR "Africa populations")) OR (("African population") OR "African populations")) OR "African people") OR "African region") OR (("African community") OR "African communities")) OR "Central Africa") OR (("North Africa") OR "Northern Africa")) OR (("South Africa") OR "Southern Africa")) OR (("East Africa") OR "Eastern Africa")) OR (("West Africa") OR "Western Africa")) OR ((("Sub Saharan Africa") OR "Sub-Saharan Africa") OR "Africa South of the Sahara")) OR (((algeria[MeSH Terms]) OR algeria) OR "People's Democratic Republic of Algeria")) OR ((angola[MeSH Terms]) OR angola)) OR (((((benin[MeSH Terms]) OR benin) OR Dahomey) OR "Republic of Benin") OR "République du Bénin")) OR ((((Botswana[MeSH Terms]) OR Botswana) OR Bechuanaland) OR "Republic of Botswana")) OR (((("Burkina Faso") OR "Upper Volta") OR "Haute-Volta") OR "Bourkina-Fasso")) OR ((((((Burundi[MeSH Terms]) OR Burundi) OR "Republic of Burundi") OR "Republika y'Uburundi") OR "République du Burundi") OR "Kingdom of Burundi")) OR (("Cabo Verde") OR "Cape Verde")) OR ((Cameroon[MeSH Terms]) OR Cameroon)) OR (((("Central African Republic") OR "République Centrafricaine") OR "Empire Centrafricain") OR "Central African Empire")) OR (((((Chad[MeSH Terms]) OR Chad) OR "Republic of Chad") OR "République du Tchad") OR "Jumhūrīyat Tashād")) OR (((((((((Comoros[MeSH Terms]) OR Comoros) OR "Union of the Comoros") OR "The Comoros") OR "The Union of Comoros") OR "Union des Comores") OR "Udzima wa Komori") OR "al-Ittiḥād al-Qumurī") OR "United Republic of the Comoros")) OR (((("Democratic Republic of the Congo"[MeSH Terms]) OR "Democratic Republic of the Congo") OR DRC) OR Zaire)) OR (((((Congo[MeSH Terms]) OR Congo) OR "Republic of the Congo") OR "French Congo") OR "Belgian Congo")) OR ((("Republic of Cote d'Ivoire") OR "Ivory Coast") OR "Côte d'Ivoire")) OR (((((Djibouti[MeSH Terms]) OR Djibouti) OR ("French Territory of the Afars and the Issas")) OR "République de Djibouti") OR "Republic of Djibouti")) OR (((Egypt[MeSH Terms]) OR Egypt) OR "Arab Republic of Egypt")) OR "Equatorial Guinea") OR ((Eritrea[MeSH Terms]) OR Eritrea)) OR (((((Swaziland[MeSH Terms]) OR Swaziland) OR Eswatini) OR "Kingdom of Eswatini") OR eSwatini)) OR (((((Ethiopia[MeSH Terms]) OR Ethiopia) OR Abyssinia) OR "Federal Democratic Republic of Ethiopia") OR Habeshastan)) OR (((Gabon[MeSH Terms]) OR Gabon) OR "Gabonese Republic")) OR ((Gambia[MeSH Terms]) OR Gambia)) OR (((Ghana[MeSH Terms]) OR Ghana) OR "Gold Coast")) OR ((Guinea[MeSH Terms]) OR Guinea)) OR ((((("Guinea-Bissau") OR "Guinea Bissau") OR "Portuguese Guinea") OR "Republic of Guinea-Bissau") OR "Republic of Guinea Bissau")) OR ((((Kenya[MeSH Terms]) OR Kenya) OR "Republic of Kenya") OR "Jamhuri ya Kenya")) OR ((((Lesotho[MeSH Terms]) OR Lesotho) OR Basutoland) OR "Kingdom of Lesotho")) OR ((Libya[MeSH Terms]) OR Libya)) OR ((Liberia[MeSH Terms]) OR Liberia)) OR ((Madagascar[MeSH Terms]) OR Madagascar)) OR ((((Malawi[MeSH Terms]) OR Malawi) OR Nyasaland) OR "Republic of Malawi")) OR ((Mali[MeSH Terms]) OR Mali)) OR ((Mauritania[MeSH Terms]) OR Mauritania)) OR ((((((Mauritius[MeSH Terms]) OR Mauritius) OR "Republic of Mauritius") OR "Mauritius Island") OR "Republic of Mauritania") OR "République Islamique de Mauritanie")) OR ((((Morocco[MeSH Terms]) OR Morocco) OR "Kingdom of Morocco") OR "Al Mamkaka Al Maghribiya")) OR ((Mozambique[MeSH Terms]) OR Mozambique)) OR ((Namibia[MeSH Terms]) OR Namibia)) OR ((Niger[MeSH Terms]) OR Niger)) OR ((Nigeria[MeSH Terms]) OR Nigeria)) OR (((((((Rwanda[MeSH Terms]) OR Rwanda) OR "Rwandese Republic") OR "Republic of Rwanda") OR "République du Rwanda") OR Ruanda) OR "Repubulika y'u Rwanda")) OR ((("Sao Tome and Principe"[MeSH Terms])) OR ("Sao Tome and Principe"))) OR ((Senegal[MeSH Terms]) OR Senegal)) OR ((Seychelles[MeSH Terms]) OR Seychelles)) OR (("Sierra Leone"[MeSH Terms]) OR "Sierra Leone")) OR ((Somalia[MeSH Terms]) OR Somalia)) OR ((((((("South Africa"[MeSH Terms]) OR "South Africa") OR "Suid Afrika") OR "Suid-Afrika") OR "Zuid Afrika") OR "Zuid-Afrika") OR "Union of South Africa") OR "Republic of South Africa")) OR ((((("South Sudan") OR "Republic of the Sudan") OR "The Sudan") OR "Anglo-Egyptian Sudan") OR "Anglo Egyptian Sudan")) OR ((Sudan[MeSH Terms]) OR Sudan)) OR ((((Tanzania[MeSH Terms]) OR Tanzania) OR ("United Republic of Tanganyika and Zanzibar")) OR "United Republic of Tanzania")) OR ((Togo[MeSH Terms]) OR Togo)) OR (((((Tunisia[MeSH Terms]) OR Tunisia) OR "تونس") OR "Republic of Tunisia") OR "الجمهورية التونسية,")) OR ((Uganda[MeSH Terms]) OR Uganda)) OR ((((Zambia[MeSH Terms]) OR Zambia) OR "Northern Rhodesia") OR "Republic of Zambia")) OR ((((((Zimbabwe[MeSH Terms]) OR Zimbabwe) OR Rhodesia) OR "Republic of Rhodesia") OR "Republic of Zimbabwe") OR "Southern Rhodesia")

