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Real-time surveillance for evidence-based responses to suicide contagion and clustering

A thesis submitted to the National University of Ireland, Cork for the degree of Doctor of
Philosophy in the School of Public Health

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List of abbreviations

CDC	Centre for Disease Control and Prevention
CHO	Community Health Organisation
COVID-19	Coronavirus
CSO	Central Statistics Office
DSM	Diagnostic and Statistical Manual
ED	Emergency Department
ESRI	Environmental Systems Research Institute
GDPR	General Data Protection Regulation
GIS	Geographical Information Systems
GP	General Practitioner
HRB	Health Research Board
HSE	Health Service Executive
ICD-10	International Statistical Classification of Diseases and Related Health Problems 10th Revision
ICD-11	International Statistical Classification of Diseases and Related Health Problems 11th Revision
LMICs	Low- and middle-income countries
MeSH	Medical Subject Headings
NSRF	National Suicide Research Foundation
NOSP	National Office for Suicide Prevention
NSHRI	National Self-harm Registry Ireland
NSSI	Non-suicidal self-injury
ROSP	Resource Officers for Suicide Prevention
RR	Relative Risk
SDG	Sustainable Development Goals
SEM	Socio-Ecological Model
SOP	Standard Operating Procedure
SSIS	Suicide Support and Information System
SSIS-ACE	Suicide Support and Information System (Psychosocial, psychiatric and work-related risk factors of suicide and high-risk self-harm) – A Case-Control Study
SSHO	Suicide and Self-Harm Observatory
SPSS	Statistical Package for Social Sciences
UCC	University College Cork
UN	United Nations
WHO	World Health Organization

Declaration

This is to certify that the work I am submitting is my own and has not been submitted for another degree, either at University College Cork or elsewhere. All external references and sources are clearly acknowledged and identified within the contents. I have read and understood the regulations of University College Cork concerning plagiarism.

Signed: 

Date: 01/04/2022

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Abstract

Background: Although a rare phenomenon, suicide clusters are a cause for great community concern. In recent years, strong emphasis has been placed on the importance of detection and real-time surveillance of suicide clusters. Cluster detection increases understanding on the aetiology of a suicide cluster and provides the basis for targeted intervention to mitigate further contagion through the identification of linked cases and socioecological factors associated with the increased risk of clustering in the affected area or population. Policy makers and public health officials benefit from detection of suicide clusters by means of implementing targeted evidence-based interventions in identified vulnerable populations and high-risk areas in a timely manner. To date, suicide cluster detection has been largely restricted to retrospective investigations, limiting its capacity as a tool for intervention.

Aim: The aim of this research was to provide a comprehensive understanding of the real-time surveillance, detection, and responses to suicide contagion and clustering.

Methods: The thesis is comprised of five interrelated studies, based on both primary and secondary research. Primary data collection was conducted on coronial records of post-inquest cases of confirmed suicide or open verdicts meeting the criteria for probably suicide, as well as pre-inquest cases of suspected suicide. This research also involved quantitative Census data from the Central Statistics Office (CSO). The retrospective and prospective space-time scan statistics based on a discrete Poisson model was employed via the R software environment using the '*rsatscan*' and '*shiny*' packages to conduct the space-time cluster analysis and deliver the mapping and graphic components of the dashboard interface in study 3. Evidence synthesis was conducted by means of narrative review of existing literature in studies 1 and 4, and by comparative review of response to a structured questionnaire in study 2. Study 5 employs a secondary research approach to report on policy and practice implications of real-time suicide surveillance.

Results: Study 1 synthesised the existing evidence on quantitative techniques to detect suicide and self-harm clusters detection, revealing that a Poisson-based scan statistical model is most effective in accurately detecting point and echo suicide clusters, while mass clusters are typically detected by a time-series regression model, albeit that limitations exist. Study 2 demonstrated more commonalities than differences in a comparison of the components and practices of real-time suicide surveillance systems internationally. Commonalities included rapid, routine surveillance based on minimal, provisional data to facilitate timely intervention and postvention efforts. Identified differences include timeliness of case submission and system infrastructure. Study 3 tested the validity of the scan statistic as a cluster detection approach inbuilt in a dashboard prototype developed to visually display real-time suicide surveillance data. Study 4 identified consistency in both increased quantity of media reports and portrayal of specific details of suicide cases to be significantly associated with suicide contagion and increased suicide rates or mass clusters. An elevated period of risk of suicide contagion has been found to take place between the first days up to the first three months following the media coverage of suicide. Study 5 demonstrated the importance of real-time suicide surveillance in the context of policy and practice, with a particular reference to public health emergencies and humanitarian crises.

