The Cape Town Violence and Injury Observatory (VIO)

Validity and utility of data sources for a prevention-oriented VIO in urban Cape Town, South Africa

Ardil Jabar

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Supervisor:

Doctor Richard Matzopoulos

Co-Supervisors:

Professor Leslie London, Associate Professor Mark Engel, Associate Professor Tolullah Oni

University of Cape Town

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The Cape Town Violence and Injury Observatory (VIO): A surveillance system for interpersonal violence in the city of Cape Town

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Dedication

This thesis is dedicated to my tribe of mentors: my grandparents, parents, aunts and big brother J. I am because you are.

We re building something here... We re building it from scratch. All the pieces matter

Detective Lester Freamon, The Wire

Thesis overview

The focus of this thesis is interpersonal violence; however some aspects may be applicable to suicide but this is not researched explicitly. Interpersonal violence is defined as violence between individuals, and is subdivided into family and intimate partner violence and community violence. Interpersonal violence is the third leading cause of premature death in South Africa (contributing to approximately 4.4% of all years of life lost, according to the 2010 Global Burden of Disease study estimates, which uses vital registration data). To date, interventions and redeployment of human resource personnel to reduce interpersonal violence in South Africa have largely been in the domain of the policing services, and the decisions underpinning this deployment have been exclusively reliant on police data. The Cardiff model purports that the true burden of violence within a community can only be quantified by the integration of violence-related data from health services with violence data reported to the police. In response to the high levels of homicide in Cali Colombia, Dr Rodrigo Guerrero, an epidemiologist by training, developed the violence and injury observatory (VIO) model in the early 1990s during his tenure as mayor. The success in homicide reduction led to the propagation of the VIO model across the countries of Central and South America. Based on these successes, I developed a proposal for the implementation of a VIO for the City of Cape Town (**Study One**). This study described key VIO functions, surveillance objectives of the pilot VIO, proposed violence and injury datasets for collection, the contribution of the pilot VIO to the South African National development plan 2030 and finally how the VIO pilot studies address global research priorities for interpersonal violence prevention. The Cape Town VIO is in its entirety a pilot study, which includes subsidiary pilot studies.

Given that no evaluation of the VIO model has been undertaken in the approximately 30 years since its inception, a Systematic Review of the best global evidence was an important first step in assessing the efficacy of the VIO model in reducing violence in adult populations (**Study Two**).

The Delphi study (**Study Three**) incorporated local and international experts of violence reduction stakeholders to identify indicators, datasets and research priorities to inform the development of a pilot VIO. This study provides a novel approach to developing a VIO in high violence areas, by using the Delphi study to identify the VIO

research infrastructure and the Delphi panel to constitute the VIO steering committee. Moreover, the experts identified in the Delphi panel represent important regional stakeholders who, in addition to new partners, could advise on and oversee implementation of research activities of the VIO going forward.

The VIO data registry (R043/2016), which has received approval by the University of Cape Town Human Research Ethics Committee (UCT HREC), provides a data warehouse for the collation and integration of varied types of data including health, police, research and administrative data, thus serving as a platform for actionable intelligence. The VIO principles of collation and integration of data are affirmed in a matching study (**Study Four**) between health and police data, providing evidence at the community level for the underreporting of interpersonal violence to the police.

As per the three key observatory functions described in Study One, this thesis has: collected, integrated and stored secondary violence-related data and information by creating a VIO data registry (R043/2016); completed data analysis producing three analytic studies (**Study Two, Three and Four**); and reported on and disseminated information and knowledge through five peer reviewed publications (with one under review at the time of submission), community stakeholders' meetings and international and local violence reduction conferences.

In so doing, this thesis presents a case for an evidence-based public health approach to the burden of interpersonal violence. In addition, it illuminates the limitations in the South African context, thus providing evidence to support the future implementation of the Cardiff model within high violence communities. In summary, this thesis addresses the public health challenge of addressing interpersonal violence in South Africa by:

- Providing original evidence for the efficacy of VIOs in reducing violent outcomes in adult populations where they have been implemented
- Providing an original evidence-based method for developing VIOs, including the development of public health observatories with themes other than violence and injury
- Developing a VIO research infrastructure and identifying experts to form the observatory steering committee, for the pilot VIO

- Providing new evidence and methodology to quantify the level of under-reporting of interpersonal violence at the community level in South Africa
- Provide original evidence for the implementation of the Cardiff data sharing model within high violence communities in South Africa

Abstract

Background

The Cardiff model purports that the true burden of violence within a community can only be quantified by the addition of violence-related data from health services to violence data reported to the police. This thesis describes the conceptualisation, development and implementation of a violence and injury observatory for the routine collection of violence-related data for the City of Cape Town. The observatory model, which was conceptualised in the early 1990s in Colombia, has gone through various iterations as a municipality-level research tool, to a city-level tool and thereafter as a national and transnational tool.

Aims of this thesis

The thesis aimed to assess the utility of clinical and non-clinical data sources in constituting a prevention-oriented violence and injury observatory (VIO) in urban Cape Town, South Africa.

The specific objectives of each study component were as follows:

- To describe the objectives of the pilot VIO, potential violence-related datasets for collection, data analysis and research dissemination plan (**Study One**)
- To assess the validity and utility of VIOs in reducing violence and violence-related harms in adult populations (**Study Two**)
- To identify the optimal data elements for inclusion in a VIO according to expert consensus (**Study Three**)
- To determine the concordance between violent crimes reported to the police with violence-related injuries presenting at health facilities in Khayelitsha (**Study Four**).

Methods

The systematic review method was used to determine whether the introduction of violence and injury observatories was associated with a reduction in violence in adult populations (**Study Two**).

A modified two-round Delphi study (**Study Three**) determined the optimal data elements (including violence and injury indicators, datasets and research priorities) for inclusion in a pilot violence and injury observatory in Cape Town. The Delphi panel of 21 participants included one Provincial Head of Emergency Medicine, one Provincial Head of Disaster Medicine, several Heads of Department of Emergency Medicine across hospitals in Cape Town, and representatives from relevant data stakeholders, including the Forensic Pathology Services (FPS), South African Police Services (SAPS), Health Systems Trust (HST) and the Violence Prevention through Urban Upgrading (VPUU). This was to ensure that decisions were made by persons in senior posts to facilitate subsequent implementation of the recommendations.

Khayelitsha, a peri-urban mixed informal township of Cape Town, was the setting for the final study (**Study Four**), which included a retrospective analysis of secondary cross-sectional health and police data, from three health facilities and three police stations in the community of Khayelitsha, Cape Town. A case-matching study, using personal identifier matching, was employed to determine the concordance between reports of violent crimes to police stations with reports of injuries arising from interpersonal violence at health facilities within the community of Khayelitsha in Cape Town, South Africa.

Results and Discussion

Subgroup analyses according to the two types of models implemented in the systematic review (**Study Two**), namely, the VIO and the injury surveillance system (ISS), provided evidence for an association between the implementation of the VIO model and a reduction in homicide count in high-violence settings (incidence rate ratio [IRR]=0.06; 95% CI 0.02 to 0.19; four studies), while the introduction of ISS showed significant results in reducing assault (IRR=0.80; 95% CI 0.71 to 0.91; three studies).

Following expert consultation through a Delphi process (**Study Three**), this study identified 14 violence and injury indicators and 12 violence-related datasets for inclusion in the pilot VIO. Additionally, research priorities within 16 research themes across five different types of violence were identified including: elder abuse, youth violence, intimate partner violence, sexual violence, and armed violence. Key findings from these thematic priorities included: (1) formal methods to define and measure violence, identification of violence-related risk factors; (2) evaluation of the effectiveness of promising programmes that target violence-related risk factors; and (3) evidence-based recommendations on scaling up programmes that were shown to be effective in reducing interpersonal violence. With regard to the key findings around data sharing, the majority of the panelists (>55%) thought that: (1) violence-related data from health services should be shared with Policing Services; (2) the data model employed should go beyond the Cardiff model (policing and health data) and also include violence-related data from the Fire and Rescue Services (FARS) and the Emergency Medical Services (EMS); and (3) the functions of a local observatory should include a civilian spatial data observatory, an information technology division, a predictive analytics division, a historical data repository and a systematic review repository. The expert-identified violence and injury indicators, datasets and research priorities provide a research framework for interpersonal violence and injury prevention work within South Africa. The findings have theoretical implications and build up evidence-based data for the general field, and they have a practical outcome in recommendations that are both general and specific for implementation in South Africa. They may also serve to guide the development of additional VIOs locally.

In the final study (**Study Four**), with regard to concordance between the datasets, among the 708 patients being treated for violence-related injuries at health facilities, only 104 reported the incident to the police which equates to a matching ratio of 14.7%. Combining health and police data revealed an 81.7% increase in potential total violent crimes over the reporting period. Compared to incidents reported to the police, those *not reported* were more likely to involve male patients (difference: +47.0%; $p<0.001$), and sharp object injuries (difference: +24.7%; $p<0.001$) and less likely to report blunt trauma i.e., push/kick/punch injuries (difference: -17.5%; $p<0.001$). These findings suggest that the majority of injuries arising from interpersonal violence presenting at health facilities in Khayelitsha are not reported to the police.

Conclusion

This research provides an evidence-based model for the development and implementation of a VIO, and the Cardiff model, to reduce interpersonal violence. It is supported by the evidence from the systematic review of the effectiveness of VIOs in reducing violence outcomes among adults in high-violence settings. This pilot VIO represents the first attempt to collect contemporary and comprehensive data on violence and injury in the Western Cape Province and South Africa.

The implementation of VIOs should be considered in high-violence communities where the collation and integration of violence-related data and violence stakeholders, may guide violence reduction. The Delphi study provided indicators, datasets and research priorities to (1) inform the basic research infrastructure of a VIO, and (2) serve as part of a regional standardised data collection framework to guide the development of other local violence and injury observatories. This is consistent with the aims of the South African National Development Plan 2030 to 'improve the health information system; to prevent and reduce the disease burden and promote health and to improve quality by using evidence'.

Finally, the research further shows a clear benefit in combining data on violence from different settings as demonstrated in our analysis of data in the Cape Town suburb of Khayelitsha, where the overwhelming majority of injuries arising from interpersonal violence presenting at health facilities in Khayelitsha are not reported to the police. This study has broader implications regionally and nationally for the surveillance of injuries arising from interpersonal violence, for the police definition and surveillance of community interpersonal violence, for community policing intelligence development (improving the configuration of violence heat maps on a real time basis) and finally for police resource utilisation and distribution, which should, in turn, impact positively on reducing crime and violence in the community, and reduce the burden on the health services.

The Western Cape Safety Plan, a policy document developed by the Western Cape Government, advocates the use of data and technology to understand violent crime patterns to inform the deployment of law enforcement resources and investigators accordingly and furthermore acknowledges research and analysis as an important

component of its evidence-based policing (EBP) strategy. The policy document and study findings provide support to the implementation of the Cardiff Model locally.

Publications arising from this thesis

1. Jabar A, Oni T, Engel M, Cvetkovic N, Matzopoulos R. Rationale and design of the Violence, injury and trauma observatory (VITO): The Cape Town VITO pilot studies protocol – BMJ Open 2017, **http://dx.doi.org/10.1136/bmjopen-2017-016485** **[STUDY ONE]**

2. Jabar A, Matzopoulos R. Violence and injury observatories: Reducing the burden of injury in high-risk communities – SA Crime Quarterly 2017, **http://dx.doi.org/10.17159/2413-3108/2017/v0n59a1547** **[LITERATURE REVIEW SUMMARY]**

3. Jabar A, Barth D, Matzopoulos R, Engel M. Is the introduction of violence and injury observatories associated with a reduction of violence in adult populations? Rationale and protocol for a systematic review. BMJ Open 2015; **doi.org10.1136/ bmjopen-2014-007073** **[STUDY TWO PROTOCOL]**

4. Jabar A, Fong F, Chavira M, Cerqueira M, Barth D, Matzopoulos R, Engel M. Is the introduction of violence and injury observatories associated with a reduction in violence-related injury in adult populations? A systematic review and meta-analysis. BMJ Open 2019; 9:e027977. **doi:10.1136/ bmjopen-2018-027977**– **[STUDY TWO]**

5. Jabar A, Bjorkman S, Matzopoulos R. Modified Delphi study to determine optimal data elements for inclusion in a pilot violence and injury observatory in Cape Town, South Africa – African Journal of Emergency Medicine 2018, **https://doi.org/10.1016/j.afjem.2018.11.001** **[STUDY THREE]**

6. Jabar A, Oni T, London L, Cois A, Matzopoulos R. Merging Health and Police datasets for characterising interpersonal violence in the community of Khayelitsha, South Africa 2013-2015. BMJ Open (submitted: 19 December 2020; manuscript ID: bmjopen-2020-048129) **[STUDY FOUR]**

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List of Abbreviations and Acronyms

CDC	Centers for Disease Control
CSI	Citizen Security Indicators
CT	Cape Town
CT VITO/VIO	Cape Town Violence, Injury and Trauma Observatory/Violence and Injury Observatory
DoH	Department of Health
eTHR	electronic Trauma Health Record
FCA	Firearm Control Act
FPS	Forensic Pathology Service
HST	Health Systems Trust
IDRC	International Development Research Centre
KDH	Khayelitsha District Hospital
LMICs	Low- and Middle-Income Countries
SAMRC	South African Medical Research Council
NIMSS	National Injury Mortality Surveillance System
OAS	Organization of American States
PIMSS	Provincial Injury Mortality Surveillance System
RXH	Red cross children s hospital
SAPS	South African Police Service
SES	Socioeconomic status
VIO	Violence and Injury Observatory

VPUU	Violence Prevention through Urban Upgrading
WHO	World Health Organization

1. CHAPTER ONE:

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Violence is now recognised as an important public health issue across the globe, with the World Health Organization (WHO) reporting that in 2019, 1.2 million people died from violence-related causes (World Health Organization, 2019a) WHO defines violence as 'the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation' (WHO, 2002). The focus of this thesis is interpersonal violence, which is defined as violence between individuals, and is subdivided into family and intimate partner violence and community violence (WHO, 2014). Some aspects of the study and observatories more broadly may be applicable to other forms of violence and injuries such as suicide but this is not researched explicitly in this thesis.

The 2010 Global Burden of Disease Study found interpersonal violence to be the third leading cause of premature death in the sub-Saharan Africa, accounting for approximately 15% of all Disability Adjusted Life Years (DALYs). South Africa s injury burden is very high, particularly for homicide, which is approximately six times the global average (Matzopoulos, Prinsloo, Wyk, Gebushe, Mathews, Martin, Abrahams(WHO, 2014) and Msemburi, 2015).

Injury surveillance is widely recognised as a critical prerequisite for effective injury prevention (Lund, 2005; Mackenzie & Pless, 1999; McGee, Peden, Waxweiler and Sleet, 2003; Nicholson, 2005; Stone, Morrison and Smith, 1999; Warda, 2003). Ongoing surveillance can monitor the incidence of injury, identify risk factors and contribute to the planning and evaluation of injury prevention programmes (Driscoll, Harrison and Langley, 2004; Macarthur and Pless, 1999). Furthermore, injury surveillance can comprise a variety of data sources, from mortality and hospital discharge data to emergency department registry data, surveys and police, fire or ambulance records (Lyons, Jones, Kemp, Sibert, Sheperd, Richmond, Bartlett and Palmer, 2002).

The City of Cape Town has access to multiple sources of violence and injury data from the health and criminal justice systems, which are not available for many other settings

or provinces, thus providing favourable conditions for the development of a local surveillance system to guide the violence prevention response. Information and communication technology (ICT) is one of the priority areas in the Western Cape Province s Integrated Development Plan, and considerable investment in ICT infrastructure projects is intended to position Cape Town as a modern global city (City of Cape Town, 2015). In addition to industrial and commercial development of its ICT structures, the city is developing plans to establish and populate a single online and open portal for data that it has generated, and that it wants to make freely accessible to everyone, in order to join a growing number of large cities worldwide that have begun open data projects to make their data freely available to citizens (Van der Berg, 2014). The terms injury surveillance system" and injury observatories" are sometimes used interchangeably in the literature, although they have different meanings. I will use the term 'observatory' as it is specific to a surveillance system that collects data from multiple sources, e.g., crime, clinical and forensic data, whereas injury surveillance systems focus almost exclusively on the use of injury data alone.

Inequality has been demonstrated internationally to be a key risk factor for interpersonal violence, which is concentrated in areas of poverty and deprivation (Butchart, Phinney, Check and Villaveces, 2004). Inequality and homicide rates in the Western Cape province of South Africa were greater than the national average for both males and females in 2000 (Norman, Matzopoulos, Groenewald and Bradshaw, 2007). The highest rates of homicide in Cape Town, the province's largest city and home to almost two thirds of the provincial population, were recorded in the metropolitan sub-districts of Klipfontein (132 per 100,000 population), Tygerberg (80 per 100,000 population) and Khayelitsha (45 per 100,000 population) with the lowest found in the Southern suburbs subdistrict (10 per 100,000 population)(Government, 2016).

Whilst the criminal justice system remains the primary tool for addressing violence in South Africa, evidence-based interventions for prevention are becoming increasingly influential, with public health assuming a more central role in policy making (Holtmann

and Domingo-Swarts, 2008). “The public health approach to injury prevention includes four elements, namely: assessment of existing conditions,; development of interventions; evaluation of programmes and scaling up of promising interventions (CDC, 2021)

Key to this approach is a surveillance system capable of providing essential information for the assessment phase in order to develop appropriate interventions and programme evaluation methods (Krug et al., 2002).

1.2 Global burden of injury

Trauma is a leading cause of death and disability worldwide, contributing significantly to the global burden of disease. The WHO estimates that injury is responsible for more than 5 million deaths annually, which is greater than the mortality caused by the human immunodeficiency virus (HIV), malaria, and tuberculosis (TB) combined (WHO, 2010a). More than 90% of the world s burden of injury originates in low- and middle-income countries (LMICs), where formal trauma systems and methods for data tracking have not yet been widely implemented (Norman *et al.*, 2007; Peden *et al*, 2002). Injury data have historically been available from police reports, mortuaries and population surveys, with surveillance of trauma patients through hospital-based registries; however, their use is not widespread in LMICs (Schultz, Ford and Cassidy, 2007). Homicide alone accounts for at least eleven percent of injury-related deaths worldwide, with the highest homicide rates found in low-income urban areas (WHO, 2010a).

1.3 South African burden of injury

African countries are particularly burdened by high rates of injury (World Health Organization, 2015). South Africa is a middle-income country, with a population of approximately 60 million people, that is burdened with a diverse spectrum of diseases, including infectious diseases, chronic and degenerative diseases, malnutrition and childbirth-related conditions and a disproportionately large burden of trauma (Brysiewicz, 2001; Goosen, 2003; Africa, 2020). Interpersonal violence and road-traffic collisions are the leading causes of injury in South Africa (Brooks, Macnab and Boffard, 1999; Goosen, 2003; Matzopoulos *et al*., 2015; Meel, 2004). In 2005, 39% of

all injury-related deaths resulted from interpersonal violence (Matzopoulos, Prinsloo, Bradshaw, Pillay-van Wyk, Gwebushe, Mathews, Martin, Laubscher, Lombard and Abrahams, 2013). Despite the reduction in political conflict in the post-apartheid era, interpersonal violence has continued to plague South Africa (), and has actually increased in the past 20 years post democracy ((Matzopoulos *et al.*, 2015)). South Africa is one of the few places in the world where rates of intentional injury exceed the rates of unintentional injury (WHO, 2015).

Of the 52 493 injury-related deaths recorded in South Africa for 2009, almost half (25 499) were intentionally inflicted (Matzopoulos *et al.*, 2015). Homicide was the leading apparent manner of death, accounting for 36.2% of all external causes (Matzopoulos *et al.*, 2015). Gunshot injuries were a leading cause across several categories, accounting for 6 428 deaths, equivalent to 17.6 firearm-related deaths per day, and of these, 5 513 were attributed to homicides (Matzopoulos *et al.*, 2015). Homicide rates in the Western Cape were greater than the national average for both males and females (Matzopoulos *et al.*, 2015). The highest rates of homicide in Cape Town, the province s largest city and home to almost two thirds of the provincial population, were recorded in the relatively impoverished sub-districts of Nyanga (143.4 per 100,000) population) and Khayelitsha (91.2 per 100 000 population) (SAPS, 2016).

1.4 Measuring the social determinants of injury

The application of socioeconomic contexts to understanding injury is reliant on national censuses as proxy representations of either individual-level or neighbourhood-level social and economic conditions. This follows a broad research community interest in quantifying how relative variations in both physical and social aspects of places, parallel variations in health outcomes (Diez-Roux, Nieto, Muntaner, Tyroler and Comstock 1997; Subramanian, Belli and Kawachi, 2002). Compositional models of this effect have been used to assess whether relative variations in socioeconomic status (SES) data within one geographic area correspond to variations in the same area s injury morbidity and mortality levels (Bell, Schuurman and Hameed, 2009; Pampalon and Raymond, 2000).

It has been suggested that injuries vary according to the social and physical environment in which one lives, rather than one s own or that of one s family s social and economic position (Cubbin, LeClere and Smith, 2000; Haynes, Reading and Gale, 2003; Soubhi, Raina and Kohen, 2004). Multilevel models separately analyse the variance between and within areal units in order to attain a nested hierarchy of contextual influences on individual health outcomes (Kennedy, Kawachi, Glass and Prothrow-Stith 1998; Ross, Tremblay and Graham, 2004; Singer, 1998). These findings point to how the absence or unequal distribution of the many facets of 'place' interact with one s individual circumstances (e.g., income, employment status) and how they may influence one s health status (Kawachi, Kennedy and Glass, 1999; Ross, Tremblay and Graham, 2004).

It is important to recognise that both composition and context affect how poverty and poorer living conditions may influence patterns or risk of injury. However, data constraints often limit injury prevention researchers from studying incidence patterns using aggregated socioeconomic data drawn from the regional census data. This is inherently problematic due to ecological fallacy. It occurs whenever a researcher makes assumptions about an individual based on aggregated data from a group of individuals (Openshaw, 1983). Although multilevel models can circumvent ecological fallacy, they can be similarly criticised for overselling the significance of contextual effects on health that must necessarily be derived from proxy indicators (Yen and Syme, 1999). These problems may be further compounded due to the level of representativeness in the data (Crampton, 2004).

1.5 The social-ecological model: A framework for prevention

The ultimate goal is to stop violence before it begins. Prevention requires understanding the factors that influence violence. Figure 1.1 below describes a four-level social-ecological model to better understand violence and the effect of potential prevention strategies (Dahlberg and Krug, 2002). This model considers the complex interplay between factors relating to the individual, to relationships, the community, and the society. This allows us to understand the range of factors that either put people at risk of violence or protect them from experiencing or perpetrating violence (Dahlberg

and Krug, 2002). The overlapping rings in the model illustrate how factors at one level influence factors at other levels.

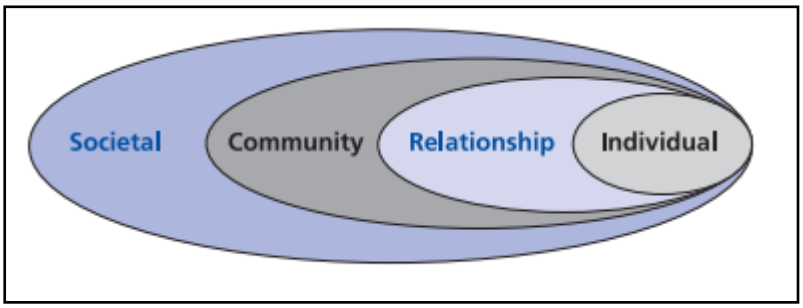


Figure 1.1 Social ecological model for understanding violence (Dahlberg and Krug, 2002).

The model also suggests that, in order to prevent violence, it is necessary to act across multiple levels of the model at the same time, with this comprehensive approach being more likely to sustain prevention efforts over time than any single intervention (CDC and WHO, 2001).

The following represents a summary description of the CDC social-ecological model framework for violence prevention (CDC and WHO, 2001):

1.5.1 Individual

The first level identifies biological and personal history factors that increase the likelihood of becoming either a victim or a perpetrator of violence. These factors include age, sex, education, income, substance use, and history of abuse. Prevention strategies at this level are often designed to promote attitudes, beliefs, and behaviours that ultimately prevent violence. Specific approaches may include education and life skills training.

1.5.2 Relationship

The second level examines close relationships that may increase the risk of experiencing violence as a victim or a perpetrator. People s closest social circles – peers, partners and family members – influence their behaviour and contribute to their range of experience. Prevention strategies at this level may include parenting or family-focused prevention programmes, as well as mentoring and peer programmes

designed to reduce conflict, foster problem-solving skills, and promote healthy relationships.

1.5.3 Community

The third level explores the community settings, such as schools, workplaces and neighbourhoods, in which social relationships occur; it seeks to identify the characteristics of these settings that are associated with becoming either victims or perpetrators of violence. Prevention strategies at this level are typically designed to affect the social and physical environment – for example, by reducing social isolation, improving economic and housing opportunities in neighbourhoods, as well as improving the climate, processes, and policies within school and workplace settings.

1.5.4 Society

The fourth level looks at the broad societal factors that help to create a climate in which violence is encouraged or inhibited. These factors include social and cultural norms that support violence as an acceptable way to resolve conflicts. Other significant societal factors include the health, economic, educational and social policies that help to maintain economic or social inequalities between groups in society.

1.6 Evidence-based violence prevention interventions

Table 1.1 demonstrates the multitude of downstream interventions with strong evidence, which is an outcome of using an epidemiological approach. Suicide is included as a type of violence, however will not be a focus of this thesis.

Table 1.1 Evidence of effectiveness of violence prevention interventions by violence type (WHO, 2010b)

Intervention	Type of violence					
	Child maltreatment	Intimate Partner Violence	Sexual violence	Youth violence	Elder abuse	Suicide
1. Developing safe, stable and nurturing relationships between children and their parents and caregivers						
Parent training, including nurse home visitation	X			O		
Parent-child programmes	O			O		
2. Developing life skills in children and adolescents						
Preschool enrichment programmes				O		
Social development programmes				X		
3. Reducing the availability and harmful use of alcohol						
Regulating sales of alcohol	O	O	O	O	O	O
Raising alcohol prices	O	O	O	O	O	O
Interventions for problem drinkers		X		O		
Improving drinking environments				O		
4. Reducing access to guns, knives and pesticides						
Restrictive firearm licensing and purchase policies				O		O
Enforced bans on carrying firearms in public				O		
Policies to restrict or ban toxic substances						O
5. Promoting gender equality to prevent violence against women						
School-based programmes to address gender norms and attitudes		X	O			
Microfinance combined with gender equity training		O				
Life skills interventions		O				
6. Changing cultural and social norms that promote violence						
Social marketing to modify social norms		O	O			
7. Victim identification, care and support programmes						
Screening and referral		O		O		
Advocacy support programmes		X		O		
Psychosocial interventions	O	O	O	O	O	O
Protection orders		O				

KEY

X – Well supported by evidence (multiple randomised controlled trials with different populations)

O – Emerging evidence

There is recognition that upstream interventions may also play a role, but that a different approach is required. This is because upstream interventions in the structural realm are not conducive to randomised controlled trials (RCTs). Public health surveillance may bridge this divide by acting as an 'intervention' when it is introduced to reduce a specific health burden; moreover, when it is successfully implemented, it can act as a monitoring and evaluation tool in relation to the health burden.

Additionally, public health surveillance is a tool for estimating the health status and behaviour of the population (Nsubuga, White and Thacker, 2006). Because surveillance can directly measure what is going on in the population, it is useful both for measuring the need for interventions and for directly measuring their effects (Nsubuga *et al.*, 2006). The purpose of surveillance is to empower decision makers to lead and manage more effectively by providing timely, useful evidence.

Surveillance is a critical component of the health system, as it serves as an early warning system to identify public health emergencies. It guides public health policy and strategies, can document the impact of an intervention or progress towards specified public health targets/goals, and helps us understand and monitor the epidemiology of a condition. This can help to set priorities and guide public health policy and strategies (WHO, 2003).

1.7 Uses of public health surveillance

Section 1.7 and 1.8 describe the uses of and conceptual frameworks for public health surveillance, and is followed by a discussion of the role of injury surveillance in LMICs, in sub-Saharan Africa and in the Western Cape (section 1.9). Section 1.10 focuses on the violence and injury observatory model by examining the historical background, the conceptual framework, and different types and components of the framework, before ending with the current evidence of effectiveness in reducing violence.

1.7.1 Monitoring health events

Health events may be monitored for the following purposes: (i) to detect sudden changes in disease occurrence and distribution, (ii) to follow long-term trends and patterns of disease, (iii) to identify changes in agents and host factors and (iv) to detect changes in health care practices (CDC, 2006).

Local and national health agencies use surveillance data to detect sudden increases in disease occurrence, such as epidemics, which agencies may investigate and subsequently initiate control and prevention activities (Garcia-Albreu, Halperin and Danel, 2002). By monitoring patterns to date, we may be able to forecast future patterns of disease occurrence, where such forecasts are useful for planning resource needs (CDC, 2006).

Monitoring changes in agents and host factors allows the potential for future disease occurrence to be assessed (CDC, 2006). For example, laboratory scientists monitor certain infectious agents for changes in their antigenic pattern or resistance to antibiotics and, by identifying antigenic drifts and shifts in these viruses, they can direct vaccine production and anticipate the effects of influenza, for instance, on the community (CDC, 2006).

1.7.2 Testing hypotheses

Surveillance data may sometimes be used to test hypotheses with regard to the impact of exposures on disease occurrence (CDC, 2006). For example, in 1973, two infants with dissimilar birth defects were born to parents who had used spray adhesives extensively while engaging in their hobby of creating foil art." As a result, the Consumer Product Safety Commission banned the sale of these spray adhesive compounds. The ban was lifted, however, after birth defect surveillance data for 1970-1973 showed a slight decrease in the total number of birth defects and in the number of birth defects in infants, despite a 5-fold increase in spray adhesive sales during the same period (CDC, 1973).

1.7.3 Archive of disease activity

Creating an archive of disease activity is not a primary goal of surveillance; however, it is a by-product of the process, with such data often reported in annual summaries issued by the responsible health agencies (CDC, 2006). Archival data may be put to good use; for example, epidemiologists used historical surveillance data to develop statistical models to predict the feasibility of proposed policies for eradicating measles and polio (Thacker and Millar, 1991).

1.7.4 Link to public health action

Figure 1.2 illustrates the components of a surveillance system and their links to public health actions, which are discussed below.

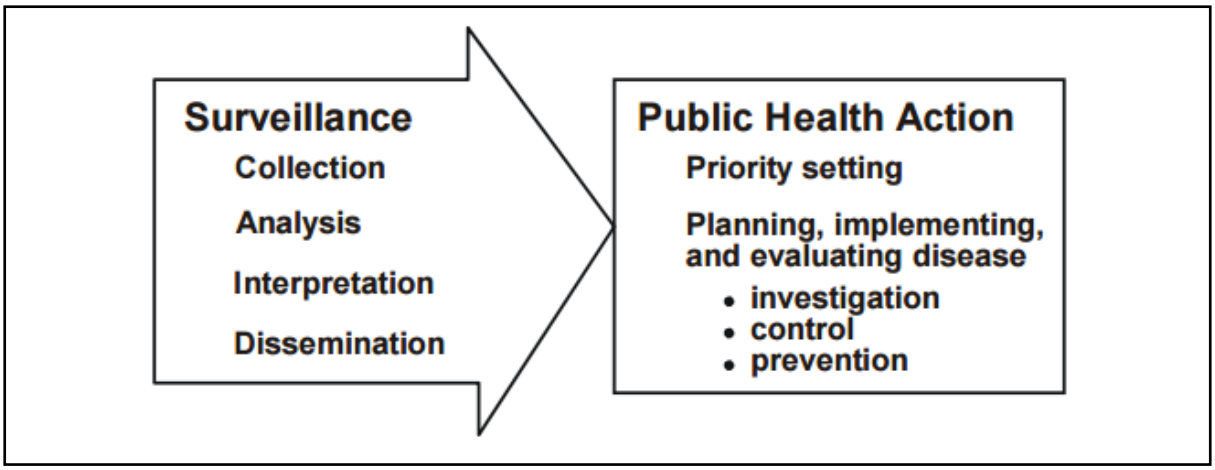


Figure 1.2 The components of surveillance and resulting public health action

1.7.5 Investigation and control

When many of the notifiable diseases are reported, local, state, and even national or international health agencies may take action, which may include searching for the source or the sources which, when found, may prompt further actions. Such actions might include the closure of a restaurant, counselling and treatment of an asymptomatic patient, the withdrawal of a commercial product, or warnings to the public (CDC, 2012). Health agencies may also act to intensify surveillance of the disease and identification of other susceptible and potentially exposed persons who may be at risk of developing disease. Moreover, when these persons are identified, they may be offered testing, counselling, treatment, vaccination, or prophylaxis as appropriate (CDC, 2006). A TB registry is an example of a notifiable disease system that is used to monitor and follow up on cases. Similarly, within a workplace, surveillance may prompt similar actions within the facility, including the identification of others at risk and elimination of workplace hazards (CDC, 2006).

1.7.6 Planning

One of the main goals of surveillance is to provide a factual basis for evidence-based decision making. By monitoring changes in disease occurrence over time and place, agencies can anticipate when and where resources will be needed, and thus will be able to plan how to allocate them effectively (CDC, 2006).

1.7.7 Evaluating prevention and control measures

Surveillance data are often used to measure the impact of program interventions (Garcia-Albreu *et al*, 2002). One example is the incidence of measles in the United States over a 35-year period, when a precipitous drop in the mid-1960s reflected the impact of the National Measles Vaccination Program. A subsequent resurgence in the late 1980s led to a revision in recommendations from a 1-dose to a 2-dose vaccination policy (CDC, 2006). Similarly, agencies may use surveillance data to monitor and modify educational and other risk-reduction programmes (Garcia-Albreu, Halperin and Danel, 2002).

1.7.8 Generating hypotheses and stimulating public health research

Collecting and analysing surveillance data on an ongoing basis may generate questions and hypotheses that provide direction for further research (Garcia-Albreu *et al*, 2002). In 1980, for example, surveillance systems documented the nationwide occurrence of a new disease that came to be known as toxic shock syndrome (TSS) (Schuchat and Broome, 1991). From a review of the initial surveillance data, epidemiologists realised that many of the cases occurred in menstruating women, thereby leading to a series of increasingly focused case-control studies, following which they found a strong association between TSS and a particular brand of tampon, which was promptly withdrawn from the market (Schuchat and Broome, 1991).

1.8 Conceptual frameworks for public health surveillance

Figure 1.3 below focuses on the data use and data generation hemispheres, which are terms to describe the surveillance and response mechanisms respectively. The data generation hemisphere is the traditional view of surveillance, whereas the data use hemisphere is the public health response that begins with the interpretation of the data from the surveillance system.