Exposure/Setting	((((fire OR fires OR flame OR flames[MeSH Terms])) OR (fire OR fires OR flame OR flames OR flaming OR flamed OR wildfire OR "wild-fire" OR wildfires OR "wild-fires" OR bushfire OR "bush-fire" OR bushfires OR "bush-fires" OR housefire OR "house-fire" OR housefires OR "house-fires")) OR (combust OR combustion OR combustions OR combustive OR combustible OR combustibles OR combusting OR combusted OR combustibility)) OR (burn OR burning OR burnings OR burned OR burnt)
Mechanism of Action	((((((((((smoke OR smokes OR inhalation OR "carbon monoxide" OR "hydrogen cyanide" OR injury OR injuries OR trauma OR traumas OR wound OR wounds OR burn OR burns[MeSH Terms])) OR toxicity[MeSH Subheading]) OR (smoke OR smokes)) OR (inhalation OR inhalations OR inhaling OR inhaled OR inhalated)) OR (expose OR exposed OR exposure OR exposures)) OR (toxic OR toxicity OR toxicities)) OR (poisoning OR poisonings)) OR "carbon monoxide") OR (cyanide OR cyanides OR "hydrogen cyanide" OR "HCN" OR "hydrocyanic acid" OR "prussic acid" OR COHb)) OR (injury OR injuries OR trauma OR traumas OR wound OR wounds OR wounding OR wounded OR burn OR burns))
Risk Factors	((((((ethanol OR alcohol OR "ethyl alcohol" OR ethanols)) OR ethanol[MeSH Terms]) OR (drug OR drugs OR substance OR substances OR drink OR drinking OR drunk)) OR (inebriated OR inebriation OR intoxicated OR intoxication OR inebriate)) OR ("drug use" OR "substance use" OR "drug abuse" OR "substance abuse" OR "substance misuse" OR "drug misuse" OR "ethanol abuse" OR "alcohol abuse" OR "ethanol misuse" OR "alcohol misuse" OR "ethanol use" OR "alcohol use")) OR (alcoholic OR alcoholism OR drunkenness)
Outcomes	((((((victim OR victims OR patient OR patients OR survivor OR survivors)) OR (patients OR survivors OR mortality OR death OR "wounds and injuries" OR morbidity[MeSH Terms])) OR (deceased OR decedent OR decedents OR die OR died OR dead OR dies OR dying OR deaths)) OR (injure OR injury OR injured OR injuries OR casualty OR casualties)) OR (morbidity OR morbidities OR mortality OR mortalities OR fatal OR fatality OR fatalities)) OR ("non fatal" OR nonfatal OR "non-fatal")

Appendix 1B: Flow diagram for the search strategy of the systematic review.



Appendix 1C: Adapted AXIS tool for critical appraisal.

CRITICAL APPRAISAL FORM					
Name of reviewer:		Date:		Review article no:	
Title of article:			Year of publication:		
No.	**Questions**	**Yes**	**No**	**Unclear**	**Comment(s)**
Introduction					
1	Does the literature background include burn and/or fire-related injuries?				
2	Were the aims/objectives related to burn or fire-related injuries?				
Methods					
3	Was the study design clearly specified?				
4	Was the target population clearly defined? *(Is it clear who the research was about?)*				
5	Was the sample frame clearly specified? *(Was it an appropriate population base that represents the reference population?)*				
6	Did the authors specify the data source used for the study?				
7	Was the sample size clearly defined?				
8	Were there any missing data?				
9	Does the article include any toxicological testing? *(Is there any reference to laboratory analyses?)*				
10	Were suitable methods used to assess alcohol or other drug use? *(Was alcohol measured qualitatively? Was alcohol measured quantitatively? Were drugs measured qualitatively? Were drugs measured quantitatively?)*				
11	Is there any mention of fire-related inhalation toxicity?				
12	Were statistical analyses performed? *(Is it clear what was used to determine statistical significance and/or precision estimates?) (e.g. p-values, CIs)*				
Results					
13	Were the case characteristics adequately described? *(Were the study subjects and the setting described in detail?)*				
14	Were burn injury data presented? More specifically, is the prevalence of fire-related incidents specified?				
15	Is the prevalence of alcohol and other drug toxicity specified?				
16	Were there any statistical significance between alcohol and/or other drug toxicity and burn or fire-related injuries?				
Discussion					
17	Did they find a relationship between alcohol and/or other drug toxicity and burn or fire-related injuries?				
18	Were other risk factors reported in investigation such a relationship?				
19	Were the limitations of the study discussed?				
Other					
20	Were there any funding sources?				
21	Was ethical approval obtained?				
Overall appraisal	**Include** ☐ **Exclude** ☐ **Consensus** ☐				
Comments*)*					
(e.g. reasons for exclusion, consensus motivations)					

Appendix 1D: Characteristics of included studies.