Conclusions: The findings of this thesis are of relevance in furthering our knowledge of monitoring, detecting, and responding to suicide clusters. Collectively, the findings from this thesis indicate that we can work more efficiently and collectively to mitigate further suicidal behaviour by utilising real-time, provisional suicide data to guide quicker action. The outcomes of this research have methodological implications in terms of suicide and self-harm cluster detection and real-time suicide surveillance. The implications of this research further extend to suicide prevention and mental health policy, clinical practice, means restriction, crisis planning and response, and media reporting of suicide.

Preface

This thesis examined suicide clusters in the context of detection and real-time surveillance to inform evidence-based responses and mitigate further contagion. The thesis opens with an introductory chapter that provides the research context for the five empirical studies underpinning this thesis. It describes the terminology and epidemiology of suicidal behaviour, the types of suicide clusters, the mechanisms at play in suicide contagion and clustering, the relevance of cluster detection and surveillance and the theoretical and policy context of this research. Chapter 2 provides an overview of the methodologies applied to the studies in this thesis, outlining the data sources, the ethical considerations and the analytical approaches applied in the thesis. Chapters 3-7 present the five interrelated research studies as follows:

1. Study 1: Quantitative methods to detect suicide and self-harm clusters: A systematic review (Chapter 3)
2. Study 2: Real-time suicide surveillance: comparison of international surveillance systems and recommended best practice (Chapter 4)
3. Study 3: The development and validation of a dashboard prototype for real-time suicide mortality data (Chapter 5)
4. Study 4: Suicide clustering and contagion: The role of the media (Chapter 6)
5. Study 5: Real-time suicide surveillance supporting policy and practice (Chapter 7)

At the time of submission of this thesis, study 4 has been published. Study 1 is currently under revision with the International Journal for Environmental Research and Public Health. Study 2 is under review with Archives of Suicide Research, study 3 is under review with Frontiers in Digital Health and study 5 is under review with Global Mental Health. The final chapter (Chapter 8) presents a discussion of the main findings of this thesis and the theoretical, methodological, clinical and policy implications resulting from the research. The strengths and limitations of the research are addressed, and the thesis concludes with a reflection on considerations for future research.

Chapter 1. Introduction

1.1 Chapter overview

This chapter provides the context for the research undertaken within this thesis. It begins by summarising the nomenclature of suicidal behaviour, while also reporting on the prevalence rates and risk factors for suicidal behaviour. An overview of the research into clusters of suicidal behaviour is then presented, including prevalence rates, different types of clusters, known risk-factors associated with clusters, and the mechanisms which underpin clusters of suicidal behaviour. Cluster detection and surveillance is outlined. Following this, the theoretical and policy contexts in which this research was conducted are described. Finally, an overview of the aims and objectives of this thesis is provided.

1.2 Nomenclature of suicidal behaviour

The language of suicidology includes different terms to describe a broad spectrum of behaviours that range in level of lethality, motive, and suicidal intent (1). According to the World Health Organisation (WHO), suicidal behaviour encompasses a range of behaviours including thinking about suicide, planning suicide, attempting suicide, and dying by suicide (2). The inclusion of suicidal ideation is a complex matter that instigates ongoing debate. Suicide itself is explicitly defined by the WHO as *‘the act of deliberately killing oneself’* (pg. 12; 2).

Consensus on a standard definition and nomenclature of non-fatal suicidal behaviour has yet to be reached given that a variety of terms have been identified in the literature referring to suicidal behaviour including deliberate self-harm, non-suicidal self-injury (NSSI), self-directed violence, parasuicide which have all been used to describe self-injurious behaviours that did not result in death, irrespective of the level of reported suicidal intent (3-5).