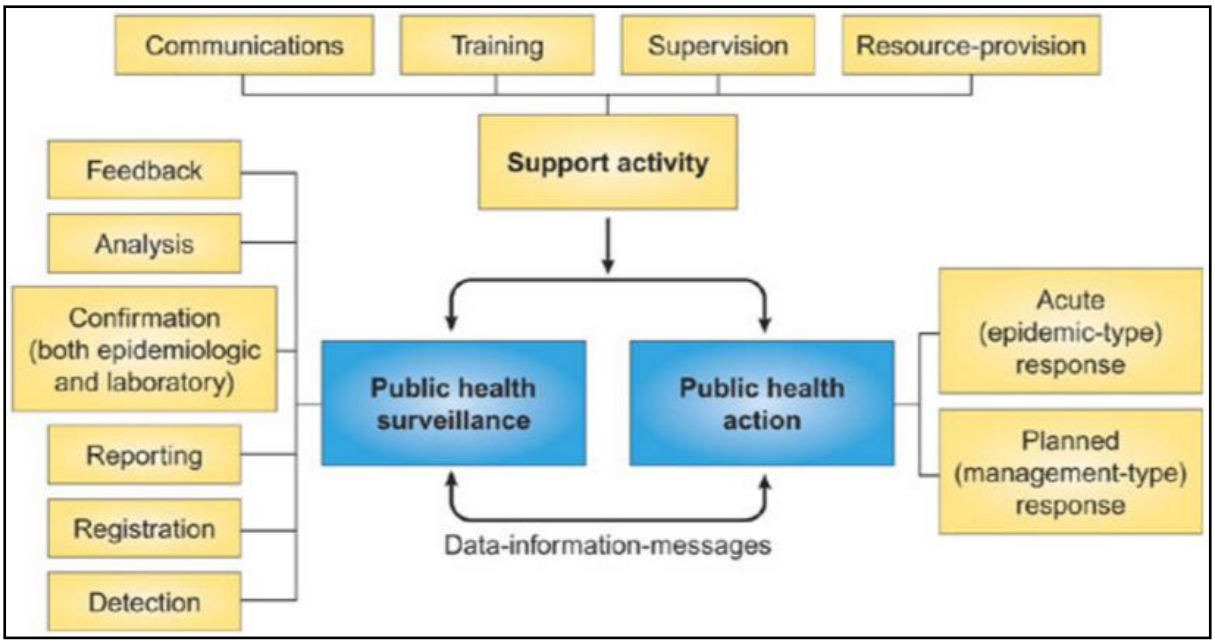


Figure 1.3 Public Health surveillance and response conceptual framework (Ridley, 2004)

1.9 Injury surveillance in low - and middle-income countries (LMICs)

Injury surveillance systems have limitations that constrain their value as a tool for public health surveillance. Many injured patients do not survive to reach a hospital or do not seek formal hospital treatment and are thus not captured by the hospital-based registry (Nwomeh, 2006). Patients who do not fall into the rigidly defined criteria for major trauma are often excluded, thus current hospital-based registries are not representative of all injuries in the population (Nwomeh, 2006). The variation in case criteria and data contents, concerns about completeness and quality, and the limit in geographic and population coverage, all limit the value of these systems with regard to quality control, injury surveillance, and planning for health services. This ultimately means that the benefits must be weighed against the costs in terms of infrastructure and work force (Nwomeh, 2006). Examples from the few lower- and middle-income countries (LMICs) discussed later (Section 1.9.1) show that trauma registries can be implemented in a cost-effective manner.

Most of the epidemiological data of trauma from LMICs are one-time surveys, retrospective clinical studies, mortuary data or population surveys (London, Mock,

Abantanga, Quansah, Boateng, 2002; Steenkamp and van der Spuy, 1997) Population-based surveys that are intermittent are limited by the memory of participants, and do not capture adequate data with regard to individual patients and injury severity (Nwomeh, 2006). A well-designed trauma registry is desirable in LMICs, as it can contribute positively towards the implementation, evaluation, and planning of trauma care. However, due to scarce economic resources, innovative registries must be designed that do not depend on costly infrastructure and highly trained technical manpower (Nwomeh, 2006).

Streamlined hospital-based data collection, such as trauma or ED-based registries, is an effective method of collecting injury data in resource-poor settings, contributing greatly to our understanding of both injury morbidity and mortality (Schultz *et al.*, 2007). A minimum dataset (MDS) that captures just the relevant information, coded to a recognised standard, may be the best approach for the collection of public health data in locations where resources, expertise and time are limited (Tierney, 2006).

Injury surveillance systems are relatively well developed in resource-rich settings; however, they are poorly equipped or non-existent in many LMICs (Mock, 2004). There is thus a growing interest in developing injury surveillance systems in LMICs. For example, recent studies have documented the development of injury surveillance systems in Colombia (Gutierrez-Martinez, Del Villin, Fandiño and Oliver, 2007), Thailand (Santikarn, 1999), Sri Lanka (Jayatilleke, Marasinghe, Nakahara, Nandasara, Jayatilleke and Simba, 2007), Ghana (London, 2002), Malawi (Samuel, 2009), Ethiopia (Kebede, 2008) and Nicaragua (Tercero, 2007).

The establishment of injury surveillance systems in Colombia, El Salvador, and Nicaragua between 2000 and 2006 provides a case study for the establishment and maintenance of an injury surveillance system in a resource poor setting. Additionally, reviewing these systems provides an opportunity to understand the development of the injury surveillance systems in terms of data elements and collections processes; human resources and training; functionality and sustainability, all of which may serve to guide the development of a similar system locally.

In 2000, the Pan American Health Organization (PAHO), with technical assistance from the U.S. Centers for Disease Control and Prevention (CDC), initiated the project to establish injury surveillance systems in emergency departments (EDs) with the goal

of advancing injury epidemiology and prevention capacity in Latin America (Sklaver, Sklaver, Benjamin, Clavel-Arcas, Fandiño-Losada, Gutierrez-Martinez, Rocha-Castillo, de García, Concha-Eastman, 2008). Colombia, El Salvador and Nicaragua were selected for the initial pilot surveillance systems, which were designed to enhance the ability of selected hospitals to monitor injury trends and promote appropriate prevention interventions (Sklaver *et al.*, 2008).

1.9.1 Case study: Injury surveillance systems in South America focusing on Colombia, El Salvador, and Nicaragua

Section 1.9.1 will focus on specific examples of injury surveillance systems in LMICs in South America by describing their respective data elements, training, data collection protocol, monitoring and evaluation and sustainability.

1.9.1.1 Data elements

The architecture for the pilot project was a sentinel surveillance system that was designed to routinely collect a minimum set of information about the circumstances of injury events, in line with World Health Organization (WHO)/CDC Injury Surveillance Guidelines (CDC and WHO, 2001). The minimum dataset (MDS) used was drawn from the International Classification of External Causes of Injury (ICECI) system (WHO, 2004). ICECI is a standard coding system established by the WHO and designed to be compatible with the 10th revision of the International Classification of Diseases (ICD-10). ICECI has a multi-axial and hierarchical structure: a core module including seven items (intent, mechanism of injury, object/substance producing injury, place of occurrence, activity when injured, alcohol use, psychoactive drug or substance use), and five additional modules to enable the collection of additional data on special topics (violence, transport, place, sports, occupational) (WHO, 2004).

The MDS for this project included socio-demographic data of the patient and general information about the injury event, such as intention, activity at the time of injury, location at the time of injury, and mechanism of injury (Sklaver *et al.*, 2008). Specific expanded modules were developed to capture information on transport injuries (including operator activities at time of injury, vehicle involved, and safety measures employed); violent injuries (including context, relationship between perpetrator and

victim, and number of perpetrators); and self-inflicted injuries (first attempt or subsequent, and precipitating factors).

The system also collected information on clinically suspected alcohol and illicit drug use during the physical examination when laboratory confirmation was unavailable (Sklaver *et al.*, 2008). Clinical information collected on each patient included injury severity (mild, moderate, severe); nature of the injury (e.g., fracture, laceration, and concussion); and final disposition of the injured patient (e.g., treated and released, or hospitalised) (CDC and WHO, 2001).

To standardise data collection, a two-page ED collection form was developed (Figure 1.4). The form collected demographic data and the MDS described above. The back of the form captured data on alcohol and drug use, clinical notes, an indication of the nature and severity of the injury, and patient disposition. The form evolved over the six years of project implementation in response to ongoing input from the participating countries and analysis of the surveillance data (Noe, Rocha, Clavel-Arcas, Aleman, Gonzales, Mock, 2004).

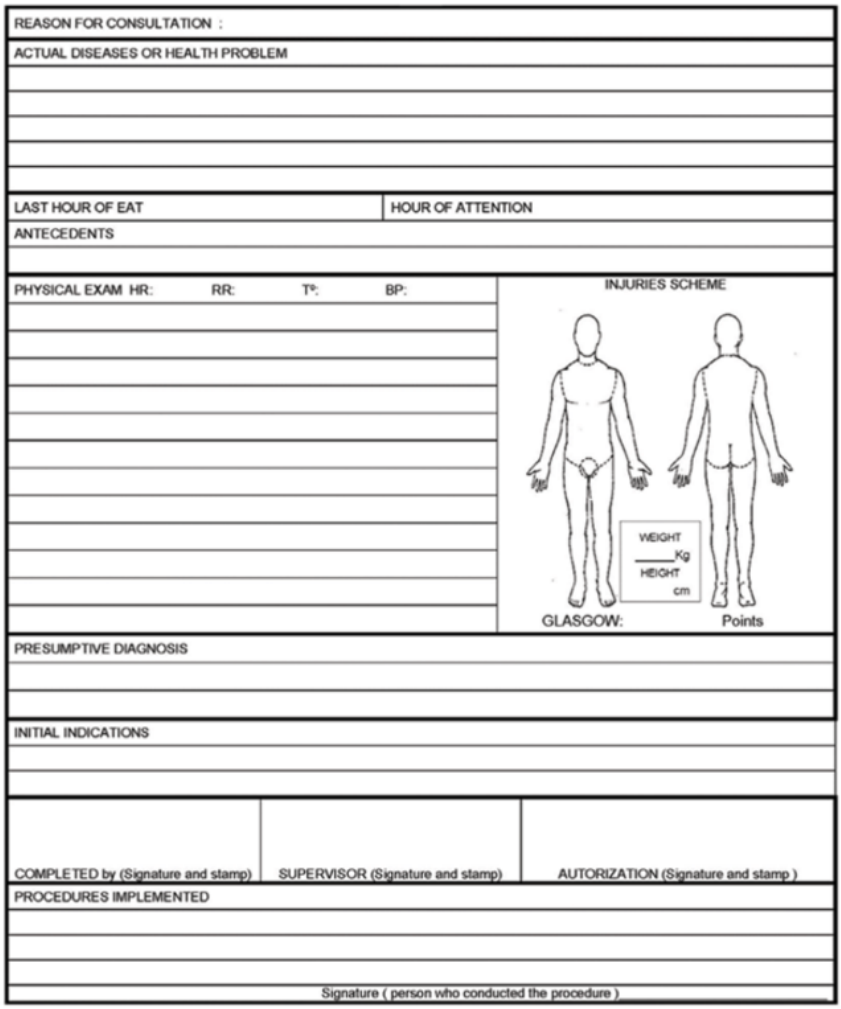


Figure 1.4 Data collection form for PAHO/CDC hospital emergency department-based injury surveillance systems in Colombia, El Salvador and Nicaragua (2000-2006)

1.9.1.2 Organization of American States (OAS) Citizen Security Indicators

The Regional system of standardised Indicators (see Table 1.2) in peaceful coexistence and Citizen Security (RIC) is a project through which fifteen countries and two capital cities of Latin America and the Caribbean, have partnered to improve and compare their statistics on crime and violence (Inter-American development bank, 2017). This initiative has been promoted and financed by the Inter-American Development Bank - IDB through the Regional Public Goods program under the

coordination and execution of the CISALVA Institute at the Universidad del Valle in Cali, Colombia (Inter-American development bank, 2017). The citizen security indicators were designed, reviewed and approved by the project's partner countries, along with established definitions and methodologies for the standardising of the collecting, processing and analysing stages of the information flow in order to support the quality of the data published (Inter-American development bank, 2017). These indicators were reviewed in various regional boards, resulting in the improvement of some of them and the selection of additional citizen security indicators. Some of these were obtained via administrative records and others via surveys. In order to ensure the comparability of the indicators, a standardisation process of concepts relating to the variables of time, place, person and circumstance was developed through regional consensus by OAS stakeholders (Inter-American development bank, 2017).

The implantation and dissemination of the injury surveillance systems throughout South America has seen the need for the standardisation of violence and injury indicators to allow for cross country comparison and regional monitoring and evaluation. The CISALVA institute in Colombia, through several conferences with OAS member states, introduced a Regional System of Standardised Indicators in Peaceful Coexistence and Citizen Security. These indicators currently serve as the gold standard to collect to monitor and evaluate violence reduction.

Table 1.2 22 Citizen Security indicators developed by OAS member states (OAS, 2014)

No.	Indicators
1	Homicide rate per every 100,000 inhabitants.
2	Suicide rate per every 100,000 inhabitants older than 5 years of age.
3	Firearm death rate per every 100,000 inhabitants.
4	Complaint rate for Sex crimes per every 100,000 inhabitants.
5	Rate of complaints of Intrafamily/family/domestic Violence per every 100,000 inhabitants
6	Theft rate per every 100,000 inhabitants.
7	Robbery rate per every 100,000 inhabitants.
8	Rate of Automotive Theft and Robbery per every 10, 000 vehicles registered.
9	Kidnapping rate per every 100,000 inhabitants.
10	Prevalence of sexual violence.
11	Prevalence of Intrafamily/family and domestic violence.
12	Rate of criminal victimization in people older than 18 years of age.
13	Percentage of victimization due to Robbery, in people older than 18 years of age.
14	Percentage of victimization due to Theft, in people older than 18 years of age.
15	Percentage of people with perception of insecurity, in people older than 18 years of age.
16	Percentage of people with perception of risk, in people older than 18 years of age.
17	Percentage of people with perception of fear, in people older than 18 years of age.
18	Percentage of people who justify the use of violence, in people older 18 years of age.
19	Percentage of people with confidence in the institutions, in people older 18 years of age
20	Death rate by Traffic accidents per every 100,000 inhabitants.
21	Complaint rate for child and adolescent maltreatment for every 1000 individuals younger than 18 years of age.
22	Violation rate for driving while intoxicated by alcohol in people over 15 years.

1.9.1.3 Training

Training of staff using the system included classroom training, interactive discussions, and practical exercises, as well as site visits and regional exchange programmes. Basic epidemiology and surveillance techniques and an overview of injury concepts, which emphasised the burden of injuries and societal impact, and definitions, formed the main part of the curriculum (Sklaver *et al.*, 2008).

1.9.1.4 Data collection protocol

A reportable injury case was defined as a patient who was treated during his or her first visit for, or who died from, an unintentional injury or a violence-related injury (Sklaver *et al.*, 2008). Case determination and data collection were done by ED medical staff in each of the participating hospitals in the three countries. The in-country

project coordinators used an Epi Info database (Epi Info version 6, CDC, Atlanta, GA, USA), developed specifically for the project, to monitor injury trends in each hospital and throughout the country. The data shared with relevant stakeholders were used to guide injury prevention campaigns by highlighting the sources of injury that could best be addressed through targeted interventions, and included interventions addressing suicide, gunpowder burns, and bicycle safety (Sklaver *et al.*, 2008).

1.9.1.5 Monitoring, evaluation and action

A PAHO/CDC project officer monitored data collection in respect of the standard core indicators between participating countries (Sklaver *et al.*, 2008). Comprehensive evaluations using established guidelines were completed in 2005 (Concha-Eastman and Villaveces, 2001). In Nicaragua, participating hospitals held annual review meetings with the Ministry of Health to facilitate data sharing and to develop recommendations for system improvement (Sklaver *et al.*, 2008).

Table 1.3 describes examples of campaigns and interventions using data from the hospital-based system in the three countries**.**

Table 1.3 Campaigns and interventions using data from the hospital-based system in three countries

Country	Campaign/Intervention
Colombia	**Road safety campaign**
	Efforts focused on mitigating bicycle and motorcycle crashes, the main cause of injuries in the city of Cali.
	Campaign against gunpowder burns
	The mayor of Pasto used data to lead a 2006 multi-agency media campaign against burns associated with fireworks. Data were used to advocate for a municipal anti-gunpowder regulation, which was passed in 2006.
El Salvador	**Bicyclist injury prevention plan**
	A multi-agency committee comprising the Ministry of Health, the Ministry of Justice, the Ministry of Transportation, the Office of the Mayor, NGOs and high school students used data to design a bicycle road-safety campaign in 2003.
	Campaign against gunpowder burns
	Data were used to inform a multi-agency media campaign against burns associated with fireworks in 2003.
	Establishment of a burn treatment unit
	Injury data were used to advocate for national anti-gunpowder legislation, which was passed in 2004. Combined with the 2003 gunpowder media campaign, it served as justification for the establishment of the Burn Treatment unit at the Benjamin Bloom Pediatric Hospital in 2005
Nicaragua	**Summer prevention plan**
	The Ministry of Health led a national multi-agency program to collect ED-based data on drowning, interpersonal violence and motor vehicle related injuries in the summer time. Key elements included a comprehensive media campaign and additional police patrols focusing on alcohol abuse and speeding. The effort integrated local police and fire officials as well as staff from Nicaraguan hospitals, universities and NGOs.
	Bicyclist injury prevention plan
	A program in the cities of León and Jinotepe relied on injury data to promote road-safety education, helmet use and increased law enforcement activities. The program was supported by the Ministry of Health, the national and local police, the Ministry of Transportation, the Office of the Mayor and several NGOs.
	'Life' campaign
	Data were used to inform a multi-agency suicide prevention campaign led by the Mental Health Department at the University of León.

1.9.1.6 Sustainability

One of the core needs expressed by a number of project participants was the need to obtain the support of the national Ministry of Health to ensure project sustainability as well as to improve the overall data collection and analysis (Sklaver *et al.*, 2008). This

has the additional benefit of initially involving key stakeholders during the project implementation phase rather than after the system is already in place.

PAHO and the Ministry of Health in El Salvador have created an injury prevention program (Programa de Prevención de las Lesiones de Causa Externa) within the national epidemiological unit to provide leadership on national injury prevention strategies (Sklaver *et al.*, 2008). Nicaragua has similarly appointed an epidemiologist at the national level dedicated to injury surveillance, whose sole responsibility is the maintenance and expansion of the nationwide injury surveillance system (Sklaver *et al.*, 2008).

Partnerships with medical and public health schools provide both technical and leadership support in national medical and public health communities (Sklaver *et al.*, 2008). In Colombia, the CISALVA Institute led the effort to translate the WHO's violence-prevention training materials from English into Spanish, and it continues to offer a series of graduate-level courses on violence prevention (Sklaver *et al.*, 2008).

1.9.2 Injury surveillance in sub-Saharan Africa

Few ED-based registries exist in sub-Saharan Africa and those that do are often poorly developed and maintained (Nwomeh, 2006). As such, little or no data are collected on injury in these settings, resulting in the causes and social implications of injuries remaining largely unknown (Mock, 2004).

A simplified system was established in Uganda and Nigeria, where a hospital-based registry was initiated as the first step in establishing an injury surveillance system ((Kipsaina, Eze and Ozanne-Smith, 2015; Kobusingye and Lett, 2000). This program used a minimal dataset in the Mulago and Kawolo hospitals, in the cities of Kampala and Lugazi respectively, where trained staff used a one page, 19-item registry form to collect data on demographics, injury causation, and outcome. This was funded by the United States Agency for International Development (USAID). It demonstrated the feasibility of establishing an effective trauma registry in an urban and rural setting using limited resources, without a sophisticated software package (Nwomeh, 2006). This program has been successfully extended to five large hospitals (60 – 1,200 beds) in Kampala and also in Addis Ababa, Ethiopia (Kobusingye *et al.*, 2002; Taye and Munie, 2003).

South Africa has a system for capturing injury mortality, the National Injury Mortality Surveillance System (NIMSS), which was established in 1998 by a research consortium, and which uses mortuary data to populate a database of injury-related deaths (Matzopoulos, 2005). The NIMSS, which has ceased, was the most detailed source of information on the who, what, when and where" and why" of fatal injuries in South Africa, and was also used for monitoring the effectiveness of prevention initiatives, injury trends and the accuracy of other data sources (MRC, 2015). This system, however, did not capture the full spectrum of the burden of injury in South Africa, particularly the massive public health issue of injury morbidity (Matzopoulos, Bowman, Mathews and Myers, 2010). It was deemed too expensive and logistically challenging for the consortium to establish and maintain without considerable financial and logistical support (Matzopoulos *et al*, 2010).

Based on the success of their registry implementation, Schuurman concluded that trauma registries and a simplified injury severity metric are economically feasible and sustainable in sub-Saharan Africa (Schuurman, Cinnamon, Matzopoulos, Fawcett, Nicol and Hameed, 2011).. Whilst these tools were demonstrated to be important innovations for collecting injury data in low-resource environments, the concept has yet to take hold in many regions (Schuurman, Cinnamon, Matzopoulos, Fawcett, Nicol and Hameed, 2011).

1.9.3 Injury surveillance and situational context in Cape Town, South Africa

There is no specific health programme to address injuries in Cape Town and the Western Cape, despite the fact that deaths due to injury are among the greatest contributors to premature mortality (Groenewald, Bradshaw, Daniels, Matzopoulos, Bourne, Blease, Zinyakatira and Naledi, 2008). According to Penelope Cummins, an European Union consultant in hospital management, Injury is one of the top five health conditions in the Western Cape, along with TB, HIV/AIDS, paediatric respiratory and gastric infections and chronic diseases" (Cummins, 2002). The Western Cape has the lowest overall mortality rate of all nine South African provinces; however, the injury-related death rate is the highest of all provinces (Bradshaw, Nannan, Laubscher, Groenewald, Joubert, Nojilana, Norman and Pieterse, 2006). In fact, traumatic injury is the leading cause of death in the province, being responsible for 23% of total

mortality (163/100 000; Cummins, 2002). The burden of injury varies greatly within the Cape Town Municipality. For example, in Khayelitsha and Nyanga, two of the township communities found on the outskirts of the city, injury mortality rates for males are as high as 333 and 357 per 100 000 respectively (Groenewald *et al.*, 2008). Bradshaw *et al*. (2006) outline the factors that may contribute to such a differential burden of injury among the different areas of South Africa. These factors include different patterns of wealth and development, geographic and environmental factors, and access to health and other basic services.

Current national violence prevention strategies reveal an over-reliance on downstream interventions to diminish the shortcomings of the criminal justice sector (Matzopoulos *et al.*, 2010). Prevention thus prioritises security through increased spending on private security systems and personnel and increased quotas of national and metropolitan police officers (Matzopoulos *et al.*, 2010). Subsequent investment in social welfare services has not been forthcoming, however, and the flawed implementation of the country s Domestic Violence Act, which ideally required an intersectoral response to span the justice, health, welfare and social services, serves as an example in this regard (Mathews and Abrahams, 2001; Parenzee and Artz, 2001). Similarly, the Children s Amendment Act no. 30884 of 2007 makes provision for psychological, rehabilitative and therapeutic programmes for abused children, but funding has primarily been allocated to the medical care of rape survivors (Matzopoulos *et al.*, 2010).

Five-year electoral cycles tend to promote short-term strategies in order to pursue quick fixes and politicise crime and violence by criticising the lack of commitment to effective enforcement (Matzopoulos, Myers, Butchart, Corrigall, Peden and Naledi, 2008).

The structure of government itself promotes a silo-based rather than an intersectoral approach, which creates an environment where several streams of morbidity and mortality data currently produced by the forensic pathology services, emergency clinical services, regional hospitals, and crime data from the South African Police Services (SAPS) are viewed in isolation by their respective departments (Matzopoulos *et al*, 2008). The Western Cape Safety Plan seeks to address this by employing the

use of data and technology to understand violent crime patterns and then inform the deployment of law enforcement resources and investigators accordingly (Western Cape Provincial Government, 2019).Furthermore the Western Cape Government intends to explore partnerships ‘with all implementing partners, practitioners and external researchers to build capacity in analysing and better understanding the impact of the data-led deployment’ (Western Cape Provincial Government, 2019).

There are limited violence and injury data collection systems built into hospitals and clinics in high-risk communities in Cape Town. Past rapid assessment surveys of hospital trauma profiles, which have been completed every six months by the Health Systems Trust (HST) since 2012 and ceased in 2015 (Mureithi, Mureithi, Van Schaik, Matzopoulos, Naledi and English, 2013), have provided valuable insight into violence within these communities. However, these surveys are costly and not sustainable in the long term. A permanent data collection tool is needed - preferably IT-based - as in the electronic trauma health record (eTHR) surveillance tool employed at the Groote Schuur Hospital (GSH) trauma unit (Zargaran, López-charneco, Garcia-rivera, Concha-eastman, Rodriguez and Conte-miller, 2014). Open-source surveillance tools are available to mitigate the cost of using proprietary software. The Hospital Emergency Centre Tracking Information System (HECTIS) is an official electronic application of the Western Cape Department of Health, which follows the flow of patients in an emergency centre from arrival to discharge or admission (Akuaake *et al.*, 2020). This application is currently being implemented at selected hospital within the Western Cape, and could prove to be a valuable data collection tool to support injury surveillance locally.

Efforts to address the burden of violence in the Western Cape require a multi-sectoral approach that spans the criminal justice, health and infrastructural domains (Matzopoulos *et al.*, 2010). The development of programme documentation and evaluation is important in driving long-term investment, ensuring effectiveness and enabling replication of successful programmes. Evaluation should, wherever possible, include the measurement of behaviour change or actual changes in injury rates (Matzopoulos *et al.*, 2010).

The institutionalisation of reliable injury surveillance and scientific research should be an integral part of any large-scale prevention strategy (Matzopoulos *et al.*, 2010). The

city of Bogota in Colombia, where high homicide rates were mainly firearm-related, as they are in the Western Cape, saw a significant decline in homicide rates between 1994 and 2004 (82–28 deaths per 100,000 population). This has been directly attributed to the programme s institutionalisation within the local government, which championed intersectoral principles in prioritising social development and cohesion, political empowerment, and investment in public infrastructure (Guerrero, 2006). These interventions were driven by an accessible evidence base and supported by reliable injury surveillance data (Guerrero, 2006). The strategic deployment of resources to interventions that systematically targeted high-risk times, places and activities, were in turn evaluated, refined and improved through ongoing epidemiological monitoring (Guerrero, 2006). The efficacy of this programme, based on observational study evidence, led to the implementation of similarly structured interventions in five other Colombian municipalities, and local evaluations have suggested that these interventions have led to significant reductions in homicide (Gutierrez-Martinez, Del Villin, Fandiño and Ronald L Oliver, 2007). This new system, employed in Colombia, which expanded on the foundations of an injury surveillance system which were limited to Emergency Department health data collection, now took a more comprehensive approach that focused on different types of violence-related data from multiple sources (including the SAPS, Emergency Medical Services [EMS] and Fire And Rescue Services [FARS]) and multiple stakeholders (including emergency service responders, local government and academics), working together to inform violence reduction.

Following the development of several violence and injury observatories (VIOs) around the world in high violence regions, the routine use and analysis of multiple sources of complementary data has shown some positive effects in contributing to violence prevention (Florence *et al*., 2011; Gutierrez-Martinez, Del Villin, Fandiño and Ronald L Oliver, 2007; Gutiérrez, Pacheco, Juárez, Palacios and Cerqueira, 2012; Quigg, Hughes and Bellis, 2012), although the lack of rigorous research data precludes the outright attribution of observatories contributing significantly to the reduction in violence (Sklaver *et al*., 2008). The analysis of violence and injury data needs to be comprehensive in terms of both collection and analysis, as well as highly contextualised, in order to facilitate an improved and appropriate response to local violence prevention efforts. The VIO's main objective is to propose strategies and

public policy recommendations to prevent and control violence and injuries, and it benefits from data acquired through a multi-sectoral, multi-disciplinary approach (Gutiérrez, Pacheco, Juárez and Palacios, Luis Alexandro Cerqueira, 2012), which are brought together to yield useful, timely and robust data for action.

1.10 Observatories for violence and injury

The meaning of the word ‘observatory’ has expanded recently from its origins in astronomy to that of specialised informational repositories and knowledge building centres, housing cross-referenced databases with advanced analytic and research capacities (Gutierrez-Martinez *et al* 2007). The crime and violence observatories developed in Colombia aim to maximise inter-institutional cooperation, information-sharing, analysis and security policy development initiatives to enhance governance (Gutierrez-Martinez *et al* 2007). The model is similar to those proposed on a broader level by the International Scientific and Professional Advisory Council of the United Nations at the Eleventh United Nations Congress on Crime Prevention and Criminal Justice (United Nations, 2005).

An observatory is primarily a tool to support the authorities in formulating effective responses to citizen safety and security issues (OAS, 2009). It is a centre dedicated to systematising information from different sources to produce periodic analyses or studies, in order to show the development of crime and violence in a given area (OAS, 2009). According to research completed by the International Crime Prevention Centre (ICPC), an observatory must meet at least three basic criteria: collection of data, analysis of data and public dissemination, which is directed toward preventing crime and violence at the local and regional level.

1.10.1 Conceptual framework for the Observatory model

The concept of an urban observatory (Figure 1.5) has been developed to address the obstacles presented by the complex network of health determinants in urban settings, and the often dispersed and uncoordinated nature of data at the local level (Ross, Matte and Kitson, 2011).

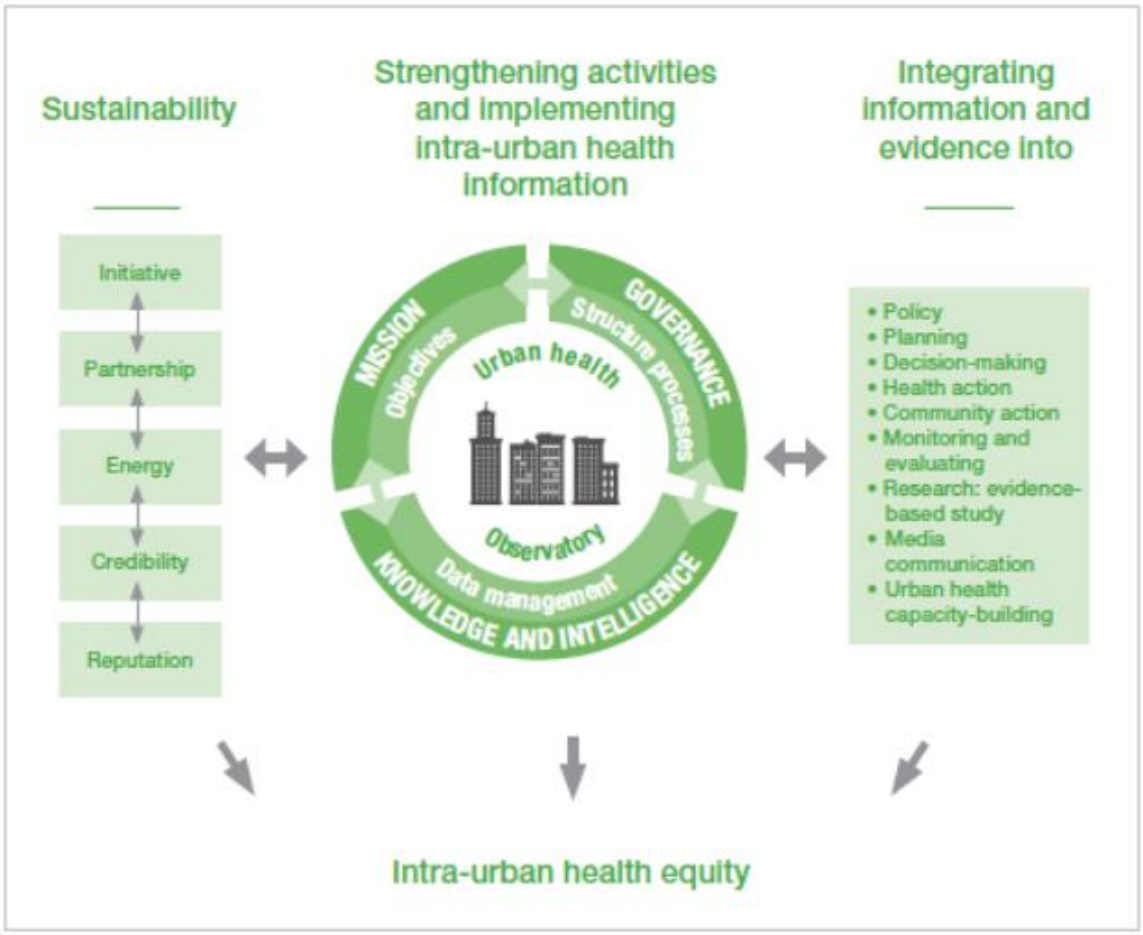


Figure 1.5 The Observatory framework (Caiaffa, Friche, Dias, Meireles, Ignacio, Prasad and Kano, 2014, pp. 13)

Observatories are intended to act as a focal point for urban monitoring by assembling, analysing, and producing information on health outcomes and their broad range of determinants. They also mobilise a network of actors/stakeholders to take action on the wider determinants of health through better-informed policies (Caiaffa *et al* 2014). Their focus is on generating information and knowledge for evidence-based health policy and decision-making" (PAHO, 2009; Ross, Matte and Kitson, 2011; Vlahov and Caiaffa, 2012). They work to monitor health trends, identify gaps in health information, provide guidance on appropriate methods, assemble data from different sources, and integrate population-based data (e.g., vital statistics, censuses, and social-demographic surveys) and institution-based data from within and outside the health sector (Figure 1.6) (Caiaffa *et al.*, 2014).

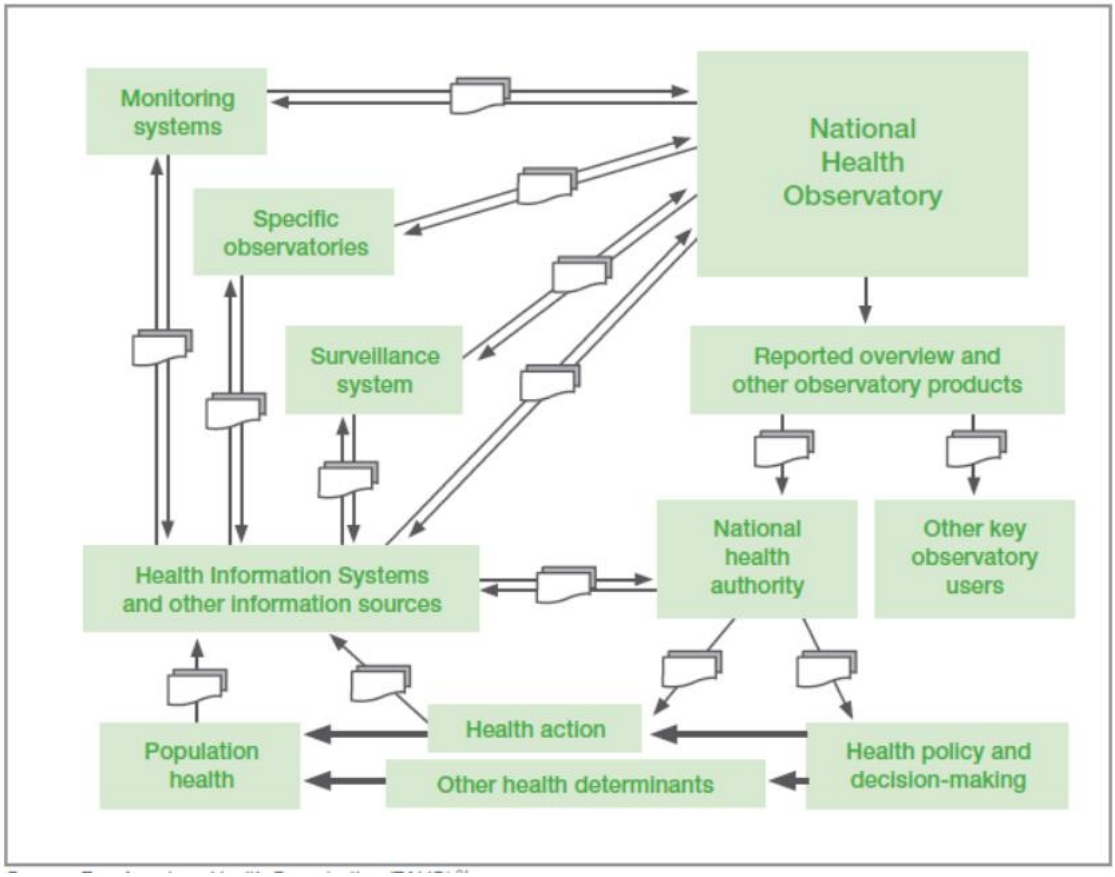


Figure 1.6 The role of a specific observatory within a national health reporting system (PAHO, 2009, p. 19)

The violence and injury observatory model was also developed within the framework of community-oriented policing and decentralisation (Gutierrez-Martinez *et al*, 2007). Community oriented policing follows a philosophical trend adopted from earlier European practices and adapted to North America during the early 1970s (Gutierrez-Martinez *et al*, 2007). Community oriented policing refers to the systematic support for a more cohesive, responsive, interactive, and user-friendly relationship between law enforcement agencies and communities. It relies on a strategy that generally seeks to open lines of communication with the community, to produce information-sharing initiatives and to improve the quality of the information obtained (Gutierrez-Martinez *et al*, 2007).