	Reference *(Author, year, country)*	Design	Sample & Study Population (Type, Setting, Region)	Context *(Clinical vs Forensic)*	Aims & Objectives	Conclusions
1	Wahdan MM, Sayed AM, Abd Elaziz KM, El-Hoseiny MM, Al-Gwaily MM; 2016; Egypt	Descriptive	Cairo City High school students Age: 15-19 years Both sexes Duration: 1 year n = 897	Clinical	Determine the prevalence of intentional and unintentional injuries among secondary school students in Cairo, Egypt, and explore the associated risk factors.	High prevalence of injuries among high school students in Egypt necessitates raising public awareness about magnitude and burden of injuries among adolescents.
2	Blom L, Klingberg A, Laflamme L, Wallis L, Hasselberg M; 2016; South Africa	Descriptive	Western Cape Province Hospital patients Age: 0-55+ years Both sexes Duration: 1 year n = 1915	Clinical	Investigate gender differences in aetiology and management of acute burns in resource-constrained settings in South Africa.	Burns were more common among children; gender differences only among adults; different disposition between men and women despite similar AIS scores; further more comprehensive studies needed.
3	Kotb NA, Ibrahim SF; 2018; Egypt	Descriptive	Cairo and Giza Cities Pregnant decedents Age: 30-40 years Female Duration: 2 years n = 37	Forensic	Reveal the prevalence of pregnancy-associated deaths in the Egyptian community and the risk factors that contribute to death during pregnancy.	Study/analysis may inform future strategies to protect pregnant women fromthe hazards of violence and labor that threaten their lives.
4	Gallaher JR, Wildfire B, Mabedi C, Cairns BA, Charles AG; 2016; Malawi	Descriptive	Lilongwe City Hospital patients Age: <18 years Both sexes Duration: 5 years n = 24365	Clinical Forensic	Describe the characteristics of paediatric intentional injury, how these injuries compare to unintentional injury, and the proportion of new trauma cases that were intentionally inflicted presenting to our tertiary trauma centre in Lilongwe, Malawi.	Sub-Saharan African tertiary hospitals are uniquely positioned to play a pivotal role in the identification, clinical management, and alleviation of intentional injuries to children by facilitating access to social services and through prevention efforts.
5	Odero W, Polsky S, Urbane D, Carel R, Tierney WM; 2007; Kenya	Descriptive	Eldoret City Hospital patients Age: 0-76 years Both sexes Duration: 8 months n = 315	Clinical	Describe the characteristics of injuries and the associated risk factors among patients presenting to a rural health centre in Western Kenya.	The pattern and certain risk factors (place, activity, alcohol use) for non-fatal injuries among patients attending a rural health centre can be identified through a facility-based electonic injury surveillance system; which can assist in developing context-specific injury prevention interventions.
6	Peltzer K; 2008; Kenya, Namibia, Swaziland, Uganda, Zambia, Zimbabwe	Descriptive	Nationwide School students Age: 13-15 years Both sexes Duration: 2 years n = 20765	Clinical	Estimate the prevalence of injury among adolescents in six African countries and examine the consistency of associations cross-nationally between sociodemographics, social risk factors, and the occurrence of adolescent injury in Africa.	Study found a high annual injury prevalence; risk-taking played a role in the etiology of injury; need for an integrated approach to injury etiology in planning injury prevention and safety promotion activities for schoolchildren; particularly focus on lifestyle factors that have the potential to influence risk of injury.
7	Van Niekerk A, Laubscher R, Laflamme L; 2009; South Africa	Descriptive	City of Cape Town Decedents Age: 0-51+ years Both sexes Duration: 4 years n = 1024	Forensic	Describe the demographics and circumstances of burn mortality across the lifespan in Cape Town (2.9 million inhabitants in 2001), one of the six South African metropolitan centres.	Concern that the high occurrence of burns among middle age men could be due to detrimental living conditions, life-style and poor socio-economic status; recommended prioritisation of prevention activities that involve the control/management of kerosene heat sources, the provision of alternatives to flammable housing materials, and the implementation of strategies to reduce harmful drinking practices.