A review of contemporary nomenclatures of suicidal behaviour by Goodfellow and colleagues (6) used intent (i.e., the presence or lack of intent) and outcome (i.e., fatal or non-fatal

behaviour) as distinguishing features to guide the analysis of 13 identified contributions to the literature. The review identified an issue in the definitions within nomenclatures as critical to how intent and outcome are applied, with some nomenclatures of suicidal behaviour employing the common conceptual constructs, and others following less conventional concepts. Issues relating to corroboration or a lack of evidence in distinguishing between the terminology and classification give rise to questions around what is specifically defined by nomenclatures of suicidal behaviour (6).

Inconsistency in defining suicidal behaviour presents significant challenges in clinical practice, suicide prevention and research, particularly in the classification of events for surveillance purposes (1,6). The codes for both suicide and intentional self-harm in the International Classification 21 of Disease 10th Revision (ICD-10), as well as the forthcoming 11th Revision (ICD-11) which is currently undergoing implementation, both combine fatal and non-fatal events into the same category (3,7). NSSI has been catalogued as a symptom of Emotionally Unstable Personality Disorder from the time when personality disorders were first officially listed in The Diagnostic and Statistical Manual (DSM) in 1980. In 2013, the DSM 5th Edition (DSM-5) added NSSI as a Condition for Further Study, including proposed diagnostic criteria; however, extensive debate still surrounds the appropriateness and utility of the term which refers to the intentional destruction of one's own body tissue (e.g., cutting, burning, hitting) without suicidal intent (5,8,9). Given that intent is a complex process underlying suicidal behaviour based on personal motives and involving varying degrees of intensity and severity, to bisect acts of self-harm into those with suicidal intent (e.g., attempted suicide) or those without suicidal intent (e.g., NSSI) leads to generalisation that could have potentially damaging implications, including a lower level of clinical attention for those cases deemed as involving no intent (10). Furthermore, an understanding that those who engage in suicidal behaviour may be experiencing a state of ambivalence about dying is crucial to recognising the transience of decisions around their fate (11,12). Approaching suicidality as a continuum

with fluid features encourages recognition of increased risk of suicide in individuals who engage in self-harm, despite uncertainty around the determination of intent (10,13).

The term 'suicidal behaviour' is used in this thesis to broadly address both non-fatal and fatal suicidal behaviour together. The term 'self-harm', defined as *'an act with non-fatal outcome in which an individual deliberately initiates a non-habitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed dosage, and which is aimed at realizing changes that the person desires via the actual or expected physical consequences'* is used in this thesis to specifically describe non-fatal suicidal behaviour (3,14). For fatal suicidal behaviour, the terms 'suicide' or 'suspected suicide' will be used exclusively.

1.3. Prevalence of suicidal behaviour

Suicide is a major public health issue and one of the leading causes of death worldwide. The World Health Organisation (WHO) have reported that one in every 100 deaths was the result of suicide in 2019 (15). Suicide occurs across the lifespan, in children and adolescents, adults and older people. It is the fourth leading cause of death among 15–29-year-olds globally, while more than half of all suicides occur in those aged under 50 years old (15). Approximately 703,000 individuals lose their life due to suicide each year, with many more attempting suicide (16). According to the most recent global estimates collated by the WHO, most deaths by suicide take place in low and middle-income countries (LMICs) where most of the global population is based, accounting for 77% of global suicides in 2019; although, high income countries represented the highest age-standardized suicide rate (10.9 per 100 000; 16). However, there are caveats that concern global suicide mortality statistics. Close to 60 of the 183 WHO Member States possess vital registration data that is of high quality, depending on statistical modelling to generate estimates for the remaining countries that predominantly consist of LMICs (15). In addition, underreporting of suicide is affected by factors including

variations in suicide registration procedures, legal restrictions, stigma, and societal attitudes surrounding suicide, contributing to the underestimation of the real burden of suicide globally, especially among LMICs (2,17,18). The quality and availability of data determine the complexity of modelling applied to calculate estimates, creating discrepancies when country-level data is incomplete and of inadequate quality. These issues may be overcome by improving the primary data through the strengthening of health information systems, including vital registration in countries with substandard surveillance practices (15).