1.10.2 Evidence of effect

Despite the proliferation of various observatory models, there is little published research on their effectiveness in producing or stimulating the production of

demonstrable social change and decreased levels of violence and crime (Gutierrez-Martinez *et al*, 2007). Jabar *et al*. (2015) published the first systemic review protocol to investigate the effectiveness of observatories in reducing violence, entitled Effectiveness of violence and injury observatories in reducing violence in an adult population (Jabar, Barth, Matzopoulos and Engel, 2015a). The protocol objectives are described in Chapter 3.

1.10.3 Observatory types

There are various types of observatories, including governmental, university or mixed/joint ones (OAS, 2009). Observatories can operate on different levels that include local, regional, national and international (Figure 1.6). There are also generalist observatories (on violence, security, crime, etc) or thematic ones (on school violence, domestic violence, trafficking in goods, trafficking in persons, organised crime, etc.) (OAS, 2009). Furthermore, there are centres that perform the same work as an observatory but that are not necessarily called observatories. Currently, there are 27 global observatories disseminating research on best practices, policies and programming for democratic governance (see www.cites-localgovernments.org), numerous public health observatories, including a EU observatory on health systems and policies (see www.euro.who.int), a global urban development observatory sponsored by the United Nations (see www.unhabitat.org), as well as numerous local, regional, national and international observatories addressing crime and security measures (see www.unicri.it.wwd/security, www.humansecuritygateway.info and www.ocdbgroup.net) (Gutierrez-Martinez *et al*, 2007).

1.10.4 Historical background of the violence and injury observatory model

Between 1993 and 1996, Cali's mayoral administration in Colombia instituted a programme of development, security and peace, referred to by the acronym of DESEPAZ (Gutierrez-Martinez *et al*, 2007). This programme applied a public health perspective to issues of violence prevention and intervention that was influenced by the mayor's background in epidemiology (Gutierrez-Martinez *et al*, 2007). The information was subsequently validated, supplemented and utilised in weekly meetings of the city's security council, whose primary focus was citizen security

issues; however, the council also sought to improve the coordination and efficiency in the use of resources (Gutierrez-Martinez *et al*, 2007).

Following a thorough review of the data, further statistical analysis led to subsequent policy planning and coordinated intervention efforts by civil authorities (Gutierrez-Martinez *et al*, 2007). Additionally, steps were initially taken to improve police functioning through the provision of pay increases, educational opportunities and housing construction incentives (Sklaver *et al.*, 2008). These initiatives would provide the initial framework for later developments of the violence and injury observatory model.

Within the area of international prevention trends, there has been a growing interest on the part of governments, municipalities, research centres, civil society and international organisations in creating observatories or analytical tools for security-related problems. This includes but is not limited to school violence, domestic violence, drug use and social and gender violence (Prince, 2009).

1.10.5 Structure and performance of the observatory model

Figure 1.7 illustrates the administrative structure of the Juarez municipal violence and injury observatory whilst Figure 1.8 describes the functions, information sources and management of such an observatory.

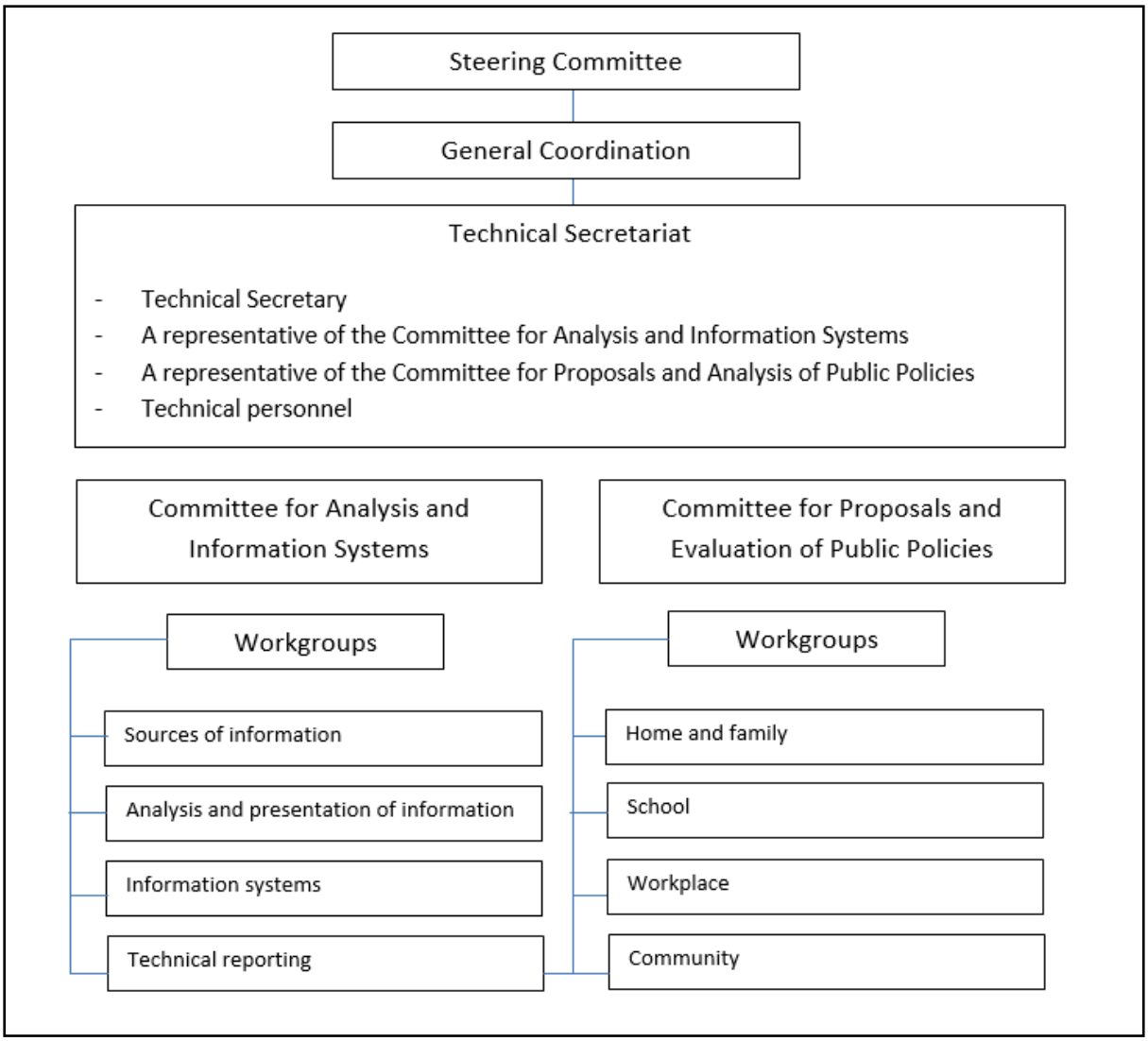


Figure 1.7 Example of the administrative structure of the Juarez municipal Observatory (Gutiérrez, Pacheco, Juárez and Palacios, Luis Alexandro Cerqueira, 2012, p. 367)

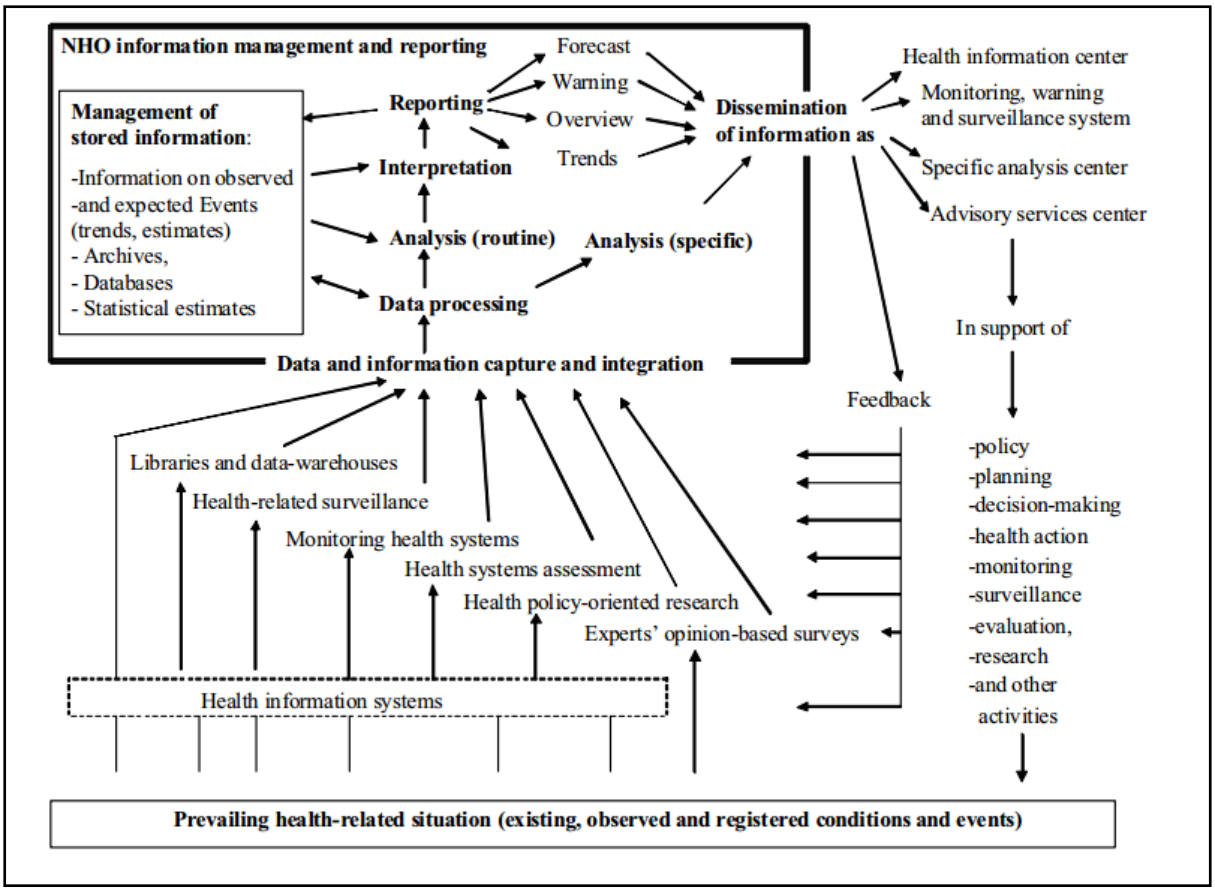


Figure 1.8 Observatory functions, information sources and management (PAHO, 2009, p. 17)

1.10.6 Collection, integration and storage of secondary data and information

Data collection and storage is a vital function of the observatory, which may additionally serve as a historical repository. A predefined set of contents and a list of data and indicators can be adopted from those used in international initiatives (Norwegian Ministry of Foreign Affairs, 2010; OAS, 2011). Data quality and completeness could be different at different administrative levels, and across different geographical areas and specific systems, with the quality of information collected by the observatory depending on how the different sources have integrated and consolidated the information (PAHO, 2009).

Agreement on information sharing facilitates the systematic flow of data between information sources and the observatory central management unit. Once the observatory is fully functioning, there will be important data and information gradually

accumulated and electronically stored. This will increase the capacity of the observatory to manage historic data and estimate the tendencies of key indicators (PAHO, 2009). Textual information, databases, historical trends in data and indicators, profiles, reports and other will thus convert the observatory into a powerful information and knowledge management centre (PAHO, 2009).

1.10.7 Data analysis

The range of multi-sectoral, multi-disciplinary sources of information may be analysed using quantitative and qualitative analysis methods for the purposes of (a) identifying patterns and trends in the incidence of violence over time, (b) monitoring and evaluating interventions and policies, (c) understanding the causes and determinants of violence and (d) developing a set of common indicators and standardised definitions (OAS, 2009).

Advanced data analysis methods for surveillance data include space-time clustering, time-series analysis, geospatial analysis, life tables, logistic regression, trend and small area analysis and methods for the forecast of epidemics based on surveillance data (Choi, 2012). Statistical analysis can be performed by the central team of the observatory or by external groups, such as those working in monitoring and surveillance using user-friendly software, such as Epi-Info or SPSS®.

1.10.8 Reporting and dissemination of information and knowledge and evaluation

The objectives of the dissemination of information are to: (a) inform stakeholders of important issues and trends, (b) influence public policy, (c) develop evidence-based interventions and policy recommendations, and (d) assist collaborating agencies and other stakeholders to improve their operations and understanding of the issues, based on the provision of an up-to-date, reliable evidence base (Department for International Development, 2013).

The communication of information to contributors and users of surveillance data is integral to program planning and decision-making. Examples of users include public health practitioners, health planners, epidemiologists, clinicians, researchers, policy-makers, data collectors, members of the public and the media (Chambers, Ehrlich, O'Connor, Edwards and Hockin, 2006). Different communication channels exist; these include formal surveillance reports or bulletins, annual reports, teleconferences with

partners, media conferences, media releases, and public advisories (Chambers *et al.*, 2006).

In order to reach its proposed objectives, every surveillance system should be evaluated periodically (CDC, 1988). Detailed guidelines for the evaluation of such public health surveillance systems are given in the CDC guidelines literature (CDC, 2001).

1.10.9 Global proliferation of the VIO model

The Geneva Declaration on Armed Violence and Development adopted in 2006, endorsed by more than 100 countries, commits signatories to “support initiatives intended to measure the human, social and economic costs of armed violence, to assess risks and vulnerabilities, to evaluate the effectiveness of armed violence reduction programmes and to disseminate knowledge of best practices”, (Gilgen and Tracey, 2011, p. 9), which describes the core functions of violence and injury observatories with respect to violence-related data, in supporting data collection, data analysis and data dissemination. Furthermore, the observatory model is proposed on a broader level by the International Scientific and Professional Advisory Council of the United Nations at the Eleventh United Nations Congress on Crime Prevention and Criminal Justice (United Nations, 2005).

Several factors have contributed to the global growth and expansion of the VIO model, including the lowered cost of working with and analysing large datasets, the growth of public health surveillance systems and the expansion of ICT infrastructure in the developing world (Alliance for Health Policy and Systems Research, 2004).

1. CHAPTER TWO:

STUDY ONE: THE ESTABLISHMENT OF THE CAPE TOWN VIO

This section has been published in part in the following peer-reviewed journal:

Jabar A, Oni T, Engel M, Cvetkovic N, Matzopoulos R. Rationale and design of the Violence, injury and trauma observatory (VITO): The Cape Town VITO pilot studies protocol – BMJ Open 2017, **http://dx.doi.org/10.1136/bmjopen-2017-016485**

2.1 Background

Within Cape Town, there exists a context of (1) high rates of morbidity and mortality due to violence and injury, with preliminary initiatives to set up surveillance thereof, and (2) access to multiple sources of health and non-health data.

However, these data sources, which include reports on homicides, and violence-related injury, lack an interface to enable sharing across platforms, nor are they used in an integrated manner to prevent violence and/or reduce public health harm.

At the core of the problem is the lack of synchroneity across the datasets, each using assorted units of collection and formats over different time periods at varied levels of aggregation. This scenario of scattered and faulty information makes it difficult to understand fully the magnitude and characteristics of the different types of violence, their roots, and the mortality burden. Critical data on violence from different sources are not shared, and established hospital injury surveillance systems are not utilised within high violence areas, thus hindering a comprehensive analysis of violence and injuries, particularly in those contexts.

Timely compilation of evidence for policy and decision makers is vital to ensure the implementation of appropriate programmes. The lack of multi-sectoral, comprehensive, and timely information hinders progress at improving efforts to prevent events leading to common acts of violence, such as intimate partner violence, violence against women, child sexual abuse and gang violence.

2.2 Study rationale

The rationale for this thesis was based on the association between violence observatories and reductions in violence and injuries in other low to middle income country (LMIC) settings. Given the high rates of interpersonal violence in South Africa, and particularly in the Western Cape, where the provincial government has identified several high-risk communities (including the study site of Khayelitsha), this study looks specifically at these areas. Better quality data and improved analyses are necessary to improve violence prevention efforts overall through appropriate allocation of resources among these high-risk areas.

The Cape Town VIO study is a collaborative initiative that aims to establish the first violence and injury non-conflict registry in Africa, with one of its main objectives being to collect comprehensive clinical, police and forensic data for violence and injury in the City of Cape Town. The Cape Town VIO will serve as a platform for further investigations including the analysis of the current context and evaluation of violence prevention interventions for the Western Cape.

2.3 Study design and setting

This is a prospective, provincial, multicentre, university- based registry involving centres in the Western Cape, many of which are signatories to the integrated provincial violence prevention policy framework, which provides the overarching policy framework for the Western Cape Government's violence prevention initiatives, focusing on key strategies to be adopted in preventing violence in the Western Cape. The Cape Town VIO seeks to document the prevalence, incidence, nature, type and location of violence-related injury in the Western Cape.

The pilot phase will focus on the Western Cape community of Khayelitsha. Khayelitsha is a peri-urban township with mixed formal and informal housing, with a population of approximately 400 000 people. It is one of the poorest areas of Cape Town with a median average income per family of ZAR20 000 (US$1872) a year compared with the City median of ZAR40 000 (US$3743) (World Bank, 2018)). Approximately half of the 118 000 households found within Khayelitsha are informal dwellings (World Health

Organization, 2014). Khayelitsha police precincts routinely document the highest homicide rates in the country (SAPS, 2016).

2.4 Objectives of the pilot VIO

As discussed in the literature review, the core functions of the VIO include: (1) the collection, integration and storage of secondary data and information; (2) data analysis; and (3) the reporting on, and disseminating of, information and knowledge. These functions will serve to support the surveillance objective of the pilot VIO which are:

1. To collect demographic, injury and location data from cases of violence and injury in the community of Khayelitsha
2. To determine factors that influence violence and injury in the local context
3. To evaluate ongoing violence prevention interventions in the Western Cape
4. To conduct studies that contribute to the growing body of knowledge informing violence prevention intervention.

2.5 Study eligibility

Participants for this study will include all persons who are located within the catchment area of the observatory who are within the scope of interpersonal violence, including the research subcategories of elder abuse, sexual violence, intimate partner violence, violence-related injury and homicide.

2.6 Data collection

The study will rely on secondary data collected from routine systems and recent violence and injury research conducted in Khayelitsha. A sample of data sources and indicators intended for use in the pilot study are described in Table 2.1. Secondary data formats include but are not limited to e-surveys, electronic records and public access websites. Clinical and non-clinical violence-related data will be entered into the

Cape Town VIO registry. In addition, a retrospective collection of violence and injury secondary data will be made in order to form a historical database, to allow for retrospective data analysis and time-trend analysis. Robbery data is important to this work and included if it has an interpersonal violence component.

Table 2.1 Sample of data sources for proposed VIO

Data source	Description
Health systems trust (HST)	**Repeated cross-sectional studies**
	This rapid assessment (RA) of the injury morbidity burden at health services in three high violence communities in the Cape Town Metropole was conducted in Khayelitsha, Nyanga and Elsies River. Data was simultaneously collected (24 hours per day) at six facilities, from the 27th of September 2012 until the 4th of October 2012. Injury data specific to Khayelitsha was collected from the Khayelitsha Day Hospital (KDH), Site B CHC and the Michael Mapongwana CHC.
	Recorded measures include patient demographics, pattern of injury, location and time of injury.
Violence prevention through urban upgrading (VPUU)	**Population and household-based rolling surveys**
	The survey was conducted between September 2012 and July 2015 time period by the Violence prevention through urban upgrading (VPUU) project. A total of 1500 dwellings were visited. 1200 of these were randomly selected from Khayelitsha and 300 were randomly selected from the Gugulethu-Nyanga areas. The sample of 1200 dwellings was drawn from GIS data of dwelling units in the designated study area in Khayelitsha.
	Recorded measures include the experience of violent crime as reported by the residents of Khayelitsha, household demographics and location.
Forensic pathology service (FPS)	**Provincial mortality registry**
	The Forensic Pathology Service is mandated by the National Health Act 61 of 2003 law to investigate all Unnatural Deaths(Government, 2003). FPS uses existing medico-forensic investigative procedures. Services of the Forensic Pathology Service pertinent to the collection of data for this study include the provision of mortality data to relevant stakeholders to inform research and prevention strategies, which is a shared goal of the observatory.
	Recorded measures include victim demographics, pattern of injury and incident location, time and context of incident.
South African Police Service (SAPS)	**Public access database**
	Homicide and injury-related crime data (e.g. assault) available through two public access websites (saps.gov.za; https://www.issafrica.org/).
	This dataset includes homicide count within Khayelitsha with data available within the three police precincts that constitute the Khayelitsha policing area for the period 2000 to 2012.
	Robbery data
	Residential robbery data available through Witwatersrand University research affiliation

2.7 Analysis plan

The information to be collected included (but not be limited to) participant demographics, mechanism of injury, victim perpetrator relationship, alcohol and drug use and location of robbery, injury and homicide among others. To protect the privacy of patients, a file will be created that will have no specific identifiers. Analysis will be conducted using Stata V.11.2. Descriptive statistics and time-trend analyses will be used to describe the epidemiology of violence and injury for the community of Khayelitsha. Geographical information systems (GIS) software will be used to plot the incident address as well as the address of victims of violence with regard to journey to injury studies. Analysed violence and injury data will employ GIS-related products to visualise appropriate datasets. Identified high-risk areas will undergo environmental hot spot scans to determine the role of natural and built environmental factors in contributing to the burden of interpersonal violence, and its consideration when developing interventions. In terms of data integration, the data matching study (Chapter 6) only matches names to identify overlap in health and police cases, without linking the records. As per the guidelines of the Cardiff data sharing model, only anonymised data is used and data is aggregated and shared in a one-month delay to the stakeholders(Violence research group, 2018). By aggregating the data, removing personal identifiers, geolocating cases to residential suburb and not street address, and employing a one-month delay of data dissemination, every technical effort is made to prevent the identification of individual cases and protect individual identity. Furthermore, the VIO data practices are guided by National legislation in the form of South African Protection of Personal Information Act (POPI), and all research is reviewed and granted permission by the UCT Human Research Ethics Committee.

2.8 Ethics

An application for ethical approval to collect injury mortality data from the selected provincial state mortuaries and non-fatal injury data from the Khayelitsha Day hospitals and other relevant data stakeholders was granted by the University of Cape Town’s Human Research Ethics Committee (UCT HREC REF: 861/2016) (Appendix

1). This includes an application to establish a registry for the collection of violence and injury-related data titled 'the Cape Town VIO registry' (UCT HREC REF: R043/2016) (Appendix 1). Data drawn from other sources and research projects will seek ethics approval from their governing bodies accordingly, with applications for these datasets made to the National Health Research Database via its online portal (https//:nhrd.health.gov.za/). Respect for autonomy of the study participants are maintained as all identifiers for the different data sets used are removed, to protect study participants. This includes aggregated data from the SAPS which will also have all identifiers removed to protect participants against criminal liability. In terms of non-maleficence, this study involves the analysis of secondary population data so that no anticipated harm is expected to the individual. As well as observing strict data privacy protocols, this study will be fully compliant with the Protection of Personal Information Act 4 of 2013 which regulates the processing of personal information.

2.9 Dissemination plan

We intend to disseminate our findings among stakeholders within the local government safety cluster which represents, inter alia, the police service, FPS; non-governmental organisations (NGOs) working within the violence prevention sector, and local communities through the SAPS and Violence Prevention through Urban Upgrading (VPUU) community forums. Additionally, findings and updates will be disseminated to collaborators, researchers, health planners and colleagues through peer-reviewed journal articles, conference publications and proceedings. Findings from this work will serve to (1) inform stakeholders of important issues and trends, (2) influence public policy, (3) develop evidence-based interventions and policy recommendations and (4) assist collaborating agencies and other stakeholders to improve their operations and understanding of the issue based through provision of an up-to-date, reliable evidence base.

2.10 Conceptual approach and knowledge framework

The Public Health Approach will be used as a conceptual framework. This PhD will contribute to:

Step 1 of the Public Health Approach: Define the problem by doing the following:

- Merging health and police datasets for characterising interpersonal violence in the community of Khayelitsha

- Identifying predictors among injured patients for not reporting violent assaults to the police in the community of Khayelitsha

Step 3 of the Public Health Approach: Developing, implementing and evaluating intervention strategies by doing the following:

- Identifying the optimal, validated violence and injury indicators, datasets and research priorities as well as making recommendations on the structure and practices of a VIO, for inclusion in a pilot VIO for the city of Cape Town.

- Assessing the effectiveness of violence and injury observatories globally in reducing violence in an adult population, thereby assessing the effectiveness of such VIOs as an intervention.

2.11 Research questions

The research question examined in this study is: Can a violence and injury observatory (VIO) be constituted from available clinical and non-clinical datasets in Cape Town?

Sub-questions:

- Is the implementation of VIOs associated with a reduction of violence in adult populations?

- What are the core violence and injury indicators, datasets and research priorities required to build a VIO?

- How does a pilot observatory perform in a local setting?

2.12 Objectives

In order to answer the above questions, the following objectives were formulated:

Objective of this thesis:

1) To assess the validity and utility of VIOs in reducing violence and violence-related harm in adult populations

2) To identify the optimal data elements for inclusion in a VIO according to expert consensus for the City of Cape Town

3) To determine the concordance between violent crimes reported to the police with violence-related injuries presenting at health facilities in the community of Khayelitsha

Study Two (systematic review) of this thesis relates to objective 1; Study Three (Delphi study) to objective 2 and Study Four (matching study) to objective 3.

2.13 Thesis outline

Figure 2.1 describes the thesis outline.

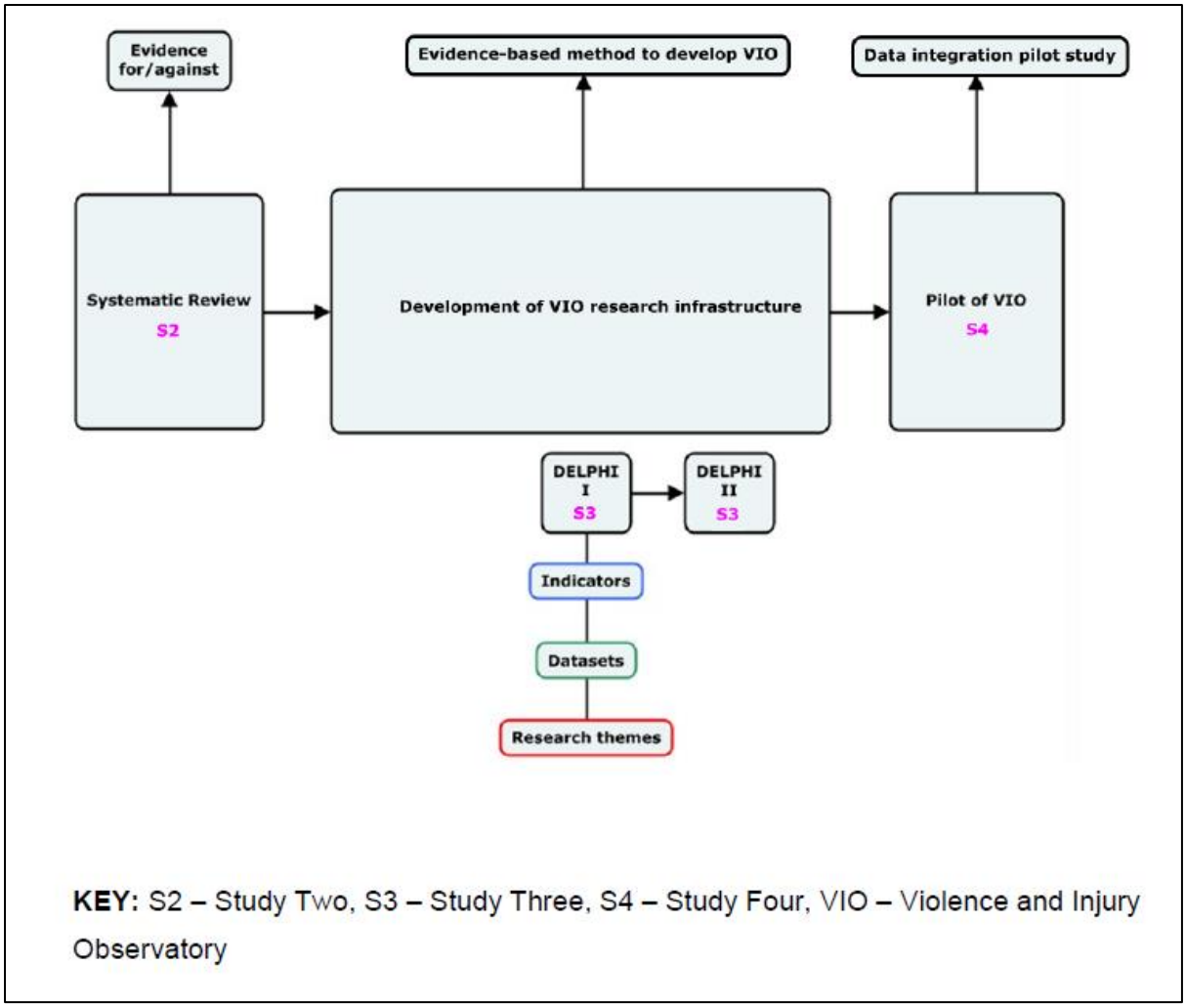


Figure 2.1 Thesis outline

The Cape Town VIO study through data collection and storage, data analysis and data dissemination, represents the first attempt to collect contemporary and comprehensive data on violence and injury in the Western Cape. The study will serve to quantify the burden of violence and injury, document the prevalent subtypes of interpersonal violence presenting in the respective communities and, provide information that could inform the development of violence prevention interventions, future research programmes and policy development, all of which have the potential to improve the management of, and prevention of, violence and injury in the Western Cape.

Detailed methods are outlined in the following chapter.

2. CHAPTER THREE:

METHODS

In this chapter, I will be describing the methods used in the inter-linked studies contained within this thesis. I will first provide a brief background followed by a discussion of the detailed approaches used in each of the three analytic studies. Figure 3.1 highlights the thesis objectives and methods in parallel steps.

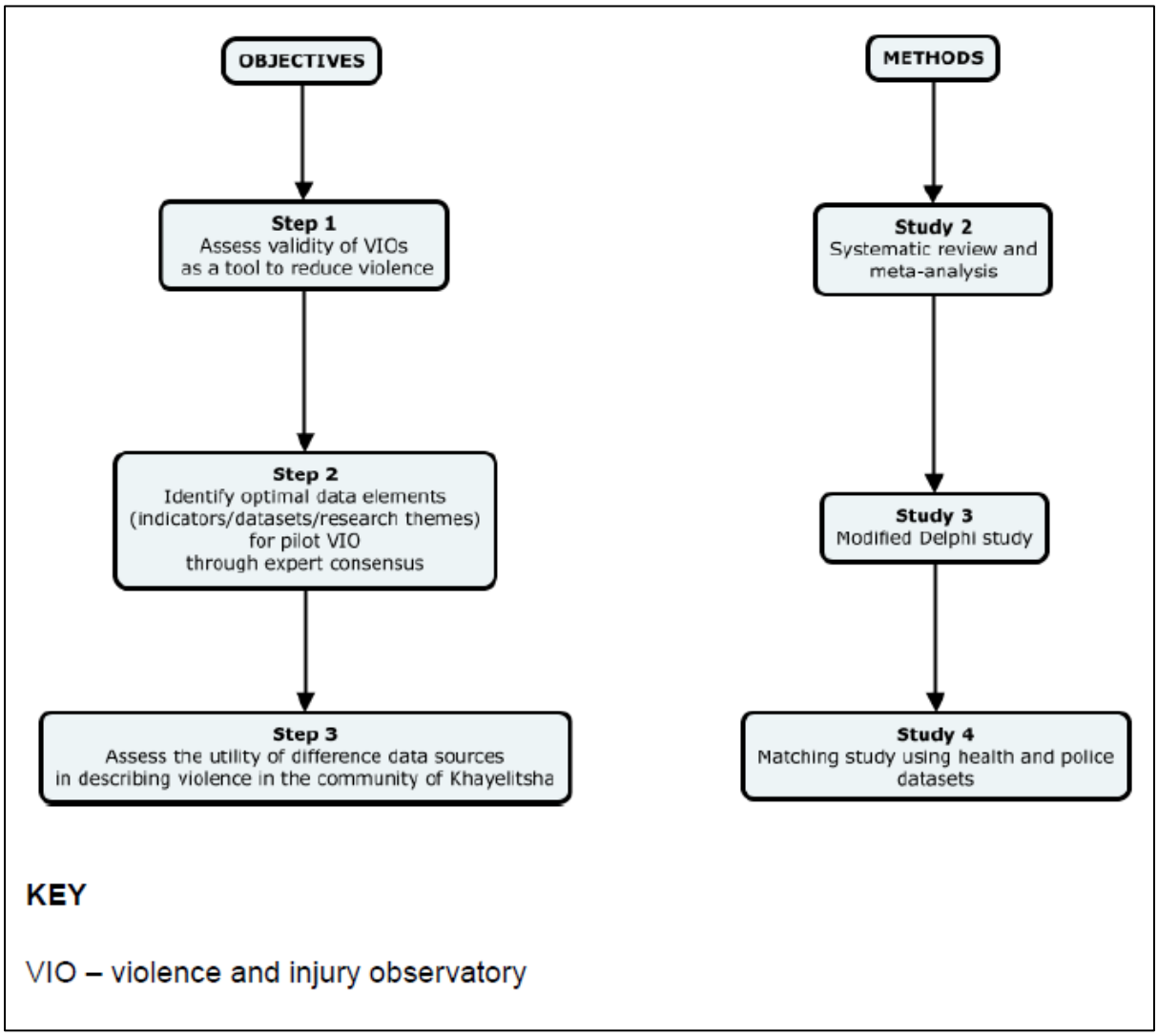


Figure 3.1 Thesis objectives and methods flow diagram

3.1 Systematic review: VIOs as an intervention to reduce violence in adult populations (Study Two)

This systematic review has been published in part in the following peer-reviewed journal:

Jabar A, Fong F, Chavira M, et al. Is the introduction of violence and injury observatories associated with a reduction in violence-related injury in adult populations? A systematic review and meta-analysis. BMJ Open 2019; 9:e027977. doi:10.1136/ bmjopen-2018-027977

This review protocol has been published in the PROSPERO International Prospective Register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO), registration number 2014: CRD42014009818.

The section describes the methods used in the systematic review (Study Two).

3.1.1 Background

The purpose of violence and injury observatories is directed towards preventing crime and violence at local and regional levels. Key strategies to achieve this end include maximising inter-institutional cooperation, information-sharing, analysis and security policy development initiatives to enhance governance. Violence and injury observatories have been developed in Colombia and throughout the Americas and Western Europe.

For more a detailed review of observatories, please see Section 1.10 of Chapter 1.

To date, there has been no systematic review of the literature to present a succinct review of the evidence for the effectiveness of violence and injury observatories in preventing violence. We therefore sought to summarise the results from existing studies reporting on the effectiveness of the introduction of violence and injury observatories.

This review protocol (Jabar *et al.*, 2015b) has been published in the PROSPERO International Prospective Register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO), registration number 2014: CRD42014009818.

3.1.2 Criteria for considering studies for this review

3.1.2.1 Type of studies

We included non-randomised controlled trials, quasi-experimental designs, prospective and retrospective cohort studies, controlled before-and-after (CBA) studies and cross-sectional studies. Studies performed in general or specific populations and in hospitals or clinics were included. Additionally, we sought to include studies performed in any country and published in any language.

3.1.2.2 Types of participants

Participants for this study included adults ≥ 18 years of age who are located within the catchment areas of the observatory study sites.

3.1.2.3 Types of interventions/exposures

For purposes of the systematic review, we have used the term ‘observatory’ to denote a surveillance system that collects data from multiple sources. Examples include crime data from policing sources and injury data from clinical and forensic sources. In contrast, injury surveillance systems almost exclusively focus on the use of injury data from clinical sources. We included observatories/injury surveillance systems that address violence prevention and whether these reduce violence in adult populations. All surveillance systems that focus specifically on the collection of violence and injury data were included in this review.

3.1.2.4 Types of comparisons

Controlled populations were extracted as presented in the respective articles. Control data were drawn from pre-intervention figures as specified by the authors. Where no data were supplied or documented, we extrapolated pre-intervention information from cities with a similar population size and make-up within the surrounding regions.