8	Blom L, van Niekerk A, Laflamme L; 2011; South Africa	Descriptive	Mpumalanga Province Decedents Age: 0-55+ years Both sexes Duration: 2 years n = 304	Forensic	Investigate the epidemiology of fatal burns in the predominantly rural province of Mpumalanga, South Africa.	Although fatal burns could be less common in rural than urban South Africa, similar groups are more at risk (older people, young children, and males); strong correlation between fatal burns and living conditions and lifestyle, which vary even within rural areas of South Africa.
9	Peltzer K, Phaswana-Mafuya N, Arokiasamy P, Biritwum R, Yawson A, Minicuci N, Williams JS, Kowal P, Chatterji S; 2015; China, Ghana, India, Mexico, the Russian Federation, South Africa	Descriptive	Nationwide Adults Age: 50+ years Both sexes Duration: 4 years n = 8145	Clinical	Examine the annual non-fatal road traffic and other bodily injury (excluding falls) prevalence and associated risk factors among older adults across six lower and upper middle-income countries.	Risk factors associated with road traffic injury (residing in a rural area, taking medications/other treatment for depression in the past 12 months, having a sleeping problem) and other bodily (younger age, residing in a rural area, hazardous/harmful alcohol use, having a sleeping problem) were identified; the study findings improved the understanding of non-fatal injuries, which various stakeholders can use to design interventions and improve safety associated with unintentional injuries.
10	Schneider M, Norman R, Parry C, Bradshaw D, Plüddemann A, South African Comparative Risk Assessment Collaborating Group; 2007; South Africa	Descriptive	Nationwide Decedents Age: 15-80+ years Both sexes Duration: 1 year n = 33699	Clinical Forensic	Make quantative estimates of the burden of disease attributable to alcohol use (by age and sex in South Africa in 2000).	More emphasis on preventing and reducing the burden of alcohol-related incidents(homicide, violence, road traffic accidents, alcohol use disorders, FAS); multilevel interventions are necessary that target high-risk drinkers; more awareness needed in the general public regarding the problems associated with alcohol abuse.
11	Meel BL; 2017; South Africa	Descriptive	Mthatha Region Decedents Age: 1-80+ years Both sexes Duration: 20 years n = 24693	Forensic	Highlight the incidence and pattern of unnatural deaths, related to gender and different age groups, in the Transkei, South Africa.	Increasing trend of unnatural deaths in this region; more male than female victims (ratio of 3.8:1) with about half of the victims between 11 and 30 years old; recommends that the situation requires urgent attention from law enforcement agencies.
12	Oyefeso OO, Madiba SE, Hoque ME; 2011; Namibia	Descriptive	Khorixas Town Hospital patients Age: <10-70+ years Both sexes Duration: 4 years n = 331	Clinical	Identify the demographic characteristics of injury victims and the types of injury cases seen and admitted for treatment in Khorixas District Hospital, Namibia.	Injuries accounted for 6.8% of all admissions, with sharp force injuries the most common injuries, followed by motor vehicle accidents and falls; recommendations: mass anti-violence education is required to reduce the high rate of intentional injuries (sharp trauma, assault, human bites, gunshot injuries); redesign donkey carts (improve stability and manoeuvrability) to reduce associated injuries.
13	Daffue B, Moolman D, Ferreira S, Roos L, Schoeman L, Smit SJA, Joubert G; 2018; South Africa	Descriptive	Bloemfontein City Hospital patients Age: <20-61+ years Both sexes Duration: 7 months n = 49	Clinical	Determine the demographics and causes and severity of burn wounds among adults admitted to the Burn Wound Unit at Pelonomi Tertiary Hospital in Bloemfontein for treatment.	Flames (including flaming liquids) were the predominant cause of burn wounds; injuries were mostly accidental; alcohol consumption and domestic activities were common in accidental burns.
14	Herbst CI, Tiemensma M, Wadee SA; 2015; South Africa	Descriptive	East Metropole of Cape Town Decedents Age: 14-62 years Both sexes Duration: 10 years n = 424	Forensic	Determine the patterns and trends of injuries sustained in so-called community assault fatalities.	Need for adequate policing in prevalent areas to address unnecessary loss of life and burden imposed by these cases on the criminal justice system and healthcare services.
15	Cloake T, Haigh T, Cheshire J, Walker D; 2017; South Africa	Descriptive	Western Cape Province Hospital patients Age: 0-60+ years Both sexes	Clinical Forensic	Assess the association between pre-injury health status/co-morbidities and patient outcome following burn injury.	Burns are multifactorial; demographic data assists with development of specific, targeted prevention strategies to at-risk groups; shack fires still contribute significantly to morbidity and mortality despite fire safety improvement efforts across social

			Duration: 18 months n = 221			sectors; presence of co-morbid HIV infection may result in poorer patient outcome.
16	Maritz D, Wallis L, Van Der Merwe E, Nel D; 2012; South Africa	Descriptive	Western Cape Province Hospital patients Age: <20-80+ years Both sexes Duration: 6 years n = 1908	Clinical Forensic	Describe the aetiology and outcome of adult burns in the Western Cape admitted to the Tygerberg hospital burn unit.	Significant increase in burn mortality over the last 20 years; patients are more critical, the cause of which is multifactorial but likely due to the HIV/AIDS pandemic and expansion of informal settlements; shack fires, assault and injuries due to fuel stoves are still common reasons for admission to the burn unit, involving mostly young individuals; improved data capturing and a standarised classification template for describing injuries are needed; largely preventable injuries place a huge economic burden on an already overstretched health system; better housing and electrification are needed; improved community education and legislation are needed for safe use of kerosene stoves, as well as safer alternatives to kerosene stoves
17	Godwin Y, Hudson DA, Bloch CE; 1996; South Africa	Descriptive	City of Cape Town, Cape Peninsula Hospital patients Age: 13-77 years Both sexes Duration: 2 years and 5 months n = 99	Clinical Forensic	Discuss the demographics and outcome of patients who sustained burns in shack fires between January 1993 and June 1995, treated at a major referral hospital.	Significant morbidity and high mortality associated with shack burns; injuries had a major impact on the victim's life; best form of treatment is prevention.
18	Khelil MB, Zgarni A, Zaafrane M, Chkribane Y, Gharbaoui M, Harzallah H, Banasr A, Hamdoun M; 2016; Tunisia	Descriptive	Northern Tunisia Decedents Age: 14-83 years Both sexes Duration: 10 years n = 235	Forensic	Analyse the trends of suicide by self-immolation over a period of ten years (2005–2014).	Self-immolation essentially affects young men who are unemployed and mostly having mental diseases.
19	Blay AA; 2015; Ghana	Descriptive	Kumasi City Hospital patients Age: <5-65+ years Both sexes Duration: 5 years n = 300	Clinical Forensic	Determine the trends, prevalence rates and main causes of burns presented at the burns unit at KATH, as well as measure the degree and total body surface area of burns and estimate the survival rate.	Most burns reported at KATH are related to domestic use of thermal materials (gas, kerosene stoves and coal pots), with most domestic-related burns occurring during the working hours of the day (the period when meals are prepared), thus women and children are more at risk; older age is associated with more serious burns, which may adversely increase their mortality; need for better strategies at the hospital to help reduce the high mortality, morbidity and disability from burns.
20	Odhiambo FO, Beynon CM, Ogwang S, Hamel MJ, Howland O, van Eijk AM, Norton R, Amek N, Slutsker L, Laserson KF, De Cock KM, Phillips-Howard PA; 2013; Kenya	Descriptive	Nyanza Province Decedents Age: 15+ Both sexes Duration: 6 years n = 447	Forensic	Assessment of deaths attributed to injuries and poisonings, identified through verbal autopsy, and the associated risk factors.	Despite the smaller contribution of trauma to death in this area (compared to the high prevalance of natural diseases), preventive interventions are available (improved road safety, home safety strategies for the elderly, curbing harmful use of alcohol) and could reduce this burden; need for better systems to record underlying causes of death from trauma.
21	Rutta E, Mutasingwa D, Ngallaba SE, Berege ZA; 2001; Tanzania	Descriptive	Mwanza Region Hospital patients Age: 0-60+ Both sexes Duration: 3 years n =3340	Clinical Forensic	Describe epidemiological characteristics of injury cases at Bugando Medical Centre.	Recommends the need for a more comprehensive study to determine the risk factors and magnitude of the problem.
22	Steenkamp WC, Botha NJ, Van der Merwe AE; 1994; South Africa	Descriptive	East Metropole, Cape Town Hospital patients Age: 20-70 years Both sexes	Clinical	Determine the prevalence of alcohol dependence in adult patients at the bums unit of the Tygerberg Hospital in Cape Town and to describe patterns of alcohol consumption, socio economic adjustment and attitudes towards drinking.	Most patients were regular weekend drinkers; more than half had previous alcohol-related accidents and attributed present injuries to alcohol intoxication; patients were motivated and willing to accept treatment; the burn injury provides an opportunity during which treatment for alcohol