The current global age-standard suicide rate is 9 per 100,000, with Ireland reporting an age-standardised suicide rate of 8.9 per 100,000 in 2019, falling just below the current global rate (16). Approximately 527 individuals die by suicide each year in Ireland (17). Globally, the age-standardized suicide rate is 2.3 times higher in males (12.6 per 100 000) than in females (5.4 per 100 000). As with this global trend, the male suicide rate in Ireland is both disproportionately and consistently higher (14.3 per 100,000) than the female rate (3.6 per 100,000), accounting for 80% of all suicides in 2019 (16). Based on the latest finalised data available (18), the rate of youth suicide (15–19-year-olds) in Ireland (10.2 per 100,000) is significantly higher than the European average (4.2 per 100,000).

Given the inconsistency in definitions of suicidal behaviour, it is difficult to accurately detect true self-harm rates globally. National data on hospital-presenting self-harm to Emergency Departments (EDs) in Ireland is recorded by the National Self-Harm Registry Ireland (19). Based on this data, the age-standardised rate of individuals presenting to EDs in Ireland following self-harm is 206 per 100,000 (20). An average of 11,800 self-harm presentations are made to EDs in the Republic of Ireland each year, involving 9,000-10,000 individuals (19-23). Rates of hospital presenting self-harm in Ireland are consistently higher among females (226 per 100,000 of the population in 2019) than males (189 per 100,000 in 2019) and consistently peak among the young population, within the 15–19-year-old female population and the 20-24-year-old male population (19-23).

1.4. Risk factors for suicidal behaviour

Multiple factors contribute to an individual's increased risk of suicidal behaviour, particularly when such factors occur simultaneously. Previous self-harm is one of the strongest risk factors for future suicidal behaviour, noted in approximately 40% of all cases of suicide, with multiple repeated episodes of self-harm heightening the risk of suicide (24-26). Psychiatric disorders, most commonly affective disorder, substance misuse and schizophrenia are highly prevalent in cases of suicide, with comorbidity of such disorders significantly increasing suicide risk (27,28). Based on psychological autopsy findings, a small proportion of individuals (10%) who die by suicide have no diagnosed psychiatric diagnosis but have displayed psychiatric symptoms and personality traits similar to those displayed by individuals who die by suicide with diagnosed psychiatric disorders (25). Physical conditions including cancer, Huntington's disease, multiple sclerosis, epilepsy, peptic ulcer, renal disease, HIV/AIDS, spinal-cord injury, systemic lupus erythematosus, and chronic pain are all associated with suicide risk (28-31). Stressful life events, including both acute psychosocial crises and humanitarian crises are factors that typically lead to suicidal behaviour (24). Childhood adversities including abuse of a physical, sexual, or emotional nature are strongly linked to suicidal behaviour, with intergenerational abuse further compounding the risk of suicidal behaviour for the offspring of child sexual abuse victims also (28,32). Adversity in childhood has also been found to transfer to adulthood, with the risk of suicide increasing 2-5 times throughout the lifespan, highlighting the long-term impact of childhood trauma (33). Unemployment and male gender are also believed to be precipitating factors for suicide risk (2,34). In addition, proneness to hopelessness, as well as aggressive or impulsive behaviour are all identified risk factors for suicidal behaviour (33,35).

Objective social isolation, subjective feelings of loneliness and an absence of social supports are all factors reportedly linked with increased risk of suicide (2,36,37). Residents of sparsely

populated rural areas tend to experience less social interaction due to geographical isolation. These areas are impacted by factors including social fragmentation and deprivation, with reduced accessibility to support services affecting the level of care available to individuals experiencing mental health issues and thereby elevating the risk of suicidal behaviour (38,39). Discrimination, particularly in the context of stigma associated with mental illness is known to be a factor influencing suicidality at both an individual and societal level (40). Minority ethnic groups experiencing acculturative stress and members of the Lesbian, Gay, Bisexual and Transgender communities experiencing perceived discrimination are also at increased risk of suicide (41-43).