3.1.2.5 Types of outcome measures

Violence is defined as the intentional threat or use of physical force against oneself, another person or a group or community that results in injury, death, psychological harm, maldevelopment or deprivation (WHO, 2010b). The former category includes child maltreatment; intimate partner violence; and elder abuse, while the latter is broken down into *acquaintance* and *stranger* violence and includes youth violence; assault by strangers; violence related to property crimes; and violence in workplaces and other institutions. Suicide is included as a form of self-directed violence but will not be the focus of this thesis. The outcome measures are based on the Organization of American States (OAS) regional system of standardised indicators in peaceful coexistence and citizen security (OAS, 2014), as they represent the largest member organisation of crime and violence observatories worldwide, and included measures obtained by administrative record or surveys.

3.1.2.6 Primary outcomes

Primary outcomes included murder/homicide, suicide, transit death, unintentional injury death, sexual violence and intra-family/family/domestic violence (OAS, 2014).

3.1.2.7 Secondary outcomes

Secondary outcomes included aggravated assault, crime victimisation and the perception of insecurity, fear or risk (OAS, 2014). The inclusion of other categories of violence (e.g., suicide) and non-violent injuries (e.g., transit injuries) are important components of an "all-injury" surveillance system that are collected for reasons of practicality and cost effectiveness, however they are not the primary interest.

3.1.2.8 Patient and public Involvement

Patients and/or public were not involved in this research.

3.1.3 Search methods for identification of studies

The search of databases and grey literature was performed by AJ with the help of the University of Cape Town Health Sciences' librarian, to identify all relevant studies available at October 2018, regardless of language or publication status. Peer-

reviewed journal articles and grey literature (postgraduate theses, unpublished, internal or non-reviewed papers and technical reports) were also searched. Search terms included combinations of keywords relating to violence and crime, and prevention and control (Table 3.1).

Table 3.1 Sample search strategy, modified as needed for use in other databases

Search PubMed #1 (violence and injury observator*) OR (injury surveillance system) OR (crime observator*) #2 (“domestic abuse*” OR “physical abuse*” OR “partner abuse*” OR violent OR violence OR assault OR homicide OR gang OR gangs OR gang violence OR bully OR aggression OR aggressive OR robbery OR assault OR GBH OR contact crime OR interpersonal violence OR murder OR homicide OR aggravated assault OR robbery OR suicide OR transit death OR non intentional death OR kidnappings OR theft OR robberies OR rape OR sexual crimes OR assault OR physical violence OR aggression OR sexual violence OR violent crime OR violent crime conviction) #3 (prevention OR preventing OR prevent OR reduction OR reduce OR decrease OR decreased OR decreasing OR decline OR declining OR control OR controlling OR impact OR effect OR effects OR affect OR affecting OR affects OR change OR changing OR changes OR intervene OR intervention) #4 adult #5 #6 #1 AND #2 #3 AND #4

MeSH, medical subject heading.

The strategy outlined here was specifically for searching the PubMed database, and was modified for use in other databases.

We searched the following electronic databases: Pubmed, Sociological abstracts and International bibliography of the social sciences (IBSS) and Education sources information centre (ERIC) via Proquest, PsycINFO and Cumulative index to nursing

and allied health literature (CINAHL) and Humanities International via Ebscohost, SCOPUS, Cochrane Collaboration, Campbell Collaboration, Social Care Online, National Criminal Justice Reference Service, Web of Knowledge and Regional databases of the WHO. The searched Spanish databases included Spanish National Research Council (CSIC), Epistemonikos, Evidence-informed policy network (EVIPNET), Universidad de La Rioja (UNIROJA), Red de Revistas Científicas de América Latina, el Caribe, España y Portugal (REDALYC), Scientific Electronic Library Online (SCIELO) and the Virtual health library.

Furthermore, the following websites were searched for relevant literature: websites of the WHO Violence Prevention Alliance (http://www.who.int/violenceprevention/en/), Blueprints for Violence Prevention (http://www.colorado.edu/cspv/blueprints), the Community Guide (http://www.thecommunityguide.org/violence/index.html), Centers for Disease Control and Prevention (http://www.cdc.gov/ViolencePrevention/index.html), the World Bank (http://www.worldbank.org), the Juarez violence and injury observatory (http://observatoriodejuarez.org/dnn/ENGLISH.aspx) and the South African Medical Research Council (MRC) burden of disease research unit (http://www.mrc.ac.za/bod/bod.html).

In addition, the following conference proceedings were searched for relevant abstracts: International Conference on Crime Observatories, United Nations Congress on Crime Prevention and Criminal Justice, Global Violence Reduction conference, Annual meeting of Violence Prevention Alliance and the International society for violence and injury prevention international conference. We used both text words and medical subject headings terms. The terms were used in varying combinations. Reviewers also searched reference lists of the relevant studies identified.

3.1.4 Data collection and analysis

The Cochrane Handbook of Systematic Reviews for Interventions (Higgins, 2009) served as the reference for the methods employed in this study.

3.1.4.1 Selection of studies for inclusion

Review authors used a screening guide developed by AJ to ensure that inclusion criteria are consistently applied. Two review authors (AJ and DB), working independently, screened the titles and abstracts of all studies identified through the English literature searches for eligibility. MC and FF completed the same process for the Spanish language studies. Full texts of potentially eligible studies were obtained by AJ. The two authors (AJ and DB) independently assessed the full text of each article for eligibility, and compared their results. Again, this was repeated by MC and FF for the Spanish language studies. Discrepancies were resolved through discussion and consensus, consulting a third author (MEE) to resolve any persistent disagreements. All reviewers documented the reasons for all studies excluded from the systematic review.

3.1.4.2 Data extraction and management

Two authors independently extracted descriptive and outcome data for each included article using a standardised data collection form (Appendix 2), resolving any discrepancies by discussion and consensus, failing which a third author (MEE) would arbitrate.

Manager V.5.1 statistical software (http://ims.cochrane.org/RevMan) was used by AJ while DB cross-checked the data entered to ensure that there were no data entry errors. References were managed using Mendeley Version 1.19.3. Incidence rate ratios (IRRs) were calculated from extracted data.

3.1.4.3 Assessment of risk of bias in included studies

Two reviewers assessed all included studies using the Effective Public Health Practice Project (EPHPP) questionnaire, which is a quantitative study assessment tool to identify methodological issues (Armijo-Olivo, Stiles, Hagen, Biondo and Cummings, 2012). The criteria used for risk of bias assessment for non-randomised studies include selection bias (dealing with confounding, adjustment and comparability of groups); performance bias (in terms of the fidelity of the interventions); detection bias (regarding unbiased and correct assessment of outcomes, including blinding of assessors); attrition bias (with regard to completeness of sample, follow-up and data); and reporting bias (with regard to publication biases and selective reporting of results)

(Armijo-Olivo *et al.*, 2012). Studies were scored as having low, high or unclear risk of bias. Any disagreements between the two authors in the assessment of risk of bias were resolved in discussion and consensus and the consultation of a third author where necessary.

3.1.4.4 Data synthesis including assessment of heterogeneity

Data analysis was managed using STATA statistical software (StataCorp, 2015). Meta-analyses using the metan routine (metan logirr selogirr), were conducted by combining IRRs defined as the incident rate of violence outcomes (homicide or assault) before and after the introduction of a VIO or ISS. The random effects model was used. Heterogeneity was assessed by examining types of participants, interventions and outcomes in each study. Statistical heterogeneity was assessed using the $\chi 2$ test and quantified with the I2 statistic (Higgins, 2009). Where heterogeneity was apparent, findings are discussed as a narrative summary.

3.1.4.5 Subgroup analyses

Subgroup analyses examining the VIO model (comprising aggregated data from regional clinical centres and mortuaries for homicide data) versus the ISS model (public hospital data) were performed.

3.1.4.6 Assessment of quality of evidence

We used the grading of recommendations assessment, development and evaluation (GRADE) approach to assess the quality of evidence for the contribution of the observatory towards violence prevention (Balshem, Helfand and Schunemann, 2011). The GRADE approach specifies four levels of quality ranging from high to very low, with the highest quality rating denoting a confidence that the true effect lies close to the estimate of the effect. Quality was rated according to an *a priori* identification of potential participant-centred outcomes, including benefits and harms (Balshem *et al.*, 2011). Two authors independently assigned the grade scores and compared results as per the process for the recording of previous aspects of the study. Discrepancies were resolved by consensus discussion between the two primary reviewers (AJ and DB), with arbitration by a third reviewer (MEE) as necessary.

3.1.4.7 Sensitivity analyses

We performed sensitivity analyses to determine the effect, if any, of type, and quality assessment of publication on outcome.

3.2 Delphi study (Study Three)

This section describes the methods for a Delphi study to determine the optimal indicators, datasets and research priorities for the pilot Cape Town VIO.

This Delphi study has been published in part in the following peer-reviewed journals:

Jabar A, Bjorkman S, Matzopoulos R, Modified Delphi study to determine optimal data elements for inclusion in a pilot violence and injury observatory in Cape Town, South Africa – **African Journal of Emergency Medicine**, **https://doi.org/10.1016/j.afjem.2018.11.001**

3.2.1 Background

Violence and injury observatories (VIOs) are primarily a tool to aid safety and security stakeholders within both governments and NGOs to develop interventions focused on violence prevention and related to citizen safety issues. VIOs are centres that focus on collating and integrating violence-related injury data sources to monitor, evaluate, and study the progression of violence and crime in a targeted region. In seeking to implement a pilot Observatory in the local context, we sought to determine the optimal data elements, which comprised violence and injury indicators, datasets and research themes, for inclusion in the pilot Observatory by means of a Delphi study.

3.2.2 Data sources

The OAS citizen security indicators (Table 3.2) were submitted to the Delphi panel in round one.

The datasets (Table 3.3) provided to the Delphi panel in round one were obtained as part of the systematic review in study one.

The Child Health and Nutrition Research Initiative priority-setting method provided the framework for the Delphi panellists in round one.

3.2.3 Study design

A two-round modified expert Delphi study was conducted between July 2017 and November 2017 utilising a panel of 21 experts from stakeholders working in violence prevention in Cape Town, South Africa. Ethical approval for this study was obtained from the Health Sciences Research Ethics Committee of the University of Cape Town (HREC REF: 861/2016). Delphi is a planned consensus process that employs a panel of experts to investigate a complex problem, utilising a sequence of structured statements (Goodman, 1987).

3.2.4 Delphi panellists

Panellists were considered for inclusion if they worked primarily in violence prevention activities. The panel included:

- Safety and security experts;
- Senior clinical staff in local emergency centres (ECs);
- Policy stakeholders in local government;
- Non-government actors working in violence prevention;
- Researchers working in the field of violence reduction;
- Senior members of provincial health services working in emergency and disaster medicine;
- Representatives from relevant data stakeholders including the Forensic Pathology Services (FPS), South African Police Services (SAPS), Health

Systems Trust (HST), and Violence Prevention though Urban Upgrading (VPUU); and

- Representatives from the University of Cape Town and University of Western Cape Law faculty, the Department of the Premier's Office, Department of Health (DOH) and Department of Community Safety (DOCS).

A decision was made to limit the clinical expertise to emergency medicine practitioners as they represented the first point of contact in Emergency Centres (ECs) in the Western Cape. Panellists whose primary field of work was not in violence prevention were excluded. All participating experts' views were given equal weight.

3.2.5 Delphi process

Elements of the Delphi method and the Child Health and Nutrition Research Initiative priority-setting method were combined. The Child Health and Nutrition Research Initiative priority-setting method employed pre-set measures to both score and generate questions systematically (Mikton, Tanaka, Tomlinson, Streiner, Tonmyr, Lee, Fisher, Hegadoren, Pim, Wang and MacMillan, 2017). This structured and transparent method attributes a priority score to all items on a list of generated research options, which are based on experts scores (Mikton *et al.*, 2017). Research thematic priorities were presented to the Delphi panel (Chapter 5, Table 5.1) using a modified version employed in the Mikton *et al* 2017 study, which focused on global research priorities for violence prevention. Our study removed child maltreatment as a type of violence, as the pilot VIO focused on violence prevention in the adult population. Furthermore, two research questions were omitted where the authors felt that there was possible duplication in a research question.

The experts answer questionnaires in two or more rounds. Following each round, a facilitator provides an anonymised summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments.

Our modified process was employed over two rounds (Goodman, 1987):

1. A panel of experts individually and anonymously formulated a series of ideas related to the subject, which was to identify the optimal indicators, datasets and

research priorities for a pilot VIO. The statements from stage 1 were collated and distributed to all panellists, where they chose their level of agreement with each statement using a 5-point Likert scale (1-can be dropped, 2-somewhat essential, 3-neither essential or unessential, 4-quite essential, 5-essential to include).

2. Each statement was returned back to the panel, with their own and the rest of the panel's previous Likert scale rating. Feedback was anonymous.

Table 3.2 below are the 19 (OAS) Citizen Security Indicators first presented in Table 1.2, submitted as baseline indicators to the Delphi panel in round one (OAS, 2014). Three indicators were excluded that related to traffic or child and adolescent injuries that were outside the scope of the pilot observatory. Rate of automotive theft and robbery was retained as they could have an interpersonal violence component.

Table 3.2 OAS Citizen Security Indicators submitted to Delphi round one

No.	Indicators
1	Homicide rate per every 100,000 inhabitants.
2	Suicide rate per every 100,000 inhabitants older than 5 years of age.
3	Firearm death rate per every 100,000 inhabitants.
4	Complaint rate for Sex crimes per every 100,000 inhabitants.
5	Rate of complaints of Intrafamily/family/domestic Violence per every 100,000 inhabitants
6	Theft rate per every 100,000 inhabitants.
7	Robbery rate per every 100,000 inhabitants.
8	Rate of Automotive Theft and Robbery per every 10, 000 vehicles registered.
9	Kidnapping rate per every 100,000 inhabitants.
10	Prevalence of sexual violence.
11	Prevalence of Intrafamily/family and domestic violence.
12	Rate of criminal victimization in people older than 18 years of age.
13	Percentage of victimization due to Robbery, in people older than 18 years of age.
14	Percentage of victimization due to Theft, in people older than 18 years of age.
15	Percentage of people with perception of insecurity, in people older than 18 years of age.
16	Percentage of people with perception of risk, in people older than 18 years of age.
17	Percentage of people with perception of fear, in people older than 18 years of age.
18	Percentage of people who justify the use of violence, in people older 18 years of age.
19	Percentage of people with confidence in the institutions, in people older 18 years of age
~~20~~	~~Death rate by Traffic accidents per every 100,000 inhabitants.~~
~~21~~	~~Complaint rate for child and adolescent maltreatment for every 1000 individuals younger than 18 years of age.~~
~~22~~	~~Violation rate for driving while intoxicated by alcohol in people over 15 years.~~

Round one required panellists to rate the violence-related indicators, datasets and local research priorities that they felt should be represented in the pilot VIO. The OAS

citizen security indicators, voted on by OAS member states in order to standardise the collection and definition of citizen security indicators within the OAS region, were provided as a gold standard baseline indicator list to rate using the Likert scale. The panellists were additionally asked to propose violence-related indicators and datasets (Table 3.3), in order to reduce the chance of indicators or datasets being overlooked. Additionally, an open text box was included for panellists to leave comments, questions or suggestions to present in the second round. Finally, the panellists were asked to rate different research themes (using an ordered ranking scale) within interpersonal violence with space for panellists to comment on the research themes and methods that should be reviewed by the pilot VIO. All replies were then collated into a sequence of statements.

In round two, these statements were returned to the panel members in the form of a series of statements, where panellists were required to choose their level of agreement with the use of the considered measure as a performance indicator. This was done using a five-point Likert scale. Positive consensus was defined a priori as 70% or more of respondents scoring four and above, with this value being used to produce final recommendations. Negative consensus was defined as 70% or more of respondents scoring two and below.

Issues expressed by panellists in round one were also added to the round two questionnaires and four questions related to data sharing were presented in round two (Chapter 5, Figures 5.1 to 5.4).

Statements that had not reached consensus in the Delphi study were not considered further.

Table 3.3 Proposed violence and injury datasets in round one

No.	Data Source	Description
1	Health Systems Trust (HST)	Repeated cross-sectional studies. A rapid assessment (RA) of the injury morbidity burden at clinical services in three high violence communities in the Cape Town Metropole was conducted in Khayelitsha, Nyanga and Elsies River. Recorded measures include patient demographics, pattern of injury, location and time of injury.
2	Violence prevention through Urban Upgrading (VPUU)	Population and household-based rolling surveys: The surveys were conducted between September 2012 and July 2015 by the Violence Prevention through Urban Upgrading (VPUU) project. A total of 1500 dwellings were visited. Recorded measures include the experience of violent crime as reported by the residents of Khayelitsha, household demographics and location.
3	Statistics South Africa (STATSSA)	Victim of Crime Survey (VOCS): The VOCS provides through questionnaire survey, information on households' perceptions about safety, and law enforcement and crime trends (StatsSA, 2017).
4	Centre for Social Science Research, University of Cape Town	Cape Area Panel Study (CAPS): studies of the lives of youths and young adults in Cape Town and is a longitudinal study. 4800 randomly selected young people, aged 14-22, were interviewed in the first part of the study during August-December, 2002 (UCT Centre for social science research, 2006).
5	Forensic Pathology Service (FPS)	Provincial Mortality Registry: The Forensic Pathology Service (FPS) is mandated by the National Health Act 61 of 2003 law to investigate all Unnatural Deaths (Government, 2003). Recorded measures include victim demographics, pattern of injury and incident location, time and context of incident.
6	South African Police Service (SAPS)	Public access database: Homicide and injury-related crime data (e.g., assault) available through two public access websites. Robbery data: Residential robbery data available through WITS research affiliation. Restricted data: Data including victim demographics, homicides/assault count and incident location (MRC).
7	Electronic trauma health record (eTHR)	Hospital clinical database: Data collected that is relevant to this study include patient demographics, pattern of injury and location of injury with data available from 2010 onwards.
8	Red Cross Hospital (RXH)	Hospital clinical database: This includes all trauma requiring medical treatment for children under the age of 12 years presenting at Red Cross Children's Hospital. Recorded measures include demographic information, date of injury/death, manner and circumstances of the injury/death, location of injury and referring centre amongst other variables.
9	Emergency Medical Services (EMS)	EMS incident data: Data collected that is relevant to this study include demographics, nature and location of injury and metrics are recorded per incident.
10	Western Cape Provincial Government (WCPG)	Clinicom Provincial Hospital Patient Database: This constitutes the patient administration system used in larger hospitals, including Groote Schuur, Tygerberg, and Red Cross Children's Hospitals.

3.2.5 Data analysis

Data analysis was generated using Qualtrics software (© 2017 Qualtrics; Provo, Utah, USA). Basic summary statistics were used to calculate the Delphi panellists' choices with regard to chosen indicators, datasets and research priorities.

3.3 Merging health and police datasets for characterising interpersonal violence (Study Four)

This matching study has been submitted to the following journal and is currently in review, i.e.:

Jabar A, Oni T, London L, Cois A, Matzopoulos R. Merging Health and Police datasets for characterising interpersonal violence in the community of Khayelitsha, South Africa 2013-2015. BMJ Open (submitted: 19 December 2020; manuscript ID: bmjopen-2020-048129)

The section describes the methods used in the matching study (Study Four).

3.3.1 Background

The Cardiff Model employs the strategic use of information from the health sector to improve policing and is an example of cross-sectoral collaboration. Developed by the Violence Research Group at Cardiff University, the model provides a way for communities to gain a clearer picture about where violence occurs by mapping both police and hospital violence data in combination (CDC, 2018). Application of the model in Cardiff in 2011 found that one half to two thirds of violence which results in hospital treatment is not known to the police (Florence, Shepherd, Brennan and Simon, 2011). Subsequent research found that police recording of violence was limited to people reporting violent offences, but that many of the injured who presented at emergency departments for treatment do not report the incident to police because they are either afraid of reprisals, do not want their own conduct scrutinised, or because they do not think the reporting will result in effective police action (Violence Research Group, 2018).

These findings have been replicated in other settings including England and the United States of America (USA), and the model is being considered for implementation in Australia and Jamaica (Boyle, Snelling, White, Ariel and Ashelford, 2013; Kollar,

Sumner, Bartholow, Wu, Moore and Mays, 2019). Similarly, findings from the United States (US) Department of Justice National Crime Victimization Survey, a national household survey that sampled 701 000 individuals 12 years and older from 2006 to 2010, revealed that more than half (52%) of all violence incidents in the USA were not reported to law enforcement (Langton, Berzofsky, Krebs and Smily-McDonald, 2012). We were unable to identify any similar studies in South Africa that compared the reporting of violence-related injuries to the police versus health facilities. However, we do know that violence is not always reported to the police. For example, in a community survey in Khayelitsha only 49% of violent incidents between family members were reported to the police (Cassidy, Inglis, Wiysonge and Matzopoulos, 2013).

The Western Cape Safety Plan, a policy document developed by the Western Cape Government, advocates the use of data and technology to understand violent crime patterns to inform the deployment of law enforcement resources and investigators accordingly. It furthermore acknowledges research and analysis as an important component of its evidence-based policing (EBP) strategy (South African Government, 2019). The policy document lends support to the implementation of EBP interventions such as the Cardiff Model locally.

The aim of this study was to determine the concordance between violent crimes reported to police stations and cases of injuries arising from inter-personal violence presenting to health facilities. Secondary objectives included the estimation of an adjusted crime profile (where police reported crime statistics included unreported violence from the health data) and a comparison between patient populations that reported violence to the police with those that did not.

3.3.2 Study setting

The study was conducted in the community of Khayelitsha. Khayelitsha is a peri-urban low-income community of approximately 400 000 people located 30km from the Cape Town city centre (City of Cape Town, 2011). The homicide rate is well above the national average of 31 murders per 100 000 population at between 76 and 108 per

100 000 at Khayelitsha s different police stations (Barolsky, 2014). The community has mixed housing (informal and approximately 45% formal dwellings) and high unemployment (36%) (City of Cape Town, 2011) and is serviced by three police stations: Khayelitsha, Harare and Lingelethu West. Trauma cases are treated at three public-sector health facilities: Khayelitsha District Hospital (KDH), Site B and Michael Mapongwana Community Health Centre (Figure 3.2).

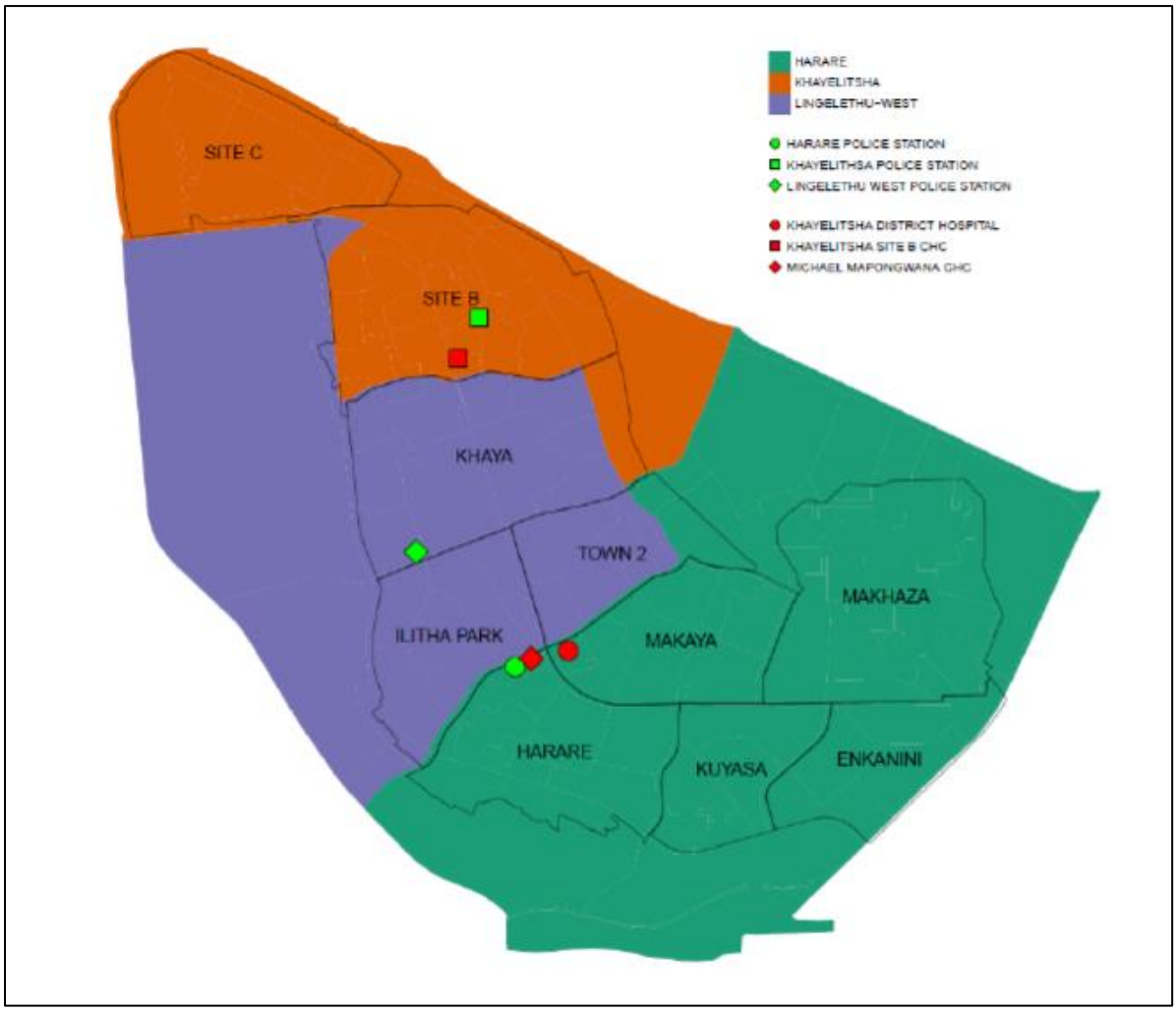


Figure 3.2 Participating health facilities and police stations in relation to study areas in the community of Khayelitsha

3.3.3 Study design

This was a retrospective cross-sectional analysis of secondary health and police data from Khayelitsha for five 1-week-long periods collected between September 2013 and October 2015.

We assessed whether people presenting with injuries arising from interpersonal violence at health facilities went on to report these incidents to the police and whether victims reporting a crime to the police sought treatment at a health facility. We quantified this using personal identifier matching.

3.3.4 Data sources

The health data used in this study were originally collected by a non-profit research organisation, the Health Systems Trust (HST), for a study commissioned by the Western Cape Department of Health (DOH). Data were collected for five 1-week-long cross-section periods between 2013 to 2015. The health data were collected via face-to-face interviews with patients with violence-related injuries using a standardised data collection tool loaded on an electronic tablet, in the three health facilities (Figure 3.2) (Mureithi, Africa, Wandai, Schaik, Naledi, Matzopoulos and English, 2016). A biostatistician prepared the original HST data for use in this matching study.

All emergency cases presenting to the health facilities were assessed for acute injuries which were classified according to cause of injury, viz: violence; transport; other unintentional injury or self-harm. Retrospective folder reviews of sexual assault cases that presented to the clinical forensic units at KDH during the corresponding study period were also included.

The police dataset included all violent crimes reported at all three police stations over the same time periods as the health dataset. This data was recorded in the national South African Police Services (SAPS) Crime Administration System (CAS) in Pretoria. A formal request to access the data was made to the SAPS National Research Division which was granted (Reference no. 3/34/2) on the 24th of November 2017.

3.3.5 Variables

Cases presenting to health facilities for violence-related injuries included the following variables: hospital folder number as a personal identifier; age; gender; date and time of injury event; instrument used, type of violence; area (incident location); triage score; and alcohol use.

The inclusion of patient hospital numbers allowed for accessing patients details on the Clinicom hospital system (a patient tracking information system) (South African Government, 2020), to identify patient names for matching with police data.

All acute injuries classified as person-on-person intentional violence were described according to the external cause of injury as per the International Classification of Disease (ICD) version 10 (World Health Organization, 2019b) ,i.e.: sharp object (ICD10 code X99), blunt object (Y00), firearm, push/kick/punch (Y04), human bite (Y08), explosion (X09), choking/strangulation (X91), fire burn (X97), other burn, poisoning (X85), or unknown; and type of violence defined in the study as rape/sexual, gang-related, property crime-related, interpersonal or unknown. Gang-related and unknown" were collapsed into a combined interpersonal violence category for purposes of comparison with the police data, which did not include these categories.

Cases recorded in the unknown category included cases that recorded a specific cause of injury, where the type of violence was marked unknown and the victim-perpetrator category was also marked unknown. Patients treated for burns of unknown cause were included in the other burn category.

The location of each assault was self-reported by patients attending health facilities according to ten predefined study areas (see Figure 3.2). The collection of incident location data allowed for geolocating each case in one of the ten study areas: Enkanini, Harare, Ilitha Park, Khaya, Kuyasa, Makaya, Makhaza, Site B, Site C, and Town 2 (Figure 3.2). Cases that were geolocated beyond the ten areas were excluded from the analysis.

The health data also included additional variables of interest that were not available in the police data. The triage colour provided a proxy for injury severity: viz: red (refer to major area for emergency management [immediate]); orange (refer to major area for urgent management [target time < 10 minutes]); yellow (refer to major area for urgent management [target time < 1 hour]); green [refer to designated area for non-urgent management (target time < 4 hours]) and blue (refer to doctor for certification [target time < 2 hours]). Alcohol and other drug use for each case was assessed by clinical judgement. Volume of consumption and consumption beyond six hours of the injury event was not assessed.

The police data included: name and surname as personal identifiers; age; gender; date and time of crime event; type of crime; instrument use; and incident location. Types of crimes included assault with the purpose to inflict grievous bodily harm; attempted murder; common assault; domestic violence; rape; sexual assault; and all types of robbery, which involve an interpersonal interaction with an implicit threat (i.e. common robbery; house robbery; robbery with a weapon or instrument other than a firearm; robbery and attempted robbery with a fire-arm; robbery and attempted robbery at business premises; carjacking [stealing an occupied motor-vehicle]) (SAPS, 2019).

For purposes of comparison with the type of violence recorded in the health data, crime type was coded as follows: rape and sexual assault cases (rape/sexual); common assault, assault with the purpose to inflict grievous bodily harm, domestic violence attempted murder (interpersonal violence); all types of robbery, which involve an interpersonal interaction with an implicit threat (i.e. common robbery; house robbery; robbery with a weapon or instrument other than a firearm; robbery and attempted robbery with a fire-arm; robbery and attempted robbery at business premises; carjacking [stealing an occupied motor-vehicle] (property crime-related).

The police recorded instrument use as a separate field and the categories were broadly consistent with the health data, as follows: sharp instrument, glass, key, knife, panga (bladed weapon), bottle, bottle head, screwdriver, (sharp object); blunt instrument, hammer, iron pipe, brick, stick, stone/brick (blunt object), firearm, pistol, revolver (firearm), head, fist, body part, feet, hands (push/kick/punch), belt, open hands (choking/strangulation); tyre, matches, petrol bomb (fire burn); electricity, ammunition (other burn); tik [methamphetamine], mandrax pills [quaalude], dagga

[cannabis] (poisoning); and cell phone, motor vehicle, vehicle, cash, money, bank card, unknown (unknown).

Police incident location data were mapped based on self-reported data provided by victims of violence and were either geolocated using XY co-ordinates or recorded as a street address.

3.3.6 Case selection

Police records with multiple victims were expanded by replicating the common information (place, type of crime, etc.) to generate a single record for each victim in the final dataset.

Cases that were excluded from the health data included medical cases not related to injuries and injuries not caused by violence perpetrated on the victim by another subject (Condition 1); events that occurred outside the ten areas of Khayelitsha (Condition 2); cases in which the victim was younger than 16 years (Condition 3) (age of sexual consent in South Africa); and events that occurred outside the time period specified (Condition 4).

Cases that were removed from the police data include cases other than the types of crimes described above (Condition 1); events that occurred outside the ten areas of Khayelitsha (Condition 2); cases in which the victims were younger than 16 years (Condition 3) and events that occurred outside the time period specified (Condition 4).

3.3.7 Data analysis

The two datasets were captured in Microsoft Excel, and imported into the R Statistical environment v. 3.5.2 for analysis (R Core Team, 2013). Two-side statistical tests with a conventional 5% cut-off for statistical significance were conducted to assess differences in characteristics between injury patients from the health database and crime victims from the police database, and between reporting and non-reporting patients in the health database.

χ^2 tests were used to evaluate differences in the distribution of categorical variables. When comparing the police dataset with the health dataset, a robust estimator of the test variance was used to take into account the partial overlapping of the two samples (Zeileis A, 2006).

Cases from health facilities were matched with police data using name, surname, gender and age as matching keys. Some latitude was accorded to allow for spelling variations and approximate recording of ages. This was done as follows: patient hospital numbers were entered into the Groote Schuur Hospital (GSH) Clinicom database to retrieve the patient's name. The Levenshtein distance (a string metric for measuring differences between two sequences of characters (Doan, Halevy and Ives, 2012)) was calculated for each patient between his/her name and each of the names present in the police dataset, and the police record(s) was selected corresponding to the minimum distance as candidate" matches. In the second step (exclusion of unlikely matches) the potential matches generated from the first step were retained for subsequent analysis if (i) names were identical between the two datasets; or (ii) the Levenshtein distance was 1, gender was the same and reported ages differed less than 5 years; or (iii) the Levenshtein distance was > 1, gender was the same and reported ages differed less than 3 years. In the third step (manual selection) the potential matches resulting from the previous step were manually inspected to verify the actual correspondence between victim names and the consistency of the reported time of the violent episode, which led to the elimination of further cases.

An estimation of an adjusted crime profile was done by adding unreported patient violence seen at health facilities to the police reported crime statistics. The patients who reported violence to police (reporting patients") and the patients who did not report the violence to the police (non-reporting patients") were inferred from the matching process, and are described with regards to demographic characteristics (age and gender), instrument use, type of offence, triage code and alcohol use.

3.4 Ethics

Ethical permission to conduct this PhD research was granted by the University of Cape Town Human Research Ethics Committee (UCT HREC 861/2016). The systematic

review (Study Two) used publicly accessible documents and thus did not require institutional ethics approval. The Delphi study (Study Three) was covered by the overall project ethics approval (UCT HREC 861/2016). The matching study (Study Four) required additional institutional approval, received from the South African Police Services Research Division (3/34/2). Informed consent was granted by Groote Schuur Hospital for permission to access the Clinicom patient database in order to complete the personal identifier matching (Appendix 1). Finally, an application to establish a registry for the collection of violence and injury-related data titled 'the Cape Town VIO registry' was granted by the UCT HREC (UCT HREC REF: R043/2016) (Appendix 1).

The study Biostatistician received both health and police datasets, conducted the identifier matching process, and deleted all data permanently following this process. By aggregating the data, removing personal identifiers, geolocating cases to residential suburb and not street address, and employing a one-month delay of data dissemination, every technical effort is made to prevent the identification of individual cases and protect individual identity.

4. CHAPTER FOUR:

STUDY TWO: IS THE INTRODUCTION OF VIOLENCE AND INJURY OBSERVATORIES ASSOCIATED WITH A REDUCTION OF VIOLENCE IN ADULT POPULATIONS? A SYSTEMATIC REVIEW AND META-ANALYSIS

This systematic review has been published in part in the following peer-reviewed journal:

Jabar A, Fong F, Chavira M, et al. Is the introduction of violence and injury observatories associated with a reduction in violence-related injury in adult populations? A systematic review and meta-analysis. BMJ Open 2019; 9:e027977. doi:10.1136/ bmjopen-2018-027977

4.0 Introduction

To date, there has been no systematic review of the literature to present a succinct review of the evidence. We therefore sought to summarise the evidence from existing studies on the contribution of violence and injury observatories towards violence prevention in adult populations. This section describes the results of the systematic review, the meta-analysis and discussion. Detailed methods are provided in Section 3.1 of Chapter 3.