			Duration: 3 months n = 30			problems can be introduced; the burn care team has a responsibility to address the patients' alcohol problems to prevent recurrent alcohol-related traumatic accidents.
23	Lerer LB; 1994; South Africa	Descriptive	West Metropole, Cape Town Decedents Age: >18 years Both sexes Duration: 2 years n = 227	Forensic	Describe the features of homicide-associated burnings (HAB) and examine distinguishing factors between intentional and accidental fatal burn injury.	10% (n = 35) of burn-related deaths were homicides, with a few (n = 5 (14%)) of these being “necklacings”; no significant differences in age, sex, residential status, or extent of burn injury between the HAB and adult residential fire victims (ARFV); the presence of soot is more likely and a higher mean carbon monoxide saturation is seen in ARFV compared to HAB; more ARFV than HAB had a blood alcohol concentration > 0.1 g/100 ml; evidence of other injuries (gunshot, stabbing, or blunt force) present in majority of HAB; despite some significant autopsy parameters characterising HAB, forensic pathologists should seek evidence of homicidal injury in all fatal burn cases.
24	Duflou JALC, Lamont DL, Knobel GJ; 1988; South Africa	Descriptive	West Metropole, Cape Town Decedents Age: 0-66+ Both sexes Duration: 6 months n = 495	Forensic	Establish the pattern of homicide in Cape Town (1 January - 30 June 1986)	Study rates confirmed that Cape Town had one of the highest homicide rates in the world, with the majority of the homicides occuring due to assaults with sharp objects; homicidal burning occurred during civil unrest; alcohol was detected in a large portion of the vicitms (62.9%)
25	Odero WO, Kibosia JC; 1995; Kenya	Descriptive	Eldoret City Hospital patients Age: 0-70+ years Both sexes Duration: 3 months n = 1304	Clinical Forensic	Examine the incidence and causes of trauma, their relationship with demographics and hospital utilization.	Similar to other developing countries, males and young adults (20-30 years) suffered more from assault and traffic accidents compared to children who predominantly sustain injuries from falls or burns; temporality (night-time and weekends) and alcohol intoxication significantly influenced the incidence of injuries; findings of study will hopefully influence policies and strategies for injury prevention and trauma management
26	Stone MJ.; 1988; South Africa	Descriptive	East Metropole, Cape Town Hospital patients Age: Not reported (mean: 32 years) Both sexes Duration: 3 months n = 50	Clinical	Examine the possible relationship between an increase in burns through assault and the socioeconomic factors of 50 coloured and black patients amongst whom this form of assault is mainly found.	The study suggests that there is a connection between the social circumstances (social behaviour e.g. alcohol/drug use, housing conditions, employment, income, religious practices, use of leisure time) of the subjects and their method of settling conflicts.
27	Allorto NL, Oosthuizen GV, Clarke DL, Muckart DJ; 2009; South Africa	Descriptive	Kwazulu Natal Province Hospital patients Age: 6 months - 82 years Both sexes Duration: 1.5 years n = 450	Clinical Forensic	Highlight the problem of thermal injury and report on the results of a conservative approach to burn care.	Young children and epileptics were vulnerable groups likely to sustain burns; a large number of burns mostly involving smaller surface areas were seen; patients with small burns had a prolonged hospital stay and delayed grafting due to a conservative surgical approach and lack of resources; large burns were more likely to be fatal.
28	Pludderman A, Parry C, Donson H, Sukhai A; 2004; South Africa	Descriptive	Cities of Cape Town, Port Elizabeth, Durban Hospital patients Age: Not reported (mean: 30-34 years) Both sexes	Clinical	Assess acute alcohol intoxication among patients presenting with recent injuries at trauma units in Cape Town, Port Elizabeth and Durban from 1999 to 2001.	Alcohol involvement among trauma patients remained consistently high for each of the three study periods; efforts to combat alcohol abuse is paramount in reducing the burden of injuries on health care services.