Exposure to suicide is postulated to increase vulnerability in both kin and non-kin of the deceased (44-46). An estimated 4.3% of the general population are exposed to a death by suicide during a one-year period and over one fifth of the population encounter suicide at least once in their life (47). Each death by suicide affects an average of 135 people (48), with more than 60 individuals directly and negatively impacted by a suicide, including five family members, 15 extended family members, 20 friends and a further 20 colleagues or classmates (49,50). Spouses bereaved by suicide are at a 6-8 times increased risk of death by suicide when compared with the general population (51). Males bereaved by the suicide of their marital partner have a higher risk of suicide, while bereaved female partners are at an increased risk of self-harm (52). Children bereaved by a parental suicide, particularly the death of their mother by suicide and especially mothers aged under 40 years old are at an elevated risk of suicide (53). Parents, particularly mothers bereaved by the suicide of their child, are at a marked risk of taking their own life (54,55). Shame and stigma associated with suicide bereavement are issues postulated to prevent help-seeking. Exposure to suicide as a risk factor for suicidal behaviour extends beyond familial risk. Irrespective of blood relatedness to the deceased, bereavement by suicide is an identified risk factor for suicide attempt in young adults (56). Furthermore, a suicide attempt by a peer is associated with a marked risk for

suicidal behaviour among youth (57). The risk of suicide having been exposed to another individual's death by suicide is 2-4 times higher among 15- to 19-year-olds than among other age groups (58). Media coverage of a death by suicide of a well-known individual has been found to be a compounding factor for suicide (59), whereby the initial suicide leads to imitative suicidal behaviour by vulnerable individuals, a phenomenon reported in the literature as suicide contagion (60). This concept of suicide contagion has been proposed as a mechanism underpinning suicide clusters (61).

1.5. Clusters of suicidal behaviour

Clusters of suicidal behaviour are commonly referred to as a higher number of suicide deaths or attempted suicides, or both, that occur in a population, location or period than usually expected based on statistical probability or community expectancy (62). However, due to a lack of consensus regarding an operational definition of suicide clusters, particularly relating to the minimal number of cases that constitute a cluster, definitions are typically determined on an ad hoc basis in terms of the spatial and temporal limits of a cluster relevant to the affected population (63). While suicide clusters are relatively uncommon, they are a cause for great community concern due to the potential impact of contagion associated with such phenomena (64). A small number of definitions indicate a specific number of suicides that constitute a cluster, based on a minimum of either two or three cases linked in both time and space (65). Suicide clusters have reportedly been on the rise in recent years, linked to the broadening of social connections through electronic communication systems and internet-based social sites (65,66), particularly in the form of suicide pacts (67).

1.5.1. Types of clusters of suicidal behaviour

The cluster patterns of suicidal behaviour mainly researched and documented within the literature are of two main types: mass clusters and point clusters. Mass clusters (or temporal clusters) involve a temporary increase in the total number of suicides within a population relative to the period before and after the cluster, with a lack of spatial relevance, typically observed in the aftermath of a real or fictional suicide documented in the media (68-70). In contrast, point clusters (or spatiotemporal clusters) are those that occur close together in both space and time within a given community or institution, and these clusters can occur without the presence of media coverage (70). A third pattern of suicide (spatial clusters) has been identified in the literature (65-77), wherein deaths cluster by location but not time, known as 'locations where people frequently take their lives', often at well-known public or historical sites. However, this pattern is not as extensively researched in comparison to mass and point clusters. A phenomenon known as echo clusters, wherein one or more successive point clusters occurs distinct from the initial cluster, has been statistically verified in indigenous populations in rural Australia, yet there is a dearth of evidence of this phenomenon elsewhere (78,79).