4.1 Description of included studies

The study selection process identified 3105 potentially relevant unique citations from all literature searches (Figures 4.1 and 4.2 detail the results from the English and Spanish/Portuguese databases, respectively). Of the 21 studies deemed potentially eligible for inclusion, nine English language studies and seven Spanish technical reports met with the inclusion criteria. Three studies were conducted in the United Kingdom, with the remaining studies taking place in Colombia, Brazil, Mexico and Uruguay. Data from technical reports were used in the five studies arising from South America. All studies were published after 1990. No studies were randomised controlled trials. Control data were reported in all the empirical studies in the form of pre-intervention figures. None of the technical reports had control data, and thus estimates were extrapolated from World bank open data (World Bank, 2018).

Details of studies included in the review are presented in Table 4.1. Reasons for the ten studies excluded from the systematic review are detailed in Table 4.2.

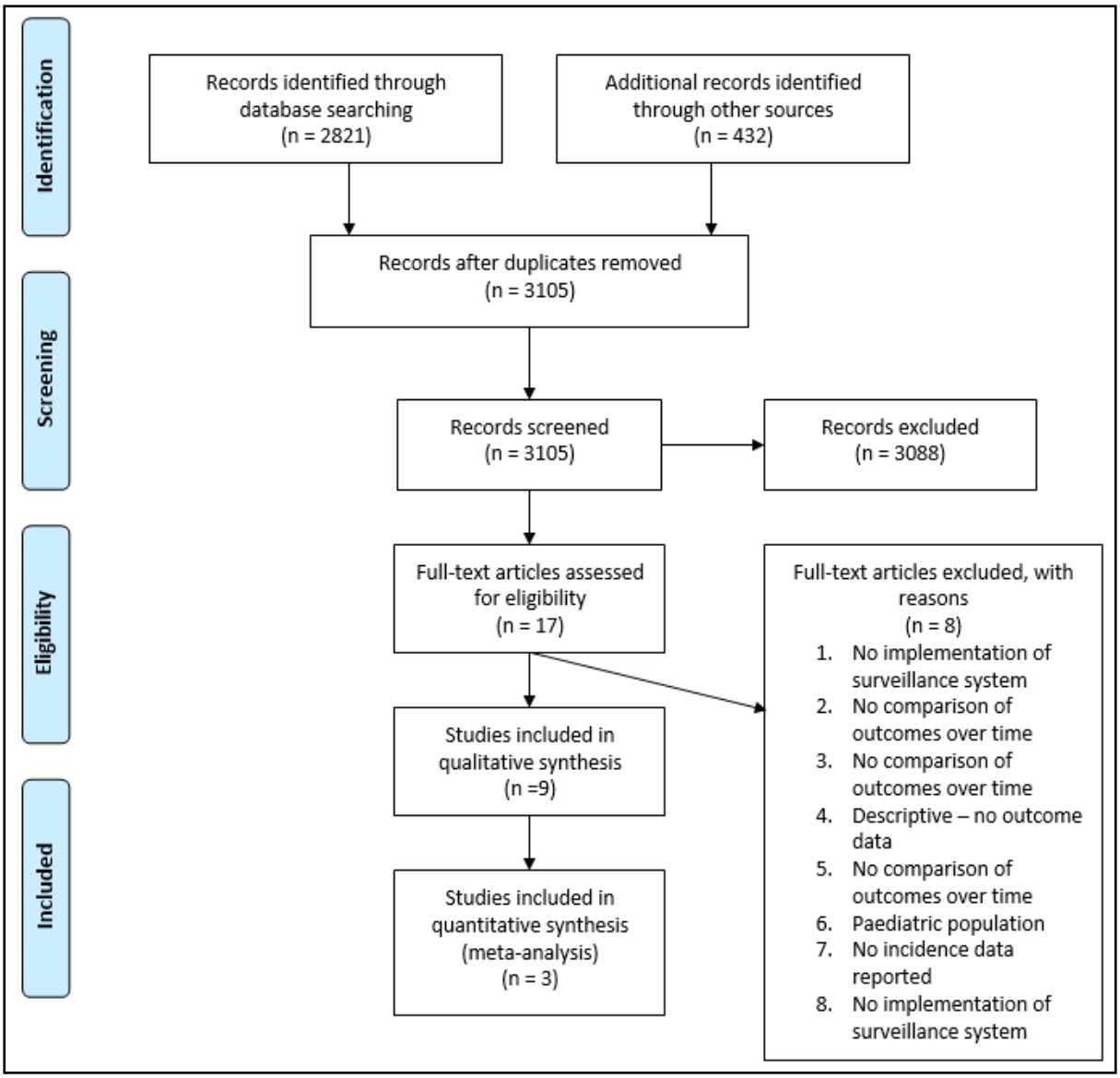


Figure 4.1 PRISMA flow diagram for studies from English databases

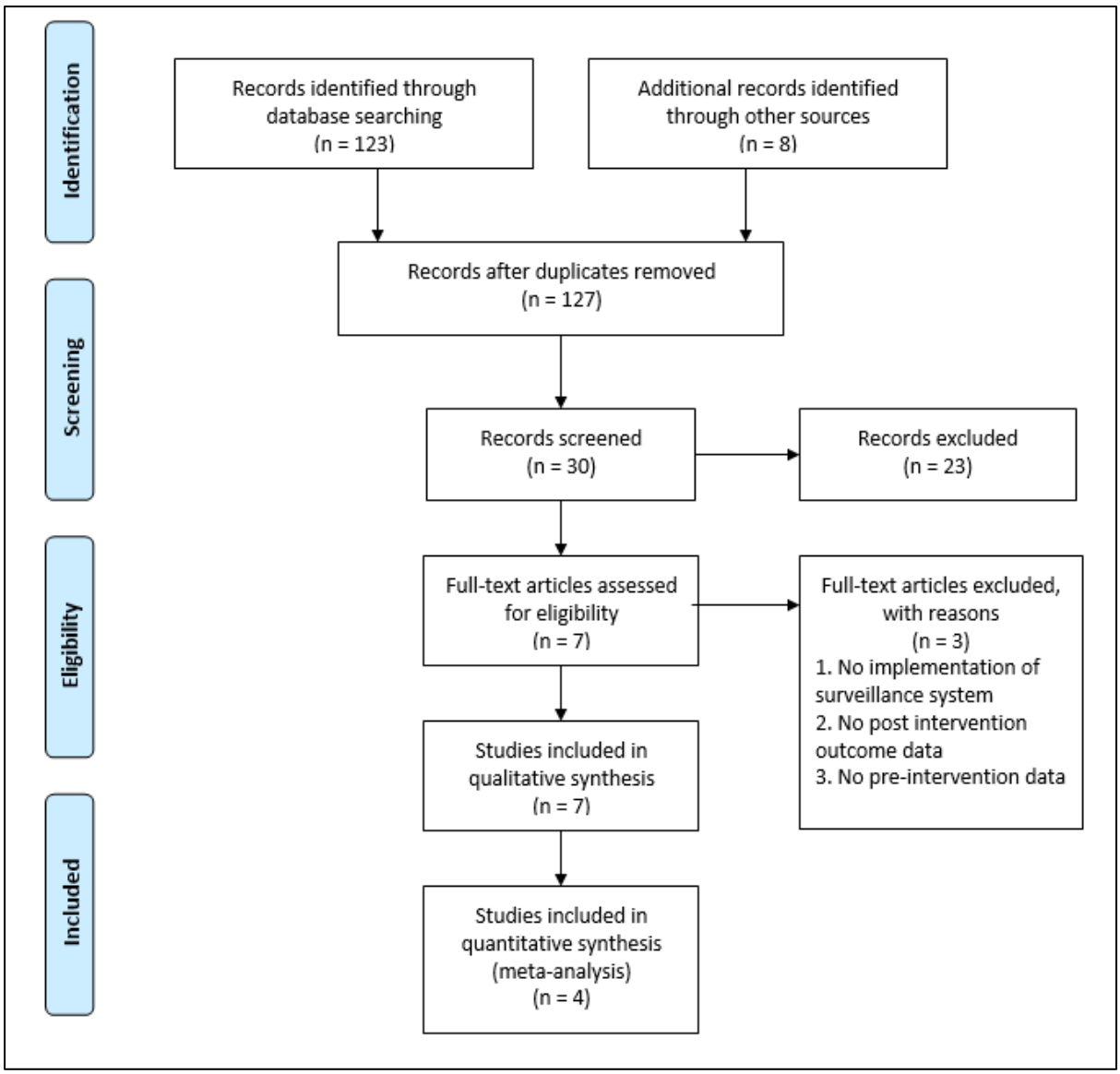


Figure 4.2 PRISMA flow diagram for studies from Spanish (n=3) / Portuguese (n=1) databases

Table 4.1 Description of Included studies

Author	Country	Setting	Dates	Type of Intervention	Outcome	Population Size
Arnetz 2011 (Arnetz Aranyos, Ager and Upfal, 2011)	USA	Hospital staff population	2003-2008	ISS	Patient violence report	7 867
Boyle 2012 (Boyle et al., 2013)	England, UK	Public hospital	2001-2011	ISS	Assault count	156 260
Col TR 2009 (Humanos, 2009)	Colombia	National	1995-2006	VIO	Homicide rate	36 823 538
Da Cruz 2010 (Batitucci, 2009)	Brazil	City	2003-2009	VIO	Homicide rate	2 265 852
Florence 2011 (Florence et al., 2011)	Wales, UK	Public hospital	2000-2007	ISS	Assault count	293 507
Franco 2012 (Franco, Mercedes, Rozo, Gracia, Gallo, Vera and García,2012)	Colombia	City	1994-2007	VIO	Homicide rate	1 630 009
Garrib 2011 (Garrib, Herbst, Hosegood and Newell, 2011)	South Africa	Rural population	2000-2007	DSS	Homicide count	142 859
Gutierrez-Martinez 2007 (Gutierrez-Martinez et al, 2007)	Colombia	Municipality	2002-2004	VIO	Homicide count	2 498 089
Hernandez 2014 (Hernandez and Hernández, 2014)	Mexico	City	2008-2011	VIO	Homicide rate	1 309 272
Mberu 2015 (Mberu, Wamukoya,Oti and Kyobutungi, 2015)	Kenya	Urban informal settlement	2003-2012	DSS	Assault count	56 479
Quigg 2012 (Quigg, Hughes and Bellis, 2012)	England, UK	Public hospital	2003-2010	ISS	Assault count	316 210
Ventura 2012 (Ventura and Maciel, 2012)	Uruguay	National	2005-2012	VIO	Homicide rate	3 324 096
Ward 2002 (Ward, Durant, Thompson, Gordon, Mitchell and Ashley, 2002)	Jamaica	Public hospital	1998-1999	ISS	Violence related injuries	575 158
Zhang 2014 (Zhang, Li, Li, Zhang, Zheng, Jiang and Li, 2014)	China	National	2004-2010	ISS	Assault count	1 286 312 905

ISS, injury surveillance system; VIO, violence and injury observatory; DSS, demographic surveillance system

Table 4.2 Description of Excluded studies

No.	Author	Reason for Exclusion
1	Biroscak 2006 (Biroscak, Smith, Roznowski, Tucker and Carlson, 2006)	No comparison of outcomes over time
2	Borges Luz 2011 (Luz, Malta, Sá, Silva and Lima-Costa, 2011)	No comparison of outcomes over time
3	Clinton-Sherrod 2010 (Clinton-Sherrod, Gibbs, Crosby, Melanson, Cindi Loomis, Farris and Leeb, 2010)	No outcome data
4	Costa Rica 2016 (Observatorio De La Violencia del Ministerio de Justicia, 2020)	No post intervention data reported
5	Gonzalez 2018 (González, Garrido, López, Muñoz, Arribas, Carbajosa and Ballano, 2018)	No implementation of surveillance system
6	London 2002 (London, 2002)	No comparison of outcomes over time
7	Odihambo 2013 (Odhiambo, Beynon, Ogwang, Hamel, Howland, Van Eijk, Norton, Amek, Slutsker, Laserson, De Cock and Phillips-Howard, 2013)	No incidence data reported
8	Peru 2016 (Dirección General de Tráfico, 2018)	No pre-intervention data reported
9	Stone 1999 (Stone et al., 1999)	Paediatric population
10	Zavala-Zegara 2012 (Zavala-zegarra, López-charneco, Garcia-rivera, Concha-eastman, Rodriguez and Conte-miller, 2012)	No implementation of surveillance system

Table 4.3 Studies included in the meta-analysis

Table 4.3 Studies included in the meta-analysis

Author	Country	Outcome	Focus of Intervention	Type of Intervention	Data Period	Population Size	Effect Size (IRR)(95% CI)
Boyle 2012 (Boyle et al., 2013)	England, UK	Assault count	Public Hospital	ISS	2000 - 2007	156 260	0.91 (0.87; 0.95)
Col TR 2009 (Humanos, 2009)	Colombia	Homicide rate	National (Colombia)	VIO	1994	36 823 538	0.05 (0.05; 0.05)
Da Cruz 2010 (Batitucci, 2009)	Brazil	Homicide rate	City (Belo Horizonte)	VIO	2002	2 265 852	0.16 (0.14; 0.18)
Florence 2011 (Florence et al., 2011)	Wales, UK	Assault count	Public Hospital	ISS	2000 - 2003	293 507	0.72 (0.66; 0.78)
Franco 2012 (Franco et al, 2012)	Colombia	Homicide rate	City (Medellin)	VIO	1993	1 630 009	0.01 (0.01; 0.01)
Quigg 2012 (Quigg et al, 2012)	England, UK	Assault count	Public hospital	ISS	2003 - 2004	316 210	0.78 (0.75; 0.81)
Ventura 2012 (Ventura and Maciel, 2012)	Uruguay	Homicide rate	National (Uruguay)	VIO	2004	3 324 096	0.19 (0.16; 0.23)

IRR, incidence rate ratio; CI, confidence interval; ISS, injury surveillance system; VIO, violence and injury observatory.

IRR, incidence rate ratio; CI, confidence interval; ISS, injury surveillance system; VIO, violence and injury observatory

Table 4.4 Bias assessment of included studies

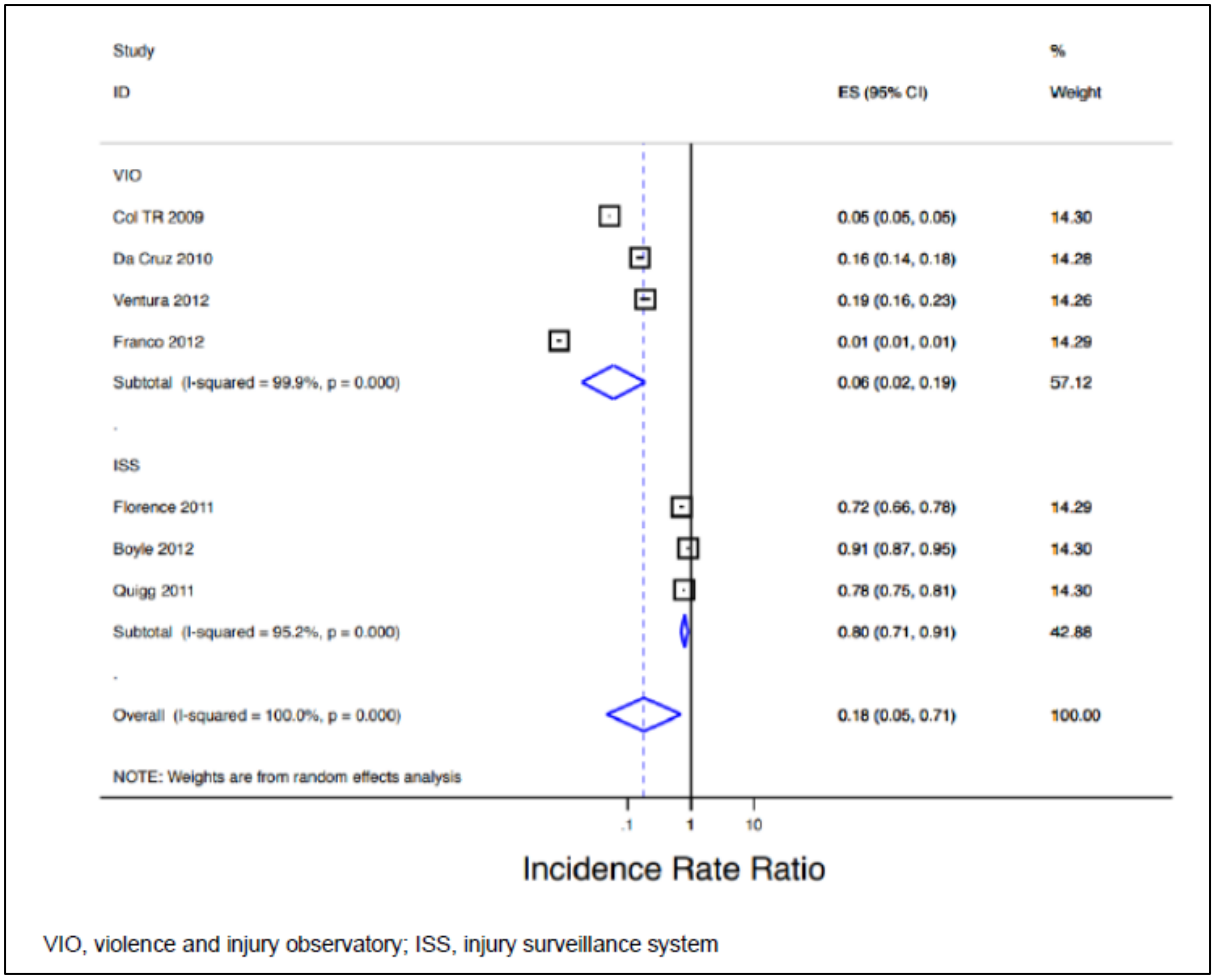
No.	Study ID	Bias
1	Arnetz 2011 (Arnetz et al., 2011)	Selection bias with all cases originating from violence experienced by patients and staff within multi-site hospital system (six hospitals)
2	Boyle 2012 (Boyle et al., 2013)	Study design was non-randomised natural experiment, with withdrawals and drop-outs not reported and no blinding noted
3	Col TR 2009 (Humanos, 2009)	Technical report with no control population
4	Da Cruz 2010 (Batitucci, 2009)	Technical report with no control population
5	Florence 2011 (Florence et al., 2011)	Non-randomised study design, with withdrawals and drop-outs not reported and no blinding noted.
6	Franco 2012 (Franco et al., 2012)	Technical report with no control population
7	Garrib 2011 (Garrib et al., 2011)	Observational study design with no population data available for rural population. Injury estimates reported.
8	Gutierrez-Martinez 2007 (Gutierrez-Martinez et al., 2007)	Interrupted time series study design, non-randomised with no control population. Withdrawals and drop-outs not reported and no blinding noted.
9	Hernandez 2014 (Hernandez and Hernández, 2014)	Technical report with no control population
10	Mberu 2015 (Mberu et al., 2015)	Interrupted time series study design, non-randomised with no control population. Withdrawals and drop-outs not reported and no blinding noted.
11	Quigg 2012 (Quigg et al., 2012)	Six year exploratory study using descriptive and time trend analyses. Non-randomised with no control population. Withdrawals and drop-outs not reported
12	Ventura 2012 (Ventura and Maciel, 2012)	Technical report with no control population
13	Ward 2002 (Ward et al., 2002)	Observational study design. Non-randomised with no control population. Withdrawals and drop-outs not reported and no blinding noted.
14	Zhang 2014 (Zhang et al., 2014)	Observational study design. Non-randomised with no control population. Withdrawals and drop-outs not reported and no blinding noted.

Meta-analysis across all studies was not possible, given heterogeneity in both the model and nature of outcome reported. Subgroup analyses was thus conducted according to the two types of models implemented (Table 4.3): three empirical studies utilised assault count as an outcome, while four technical reports used homicide rate. One technical report (Hernandez and Hernández, 2014), initially deemed eligible for meta-analysis, was considered an outlier after closer inspection, and subsequently, excluded from the meta-analysis; instead, it is discussed in the summary of findings below. The quality assessment of included studies are described in Table 4.4.

4.2 Overall effect of violence interventions

The pooled crude IRR for the seven violence intervention studies was 0.18 (95% Confidence interval [CI] 0.05, 0.71) (Figure 4.3). Heterogeneity was observed across studies (I2 statistic 100%).

Subgroup analysis by model of surveillance system indicates an effectiveness for the introduction of a VIO in reducing homicide, (IRR, 0.06; 95% CI, 0.02, 0.19) (4 studies, n=44 043 495). In the three studies employing an ISS model, the pooled IRR for the association between the intervention and assault count was 0.80 (95% CI 0.71; 0.91). Sensitivity analyses for language of publication, region, and type of report rendered identical results.



VIO, violence and injury observatory; ISS, injury surveillance system

Figure 4.3 Violence outcome count after VIO implementation

4.3 Narrative review of studies excluded from meta-analysis

Among the six studies included in this review but not included in the meta-analysis, there was no control group and thus a statistical effect could not be determined. An additional limitation to these studies, including Arnetz *et al.,* 2011; Gutierrez-Martinez *et al.*, 2007; Garrib *et al*., 2011; Mberu *et al*., 2015; Ward *et al*., 2002 and Zhang *et al*., 2014, was the lack of pre-intervention data. Furthermore, Mberu *et al*., 2015 and Garrib *et al*., 2011 utilised data from demographic surveillance systems, which were data collection tools whose primary focus was not violence-related injuries or outcomes. In the Arnetz *et al.,* 2011 study, the injury surveillance system implemented was limited to a large metropolitan multi-site hospital system (six hospitals) whose sole focus was the recording of violence incidents that resulted in injuries to patients or hospital employees, thus limiting the generalisability of the results.

With regard to the study setting, each of the six studies had divergent settings. Arnetz *et al.,* 2011 had a focus on violence amongst the hospital staff population within several regional hospital whilst Ward *et al*., 2002 was set in a single public hospital. Zhang *et al*., 2014, focus was national whilst Gutierrez-Martinez *et al.*, 2007 focused on six municipalities within Colombia. Mberu *et al*., 2015 looked at an urban slum population on the outskirts of Nairobi, Kenya whilst Garrib *et al*., 2011 was set in a northern KwaZulu Natal rural population in South Africa.

In terms of one of the primary outcomes, homicide count, only Garrib *et al*., 2011 and Gutierrez-Martinez *et al.*, 2007 reported this outcome of these six included studies, which did not undergo meta-analysis. Furthermore, when considering the secondary outcome, assault count, only Mberu *et al*., 2015 and Zhang *et al*., 2014 reported this outcome.

Finally, with regard to study design, the lack of a control group was a consistent feature for all six studies.

4.4 Summary of findings

This systematic review provides the best evidence to support the effectiveness of violence surveillance systems in reducing violence-related outcomes in adult populations. This effect was consistent across the introduction of violence and injury observatories in reducing mortality and injury surveillance systems on lowering assault outcomes. Additionally, this review highlights the paucity of studies evaluating VIOs/ISSs, the lack of rigorously designed studies, publication biases amongst the South American and European literature and the political context of study locations.

The remarkable reduction of 82% in violence-related outcomes following the implementation of a violence and injury observatory may be explained by the purposeful sharing and communication of violence-related data between violence prevention stakeholders within a given setting. The Cardiff model, which advocates for the sharing of violence-related data between clinical (including emergency medical services) and policing services has demonstrated effectiveness in reducing violence outcomes where implemented (Violence research group, 2018). The VIOs incorporate this data sharing principle, which they extend to other violence prevention stakeholders in their target area including emergency service providers (policing, fire

and rescue and clinical), local and provincial government actors, and non-government organisations and researchers working in violence prevention. This whole-of-society approach is grounded in using appropriate data from multiple sources to strengthen and improve the monitoring and evaluating of violence. In working closely with policing services, interventions to reduce violence may be consistently evaluated and supported, or removed using an evidence-based approach to policy. The maintenance of violence data registries within VIOs allow for long term violence trend analysis, violence prevention intervention development and evaluation, monitoring and evaluation of current violence trends, and through predictive analytics, the modelling of future violence trends. The collation and integration of violence-related data (from multiple sources) and violence prevention stakeholders (from diverse structures) are core VIO principles, which promote the reduction of violence outcomes where VIOs are implemented.

Sensitivity analyses for language of publication, region, and type of report rendered results identical to the sub group analyses. Technical reports comprise aggregated data sourced from regional or national hospitals and mortuaries. The extraction of data from aggregated data sources may provide a more comprehensive view of the regional burden of violence compared with the extraction from a single study site in the form of a local public hospital. Outcomes were clearly defined and standardised in technical reports whereas outcomes varied between empirical studies. Furthermore, the Organization of American States in 2007 developed a list of 22 citizen security indicators, which were standardised for collection in 19 countries and 2 cities in the central and South American region. This was done to address the region's lack of good quality and up to date statistical data. All participating regions have since then collected these indicators routinely and published them in their technical reports related to violence and injury.

We identified several technical issues within most of the included studies including the lack of control or pre-intervention data. Furthermore, the study designs were primarily observational and the lack of standardisation was highlighted by the recording of disparate outcomes. One technical report, initially deemed eligible for inclusion into the meta-analysis, was later considered to be an outlier. The regional political context should be noted with regard to this technical report (Hernandez and Hernández, 2014). This technical report recorded the number of homicides taking place in Juarez, Mexico

from 2008-2012. The partial victory achieved in the war on drugs in Colombia had contributed towards a surge in drug-related violence in Mexico. Violence first began to surge in 2007 after the Sinaloan cartel attempted to take over Juarez's highly prized drug trafficking routes. Local enforcer gangs like La Linea and the Aztecas fought a bitter war, often using unrestrained violence that targeted civilians and drove up the murder count. In 2007, Mexican president Felipe Calderón responded by launching a major offensive against drug-trafficking groups, sparking an explosion of violence that had gained the intensity of a regional war (Gootenberg, 2008). Calderón had fully militarised the conflict, sending thousands of troops and federal police into trafficking centres in what became a virtual military occupation of Ciudad Juárez. The result has been the much publicised, massive bloodshed, with more than 26,000 people killed since 2007, much of it taking place in the north of Mexico, near the U.S. border (Aguilar and Casteñeda, 2009). Homicide counts from the Hernandez 2014 report details (Table 4.5) the spike in homicides over this period from 2007 to 2012 (Hernandez and Hernández, 2014).

Table 4.5 Homicides in Juarez, Mexico 2007-2012

Year	Homicide count	Homicides per day
2007	319	Less than 1 murder per day
2008	1 623	4.4 per day
2009	2 754	7.5 per day
2010	3 622	9.9 per day
2011	2 086	5.7 per day
2012	797	2 per day

With these extraneous (irregular) circumstances in mind, a decision was made by study authors to exclude this technical report from the subsequent meta-analysis. VIOs are by nature narrow in their scope and local in their implementation. Juarez experienced levels of violence that were provoked by activities at broader regional levels, with casualties comparable to those of ongoing wars in different regions of the

world. The influence of transnational drug policy in the region influenced the levels of violence within Juarez, limiting the effectiveness of local interventions developed by the Juarez observatory. Additionally, according to the WHO typology of violence, this would be classified as collective violence, which refers to violence committed by larger groups of individuals and can be subdivided into social, political and economic violence. The VIO mandate is limited to interpersonal violence, in other words, violence between individuals.

Table 4.6 Homicides in Uruguay, 2002-2012

Year:	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Homicide Rate	6,9	5,9	5,8	5,7	6,1	5,8	6,6	6,7	6,1	5,9	7,9
Homicide Count	231	197	194	188	203	194	221	226	205	199	267

Ventura 2012, located in Uruguay, was the sole meta-analysis case to show a rise in homicide rate following the implementation of a VIO. Historically one of Latin America's more peaceful countries with a homicide rate below the global average of 6.2 per 100 000 population (2012), 2012 saw the homicide rate in Uruguay increase from 5.9 to 7.9 per 100 000 population (Table 4.6) (Fox, 2012). Officials from the Uruguayan Ministry of the Interior reported that a spate of gang shootouts and murders in Montevideo pointed to an increase in organised criminal activity in the country, which was attributed to warring drug gangs (Fox, 2012).

Drug traffickers from Colombia, Mexico and Bolivia are, according to the US State Department, increasingly using Uruguay as a transit point for narcotics, reporting that criminals may be moving cocaine production operations to the country (Fox, 2012). Additionally, the US Drug Enforcement Administration (DEA) recently announced that it would re-open its office in Uruguay, 18 years after it was closed, highlighting the country's re-emergence in the international narcotics trade (Fox, 2012).

4.5 Comparison with previous systematic reviews

To date, this is the first systematic review to assess the evidence of effect for VIOs/ISSs reduction of violence amongst adult populations. This review confirms the findings of previous observational studies, which have shown reductions in violence outcomes (Jabar *et al.*, 2015a; Prince, 2009), following the implementation of a VIO.

4.6 Strengths and weaknesses

One of the strengths of this review is that it incorporated a range of search approaches amongst a number of well-known databases, without language restriction, to ensure a comprehensive strategy in evaluating the evidence. In cases where English abstracts of publications in non-English journals were deemed relevant, full-length foreign language articles were translated and assessed for inclusion in this review. The lack of evaluation of randomised controlled studies is a weakness generally noted in this type of research, which involve a prohibitive cost to run. Furthermore, the lack of controls, pre-intervention data, blinding and the reporting of withdrawals and dropouts, were weaknesses identified within included studies. A publication bias was noted in the South American literature, which more often published data in regional technical reports, favouring this type of publication over peer-reviewed journal publication.

4.7 Interpretation and mechanisms

The formation of an observatory allows for the collation and integration of violence-related data. Furthermore, it brings together relevant stakeholders from government, emergency services (including medical, police and forensic), and non-government actors in the safety sector, to promote a comprehensive understanding of the burden of violence-related injuries through data sharing. The observatory principle practices, include the monitoring and evaluation of violence-related injuries and crimes, and intervention development with stakeholders to promote violence reduction. Interventions may be applied at multiple levels, including places, people or behaviour-based approaches such as alcohol use. Examples of a ‘place-based’ approach would include interventions focused on geographic locations such as hot spot or disorder (broken windows) policing. Examples of a ‘people-based' approach includes ones focused on individuals and groups and include interventions such as focused

deterrence, cognitive behavioural therapy or vocational training. Finally, examples of a ‘behaviour-based’ approach include the targeting of known risk factors for violence such as firearms, alcohol, drugs and gangs. These may be addressed through policy changes or interventions such as drug courts and treatment.

An alternate consideration of the mechanism is that observatories are the ‘outcome’ of an intersectoral initiative by various stakeholders to act collectively against violence. It is this collective action that brings about the reduction with the observatory being a mediator on that causal pathway.

4.8 Clinical relevance

VIOs and ISSs remain a viable model for the surveillance of violence-related injuries and outcomes. This is consistent with the public health surveillance principles, which have been applied successfully to other communicable and non-communicable diseases worldwide. Physicians should be encouraged to share their violence-related data with violence prevention stakeholders, as this provides a more complete picture of the local burden of violence-related injury. This is demonstrated with the advent of targeted policing and the Cardiff model, which promotes data sharing between hospital emergency departments and local policing services, and has demonstrated both reductions in hospital admissions related to violence as well as reduced the number of violence-related crimes reported to the police (Fox, 2012; Violence research group, 2018).

This systematic review provides the best evidence available for the effectiveness of the introduction of violence and injury observatories and injury surveillance systems in reducing violence outcomes in adults in high-violence settings. The limitations of study design, political context of study locations and paucity of evaluative research in this field were noted in the process of conducting the review. Florence *et al.,* 2011 and Boyle *et al.*, 2012 are two studies that provided rigorous study designs with control populations, which may serve as a standard to future research in this field. Additionally, this review has shown a publication bias in Latin American research, which favoured publication in regional technical reports as opposed to peer-reviewed journals. It is hoped that this review will encourage further evaluative research in not only the other violence and injury observatories found across the world, but also the

over 100 differently themed observatories found globally, which may help us understand how observatories influence social change.

5. CHAPTER FIVE:

STUDY THREE: MODIFIED DELPHI STUDY TO DETERMINE OPTIMAL DATA ELEMENTS FOR INCLUSION IN A PILOT VIOLENCE AND INJURY OBSERVATORY IN CAPE TOWN, SOUTH AFRICA

This Delphi study has been published in part in the following peer-reviewed journal:

Jabar A, Bjorkman S, Matzopoulos R, Modified Delphi study to determine optimal data elements for inclusion in a pilot violence and injury observatory in Cape Town, South Africa – **African Journal of Emergency Medicine**, **https://doi.org/10.1016/j.afjem.2018.11.001**

5.1 Introduction

The establishment of violence and injury Observatories elsewhere has been found to reduce the burden within a relatively short period (Gutierrez-Martinez *et al*., 2007; Gutiérrez-Martinez *et al.*, 2012). Currently no integrated system exists to provide collated data on violence, to allow for targeted interventions and routine monitoring and evaluation.

This research seeks to identify the optimal violence and injury-related indicators, datasets and interpersonal violence research themes and methods, which will form the foundational research components for the pilot VIO. Detailed methods are provided in Section 3.2 of Chapter 3.

5.2 Delphi round one

Thirty-three experts met the inclusion criteria and were invited to participate in the Delphi study (Appendix 3); 21 responses (64%) were received. All 21 experts completed both rounds and comprised the Delphi panel. Round one produced a series of 31 statements (Appendix 4) and 16 research themes (Table 5.1) across five different types of violence for priority rating, which were presented to the panellists. The second and final round comprised 25 statements. Research priorities for violence prevention were answered comprehensively and are described in Table 5.1, using a modified voting template employed from the Mikton *et al* 2017 Delphi study. Voting with regard

to research priorities took place using a numbered scale that ranged from highest priority (1) to lowest priority (5), as demonstrated in Table 5.1.

5.2.1 Research priorities for pilot VIO

Table 5.1 Research priorities for violence prevention in South African context (Modified template from Mikton *et al* 2017) (Mikton *et al.*, 2017)

Public Health Approach Step	Type of Violence				
Step 1: Define the problem	**IPV***	**Youth**	**Armed**	**Sexual**	**Elder Abuse**
1. Defining and measuring violence	1	1	1	1	1
2. Research on the magnitude and distribution of violence	3	2	4	3	3
3. Research on the consequences of violence	4	4	2	4	2
4. Research on the cost of violence	5	5	5	5	5
5. Research on the validity of administrative data	2	3	4	2	4
Step 2: Identify risk and protective factors	**IPV**	**Youth**	**Armed**	**Sexual**	**Elder Abuse**
1. Research on risk factors	1	1	1	1	1
2. Research on protective factors	2	2	2	2	2
3. Research on the relationship between collective violence and interpersonal violence	3	3	3	3	3
Step 3: Develop and test prevention strategies	**IPV**	**Youth**	**Armed**	**Sexual**	**Elder Abuse**
1. Evaluating the effectiveness of programmes that target actual violence	2	2	1	1	2
2. Evaluating the effectiveness of promising programmes (e.g. targeting risk factors)	1	1	2	2	1
3. Evaluating violence prevention policies	3	3	3	3	3
4. Developing primary prevention programmes based on country-specific risk factors	4	4	4	4	4
Step 4: Assure widespread adoption	**IPV**	**Youth**	**Armed**	**Sexual**	**Elder Abuse**
1. Research on scaling up programmes that have been shown to be effective	1	1	1	1	1
2. Research on the feasibility and acceptability of programmes	3	2	4	3	4
3. Research on adapting effective programmes to new contexts	2	4	2	2	3
4. Economic analysis, including cost–effectiveness analysis	4	3	3	4	2

Note: 1 = highest priority, 5 = lowest priority; *IPV: Intimate partner violence

5.3 Delphi round two

After round two, 13 indicators and 12 datasets from 9 data sources had reached positive consensus. This represented 55.3% of the total number of statements. Nineteen statements reached consensus at >90% and 40 statements reached consensus at >80%. The additional statements originate from panellist suggestions following round one. 14 indicators reached positive consensus, 7 indicators reached negative consensus (>70% scored the indicator as 1 or 2 on the Likert scale) and 10 indicators did not reach consensus.

5.3.1 Violence and injury indicators

From the Delphi panellist proposed indicators from round one that reached positive consensus, three were related to alcohol and/or drug use in violent incidents, one was related to vigilantism, and one each for homicide rate using sharps and adult males who experience sexual violence (Table 5.2). All five new indicators proposed by the Delphi panellists in round one reached positive consensus in round two.