			Duration: 3 years n = 1900			
29	Ehmke U, du Toit-Prinsloo L, Saayman G; 2014; South Africa	Descriptive	City of Tshwane Metropolitan Municipality Decedents Age: 4-89 years Both sexes Duration: 1 year n = 1455	Forensic	Review the alcohol levels in medico-legal investigations of unnatural deaths to find trends in alcohol consumption and other drug or poison usage.	Alcohol is an important factor in all types of unnatural deaths, involved in almost half of the medico-legal deaths in Pretoria (which is likely an underrepresentation) and in 36% of deaths due to natural causes; most drivers with a positive BAC was over the legal driving limit, with an apparent increase in alcohol involvement in RTAs over time.
30	Ndiritu S, Ngumi ZWW, Nyaim O; 2006; Kenya	Descriptive	Nairobi City Hospital patients Age: <5-70 years Both sexes Duration: Not reported n = 109	Clinical	Determine the epidemiological pattern of burns and assess awareness of burn risk and preventative measure among patients admitted to KNH with burns.	Similar patterns of burns to other studies, but more enhanced role of accelerants and assault; need for public education campaigns aimed at burns reduction to be tailored at the target population education level.
31	Kingu HJ, Mazwai EL; 2010; South Africa	Descriptive	Mthatha Region Hospital patients Age: <1-64 years Both sexes Duration: 2.5 years n = 66	Clinical Forensic	Investigate the demographics, aetiological factors, anatomical lesions, biological features, management protocol and outcomes of patients admitted with major burn injuries.	High mortality rate; need for community health education, raised socio-economic status, and safety legislation to alleviate the strain of aggressive management to reduce mortality and morbidity; need for a well-staffed and well-equipped burns unit to improve patient care.
32	Virich G, Lavy CBD; 2006; Malawi	Descriptive	Blantyre City Hospital patients Age: 3-42 years Both sexes Duration: 4 weeks n = 12	Clinical	Describe burns with respect to aetiology, presentation, and management.	Need for cheap preventive health promotion measures and the provision of simple resources, which would effectively manage most burns encountered.
33	Mzezewa S, Jonsson K, Aberg M, Salemark L; 2000; Zimbabwe	Descriptive	Harare City Hospital patients Age: 0-50 years Both sexes Duration: 2 years and 8 months n = 47	Clinical Forensic	Obtain prospective information on suicidal (attempted suicide) burns patients admitted to the Harare burns unit during 1995±1998.	Majority of suicidal burns patients were young women married according to customary law, who doused themselves with paraffin after relationship conflicts; these extensive burns had high mortality rates.
34	Garrib A, Herbst AJ, Hosegood V, Newell ML; 2011; South Africa	Analytical	Kwazulu Natal Province Decedents Age: 0-80+ years Both sexes Duration: 8 years n = 1022	Forensic	Estimate injury mortality rates in a rural population in KwaZulu-Natal, South Africa and identify socio-demographic risk factors associated with adult injury-related deaths.	Reducing the high levels of injury-related mortality in South Africa requires intersectoral primary prevention efforts that redress the root causes of violent and accidental deaths: social inequality, poverty and alcohol abuse.
35	van Eijk AM, Adazu K, Ofware P, Vulule J, Hamel m, Slutsker L; 2008; Kenya	Analytical	Nyanza Province Decedents Age: <20-65+ years Both sexes Duration: 1 year n = 1816	Forensic	Establish causes and patterns of deaths among adolescents and adults using verbal autopsy (VA) in a rural area of western Kenya where malaria and HIV are common, and the use of alcohol and lifestyle drugs among the deceased, and their association with the main causes of death.	Majority of adult and adolescent deaths were potentially due to preventable infectious diseases; deaths in health facilities were not representative of deaths in the community; programmes to prevent HIV and TB infection and to decrease mortality have started and their impact can be evaluated against this baseline information.
36	Le Roux LC, Smith LS; 1964; South Africa	Descriptive	Cape Peninsula Decedents Age: 0-80 years Both sexes	Forensic	Determine whether there exists any correlation between the incidence of intoxication and the frequency of violent deaths.	Some casual correlation exists between alcohol intoxication and possibly dying a violent death, although other factors need to be considered.

			Duration: 1 year n = 376			
37	Butchart A, Nell V, Yach D, Brown DSO, Anderson A, Radebe B, Johnson K; 1991; South Africa	Descriptive	City of Johannesburg Hospital patients Age: 0-75+ years Both sexes Duration: 1.25 years n = 3436	Clinical	Provide a breakdown of trauma cases, including the incidence and causes of non-fatal injuries, demographics and temporality and establish what proportion of all trauma is due to assault.	Findings contributed to the existing data base regarding the risk factors and causes of non-fatal trauma in South Africa, and confirmed that the low-cost methodology used can be applied in other geographical areas and to other problems; initiated explanatory processes and produced testable hypotheses for more effective treatment and tailored prevention.
38	Groenewald P, Bradshaw D, Daniels J, Matzopoulos R, Bourne D, Blease D, Zinyakatira N, Naledi T; 2008; South Africa	Descriptive	City of Cape Town Decedents Age: 0-85+ years Both sexes Duration: 5 years n = unspecified	Forensic	Report key findings and trend analysis of cause of death in the Cape Metropole for 2001-2006 and the 8 new sub-districts for 2003-2006.	Mortality surveillance is paramount in identifying health needs, monitoring progress and tracking changes; system for CoD data has been revamped to provide more relevant information; HIV/AIDS mortality has increased and remains a leading cause of premature mortality across sub-districts, emphasising the need for prevention strategies; injury-related mortality remains extremely high and is among the highest in the world, particularly for men (especially homicide and road traffic fatalities) – multi-sectoral prevention strategies are needed; National Injury Mortality Surveillance System (NIMSS) data confirm a strong association between alcohol and fatal injuries; mortality rates due to non-communicable diseases (NCD) are high and account for a high proportion of premature mortality, particularly among adult women.
39	Norman R, Matzopoulos R, Groenewald P, Bradshaw D; 2007; South Africa	Descriptive	Nationwide Decedents Age: 0-60+ years Both sexes Duration: 1 year n = 59935	Forensic	Estimate the magnitude and characteristics of the injury burden in South Africa within a global context.	Injuries are an important public health issue that require effective prevention programmes; social and economic determinants of violence must be addressed to reduce societal inequalities and strengthen community cohesion; need for multisectoral interventions to reduce traffic injuries.
40	Nthumba PM, Oliech JS; 2005; Kenya	Descriptive	Nairobi City Hospital patients Age: 0-86 years Both sexes Duration: 2 years n = 1157	Clinical Forensic	Investigate the outcome of moderate and severe burns managed at the Kenyatta National Hospital (KNH) and try to validate an existing simple clinical burn injury score, based on the Abbreviated Burn Severity Index (ABSI) score.	Recommended that the ABSI score be adopted into clinical practice in this country, as an objective and accurate predictive clinical score.
41	Loftus IAJ, Dada MA; 1992; South Africa	Descriptive	East Metropole, Cape Town Decedents Age: <18-60+ years Both sexes Duration: 5 years n = 948	Forensic	Assess the relationship between alcohol and death (as seen at Tygerberg Mortuary).	Similarly to other local studies, homicides, vehicular accidents and suicides were the most common modes of death; more than half of the cases tested positive for alcohol, with males more likely to test positive.
42	Matzopoulos R; 2005; South Africa	Descriptive	Nationwide Decedents Age: <1-65+ years Both sexes Duration: 1 year n = 10 499	Forensic	Quarterly report on surveillance data on injury mortality, describing selected findings and interpretations from the most recent NIMSS data pertaining to homicide	Homicide remains the most common cause of injury-related deaths; rates varied significantly between the four major urban centres covered; firearms were a key contributor to the high homicide rates; alcohol was confirmed as an important risk factor for murder, with the highest percentage of alcohol positive cases being recorded in Cape Town.

Appendix 2A: The challenges and limitations of the chosen retrospective data sources, and the recommended best practices.

Data Sources	Challenges & Limitations	Recommendations for Best Practices
1. *Post-mortem case files*	· Missing (or lost) post-mortem case files at the respective mortuary facility.	✓ Mortuary facilities must seek to have a proper, effective, and efficient central-record-keeping system for medicolegal cases (containing both electronic and hardcopy records) in order to prevent loss.
2. *Autopsy reports*	· Missing (or lost) reports of post-mortem examinations at the respective mortuary facility. · Outstanding reports of post-mortem examinations from the pathologists. Old reports from years back are difficult to locate as the pathologists are no longer working at that particular mortuary facility. Recent autopsies with outstanding reports are difficult to obtain as the pathologists are experiencing considerable backlog.	✓ Mortuary facilities must seek to have a proper, effective, and efficient central-record-keeping system for medicolegal autopsies (containing both electronic and hardcopy records) in order to prevent loss. ✓ Pathologists should complete all allocated post-mortem reports prior to leaving from their current workplace. ✓ Forensic pathology specialists are outnumbered against the growing numbers of death cases in the Western Cape. As such, official autopsy reports take a significant amount of time to be completed.
3. *Ancillary toxicological laboratory-based reports*	· Missing (or lost) toxicological testing results at the respective mortuary facility, as well as at the Woodstock National DoH's Forensic Chemistry Laboratory (FCL) (one of only four such National government laboratories in the country). · Major discrepancies and inconsistencies on ancillary toxicological testing requests and findings between the autopsy reports and the laboratory results.	✓ Forensic laboratories must seek to have a proper, effective, and efficient central-record-keeping system for medicolegal cases (containing both electronic and hardcopy records) in order to prevent loss. ✓ While reasoning behind this is historically multi-faceted; the contribution of the large backlog at the government FCL laboratories, together with high caseloads and resource limitations, cannot be overlooked. This has unfortunately limited the understanding of drug contribution to death (particularly violent death). ✓ Both state mortuaries and forensic laboratories ought to assure information accuracy, confidentiality, and accessibility in their services provided using a well-implemented information management system.
4. *FPS death scene documentation* *(forms & records)*	· Missing (or lost) death scene forms and records on relevant fire-related death cases at the respective mortuary facility. · Missing information not recorded on specific death scene forms resulting in incomplete and inconsistent records.	✓ Mortuary facilities must seek to have a proper, effective, and efficient central-record-keeping system for medicolegal cases (containing both electronic and hardcopy records) in order to prevent loss. ✓ FPS services, specifically mortuary operations should be aligned to ensure standard operating procedures as well as accurate, reliable and complete documentation.
5. *FPS Livelink Enterprise Content Management (ECM) system*	· The ECM system serves as FPS' overall document repository. It is inconsistent with the available hardcopy records, and lacks substantial data for the early years. · The ECM system is not optimally organised to ensure ease of use, access to standardised information, and completion of records.	✓ Forensic laboratories must seek to have a proper, effective, and efficient central-record-keeping system for medicolegal cases (containing both electronic and hardcopy records) in order to prevent loss. ✓ FPS services, specifically mortuary operations should be aligned to ensure standard operating procedures as well as accurate, reliable and complete documentation.

DoH – Department of Health; **FPS** – Forensic Pathology Services; **FCL** – Forensic Chemistry Laboratory

Appendix 2B: Description of variables extracted during data collection for the retrospective component.

Variable name	Description
mortuary	the mortuary at which the case was admitted to.
WC number	the official case number assigned to a case according to the mortuary facility.
year	the year of death.
ancestry	one's family or ethnic descent.
sex	the apparent anatomy of the decedent's reproductive system.
age	the length of time that the decedent lived in years.
autopsy date	the date when an autopsy was performed.
autopsy day	the day of the week when the autopsy was performed.
admission	whether the decedent was admitted to hospital after fire incident.
date of death (DOD)	the date when person died after fire injury.
day of death	the day of the week when person died of fire injury.
scene of incident	the scene where the fire incident occurred.
area of incident	the suburb area in the Western Cape where fire incident occurred.
police station	the SAPS (south African Police Station) station to which the medicolegal case is assigned to.
alcohol/drugs on scene	whether alcohol and/or other drugs were found at the scene of death.
decedents count	the number of individuals involved in the fore incident.
death circumstances	the alleged circumstance of death upon admission to mortuary.
manner of death	the decedent's alleged manner of death.
method of death	the decedent's alleged method of death.
cause of death (COD)	the decedent's cause of death as determined following autopsy.
Crow-Glassman scale	the extent of burn injury according to Crow-Glassman
injury type	the presence/absence as well as the type of injury sustained.
cherry marker	the evidence/suggestion of cherry red post-mortem lividity.
smoke marker	the presence/absence of soot in decedent's airways.
fracture marker	the presence/absence of bone fractures on the decedent's body.
Pugilistic pose	Whether the decedent was found in a characteristic boxer position.
remnant debris	any remnants of clothing, medical additions or fire artefacts found with/on the decedent.
type of toxicity	the specific intoxication (gas/volatiles, drugs, or a combination of both).
specimen	the specimens collected for toxicological testing.
toxicological tests	the type of analyses performed.
toxicological findings	the official results reported by the laboratory analysis.
report date	the official release date of the laboratory report.