The violence and injury indicators that reached positive consensus, negative consensus, and no consensus are further described below (Table 5.2). With regard to the indicators that reached positive consensus, three indicators represented death as an outcome, four indicators were related to sexual and/or domestic violence and one indicator (Robbery rate per every 100,000 inhabitants) was related to theft.

Table 5.2 List of violence-related indicators that reached positive consensus, negative consensus and no consensus

Positive consensus
1. Homicide rate per every 100,000 inhabitants
2. Suicide rate per every 100,000 inhabitants older than 5 years of age
3. Firearm death rate per every 100,000 inhabitants
4. Robbery rate per every 100,000 inhabitants.
5. Complaint rate for Sex crimes per every 100,000 inhabitants
6. Rate of complaints of Intrafamily/family/domestic Violence per 100,000 inhabitants
7. Prevalence of sexual violence
8. Prevalence of Intrafamily/family and domestic violence
9. Numbers of victims(assault and/or homicide) of community justice(Kangaroo courts)*
10. Alcohol and other drug related violence incidents *
11. Percentage of male 18 years and above who experienced sexual violence*
12. Percentage of homicide victims testing positive for alcohol/drug use *
13. Homicide rate using sharps (penetrating trauma) per 100 000 in Cape Town*
Negative consensus
1. Theft rate per every 100,000 inhabitants
2. Percentage of victimisation due to theft, in people older than 18 years of age
3. Percentage of people with perception of insecurity, people older than 18 years of age
4. Percentage of people with perception of risk, in people older than 18 years of age
5. Percentage of people who justify the use of violence, in people older 18 years of age.
6. Rate of Automotive Theft and Robbery per every 10, 000 vehicles registered.
7. Kidnapping rate per 100, 000 inhabitants
No consensus reached
1. Rate of criminal victimisation in people older than 18 years of age.
2. Percentage of victimisation due to robbery, in people older than 18 years of age
3. Percentage of people with perception of fear, in people older than 18 years of age.
4. Percentage of people with confidence in the institutions, people older 18 years of age
5. Perceptions of safety indicators including: 1. Crime shift, year-on-year; 2. Safe at home, day/night; 3. Safe in area, day/night; 4. Safe to commute, AM/PM; and 5. Safety of learners, on commute (AM/PM).
6. Rape conviction rate.
7. Percentage of people who know where to access help if being victim of crime.
8. Perception about most common crime in the City of Cape Town.
9. Perception about the most feared crime in the City of Cape Town.

*****These represent indicators that were introduced by Delphi panellists in round one and reached positive consensus after round two voting (i.e. positive consensus indicators 9-14)

5.3.2 Violence-related datasets

Twelve datasets from nine data sources reached positive consensus (Table 5.3) meaning that the Delphi panellists recognised theses datasets as being important for the pilot VIO to collect, integrate with other datasets and analyse, with only one dataset not reaching consensus (The Cape Panel Area Survey). The nine datasets that reached positive consensus originated from the systematic review process in study one.

Table 5.3 Violence-related datasets that reached positive consensus

Data Source	Cost and Availability	Description
Health Systems Trust	Free. Availability based on ethical approval of study.	Repeated cross-sectional studies. A rapid assessment (RA) of the injury morbidity burden at clinical services in three high violence communities in the Cape Town Metropole was conducted in Khayelitsha, Nyanga and Elsies River. Recorded measures include patient demographics, pattern of injury, location and time of injury.
Violence prevention through Urban Upgrading	Free. Availability based on ethical approval of study.	Population and household-based rolling surveys: The surveys were conducted between September 2012 and July 2015 by the Violence Prevention through Urban Upgrading (VPUU) project. A total of 1500 dwellings were visited. Recorded measures include the experience of violent crime as reported by the residents of Khayelitsha, household demographics and location.
Statistics South Africa	Free. Availability based on ethical approval of study.	Victim of Crime Survey (VOCS): The VOCS provides through questionnaire survey, information on households' perceptions about safety, and law enforcement and crime trends (StatsSA, 2017).
Forensic Pathology Service	Free. Requires an extensive application and time to acquire data is on the order of months at a minimum.	Provincial Mortality Registry: The Forensic Pathology Service (FPS) is mandated by the National Health Act 61 of 2003 law to investigate all Unnatural Deaths (Government, 2003). Recorded measures include victim demographics, pattern of injury and incident location, time and context of incident.
South African Police Service	Free. Requires an extensive application and time to acquire data is on the order of months at a minimum	Public access database: Homicide and injury-related crime data (e.g., assault) available through two public access websites; Robbery data: Residential robbery data available through WITS research Restricted data: Data including victim demographics, homicides/assault count and incident location (MRC).
Electronic trauma health record	Free. Availability based on ethical approval of study	Hospital clinical database: Data collected that is relevant to this study include patient demographics, pattern of injury and location of injury with data available from 2010 onwards.
Emergency Medical Services	Free. Availability based on ethical approval of study.	EMS incident data: Data collected that is relevant to this study include demographics, nature and location of injury and metrics are recorded per incident.
Western Cape Provincial Government	Free. Availability based on ethical approval of study.	Clinicom Provincial Hospital Patient Database: This constitutes the patient administration system used in larger hospitals, including Groote Schuur, Tygerberg, and Red Cross Children's Hospitals.

5.3.3 VIO data sharing and operations

Four questions were generated from the panellists from round one with regard to the subject of VIO data sharing and operations, and were presented to the panel in round two in the form of three multiple choice questions and one true or false statement (Figures 5.1-5.4).

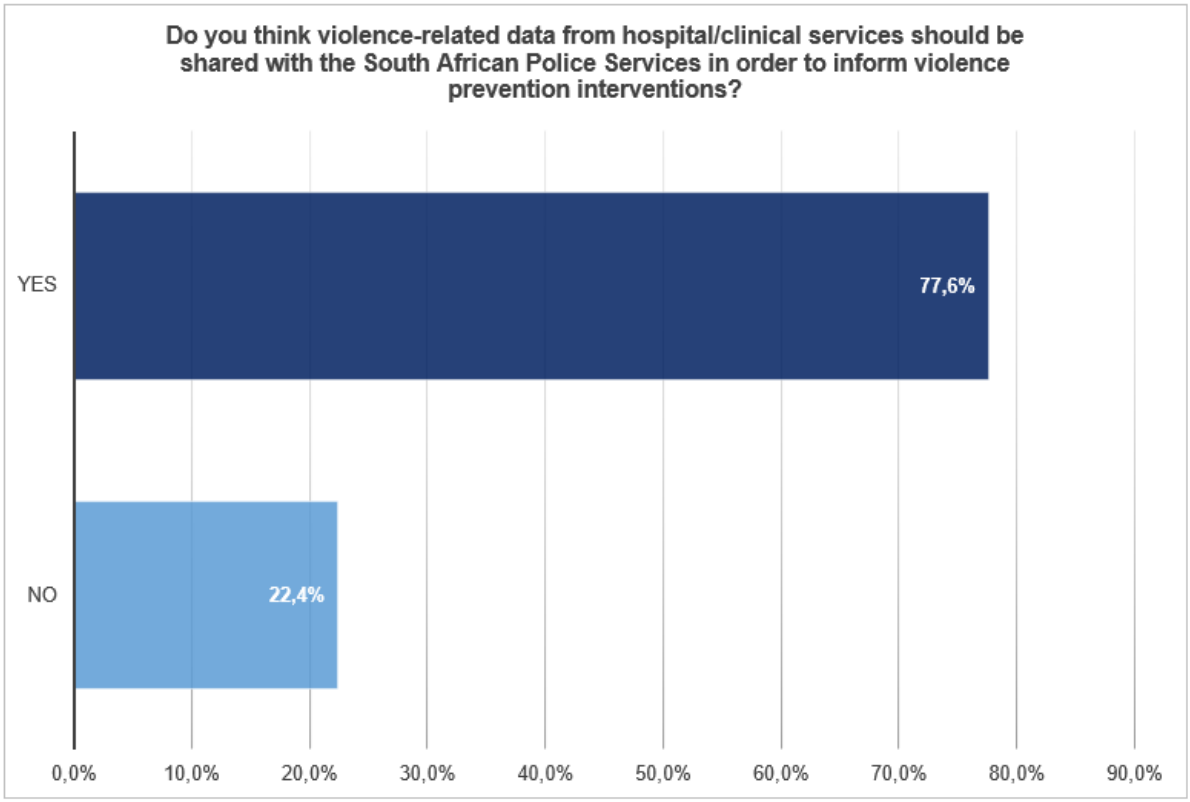
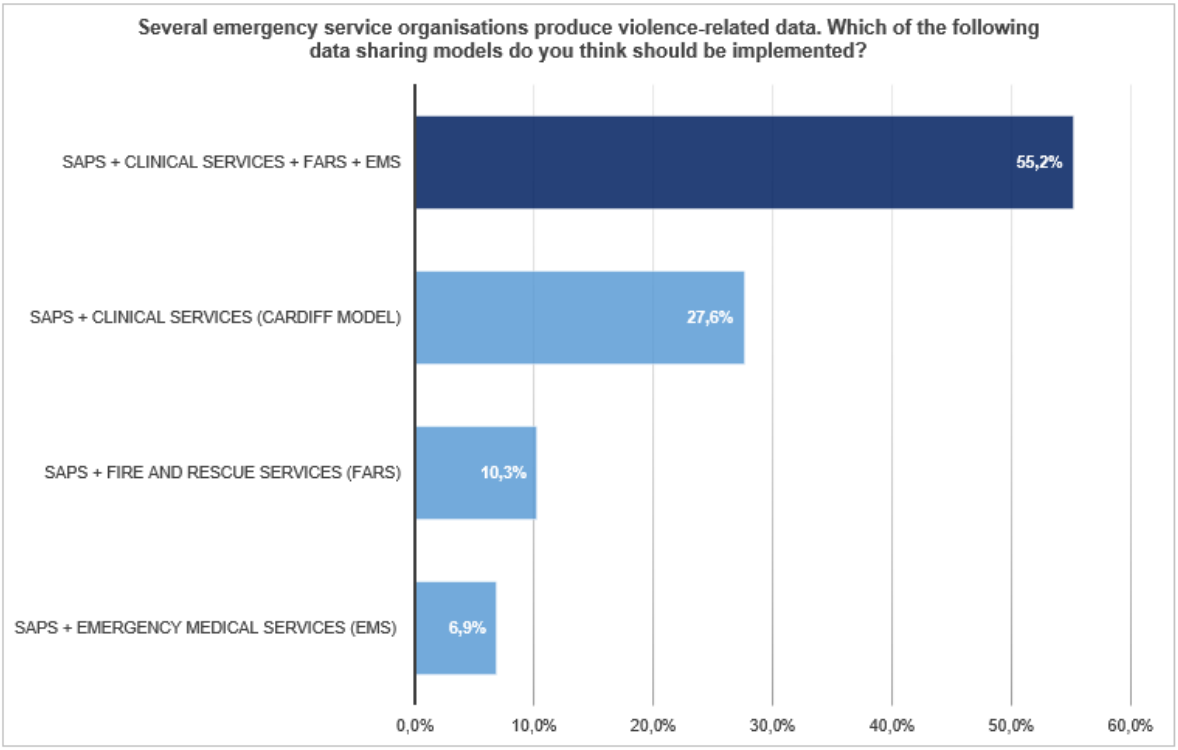


Figure 5.1 Data sharing between SAPS and clinical services

Figure 5.1 shows that the overwhelming majority of Delphi panellists (77.6%) believed that violence-related data from hospital/clinical services should be shared with the SAPS in order to inform violence prevention interventions.



South African Police Service (SAPS), Fire and rescue service (FARS), Emergency Medical Service

Figure 5.2 Data sharing models to inform violence prevention

Figure 5.2 shows that the majority of Delphi panellists (55.2%) thought that non-identifier violence-related data from all emergency service organisations should be shared with the SAPS, clinical services, FARS and EMS, whilst 27.6% of panellists thought the existing Cardiff data sharing model should be implemented.

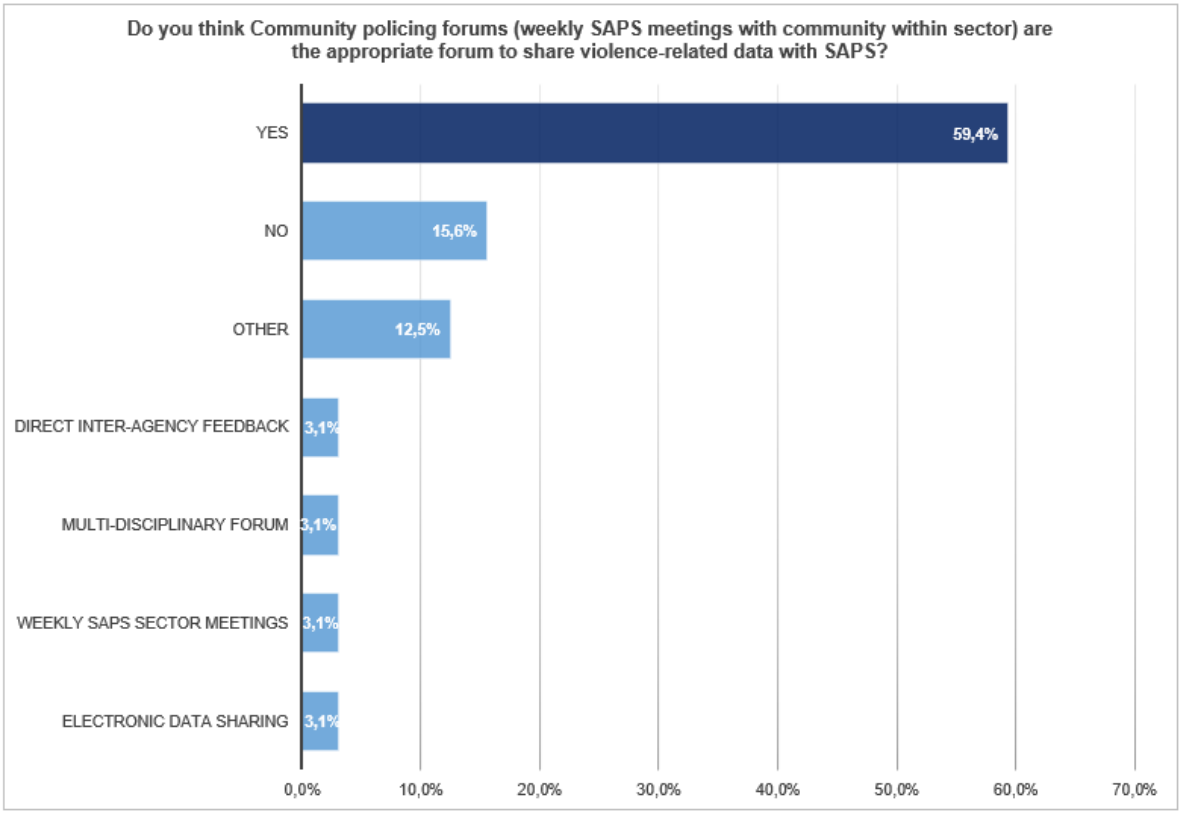


Figure 5.3 Using Community policing forums to share violence-related data with SAPS

The majority of panellists (59.4%) thought that the SAPS community policing forums were the appropriate forum to share violence-related data with the SAPS (Figure 5.3).

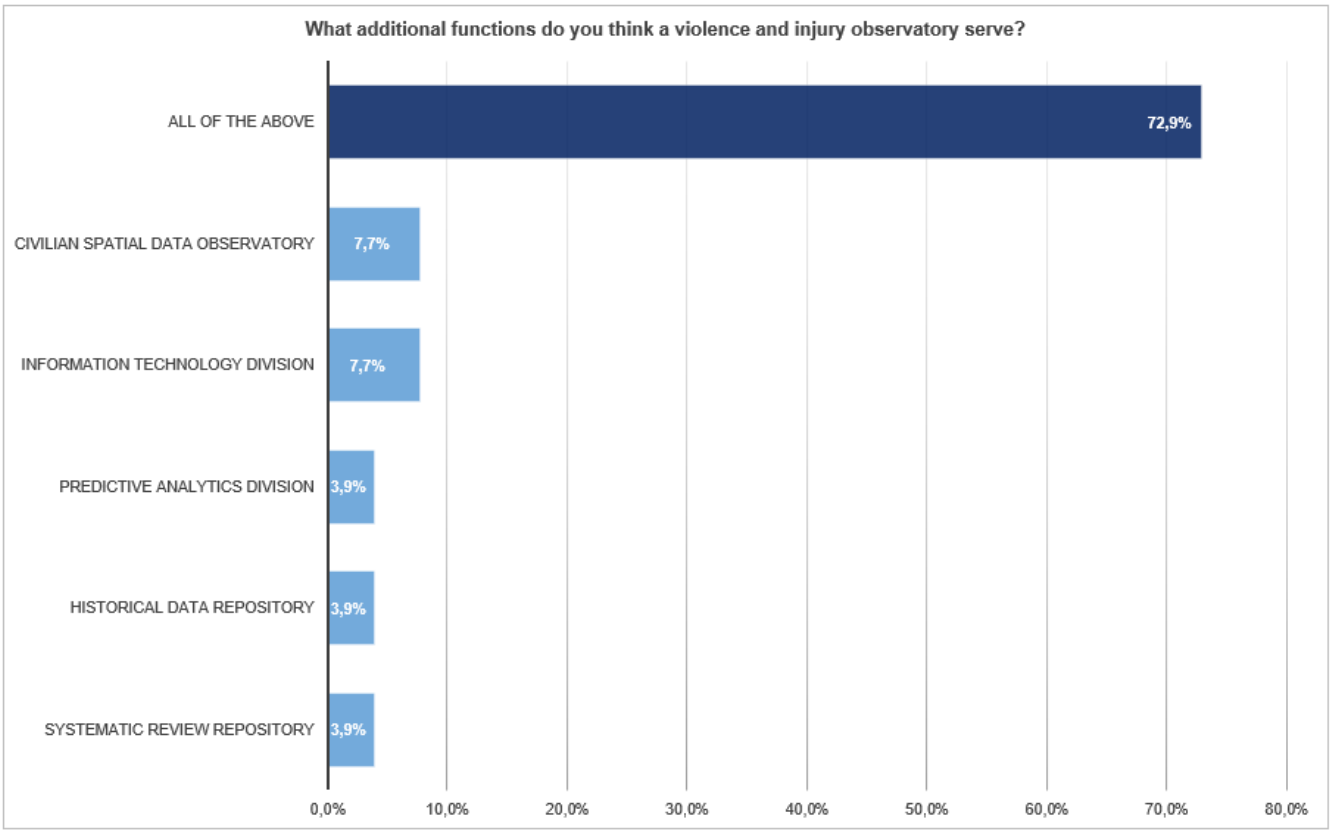


Figure 5.4 Different functional capacities of the pilot VIO

The majority of panellists (72.9%) thought that the pilot VIO should serve several functions including a civilian spatial data observatory, an information technology division, a predictive analytics division and a historical data and systematic review repository (Figure 5.4).

5.4 CT VIO research framework and policy relevance

This study provides a research priority framework for violence and injury research within the Western Cape Province of South Africa (Table 5.1). All research priorities identified by the Delphi panel have a corresponding pilot study that is complete or is undergoing research protocol development at the CT VIO (Table 5.4).

Table 5.4 Delphi identified research priorities for interpersonal violence reduction and CT VIO planned pilot studies

Research priorities for interpersonal violence reduction (Mikton et al., 2017)	Cape Town VIO pilot studies
Step 1 of the public health approach	
1. Defining and measuring violence	Merging Health and Police datasets for characterising interpersonal violence in the community of Khayelitsha, South Africa 2013-2015 *
2. Research on the magnitude and distribution of violence	The magnitude and distribution of violence-related crime in the community of Khayelitsha, South Africa
3. Research on the consequences of violence	
4. Research on the cost of violence	Economic cost of homicide
5. Research on the validity of administrative data	Comparison of structural correlates studies, Homicide (FPS) vs Experience of violence (IDRC survey)
Step 2 of the public health approach	
1. Research on risk factors	Structural correlates of experience of violence for the community of Khayelitsha
2. Research on protective factors	Journey to injury (JTI) studies for the community of Khayelitsha
3. Research on the relationship between collective violence and interpersonal violence	
Step 3 of the public health approach	
1. Evaluating the effectiveness of programmes that target actual violence	Is the introduction of violence and injury observatories associated with a reduction of violence in adult populations? A Systematic review *
2. Evaluating the effectiveness of promising programmes (e.g. targeting risk factors)	
3. Evaluating violence prevention policies	
4. Developing primary prevention programmes based on country-specific risk factors	Modified Delphi study to determine optimal data inputs for Cape Town pilot violence, injury and trauma observatory *
5. Identifying subgroups within intervention populations	Spatial comparison of experience of intimate partner violence with HIV/TB prevalence for the community of Khayelitsha
6. Developing operational programme manuals	The Cape Town VIO implementation manual *
7. Developing and evaluating approaches that help individuals in abusive relationships	
8. Determining prevention approaches for younger age groups	
Step 4 of the public health approach	
1. Research on scaling up programmes that have been shown to be effective	Cardiff model implementation in Khayelitsha
2. Research on the feasibility and acceptability of programmes	
3. Research on adapting effective programmes to new contexts	Modified Delphi study to determine optimal data elements for inclusion in a pilot VIO * Critical appraisal of Organization of American States (OAS) citizen security indicators for use in South African setting*
4. Economic analysis, including cost–effectiveness analysis	Economic cost of homicide
5. Developing operational manuals for prevention programmes	
6. Developing a database summarizing research to guide the general public	CT VIO data registry*, CT VIO public website

***Indicates completed studies**

Additionally, violence and injury indicators and datasets have been identified through expert consensus, which provide the optimal data elements to develop prospective VIOs regionally. One of the study limitations is that several SAPS members from the divisions of Visible Policing, Forensic Service and Detective Service did not respond in time to participate in the Delphi panel; only one SAPS member was able to participate and complete both rounds of the study.

The research priorities identified in this study together with the South African National development plan (NDP) (Table 5.5), have informed the research agenda for the pilot VIO. The NDP aims to eliminate poverty and reduce inequality by 2030, where planning and implementation should be informed by evidence-based monitoring and evaluation. The priority agenda highlighted by the South African National Development Plan 2030 are reflected in the CT VIO objectives (Table 5.5) and research agenda (Table 5.4).

Table 5.5 Contribution of the Cape Town VIO to the National development plan 2030

No.	National Development Plan Priorities 2030*	Cape Town Violence and Injury Observatory (CT VIO) objectives
1	Address the social determinants that affect health and diseases	Provide an analysis of social factors that play a key role in determining health status related to interpersonal violence
2	Improve the health Information system	Collate data from a range of sources; stratify, repackage, translate and disseminate the information in ways that make it accessible for use by different violence prevention stakeholders
3	Prevent and reduce the disease burden and promote health	Contribute to the identification of the types and levels of the burden of disease related to interpersonal violence; make recommendations for their prevention, reduction and mitigation
4	Improve quality by using evidence	Analyse all data received and provide feedback for translation of research into practice; make findings accessible to all violence prevention stakeholders for improved quality of health care
5	Meaningful public-private partnerships	Vigilance on events and trends leading to balanced feedback to all sectors will enable development of meaningful partnerships between public and private sector stakeholders involved in violence prevention to help parties engage in using synergies for mutual benefit

* Mekwa, Madela-Mntla, Loots, Van Niekerk, Jeenah and Mayosi, 2016

The indicators and datasets identified in this study for routine collection have informed the pilot VIO study in chapter 6, titled Merging health and police datasets for characterising interpersonal violence in the community of Khayelitsha, South Africa 2013-2015 .

This case matching study used two datasets (health and police), three research themes (Defining and measuring violence; research on the magnitude and distribution of violence, research on the validity of administrative data) and five indicators that reached positive consensus in the Delphi study.

Furthermore, this Delphi study advocates for the collection of Suicide rate per every 100,000 inhabitants older than 5 years of age. Mental health disorders are a major impediment to the well-being of populations in high income and LMICs. People with these disorders are often subjected to social isolation, poor quality of life and increased mortality. These disorders are the cause of staggering economic and social costs.

Consequently, there is a need for preventing and curing mental disorders as part of the efforts to strengthen the capacity of health-care systems.

The current focus of the pilot VIO is to form a steering committee to oversee the VIO implementation. This includes providing other researchers in the field access to datasets housed within the VIO. Additionally, several VIO initiated studies have commenced including a systematic review, several GIS-based spatial studies and evaluative research, which focuses on alcohol policy and the firearm control act.

There have been calls in the 2017 South African national health review for the development of a national health observatory. Whilst this is agreeable in principle, it is felt that an emphasis should be placed on the development of regional/provincial health observatories or VIOs prior to the development of a national observatory. In starting with a smaller regional focus, it is possible to identify systemic problems with data collection at the primary level. This allows lessons learnt to be disseminated to other prospective VIOs. Additionally, it is possible to contextualise regional health and violence burdens, with the intention to develop interventions tailored to the local health burdens and not utilise a generic top-down intervention approach. A national health observatory or VIO would then serve as the collection point of national health data, allowing for strategic development of national health policy based on evidence-based quality and timely data.

The indicators, datasets, research priorities and data sharing recommendations identified by the Delphi study have informed the pilot study of the VIO which follows in the next chapter.

6. CHAPTER SIX:

STUDY FOUR: MERGING HEALTH AND POLICE DATASETS FOR CHARACTERISING INTERPERSONAL VIOLENCE

This case matching study has been submitted to the following journal and is currently in review:

Jabar A, Oni T, London L, Cois A, Matzopoulos R. Merging Health and Police datasets for characterising interpersonal violence in the community of Khayelitsha, South Africa 2013-2015. BMJ Open (submitted: 19 December 2021; manuscript ID: bmjopen-2020-048129)

6.1 Introduction

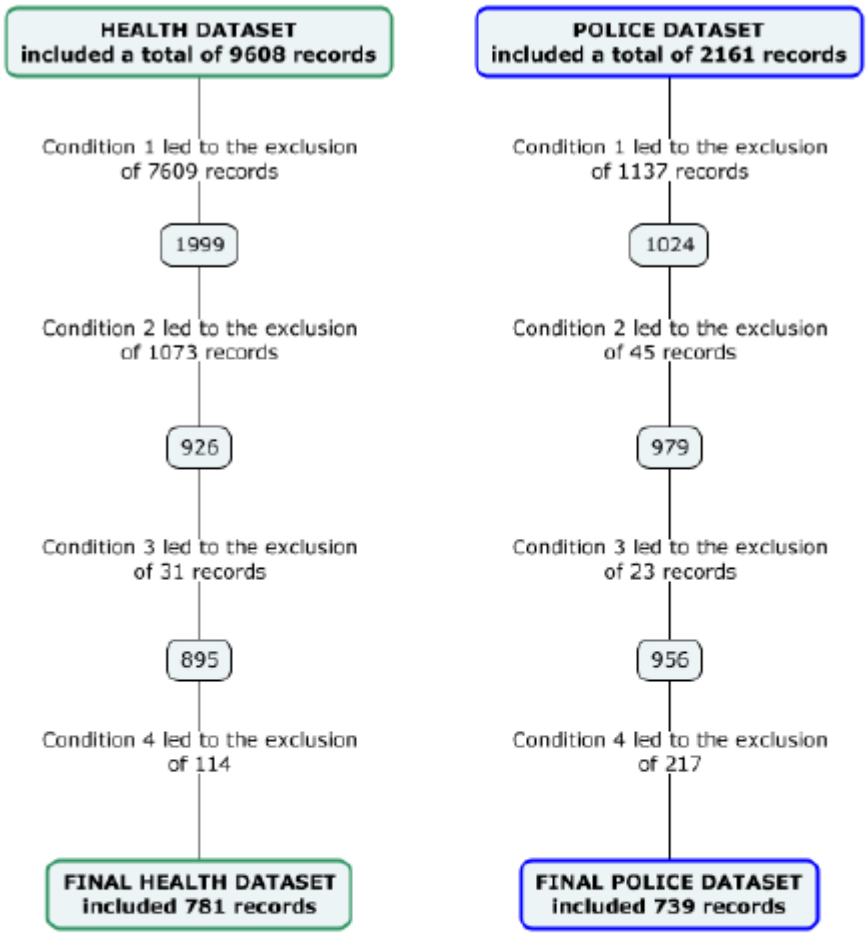
The Cardiff Model is premised on the idea that the majority of injury cases from interpersonal violence presenting to health facilities will not be reported to the police. The aim of this study was to determine the concordance between violence-related injuries recorded at health facilities and those that were reported to the police in Khayelitsha.

Employing a retrospective analysis of secondary cross-sectional health and police data, from three health facilities and three police stations, we identified 783 interpersonal violence cases from Khayelitsha health facilities, which were matched with 749 violence-related crimes that were reported to the police. Data were collected over five week-long sampling periods between 2013 and 2015. Detailed methods are provided in Section 3.3 of Chapter 3.

6.2 Summary of included data

The health dataset initially included a total number of 9608 records of patients who presented to the emergency departments at the three health facilities during the five time periods considered.

The police dataset initially included a total number of 2161 records of criminal episodes. 358 police records had missing values on gender and age.



KEY:

Health condition 1: Cases that were excluded from the health data included medical cases not related to injuries and injuries not caused by violence perpetrated on the victim by another subject

Police condition 1: Cases that were removed from the police data include cases other than the types of crimes described in variables section

Condition 2: events that occurred outside the ten areas of Khayelitsha

Condition 3: cases in which the victim was younger than 16 years

Condition 4: events that occurred outside the time period

Figure 6.1 Case selection flow chart for health and police data

6.3 Descriptive statistics

Patients seen at health facilities (69.8%) and from police data (51.4%) were both more frequently male (Table 6.1). The mean age for patients was 29.9 for patients and 35.2 for victims of violence from police data. The most common age ranges for both datasets were 25-34 (health 42.2%, police 34.1%), 16-24 (health 33.7%, police 22.3%) and 35-44 (health 15.1%, police 18.9%). At health facilities violence peaked on

Sundays (33.7%), whereas violent crimes from police data were most frequently reported to the police on Saturdays (22.3%).

The most common instrument described in the police data was an assault with body part (push/kick/punch) followed by unknown, firearm, sharp object and blunt object. At health facilities, the most common instrument use was sharp objects, followed by an assault with body part (push/kick/punch), blunt objects, unknown and firearms. Sharp objects comprised 60.7% for health presentations versus 12% for police presentations while body part was 41.8% for police, while only 14.7% for health.

Site B recorded the most cases in both health (36.2%) and police (32.9%) data with Ilitha Park (2.7%) and Enkanini (1.2%) recording the fewest cases respectively.

Table 6.1 Distribution of health and police cases by co-variate

Variable	HEALTH Data (N=781)	POLICE Data (N=739)
	n (%)	n (%)
Name Surname Completeness	708 (90.7)	739 (100)
Gender*		
Males	545 (69.8)	196 (51.4)
Females	236 (30.2)	185 (48.6)
Age (years)*		
16-24	263 (33.7)	85 (22.3)
25-34	330 (42.2)	130 (34.1)
35-44	118 (15.1)	72 (18.9)
45-54	46 (5.9)	56 (14.7)
55+	24 (3.1)	38 (10.0)
Day of week		
Monday	95 (12.2)	103 (13.9)
Tuesday	50 (6.4)	72 (9.7)
Wednesday	48 (6.1)	75 (10.1)
Thursday	45 (5.8)	64 (8.7)
Friday	77 (9.8)	100 (13.5)
Saturday	203 (26.0)	165 (22.3)
Sunday	263 (33.7)	160 (21.7)
Time of day		
00h00:01h59	65 (8.3)	60 (8.1)
02h00:03h59	42 (5.4)	29 (3.9)
04h00:05h59	40 (5.1)	42 (5.7)
06h00:07h59	65 (8.3)	71 (9.6)
08h00:09h59	52 (6.7)	34 (4.6)
10h00:11h59	64 (8.2)	49 (6.6)
12h00:13h59	73 (9.3)	45 (6.1)
14h00:15h59	63 (8.1)	68 (9.2)
16h00:17h59	76 (9.7)	67 (9.1)
18h00:19h59	57 (7.3)	69 (9.3)
20h00:21h59	101 (12.9)	119 (16.1)
22h00:23h59	83 (10.6)	86 (11.6)
Type of violence		
Rape/sexual	16 (2.0)	67 (9.1)
Property crime-related	290 (37.0)	250 (33.8)
Interpersonal	266 (44.8)	422 (57.1)
Gang-related	84 (10.7)	
Unknown	125 (16.0)	**

Variable	HEALTH Data (N=781)	POLICE Data (N=739)
	n (%)	n (%)
Name Surname Completeness	708 (90.7)	739 (100)
Instrument used		
Sharp object	474 (60.7)	89 (12.0)
Blunt object	112 (14.3)	70 (9.5)
Firearm	29 (3.7)	89 (12.0)
Push/kick/punch	115 (14.7)	309 (41.8)
Human bite	6 (0.8)	2 (0.3)
Choking/strangulation	2 (0.3)	8 (1.1)
Fire burn	2 (0.3)	5 (0.7)
Other burn	3 (0.4)	2 (0.3)
Poisoning	0 (0.0)	56 (7.6)
Unknown	38 (4.9)	109 (14.7)
Area		
Enkanini	41 (5.2)	9 (1.2)
Harare	85 (10.9)	66 (8.9)
IlithaPark	21 (2.7)	42 (5.7)
Khaya	30 (3.8)	74 (10.0)
Kuyasa	39 (5.0)	45 (6.1)
Makaya	43 (5.5)	37 (5.0)
Makhaza	85 (11.0)	96 (13.0)
SiteB	283 (36.2)	243 (32.9)
SiteC	118 (15.1)	91(12.3)
Town2	36 (4.6)	36 (4.9)
Triage scores * **		
Red	65 (8.3%)	-
Orange	251 (32.1%)	-
Yellow	380 (48.6%)	-
Green	68 (8.7%)	-
Blue	1 (0.12)	-
Unknown	18 (2.2%)	-
Alcohol use * **		
Yes	444 (56.8%)	-
No	284 (36.4%)	-
Unknown	53 (6.8%)	-

* 358 police records had missing values on gender and age

** For type of violence, the police data did not record an unknown or gang-related category

*** Triage score and alcohol use data were only available for the health dataset

6.4 Concordance between health and police data

Among the 708 patients being treated for violence-related injuries at health facilities for which the name and surname could be retrieved from the Clinicom database, only 104 reported the incident to the police, which equates to a matching ratio of 14.7% (Figure 6.2).