Appendix 2C: Completed data collection for Salt River mortuary (2006-2018).

Mortuary Facility	Year												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Salt River													
No. of total unnatural deaths	2720	3085	3037	2929	2963	2904	3045	3340	3461	3695	3627	3883	4039
No. of fire-related deaths	107	123	102	79	107	82	95	102	89	115	112	134	133
No. of autopsy reports missing	0	0	0	0	0	0	0	0	0	0	1	0	0
No. of toxicology results missing	49	39	19	10	1	8	9	14	17	16	15	16	33

Appendix 2D: Trail of finalised data collection for all 16 mortuaries (2010-2018) to date from current available sources.

Mortuary Facility	Year								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
1. Beaufort West									
No. of total unnatural deaths	123	125	99	107	118	123	110	120	91
No. of fire-related deaths	2	2	-	1	1	-	1	1	2
No. of autopsy reports missing	2	2	-	-	-	-	-	1	-
No. of toxicology results missing	2	2	-	-	-	-	-	-	1
2. George									
No. of total unnatural deaths	72	335	342	342	308	312	317	303	345
No. of fire-related deaths	24	17	17	13	20	16	11	19	19
No. of autopsy reports missing	24	15	1	2	-	-	-	-	2
No. of toxicology results missing	-	-	1	-	1	1	1	5	7
3. Hermanus									
No. of total unnatural deaths	301	348	353	357	318	382	335	392	379
No. of fire-related deaths	11	8	9	12	7	5	7	13	15
No. of autopsy reports missing	-	2	-	-	-	3	-	-	-
No. of toxicology results missing	3	-	1	-	1	2	2	1	3
4. Knysna									
No. of total unnatural deaths	112	190	157	178	117	182	180	188	187
No. of fire-related deaths	7	2	-	3	4	9	12	15	15
No. of autopsy reports missing	7	-	-	-	-	-	-	-	-
No. of toxicology results missing	-	1	-	1	-	2	2	1	-
5. Laingsburg									
No. of total unnatural deaths	135	87	119	96	91	107	103	96	99
No. of fire-related deaths	-	1	-	3	-	-	-	1	2
No. of autopsy reports missing	-	-	-	-	-	-	-	-	-
No. of toxicology results missing	-	-	-	-	-	-	-	-	-
6. Malmesbury									
No. of total unnatural deaths	174	191	185	191	183	205	189	197	180
No. of fire-related deaths	-	3	5	4	2	4	5	3	1
No. of autopsy reports missing	-	-	-	-	-	-	-	-	-
No. of toxicology results missing	-	-	3	1	-	2	-	-	-
7. Mossel Bay									
No. of total unnatural deaths	62	126	131	133	137	136	123	141	123
No. of fire-related deaths	7	5	10	3	5	3	4	9	4
No. of autopsy reports missing	5	-	-	-	-	-	-	1	-
No. of toxicology results missing	2	3	5	-	2	-	1	6	2
8. Oudtshoorn									
No. of total unnatural deaths	83	195	211	148	155	170	162	167	168
No. of fire-related deaths	5	15	11	4	9	8	2	2	11
No. of autopsy reports missing	3	1	-	-	-	-	-	-	10
No. of toxicology results missing	-	1	-	-	-	1	2	-	2
9. Paarl									
No. of total unnatural deaths	370	352	439	424	477	424	520	591	579
No. of fire-related deaths	15	15	10	12	10	10	13	20	16
No. of autopsy reports missing	8	15	6	-	-	-	-	-	-
No. of toxicology results missing	2	2	3	8	1	-	4	13	12

10. Riversdale									
No. of total unnatural deaths	5	78	67	66	65	79	74	72	61
No. of fire-related deaths	-	5	-	-	-	1	-	2	-
No. of autopsy reports missing	-	4	-	-	-	1	-	-	-
No. of toxicology results missing	-	-	-	-	-	1	-	-	-
11. Tygerberg									
No. of total unnatural deaths	813	710	3065	3071	3215	3262	3776	4103	4402
No. of fire-related deaths	131	130	124	123	104	126	137	179	-
No. of autopsy reports missing	131	130	113	75	104	-	137	153	-
No. of toxicology results missing	6	39	13	9	8	17	9	4	-
12. Wolseley									
No. of total unnatural deaths	166	140	164	147	166	170	206	165	201
No. of fire-related deaths	4	6	2	3	9	5	3	2	4
No. of autopsy reports missing	2	-	-	-	-	-	-	-	-
No. of toxicology results missing	-	-	-	-	2	1	-	-	-
13. Swellendam	ongoing data collection								
No. of total unnatural deaths									
No. of fire-related deaths									
No. of autopsy reports missing									
No. of toxicology results missing									
14. Vredendal	ongoing data collection								
No. of total unnatural deaths									
No. of fire-related deaths									
No. of autopsy reports missing									
No. of toxicology results missing									
15. Vredenburg	ongoing data collection								
No. of total unnatural deaths									
No. of fire-related deaths									
No. of autopsy reports missing									
No. of toxicology results missing									
16. Worchester	ongoing data collection								
No. of total unnatural deaths									
No. of fire-related deaths									
No. of autopsy reports missing									
No. of toxicology results missing									