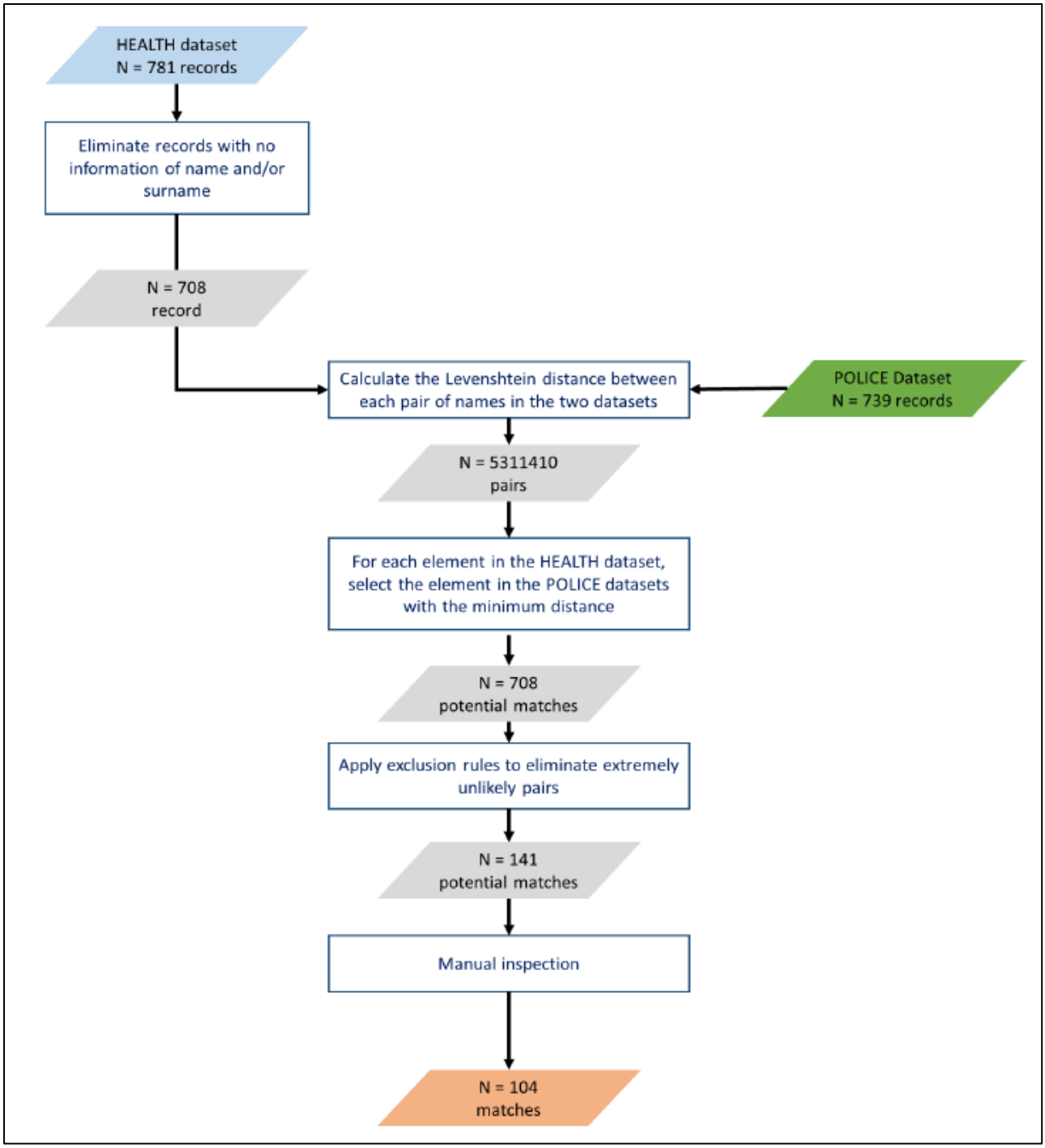


Figure 6.2 Personal identifier matching between datasets

6.5 Adjusted crime profile

Combining unreported cases from health records to the police reported crime statistics provides an adjusted crime profile (Table 6.2). The addition of patient violence from the health data to the police reported crime statistics, resulted in an 81.7% increase in potential total violent crimes from police data over the reporting period. Males represent the majority in the combined (65.0%) dataset. In terms of day of week, Saturday and Sunday were the busiest days in the combined dataset with Thursday being the quietest.

Push/kick/punch (41.8% and 40.3%) is the most common instrument used in the police and combined dataset respectively, with the commonest type of violence being interpersonal violence for both (57.1 and 58.1%). Site B, Site C and Makhaza ranked amongst the top three for both datasets with Enkanini (1.5%) similarly recording the fewest cases.

Notable shifts in ranking when combining the datasets were found in day of week (Saturday ranked 1 in police versus 2 in combined dataset), time of day, instrument used (push/kick/punch ranked 1 in police data [41.8%], and sharp object ranked 1 in combined data [35.4%]), and area where the positions for Makhaza and Site C were changed in the top 3 ranked areas.

Table 6.2 Adjusted crime profile comparing police versus police and health combined data

Variable	POLICE data (N=739)		Combined Data (N=1343)	
	Rank	n (%)	Rank	n (%)
Gender*				
Males	1	196 (51.4)	1	640 (65.0)
Females	2	185 (48.6)	2	345 (35.0)
Age (years)*				
16-24	2	85 (22.3)	2	274 (27.8)
25-34	1	130 (34.1)	1	394 (40.0)
35-44	3	72 (18.9)	3	173 (17.6)
45-54	4	56 (14.7)	4	87 (8.8)
55+	5	38 (10.0)	5	57 (5.8)
Day of week				
Monday	3	103 (13.9)	3	178 (13.2)
Tuesday	6	72 (9.7)	6	107 (8.0)
Wednesday	5	75 (10.1)	5	109 (8.1)
Thursday	7	64 (8.7)	7	96 (7.1)
Friday	4	100 (13.5)	4	155 (11.5)
Saturday	1	165 (22.3)	2	320 (23.8)
Sunday	2	160 (21.7)	1	378 (28.1)
Time of day				
00h00:01h59	7	60 (8.1)	6	109 (8.1)
02h00:03h59	12	29 (3.9)	11	63 (4.7)
04h00:05h59	10	42 (5.7)	10	70 (5.2)
06h00:07h59	3	71 (9.6)	4	120 (8.9)
08h00:09h59	11	34 (4.6)	9	79 (5.9)
10h00:11h59	8	49 (6.6)	8	97 (7.2)
12h00:13h59	9	45 (6.1)	7	101 (7.5)
14h00:15h59	5	68 (9.2)	5	113 (8.4)
16h00:17h59	6	67 (9.1)	3	131 (9.7)
18h00:19h59	4	69 (9.3)	6	109 (8.1)
20h00:21h59	1	119 (16.1)	1	198 (14.7)
22h00:23h59	2	86 (11.6)	2	153 (11.4)
Instrument used				
Sharp object	3	89 (12.0)	1	476 (35.4)
Blunt object	4	70 (9.5)	5	155 (11.5)
Firearm	3	89 (12.0)	4	111 (8.3)
Push/kick/punch	1	309 (41.8)	2	383 (28.5)
Human bite	8	2 (0.3)	9	5 (0.4)
Choking/strangulation	6	8 (1.1)	7	9 (0.7)
Fire burn	7	5 (0.7)	8	7 (0.5)
Other burn	8	2 (0.3)	10	5 (0.4)
Poisoning	5	56 (7.6)	6	56 (4.2)
Unknown	2	109 (14.7)	3	136 (10.1)
Type of violence				
Rape/sexual	3	67 (9.1)	3	74 (5.5)
Property crime-related	2	250 (33.8)	2	489 (36.4)
Interpersonal **	1	422 (57.1)	1	780 (58.1)
Area				
Enkanini	10	9 (1.2)	8	41 (3.1)
Harare	5	66 (8.9)	4	129 (9.6)
IlithaPark	7	42 (5.7)	7	59 (4.4)
Khaya	4	74 (10.0)	4	96 (7.1)
Kuyasa	6	45 (6.1)	5	74 (5.5)
Makaya	8	37 (5.0)	6	70 (5.2)
Makhaza	2	96 (13.0)	3	163 (12.1)
SiteB	1	243 (32.9)	1	461 (34.3)
SiteC	3	91(12.3)	2	188 (14.0)
Town2	9	36 (4.9)	7	62 (4.6)

*358 police records had missing values on gender and age

** For purposes of comparison, gang-related' cases from the health data were included as interpersonal violence' cases. Additionally, the unknown' category was included as interpersonal violence' for purposes of comparison and ranking.

6.6 Predictors of non-reporting

Male patients (73.5%) that were stabbed (64.1%), had alcohol use confirmed or suspected (58.9%) and experienced crime (39.6%) or gang-related incidents (11.4%) were less likely to report their injuries to the police. Patients suffering sharp object (39.4%) or push/kick/punch injuries (29.8%) or sexual assault/rape (8.7%) were more likely to report their injuries (Table 6.3).

No statistically significant differences were present regarding age and severity of the injury (as measured by the triage code). There were minimal differences in location and timing of the violent episode between reporting and non-reporting patients. The one significant difference in timing of the violence episode was the almost double number of episodes reported on Sunday among non-reporting patients when compared to reporting patients (36.1% vs. 20.2%, p=0.017).

Table 6.3 Difference in demographic and clinical characteristics and in type of offence between patients who did/did not report the violence to police

Variable	Patients who did not report the violence: N = 604 n (%)	Patients who reported the violence: N = 104 n (%)	All patients: * N = 708 n (%)	p-value**
Gender				
Male	444 (73.5%)	44 (42.3%)	488 (68.9%)	<0.001
Female	160 (26.5%)	60 (57.7%)	220 (31.1%)	
Age (years)				
16-24	188 (31.2)	41 (39.4)	229 (32.4)	0,017
25-34	264 (43.8)	34 (32.7)	298 (42.1)	
35-44	101 (16.7)	16 (15.4)	117 (16.5)	
45-54	31 (5.1)	12 (11.5)	43 (6.1)	
55+	20 (3.2)	1 (1.0)	21 (2.8)	
Day of week				
Monday	75 (12.4)	14 (13.5)	89 (12.6)	0,017
Tuesday	35 (5.8)	12 (11.5)	47 (6.6)	
Wednesday	34 (5.6)	10 (9.6)	44 (6.2)	
Thursday	32 (5.3)	5 (4.8)	37 (5.2)	
Friday	55 (9.1)	15 (14.4)	70 (9.9)	
Saturday	155 (25.7)	27 (26)	182 (25.7)	
Sunday	218 (36.1)	21 (20.2)	239 (33.8)	
Time of day				
00h00:01h59	49 (8.1)	8 (7.7)	57 (8.1)	0,267
02h00:03h59	34 (5.6)	6 (5.8)	40 (5.6)	
04h00:05h59	28 (4.6)	6 (5.8)	34 (4.8)	
06h00:07h59	49 (8.1)	10 (9.6)	59 (8.3)	
08h00:09h59	45 (7.5)	5 (4.8)	50 (7.1)	
10h00:11h59	48 (7.9)	7 (6.7)	55 (7.8)	
12h00:13h59	56 (9.3)	12 (11.5)	68 (9.6)	
14h00:15h59	45 (7.5)	15 (14.4)	60 (8.5)	
16h00:17h59	64 (10.6)	4 (3.8)	68 (9.6)	
18h00:19h59	40 (6.6)	8 (7.7)	48 (6.8)	
20h00:21h59	79 (13.1)	12 (11.5)	91 (12.9)	
22h00:23h59	67 (11.1)	11 (10.6)	78 (11)	
Type of				
Rape/sexual	7 (1.2)	9 (8.7)	16 (2.3)	<0.001
Property crime-related***	239 (39.6)	26 (25.0)	265 (37.4)	
Interpersonal	199 (33.0)	45 (43.2)	244 (34.5)	
Gang-related	69 (11.4)	6 (5.8)	75 (10.6)	
Unknown	90 (14.9)	18 (17.3)	108 (15.3)	

Variable	Patients who did not report the violence: N = 604 n (%)	Patients who reported the violence: N = 104 n (%)	All patients: * N = 708 n (%)	p-value**
Instrument				
Sharp object	387 (64.1)	41 (39.4)	428 (60.5)	<0.001
Blunt object	85 (14.1)	18 (17.3)	103 (14.5)	
Firearm	22 (3.6)	5 (4.8)	27 (3.8)	
Push/kick/punch	74 (12.3)	31 (29.8)	105 (14.8)	
Human bite	3 (0.5)	1 (1)	4 (0.6)	
Choking/strangulation	1 (0.2)	1 (1)	2 (0.3)	
Fire burn	2 (0.3)	0 (0)	2 (0.3)	
Other burn	3 (0.5)	0 (0)	3 (0.4)	
Poisoning	0 (0)	0 (0)	0 (0)	
Unknown	27 (4.5)	7 (6.7)	34 (4.8)	
Area				
Enkanini	32 (5.3)	4 (3.8)	36 (5.1)	0,689
Harare	63 (10.4)	14 (13.5)	77 (10.9)	
Ilitha Park	17 (2.8)	1 (1)	18 (2.5)	
Khaya	22 (3.6)	4 (3.8)	26 (3.7)	
Kuyasa	29 (4.8)	6 (5.8)	35 (4.9)	
Makaya	33 (5.5)	7 (6.7)	40 (5.6)	
Makhaza	67 (11.1)	13 (12.5)	80 (11.3)	
Site B	218 (36.1)	38 (36.5)	256 (36.2)	
Site C	97 (16.1)	10 (9.6)	107 (15.1)	
Town 2	26 (4.3)	7 (6.7)	33 (4.7)	
Triage code				
Red	47 (7.8)	7 (6.7)	54 (7.6)	0,278
Orange	204 (33.8)	23 (22.1)	227 (32.1)	
Yellow	290 (48)	58 (55.8)	348 (49.2)	
Green	53 (8.8)	8 (7.7)	61 (8.6)	
Blue	1 (0.2)	0 (0)	1 (0.1)	
Unknown	9 (1.5)	8 (7.7)	17 (2.4)	
Alcohol use				
Yes/Suspected	356 (58.9)	49 (47.1)	405 (57.2)	0,012
No	205 (33.9)	50 (48.1)	255 (36)	
Unknown	43 (7.1)	5 (4.8)	48 (6.8)	

* For which the name and surname could be retrieved from the Clinicom database;

** Statistical test for the existence of differences between reporting and not-reporting patients.

*** Property crime-related refers to the type of violence that could not be categorised under rape/sexual, interpersonal violence, gang violence or unknown. Cases in this category included violence initiated to facilitate property theft from an individual.

6.7 Discussion

One of the key findings of a 2014 systematic review of the feasibility and effectiveness of community-level interventions involving emergency department data sharing to reduce alcohol-related violence, was that data sharing protocols can be cheaply and easily implemented into modern Emergency Department (ED) triage systems (Droste, Miller and Baker, 2014). There was general consensus among studies that this could be done with minimal cost, staff workload burden and impact to patient safety. Additionally, there was minimum risk to patient service and anonymity, risk of harm displacement to other licensed venues or increase to length of patient stay (Droste *et al*., 2014). The Cardiff Model is cost-effective with one study finding that for every $1 spent, nearly $15 in health system and over $19 in criminal justice system costs are saved (Holder, 2001).

To the best of our knowledge, this is the first study to attempt direct name matching between the health and the police to quantify the level of underreporting of interpersonal violence-related incidents. The matching method using personal identifiers suggest that only a small fraction (approximately 15 %) of patients being treated for interpersonal violence at local health facilities will go on to report these as crimes to local police stations within a week. Conversely, only a small proportion of those who report a violent crime to the police go on to present to a health facility with an injury within a week.

The proportion of cases in this study of injuries arising from interpersonal violence which are not reported to the police (approximately 82%), is consistent with the findings of the Cardiff model which found that one half to two thirds of violence which results in hospital treatment is not known to the police (Florence *et al.*, 2011). This finding is much lower when compared with other regions including in developed countries. According to a 2016 U.S. Department of Justice report, many crimes go unreported to law enforcement, including 53% of violent crime in 2015; 58% of simple assaults in 2015 and 43% of violent crime involving an injury in 2015 (Morgan and Kena, 2018).

Possible reasons for the high level of underreporting (30%+ discrepancy between the level of under reporting in this study [82%) and the Cardiff model [50%]), can be found in the report of the 2012 Khayelitsha Commission of inquiry (also known as the O'Regan/Pikoli Commission) which investigated allegations of police inefficiency in Khayelitsha and the breakdown in relations between the Khayelitsha community and the police. Poor policing conditions characterised by police in the area being generally lower-ranked, poorly equipped, few in number, under-qualified and reluctant to open cases, led to breakdown in trust with the community resulting in the lack of reporting (WCG, 2014). Other possible reasons for underreporting include the fear of reprisal from perpetrators, being turned away by police when presenting at the police station to report a crime, stigma/shame, or not perceiving an injury arising from interpersonal violence as a crime.

Type of injury

The majority of police reported crimes are related to assault with body part (push/kick/punch). Victims of knife crimes represented in the health data, which often cause worse injuries requiring medical intervention, are not reporting these incidents to police. Gang/property crime-related episodes were more common among non-reporting patients, which may be due to a lack of confidence in the police s ability to protect them from reprisal, or if the victim perceived the gangs as being protected by or working with the police, in a known context of mistrust of police in the community of Khayelitsha (WCG, 2014). Additionally, the underreporting of knife wielding gang-related violence incidents in police statistics may be a contributing factor. This is supported by the lower proportion of younger male victims (age 16-24) reporting crime compared to those receiving treatment for an injury arising from interpersonal violence (31.2% vs 39.4%, p=0.017).

The scale in difference of sharp object injuries presenting at police (89 cases) and health facilities (474), means that 385 victims of violence from police data treated for a sharp object injury at a health facility did not go on to report the crime to the police, which if added to the official police statistics would represent a 52% increase in all violent crimes from police data reported. This provides evidence for an excess burden of injuries arising from interpersonal violence which is not being reported to police – a situation that is consistent with the premise of the Cardiff model.

6.7.1 Limitations

One of the limitations of this study is that approximately 10% of health records lacked names and were thus excluded from the matching process. A 2013 South African study of missing medical records found that up to 8% of hospital folders had the wrong names and that 17% of hospital folders had names without folder numbers (Wegner and Rhoda, 2013).

No cases of poisoning were recorded in the health data. The current referral practice is for Michael M and Site B to refer their poisoning cases to KDH. At KDH most poisoning cases are triaged to the medical department and thus these cases would not be recorded in the health data. The exception being cases of poisoning due to a corrosive substance such as bleach, which would be triaged to the Trauma/Surgical department due to the possible need for a surgical therapeutic intervention. It is a recommendation of study authors that the poisoning data from medical emergencies be included to inform this work going forward.

One of the weaknesses of this study is that patients who presented to a health facility but only lodged criminal cases later outside of the one-week study periods over the five years would not be included in the police dataset and therefore not be included in the matching process. Similarly, if victims of injuries arising from interpersonal violence presented to the police first and did not present to the health facilities for treatment within the one-week study period, they were also not included in the matching process. The inclusion of these late reporting cases could increase the overall proportion of interpersonal violence-related injuries that were reported to the police.

The reporting delay was examined and noted that it was likely to have limited impact, with the analysis provided in Appendix 5.

Finally, patients experiencing inter-personal violence and who sought private health care or presented directly to the hospitals outside of the district (such as the tertiary referral hospital, Tygerberg Hospital) would not be included in the analyses. This may increase or decrease the estimate of concordance depending on whether these patients reported to the police.

6.7.2 Implications for policy and interventions

Murder and violence are often linked to alcohol with a 2016 analysis of murder dockets finding that in up to 48% of murders, the victim or perpetrator was intoxicated (SAPS, 2016). Alcohol use was higher in patients who did not report violence than patients who did report violence to the police. This is of public health importance as alcohol has been identified as a major risk factor for and predictor of violence and is amenable to policy change to reduce alcohol harms. The current evidence base for measuring alcohol use within crime data will underestimate the extent of the problem because of the underreporting in routine crime statistics highlighted by this research.

Furthermore, with regard to local municipal alcohol policy on liquor outlet licences (Municipality, 2020), reasons for limitation of liquor outlet licences may include, safety and social problems and/or concerns due to alcohol abuse, alcohol-related crimes, illegal criminal activity, etc, using data originating from the South African Police Service . The local alcohol policy is heavily reliant on the SAPS data to guide license approvals, which this research has shown to be incomplete and flawed in its underestimation of interpersonal violence at the community level. Alcohol policy decisions made by Government at any level (local, district, provincial and national) that is informed by this data, may aggravate alcohol related harms.

The level of underreporting exposed by the merging of health and police data and matching exercise may speak to a larger question of police resourcing within Khayelitsha. The Khayelitsha commission of inquiry highlighted the insufficient police human resources within police stations in Khayelitsha as one of the reasons for community mistrust of the police (WCG, 2014). The current SAPS resource allocation model is based on the Theoretical Human Resource Requirement (THRR) and fixed establishment (FE) approach which was developed in 2012 (South African Government, 2017). The tool takes into consideration annual reported crime per police station (South African Government, 2017) which suggests that current police human resources deployed in Khayelitsha may be severely under resourced to deal with the ‘real’ burden of violence, when unreported health data is considered.

The validity of self-reported drinking using ED data from 16 countries reported findings suggesting that the overall validity of self-reported alcohol consumption before injury is high (88%) compared with a blood alcohol concentration (BAC) estimate obtained at the time of admission to the ED, with a caveat that demographic, drinking and injury characteristics may affect validity (Cherpitel, Ye, Bond, Borges, Macdonald, Stockwell, Room, Marais, Sovinova and Giesbrecht, 2006). This implies that self-reported drinking is an accurate variable reflecting self-reported alcohol consumption.

This study provides evidence showing that interpersonal violence at the community level cannot be estimated accurately relying solely on reported crimes to the police services. Injuries arising from interpersonal violence treated at health facilities must be included to more accurately define the level of interpersonal violence within a community.

Implementation of the Hospital Emergency Centre Tracking Information System (HECTIS), an electronic data collection system for Emergency Departments (ED), is currently underway at the Michael Mapongwana CHC and KDH. The HECTIS system is not currently implemented in target communities. Following implementation, it will be considered for inclusion in the VIO. This will improve the monitoring of injuries arising from interpersonal violence (the majority of which are not reported to the police) and provide a method for the evaluation of violence prevention interventions. Additionally, this will provide the data infrastructure required for the potential implementation of the Cardiff model locally.

6.8 Contribution to violence prevention in Cape Town and South Africa

The matching exercise described above represents the first attempt within South Africa to match patients at health facilities treated for injuries arising from interpersonal violence with those of victims reporting violent crimes to police stations within the same community and time period. This matching study suggests that the majority of injuries arising from interpersonal violence presenting at health facilities in Khayelitsha are not reported to the police there.

This study has broader implications regionally and nationally for the surveillance of injuries arising from interpersonal violence, for the police definition and surveillance of community interpersonal violence, for community policing intelligence development (improving the configuration of violence heat maps on a real time basis) and finally for police resource utilisation and distribution, which should, in turn, impact positively on reducing crime and violence in the community, and reduce the burden on the health services. The implementation of the Cardiff data sharing model should be adopted to inform violence reduction locally.

7. CHAPTER SEVEN:

CONCLUSIONS AND FUTURE DIRECTION

SUMMARY AND CONCLUSIONS

IMPLICATIONS FOR POLICY, PRACTICE AND FUTURE RESEARCH

This research set out to demonstrate the validity and utility of a prevention-oriented violence and injury observatory for the City of Cape Town, resulting in four linked studies, with all studies either submitted to or published in peer reviewed journal publications. This chapter will discuss what was achieved in terms of originality and novel insights, explore implications for policy and practice and implications for future research.

Figure 7.1 represents graphically, the research outputs related to this work.

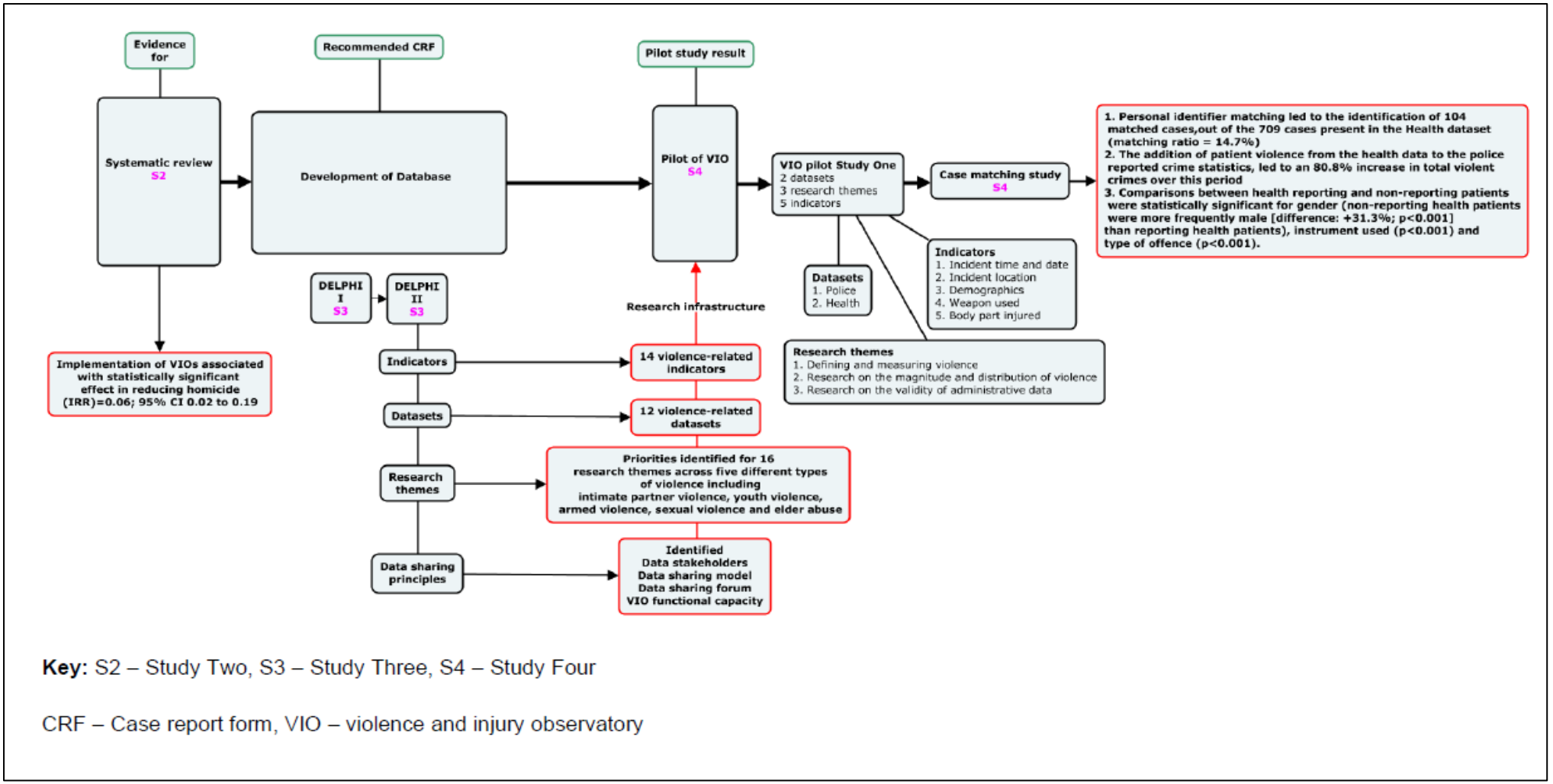


Figure 7.1 PhD research outputs

7.1. Originality and novel insights

The primary purpose of this thesis was to determine whether a prevention-oriented violence and injury observatory can be constituted from available clinical and non-clinical datasets for the City of Cape Town. To provide context, I sought to identify and summarise all studies reporting on the implementation of VIOs globally, and by means of meta-analysis to assess the level of efficacy in reducing violence in adult populations. In South Africa specifically, I endeavoured to (1) critically appraise the OAS Citizen Security indicators for use in a local context, (2) use an evidence-based approach to develop a basic research infrastructure and data sharing guidelines for a prospective local VIO, (3) characterise interpersonal violence by merging police and health datasets in a local resource limited setting and, finally, (4) establish the Cape Town pilot violence, injury and trauma observatory.

Four principal findings have emerged from this series of studies:

- Study 2: This systematic review provided the first comprehensive assessment of the efficacy of VIOs in reducing violence in adult populations where they were implemented. The evidence provided by this review suggests that the implementation of VIOs should be considered in high-violence communities where a reduction in homicide rates is desired. In addition, this work highlights the limitations of study design, publication bias in Latin American research, political context of study locations and the paucity of evaluative research in this field.

- Study 3: This is the first study globally to describe a scientific evidence-based approach to the development of the basic VIO research infrastructure and VIO steering committee. Violence and injury related indicators, datasets, data sharing guidelines and research priorities for violence and injury were described in detail, thus providing a model for the development of VIOs within other cities in South Africa and its regional neighbours.

- Study 4: This study was the first of its kind in South Africa to characterise interpersonal community violence by merging police and health datasets. The study not only highlighted the under-reporting of violence-related crimes within the community of Khayelitsha, but also demonstrated the production of

improved police intelligence to accurately describe the burden of violence at the community level. This may serve police violence prevention interventions by the merging of police and clinical datasets for the same time period and the same community. Finally, the study provides the first unique profile of violence within the community of Khayelitsha, derived by combining police and health datasets to estimate an adjusted crime profile when health data is considered.

This thesis highlights the need for comprehensive public health surveillance systems to record complete and accurate information on the epidemiology of interpersonal violence in South Africa and Africa, as an essential step to reduce the burden of violence-related injury in Africa. The use of accurate surveillance systems promotes confidence in estimating the burden of violence-related injuries and their characteristics. This, in turn, better informs violence prevention interventions and the routine monitoring and evaluation of interpersonal violence.

7.2 Implications for Policy and Practice

The findings of this thesis provide important baseline information for clinicians, health care workers, violence prevention stakeholders and policy makers regarding the burden of interpersonal violence in South Africa. The evidence for an association between implementing the VIO model and a reduction in the homicide count in high-violence settings (incidence rate ratio [IRR]=0.06; 95% CI 0.02 to 0.19; four studies) provides support for the implementation of local VIOs in high violence communities within South Africa.

Within the Western Cape, the 2018 Safety Western Cape conference called for a collaborative and inclusive vehicle to addressing the high interpersonal violence levels. The Cape Town VIO addresses this gap and will move from the pilot phase to becoming operational in 2021. Furthermore, violence prevention stakeholders identified by Study Three, as well as certain attendees of the invitation-only Safety Western Cape conference, will constitute the VIO steering committee following its full implementation in 2021.

Finally, this thesis advocates for the further development and investment in the SAPS national research division, which had been launched in 2016, to add data-driven

policing (DDP) to the current theoretical models of community-based policing and problem-oriented policing.

7.3 Implications for Future Research

The natural sequelae based on the results of Study Four is to implement the Cardiff model in a local setting, which will form part of my post-doctoral research project (UCT HREC 156/2020), and will represent only the second implementation of the Cardiff model in a LMIC setting globally (Figure 7.2). Preparation for this implementation in the Site B neighbourhood of Khayelitsha has already begun, and it includes plans to share health data from the Khayelitsha District Hospital, the Michael Mapongwana Clinic and Site B clinic, with the Transport Management Centre (TMC) to inform City of Cape Town Law Enforcement Officers' resource deployment within Khayelitsha.

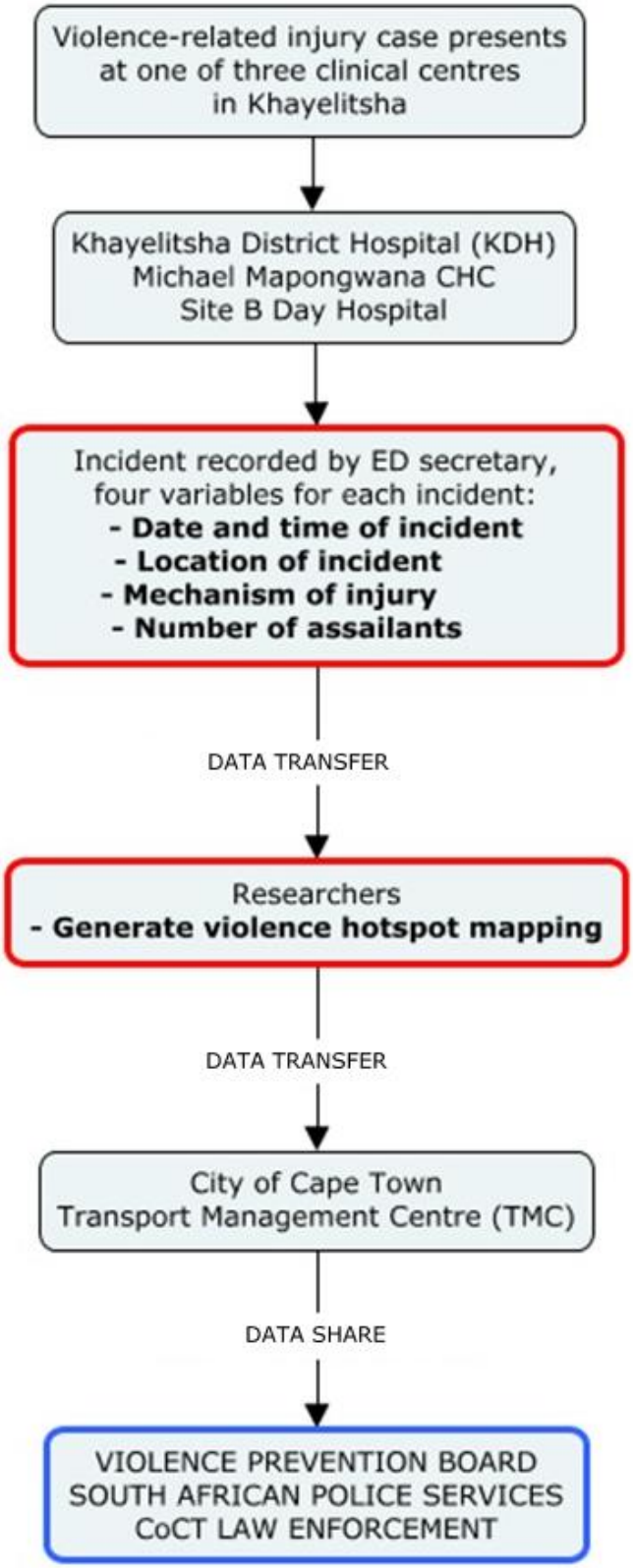


Figure 7.2 Implementation of the Cardiff model in Khayelitsha

The Cape Town VIO data registry (UCT HREC R043/2016) is currently operational and hosts multiple violence-related datasets. The registry seeks to improve access to

data for local, international and interdisciplinary researchers working in the field of interpersonal violence. In the case of international researchers, the caveat is that the data cannot cross national boundaries, and thus all research and analysis must be conducted within South Africa.

A provisional observatory steering committee (Figure 7.3) will include representatives from:

Local and national government: City of Cape Town, Western Cape Provincial Government, Department of Social Development, Department of Health, Statistics South Africa

Emergency services: South African Police Services, Emergency Medical Services, Forensic Pathology Services

Academia: University of Cape Town School of Public Health and Family Medicine, Witwatersrand University, South African Medical Research Council, Health Systems Trust

Hospitals: Khayelitsha Day Hospital, Groote Schuur Hospital

NGOs: South African Violence Initiative, Violence prevention through urban upgrading

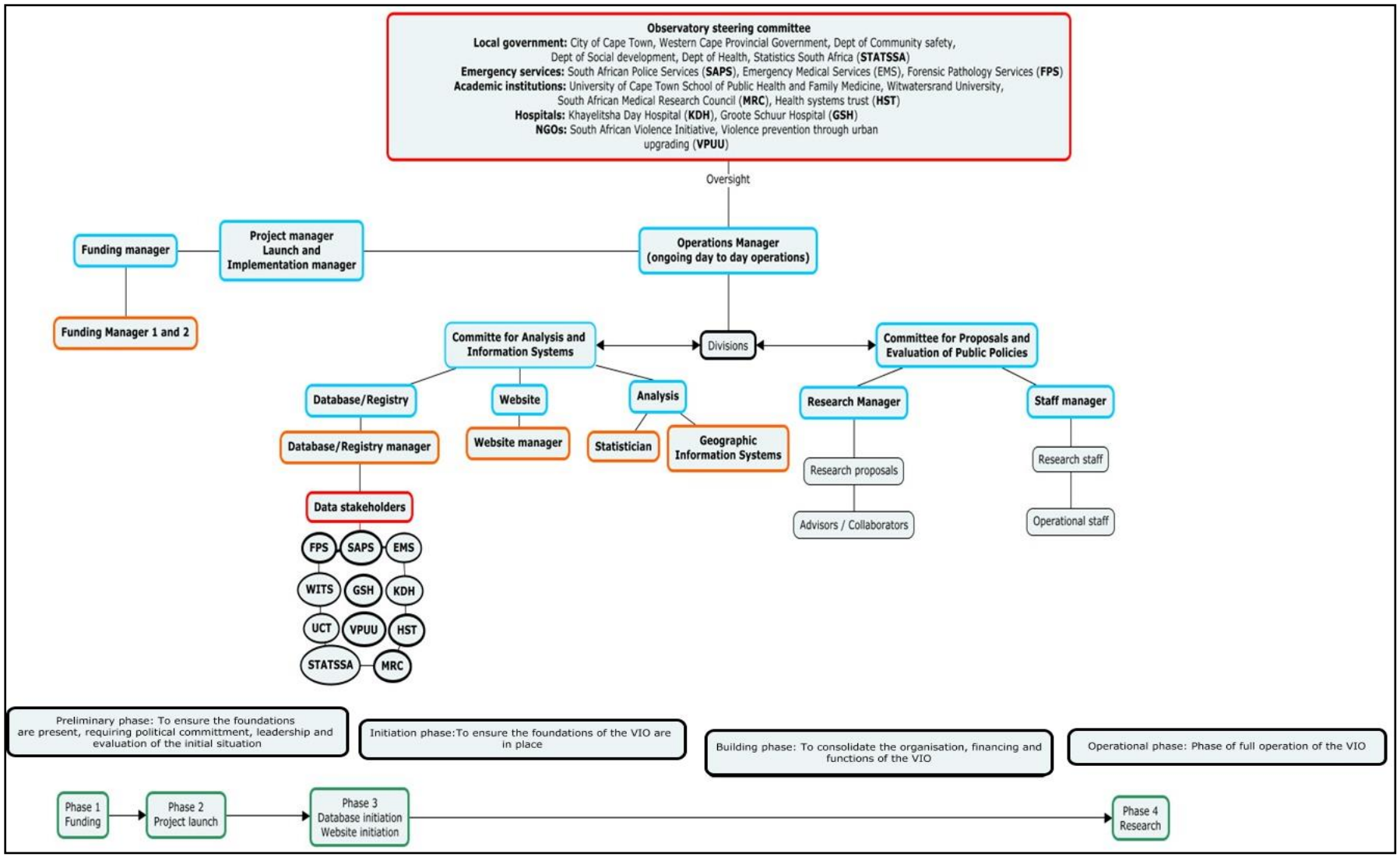


Figure 7.3 Cape Town VIO implementation plan

Finally, the full implementation of the Cape Town violence and injury observatory is planned for late 2021 (Figure 7.3). This thesis work has informed the development and structure of the CT VIO with regard to research structure (indicators, datasets and research themes) and human resource structure, through the Delphi panellists who will serve as the CT VIO steering committee; the thesis has furthermore demonstrated through a systematic review that VIOs are associated with a reduction in homicide in areas where they have been implemented.

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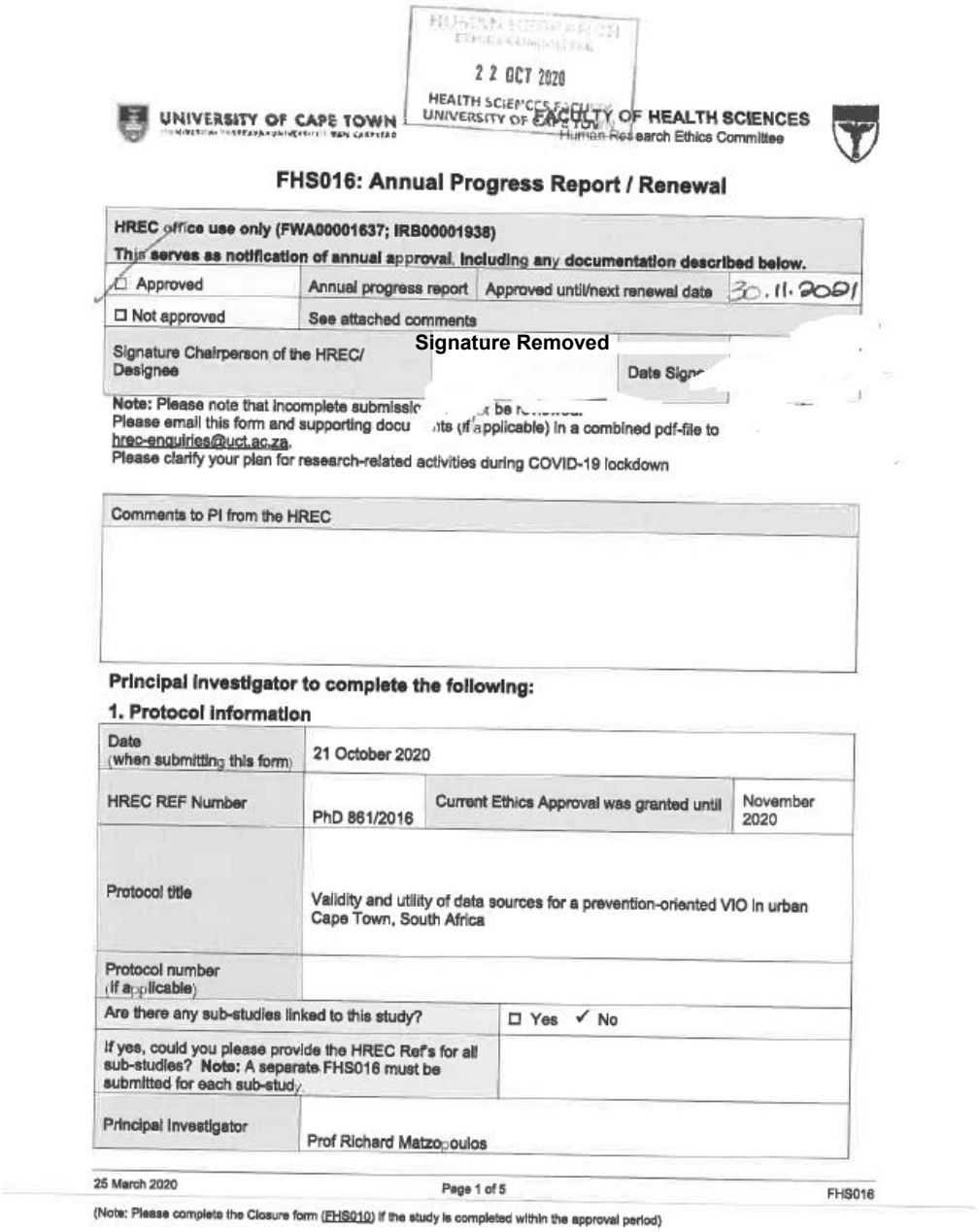
APPENDICES 1 to 5

Appendix 1: University of Cape Town IRB Ethics approval



22 OCT 2020
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

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	30.11.2021
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee	Signature Removed	Date Sign	

Note: Please note that incomplete submissio ... be r...
Please email this form and supporting docu ...nts (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

Comments to PI from the HREC

Principal investigator to complete the following:

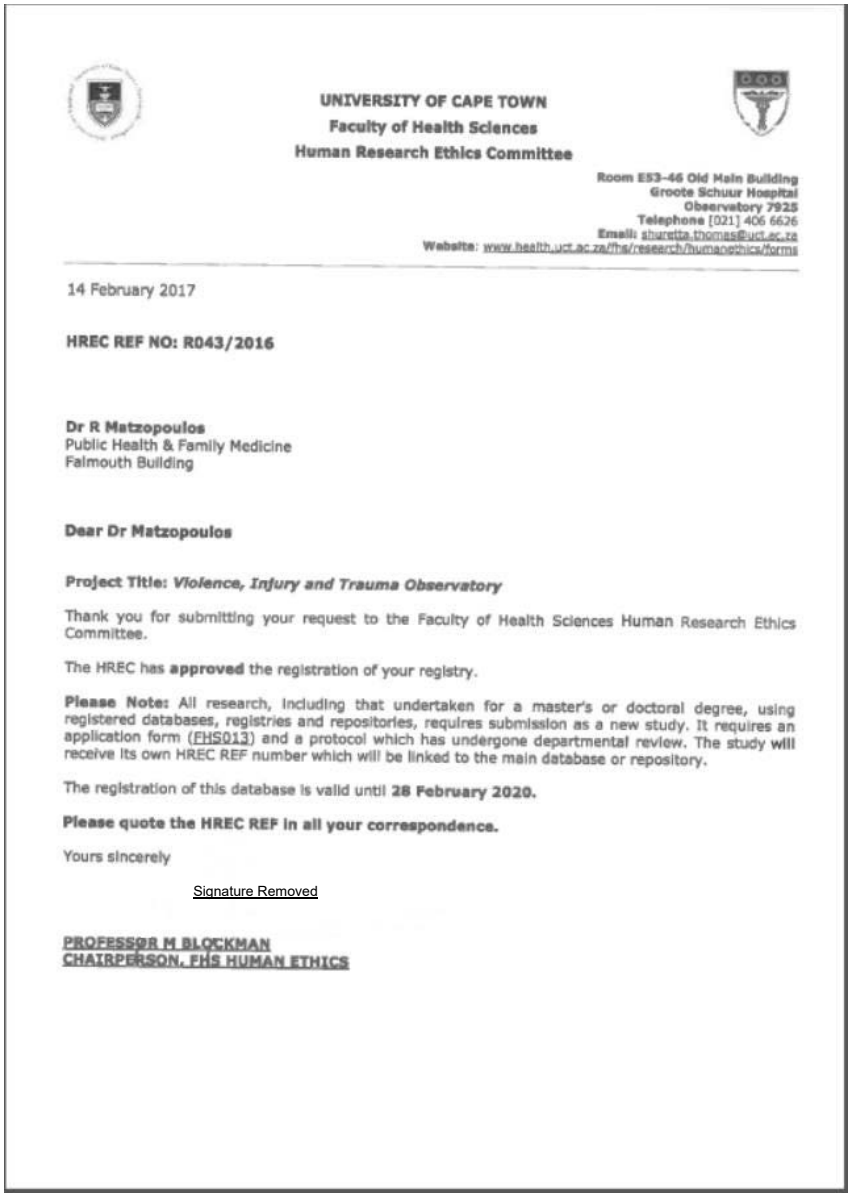
1. Protocol information

Date (when submitting this form)	21 October 2020		
HREC REF Number	PhD 861/2016	Current Ethics Approval was granted until	November 2020
Protocol title	Validity and utility of data sources for a prevention-oriented VIO in urban Cape Town, South Africa		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	☐ Yes ✓ No		
If yes, could you please provide the HREC Ref's for all sub-studies? **Note:** A separate FHS016 must be submitted for each sub-study			
Principal Investigator	Prof Richard Matzopoulos		

25 March 2020 Page 1 of 5 FHS016

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

UCT HREC (861/2016) Approval for PhD research till 30 November 2021



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

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6626
Email: shuretta.thomas@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

14 February 2017

HREC REF NO: R043/2016

Dr R Matzopoulos
Public Health & Family Medicine
Falmouth Building

Dear Dr Matzopoulos

Project Title: ***Violence, Injury and Trauma Observatory***

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

The HREC has **approved** the registration of your registry.

Please Note: All research, including that undertaken for a master's or doctoral degree, using registered databases, registries and repositories, requires submission as a new study. It requires an application form (FHS013) and a protocol which has undergone departmental review. The study **will** receive its own HREC REF number which will be linked to the main database or repository.

The registration of this database is valid until **28 February 2020.**

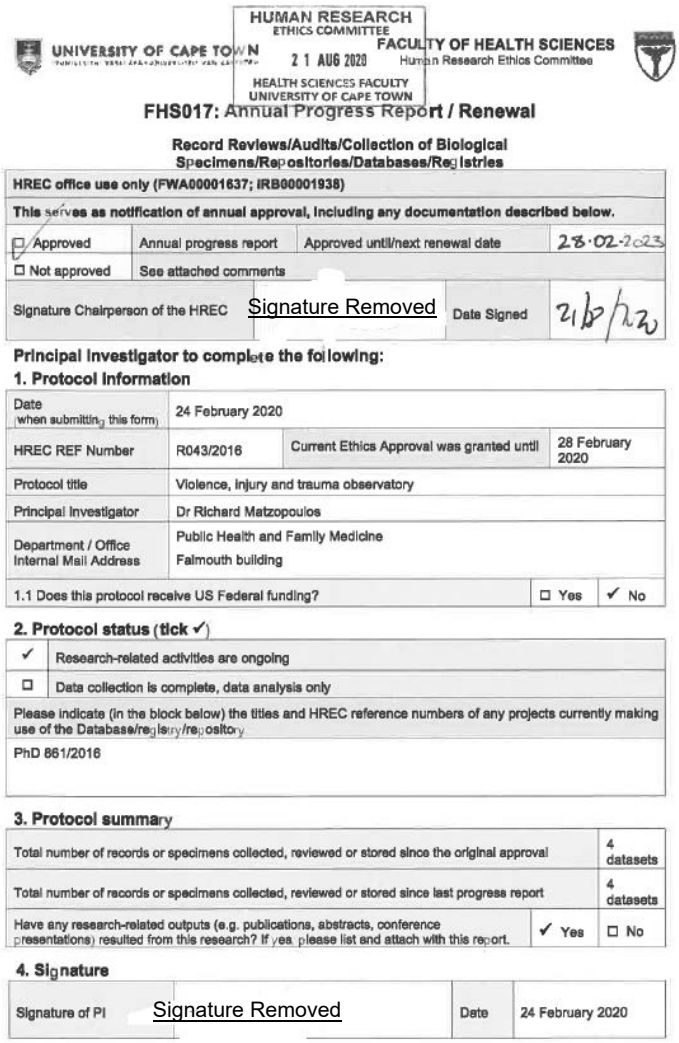
Please quote the HREC REF in all your correspondence.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN ETHICS

UCT HREC (R043/2016) Approval for registration of Violence, injury and trauma observatory registry



UNIVERSITY OF CAPE TOWN

HUMAN RESEARCH ETHICS COMMITTEE
21 AUG 2020
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS017: Annual Progress Report / Renewal

Record Reviews/Audits/Collection of Biological Specimens/Repositories/Databases/Registries

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	28-02-2023
☐ Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	21/2/20

Principal Investigator to complete the following:

1. Protocol Information

Date (when submitting this form)	24 February 2020		
HREC REF Number	R043/2016	Current Ethics Approval was granted until	28 February 2020
Protocol title	Violence, injury and trauma observatory		
Principal Investigator	Dr Richard Matzopoulos		
Department / Office Internal Mail Address	Public Health and Family Medicine Falmouth building		
1.1 Does this protocol receive US Federal funding?		☐ Yes	✓ No

2. Protocol status (tick ✓)

✓	Research-related activities are ongoing
☐	Data collection is complete, data analysis only
Please indicate (in the block below) the titles and HREC reference numbers of any projects currently making use of the Database/registry/repository	
PhD 861/2016	

3. Protocol summary

Total number of records or specimens collected, reviewed or stored since the original approval		4 datasets
Total number of records or specimens collected, reviewed or stored since last progress report		4 datasets
Have any research-related outputs (e.g. publications, abstracts, conference presentations) resulted from this research? If yes, please list and attach with this report.	✓ Yes	☐ No

4. Signature

Signature of PI	Signature Removed	Date	24 February 2020

UCT HREC (R043/2016) Approval for registration of Violence, injury and trauma observatory registry till February 2023

Western Cape Government
Health

GROOTE SCHUUR HOSPITAL
Enquiries: Dr Bernadette Eick
E-mail : Bernadette.Eick@westerncape.gov.za

Dr R. Matzopoulos
PUBLIC HEALTH & FAMILY MEDICINE

E-mail: Richard.Matzopoulos@uct.ac.za / a.jabaroo@gmail.com

Dear Dr Matzopoulos,

RESEARCH PROJECT: Validity And Utility Of Data Sources For A Prevention-Oriented Violence, Injury And Trauma Observatory In Urban Cape Town, South Africa (PhD Dr Ardil Jabar)

Your recent letter to the hospital refers.

You are granted permission to proceed with your research, which is valid until **30 November 2019.**

Please note the following:

a) Your research may not interfere with normal patient care.
b) Hospital staff may not be asked to assist with the research.
c) No additional costs to the hospital should be incurred i.e. Lab, consumables or stationary.
d) **No patient folders may be removed from the premises or be inaccessible.**
e) Please provide the research assistant/field worker with a copy of this letter as verification of approval.
f) Confidentiality must always be maintained .
g) **Should you at any time require photographs of your subjects, please obtain the necessary indemnity forms from our Public Relations Office (E45 OMB or ext. 2187/2188).**
h) Should you require additional research time beyond the stipulated expiry date, please apply for an extension.
i) Please discuss the study with the HOD before commencing.
j) Please introduce yourself to the person in charge of an area before commencing.
k) On completion of your research, please forward any recommendations/findings that can be beneficial to use to take further action that may inform redevelopment of future policy / review guidelines.
l) **Kindly submit a copy of the publication or report to this office on completion of the research.**

I would like to wish you every success with the project.

Yours sincerely

Signature Removed

DR BERNADETTE EICK
CHIEF OPERATIONAL OFFICER
Date: 23 May 2019

C.C. Mr. L. Naidoo
Dr B. Jacobs
Dr F. Conrad
Professor N. Nicol
Ms. W. Bryant

G46 Management Suite, Old Main Building,
Observatory 7925
Tel: +27 21 404 6288 fax: +27 21 404 6125

Private Bag X,
Observatory, 7935
www.capegateway.go.v.za

Western Cape Department of Health, Groote Schuur Hospital permission to access Clinicom database

Appendix 2: Systematic review data extraction form

Review Title:	**Is the introduction of violence and injury observatories associated with a reduction of violence in adult populations?**

Study ID **(e.g Jabar 2015)**	

General information

Date form completed **(dd/mm/yyyy)**	
Name of person extracting data	
Reference citation **(e.g. Medline)**	
Study author contact details	

Publication type (e.g. full report, abstract)	
Bibliography hand search, References for possible eligible studies	
Notes:	

Study Eligibility

Study Characteristics	**Eligibility criteria**	Eligibility criteria met?
Types of study	**RCT, CCT, CBA, Quasi-randomised trial, cross-over study, cohort study, Observational study**	Yes No Unclear
Participants	**Including adults >= 18 years of ages**	Yes No Unclear
Types of Outcome measure	**Primary outcome:** **Murder/homicide, suicide, transit death, unintentional injury death, sexual violence and intrafamily/family/domestic violence**.	Yes No Unclear

	Secondary outcomes: **Aggravated assault, crime victimisation and the perception of insecurity, fear or risk**	Yes No Unclear
Results	**Incidence**	Yes No Unclear
INCLUDE	**EXCLUDE**	**PENDING**
Reason for exclusion/pending?		
Notes:		

DO NOT PROCEED IF STUDY EXCLUDED FROM REVIEW

Characteristics of the Study

	Descriptions as stated in report/paper
Aim of study	
Study Design	
Start date	
End date	

Type of intervention/exposure	
Reported measure **(homicide count, assault rate)**	
Country, language	
Ethical approval needed/ obtained for study	**Yes No Unclear**
Notes:	

Participants

	Descriptions as stated in report/paper
Country **(Developing)**	
Population description	
Setting (location, social context)	

Inclusion criteria	
Exclusion criteria	
Method of recruitment of participants (e.g. mail, phone)	
Site of recruitment of participants (e.g. clinic, schools)	
Selection methods (e.g. randomized)	
Recruited sample size	
Age(s)	
Gender	
Ethnicity	
Data source (e.g. medical, police, forensic, surveys, multiple, surveillance registries)	

High income/Low income Area	
Notes:	

INTERVENTION CHARACTERISTICS

Intervention: Violence and injury observatory and/or injury surveillance system

Details of intervention	
Details of co intervention in all groups	
Delivery of intervention *(e.g. stages, timing, frequency, duration)*	
Details of providers (W*ho delivers the intervention?; number of providers; training of providers in delivery of intervention*)	

Fidelity/integrity *(Was the intervention delivered as intended? Record any assessment of this*)	
Other remarks	

Control: No intervention. (Period prior to intervention)

Details of control	nil
Frequency	
Other remarks	

Outcome

Primary Outcome: Murder/homicide, suicide, transit death, unintentional injury death, sexual violence and intrafamily/family/domestic violence

	Intervention	**%**	**Control**	**%**	**Difference**	**RRR**

Total violent acts						
Primary:						
Age-group Breakdown						
	/					

Secondary Outcome: Aggravated assault, crime victimisation and the perception of insecurity, fear or risk

	Intervention	**%**	**Control**	**%**	**Difference**	**RRR**
Total violent acts						
Secondary:						
Age-group Breakdown						
	/					

Discussion

	Descriptions as stated in report/paper
Key conclusions of study authors	
Study Limits as reported by authors	
Recommendations	
Notes:	

Other Information

Study funding sources **(Including role of funders)**	
Possible conflicts of interest **(For study authors)**	
Missing data	

Statistical methods and their appropriateness (if relevant)	
Correspondence required for further study information (from whom, what and when)	
Notes:	

COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1 Very likely
2 Somewhat likely
3 Not likely
4 Can't tell

(Q2) What percentage of selected individuals agreed to participate?

1 80 - 100% agreement
2 60 – 79% agreement
3 less than 60% agreement
4 Not applicable
5 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

B) STUDY DESIGN

Indicate the study design

1 Randomized controlled trial
2 Controlled clinical trial
3 Cohort analytic (two group pre + post)
4 Case-control
5 Cohort (one group pre + post (before and after))
6 Interrupted time series
7 Other specify _____
8 Can't tell

Was the study described as randomized? If NO, go to Component C.

No Yes

If Yes, was the method of randomization described? (See dictionary)

No Yes

If Yes, was the method appropriate? (See dictionary)

No Yes

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?

1 Yes
2 No
3 Can't tell
4 Not Applicable (i.e. one time surveys or interviews)

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell
5 Not Applicable (i.e. Retrospective case-control)

RATE THIS SECTION	STRONG	MODERATE	WEAK	
See dictionary	1	2	3	Not Applicable

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

1 80 -100%
2 60 - 79%
3 less than 60%
4 Can't tell

(Q2) Was the consistency of the intervention measured?

1 Yes
2 No
3 Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

4 Yes
5 No
6 Can't tell

H) ANALYSES

(Q1) Indicate the unit of allocation (circle one)

community organization/institution practice/office individual

(Q2) Indicate the unit of analysis (circle one)

community organization/institution practice/office individual

(Q3) Are the statistical methods appropriate for the study design?

1 Yes
2 No
3 Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

1 Yes
2 No
3 Can't tell

C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

1 Yes
2 No
3 Can't tell

The following are examples of confounders:

1 Race
2 Sex
3 Marital status/family
4 Age
5 SES (income or class)
6 Education
7 Health status
8 Pre-intervention score on outcome measure

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

1 80 – 100% (most)
2 60 – 79% (some)
3 Less than 60% (few or none)
4 Can't Tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

1 Yes
2 No
3 Can't tell

(Q2) Were the study participants aware of the research question?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?

1 Yes
2 No
3 Can't tell

(Q2) Were data collection tools shown to be reliable?

1 Yes
2 No
3 Can't tell

RATE THIS SECTION	STRONG	MODERATE	WEAK
See dictionary	1	2	3

GLOBAL RATING

COMPONENT RATINGS
Please transcribe the information from the gray boxes on pages 1-4 onto this page. See dictionary on how to rate this section.

A	**SELECTION BIAS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
B	**STUDY DESIGN**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
C	**CONFOUNDERS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
D	**BLINDING**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
E	**DATA COLLECTION METHOD**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	
F	**WITHDRAWALS AND DROPOUTS**	**STRONG**	**MODERATE**	**WEAK**	
		1	2	3	Not Applicable

GLOBAL RATING FOR THIS PAPER (circle one):

1	STRONG	(no WEAK ratings)
2	MODERATE	(one WEAK rating)
3	WEAK	(two or more WEAK ratings)

With both reviewers discussing the ratings:

Is there a discrepancy between the two reviewers with respect to the component (A-F) ratings?

No Yes

If yes, indicate the reason for the discrepancy

1	Oversight
2	Differences in interpretation of criteria
3	Differences in interpretation of study

Final decision of both reviewers (circle one):

1	**STRONG**
2	**MODERATE**
3	**WEAK**

Appendix 3: Delphi participant information sheet

Dear expert panel member,

It is time (ke nako). A few months ago, you graciously agreed to take part in the first study of my PhD project, a Delphi study.

To refresh your memory, you were formally invited to partake in a research project with the purpose of identifying the optimal set of violence and injury-related datasets and indicators for inclusion in a pilot Observatory/surveillance system for the City of Cape Town.

The study in short: detailed information follows on page 2.

- **Aim:** identifying the optimal set of violence and injury-related datasets and indicators to serve as a basis for a pilot violence and injury observatory/surveillance system for the City of Cape Town.
- **Method:** Delphi method. Rounds in which statements using a Likert scale are sent out to an expert panel until 80% consensus is reached. Maximum 3 rounds
- **Delphi expert panel:** Consists of approximately 12-25 experts
- **Quasi-anonymity:** Individual suggestions and comments etc. may be used in rounds two and three but will not be tied to individuals.
- **Ethical considerations** are according to Declaration of Helsinki and anonymity is guaranteed.
- **Time:** It is estimated that each round takes approximately 20-30 minutes. A total of 3 rounds are planned.
- **NO physical meetings**
- **We'd appreciate completed documents by 1 August 2017.**

Introduction

Violence has been recognised officially as a global health issue, with the World Health Organization (WHO) reporting that 1.6 million people die annually from violence. South Africa's injury burden is very high, particularly for homicide, which is seven times the global average [1]. The idea of an 'observatory' has expanded recently, from its origins in astronomy to that of specialised informational repositories and knowledge building centres housing cross-referenced databases with advanced analytic and research capacities. The intention of this study is to identify the optimal set of violence and injury-related datasets and indicators for inclusion in a pilot observatory. In doing so this will provide the pilot observatory with foundational research data to initiate violence prevention-related research with the additional capacity to engage monitoring and evaluation of the burden of violence and injury and specific interventions.

Aim

The intention of this study is to identify the optimal set of violence and injury-related datasets and indicators for inclusion in a pilot observatory. Your participation and answers are of importance for providing the pilot observatory with foundational research data to initiate violence prevention-related research with the additional capacity to engage monitoring and evaluation of the burden of violence and injury and specific interventions.

Method

Delphi Technique

The method we have chosen to create this questionnaire is the modified Delphi technique consisting of three rounds in which consensus of an expert panel, is sought identify the optimal set of violence and injury-related datasets and indicators for inclusion in a pilot observatory [3].

Rounds

In all three rounds, you will be asked to rate how essential each statement is for a pilot violence and injury observatory with the aid of a Likert rating system. For each statement or construct, you are encouraged to leave comments and suggestions.
Individual suggestions for additional statements to be included are also encouraged.
Answers and comments are analysed after every round. In addition to the statements that have not reached consensus (set at 80%), new suggestions sent in by you the expert, or revised statements will be sent out again in rounds 2 and 3. This allows for the possibility of reassessment of opinion concerning statements. Additionally, you will be asked your opinion concerning how well the statements cover the field.

Delphi expert group /Criteria

This Delphi study consists of 4 groups of experts.

Group I: National Academic. Criteria: South African researcher working in area of violence and injury or injury surveillance systems.

Group II: International Academic: Same criteria as for Academic Group, but holding a position in a country other than South Africa.

Group III: Disaster preparedness coordinators at the major emergency hospitals in the Western Cape Province.

Group IV: Data stakeholders, from the City of Cape Town, working in area of violence and injury or injury surveillance systems.

Background to chosen statements:
In order to create a foundational database that not only is reliable and valid but allows results to be subjected to comparison on an international level, we've decided to use the Organization of American States (OAS) Citizen Security Indicators as a starting point [4]. Additionally datasets available with full descriptions will be provided to the panel as well as the results of a systematic review to determine the effectiveness of the observatory model in reducing violence in adult populations.

Quasi-Anonymity
As participants are known to the authors of the study, true anonymity is not attainable.
While participants will be known to each other, participants will not be able to link responses to other participants eliminating subject bias thus resulting in the inability of individual participants to influence others in order to gain consensus [3]. In addition to expert group consensus, each participant will receive individual feedback as well as the expert group's median value for statements.

Time

The amount of time needed to complete each round will vary from participant to participant but it is estimated that each round should take **20-30 minutes** to complete.
There are no correct or incorrect answers. Results of each round will be presented in the following round.
The three rounds are expected to take a total of four to five months.
There are **no physical meetings**. Correspondence will be primarily through email.

Your participation in this study is greatly appreciated and valuable, as your input based on expert knowledge and experience is vital towards the formation of a pilot violence and injury observatory for the City of Cape Town.

The knowledge gained will provide information that may impact the proliferation and dissemination of the observatory model throughout the region.

Questions concerning the questionnaire or the project, please don't hesitate to contact:

Dr Ardil Jabar
MBChB, EMDM, MPH
Project leader PhD Student
School of Public Health and Family Medicine
Faculty of Health Sciences, University of Cape Town
a.jabaroo@gmail.com

Dr Richard Matzopoulos
Specialist scientist, MRC burden disease unit
Hon. Research Associate
School of Public Health and Family Medicine
Faculty of Health Sciences, University of Cape Town
richard.matzopoulos@gmail.com

This study has been approved by the Human Research Ethics Committee of the University of Cape Town (UCT HREC 861/2016). If you have any problem with this study, please contact this committee at 021 406 6338.

General information of first author and the project:

- This is first study of the first author's PhD studies with the aim to establish the first non-conflict violence and injury observatory on the continent.

- Dr Ardil Jabar is a Public Health Specialist with a further specialisation in Disaster Medicine. He is currently completing his PhD research at the University of Cape Town's School of Public Health and Family Medicine

References

1. *Kompetensbeskrivning för legitimerad sjuksköterska* 2005 [cited 2013 Nov. 18]; Available from: http://www.socialstyrelsen.se/lists/artikelkatalog/attachments/9879/2005-105-1_20051052.pdf.
2. *SOSFS 2013:22 Socialstyrelsens föreskrifter och allmänna råd om katastrofmedicinsk beredskap* 2013.
3. Keeney, S., F. Hasson, and H. McKenna, *The Delphi Technique in Nursing and Health Research*. 2011, United Kingdom: Wiley.
4. OAS CSI 22, OAS.org
4. Garbutt, S.J., J.W. Peltier, and J.J. Fitzpatrick, *Evaluation of an instrument to measure nurses' familiarity with emergency preparedness.* Mil Med, 2008. **173**(11): p. 1073-7.
5. *Risk- och sårbarhetsanalys 2012. Klarar Stockholms län krisen?* 2012, Länsstyrelsen i Stockholms län.

Appendix 4: Delphi study round 1 statements submitted to Delphi panel

Likert scale:
0 - Can be dropped
1 - Somewhat essential
3 - Neither essential or unessential
4 - Quite essential
5 - Essential to include

Q1 - Homicide rate per 100,000 inhabitants

Q2 - Suicide rate per 100,000 inhabitants older than 18 years of age

Q3 - Firearm death rate per 100,000 inhabitants

Q4 - Complaint rate for Sex crimes per 100,000 inhabitants

Q5 - Rate of complaints of Intrafamily/family/domestic Violence per 100,000 inhabitants

Q6 - Theft rate per 100,000 inhabitants

Q7 - Robbery rate per 100,000 inhabitants

Q8 - Rate of Automotive Theft and Robbery per 10, 000 vehicles registered

Q9 - Kidnapping rate per 100,000 inhabitants

Q10 - Prevalence of sexual violence

Q11 - Prevalence of Intrafamily/family and domestic violence

Q12 - Rate of criminal victimisation in people older than 18 years of age

Q13 - Percentage of victimisation due to Robbery, in people older than 18 years of age

Q14 - Percentage of victimisation due to Theft, in people older than 18 years of age

Q15 - Percentage of people with perception of insecurity, in people older than 18 years of
age

Q16 - Percentage of people with perception of risk, in people older than 18 years of age

Q17 - Percentage of people with perception of fear, in people older than 18 years of age

Q18 - Percentage of people who justify the use of violence, in people older 18 years of
Age

Q19 - Percentage of people with confidence in the institutions, in people older 18 years of
age

Q20 - Please feel free to add any violence and injury-related indicators that you feel should be collected by the proposed violence, injury and trauma observatory for the City of
Cape Town. Please include reason/s for additional indicators.

Q21 - Data source: Health Systems Trust (HST) Data description: Repeated cross-sectional studies This rapid assessment (RA) of the injury morbidity burden at health services in three high violence communities in the Cape Town Metropole was conducted in Khayelitsha, Nyanga and Elsies River. Data was simultaneously collected (24 hours per
day) at six facilities, from the 27th of September 2012 until the 4th of October 2012. Injury data specific to Khayelitsha was collected from the Khayelitsha Day Hospital (KDH), Site B CHC and the Michael Mapongwana CHC. Recorded measures include patient demographics, pattern of injury, location and time of injury.

Q22 - Data source: Violence prevention through urban upgrading (VPUU) Data description: Population and household-based rolling surveys. The survey was conducted between September 2012 and July 2015 time period by the Violence prevention through urban upgrading (VPUU) project. A total of 1500 dwellings were visited. 1200 of these were randomly selected from Khayelitsha and 300 were randomly selected from the Gugulethu-
Nyanga areas. The sample of 1200 dwellings was drawn from GIS data of dwelling units in the designated study area in Khayelitsha. Recorded measures include the experience of violent crime as reported by the residents of Khayelitsha, household demographics and location.

Q23 - Data source: Statistics South Africa (STATSSA) Data description: Victim of crime (VOC) survey The Victims of Crime Survey (VOCS) series is a continuous, annual, countrywide household-based survey and has three main objectives: (1) Provide information about the dynamics of crime from the perspective of households and the victims of crime; (2) Explore public perceptions of the activities of the police, prosecutors, courts and correctional services in the prevention of crime and victimisation; (3) Provide complementary data on the level of crime within South Africa (SA) in addition to the statistics published annually by the South African Police Service (SAPS).

Q24 - Data source: Centre for Social Science Research (UCT) Data description: Cape area panel survey The Cape Area Panel Study (CAPS) is a longitudinal study of the lives of youths and young adults in metropolitan Cape Town, South Africa. The first wave of the study collected interviews from about 4800 randomly selected young people age 14-22 in August-December, 2002.

Q25 - Data source: Forensic pathology service (FPS) Data description: Provincial mortality registry The Forensic Pathology Service is mandated by the National Health Act 61 of 2003 law to investigate all Unnatural Deaths. FPS uses existing medico-forensic investigative procedures. Services of the Forensic Pathology Service pertinent to the
collection of data for this study includes the provision of mortality data to relevant stakeholders to inform research and prevention strategies, which is a shared goal of the observatory. Recorded measures include victim demographics, pattern of injury and incident location, time and context of incident.

Q26 - Data source: South African Police Services (SAPS) Data description: Public access database Homicide and other violence related crime data (e.g. assault) are available through two public access websites (www.saps.gov.za; www.issafrica.org/) which record all crimes reported at SAPS precincts across South Africa. The SAPS has changed it publication schedule to release data quarterly, to give a better indication of crime in the country.

Q27 - Data source: Electronic trauma health record (eTHR) Data description: Hospital clinical database. The electronic trauma health record (eTHR) is a Tablet-based tool for trauma care and injury surveillance, currently in use at the Groote Schuur Trauma Unit. It was designed to capture patient information including demographics, past medical history,
residential neighbourhood, specifics about the scene of injury, injury mechanism, and the use of drugs and alcohol. Additional recorded measures include patient demographics, pattern of injury and location of injury with data available from 2010 onwards.

Q28 - Data source: Red Cross Hospital (RXH) Data description: Hospital clinical database. This includes all trauma requiring medical treatment for children under the age of 12 years presenting at Red Cross Childrens' Hospital. Recorded measures include demographic information, date of injury/death, manner and circumstances of the injury/death, location of
injury and referring centre amongst other variables.
Q29 - Data source: Emergency medical services (EMS) Data description: EMS incident data Emergency medical services in South Africa are a public/private system aimed at the provision of emergency ambulance service, including emergency care and transportation to hospital. Recorded measures include demographic information and nature and location of injury per violence-related incident.

Q30 - Data source: Western Cape Provincial Government (WCPG) Data description: Clinicom Provincial hospital patient database Western Cape has installed a patient administration system called Clinicom amongst 49 Western Cape hospitals. This allows for patient detail and history to be viewed across institutions in developing a single patient record. The system will also provide improved operational reporting and will greatly improve the availability of statistical information regarding patient services. Recorded measures include patient demographics and details related to violence-related injuries.

Q31 - Please feel free to add any violence and injury-related datasets that you feel should
be collected by the proposed violence, injury and trauma observatory for the City of Cape
Town. Please include reason/s for additional datasets.

Appendix 5: Matching study analysis for reporting delay

All data collection weeks started on a Thursday at 07:00 (Table 1). The average difference between time of presentation to the clinical facility and time recorded in the SAPS database (absolute value) was 7.9 hours.

Table 1. Matching proportion per day of week of presentation to the clinical facility

Day	Matching proportion [%]
Thursday	11.1
Friday	19.5
Saturday	13.2
Sunday	8.0
Monday	14.4
Tuesday	24.0
Wednesday	20.8

The data (Table 1) does not seem to show a declining rate, and most cases are reported within 24 hours. We conclude that if certainly, the problem exists, there is no indication of a large bias in our results.