1.5.2. Risk factors associated with clusters of suicidal behaviour

Individuals who engage in imitative suicidal behaviour typically display a high number of risk factors for suicide, with those dying as part of a cluster exhibiting particularly high-risk factors (69,75). As with general suicide rates, deaths within suicide clusters more commonly occur among males (75). Clusters of suicidal behaviour involving only females typically involve self-harm or attempted suicide (63). Previous self-harm, substance abuse, psychiatric illness, family conflict, poor educational experience, unemployment and a history of traumatic life events are all reported risk factors for individuals involved in clusters of suicidal behaviour (75). Clusters of suicidal behaviour are mostly reported among adolescents and young people, particularly 15–24-year-olds (69,70,80), and are estimated to account for between 1% and 5%

of all adolescent deaths by suicide (71,72). Furthermore, statistical evidence implies the relative risk of being involved in a suicide cluster is two to four times greater as an adolescent or young person than an adult (60, 75). Among clusters of suicidal behaviour in young people, males are more likely to complete suicide, while females more often attempt suicide (81). Furthermore, previous research has identified the 90-day period following exposure to a suicide by a young person represents a time of elevated risk of suicide and possible development of a suicide cluster (82). Geographical remoteness, economic deprivation, indigenous status, and residing in high rise buildings are all factors associated with suicide clusters (75,76,83,84). Furthermore, suicide clusters are more likely to occur in areas inhabited by disadvantaged cohorts as certain risk factors associated with suicide including unemployment, socio-economic deprivation and substance abuse occur more often in this population (85). Clusters of suicidal behaviour most often occur in settings occupied by groups of vulnerable individuals such as prisons, mental health institutions and educational settings (86-89). In the context of mental health inpatient settings, the risk of suicide clustering is increased by clinical staff turnover, issues with treatment plans or similar clinical profiles to individuals who have most recently died within the cluster (75).

1.5.3. Mechanisms underpinning clusters of suicidal behaviour

A number of social and psychological theories have been proposed to explain the mechanisms underpinning suicide clusters. Contagion is a term that is often and controversially used to describe the mechanism at play in the clustering of suicidal behaviour given that the word commonly relates to the transmissibility of a communicable disease (63). Yet, the phrase has also been used to reference the spread of a harmful notion or practice, as well as the prompt propagation of a belief or influence that may not be negative in nature, explaining its theoretical utility in suicide-related research (63). However, the inconsistency in defining suicide contagion has resulted in a lack of standardisation in the application of the term within

the literature (63). In the context of suicidal behaviour, it refers to a situation wherein vulnerable individuals identify with other individuals who have taken their own life and imitate their behaviour in a phenomenon coined “the Werther Effect”, based on an observed upsurge in suicide rates following the graphic depiction of a fictional suicide in Goethe's *The Sorrows of Young Werther* in 1774 (90-92). Vulnerable individuals may be exposed directly by personal contact with one's family or peer group, or indirectly through traditional and contemporary media reports or fictional portrayals of suicide (93,94). However, Hawton and colleagues (95) argue that exposure alone is not a catalyst for social transmission of suicidal behaviour within the general population, emphasizing that both personal and environmental factors influence the effect of exposure on an individual.

On the other hand, Mesoudi (68) postulates that individuals who are vulnerable to suicidal behaviour may cluster prior to the presence of a suicide-related trigger and upon experiencing a negative event relating to at least one member, the risk of suicidality among the entire group increases, particularly in the absence of strong social support, thereby leading to the phenomenon of suicide clustering in the rare event that all factors occur simultaneously. This concept is known as homophily, wherein individuals with similar qualities or issues form relationships with one another, supports the findings of clusters occurring within institutional settings well, given the shared characteristics of individuals in such settings.

Johansson and colleagues (96) put forward an alternative explanation for suicide clustering which suggests that exposure to a suicide leads to or intensifies depressive symptoms in vulnerable individuals due to the difficulty in coping with the grief of suicide bereavement, consequently leading to suicidal behaviour. This postulation is linked with a significantly increased risk of suicide among bereaved family and peers of an individual who took their own life.

In recent years, descriptive norms have been suggested as an underexplored mechanism involved in suicide clustering. This notion implies that an individual's perception of the

commonality of a particular behaviour makes them more inclined to believe that engaging in such a behaviour is normal and increases their likelihood of engaging in the behaviour themselves (95,97). Findings from previous research lend support to this postulation, particularly when an individual has been directly exposed to the suicidal behaviour of others, leading their observation of suicidal behaviour to be normative and thereby increasing their probability of engaging in suicidal behaviour (98,99).

1.6. Cluster detection and surveillance

Since there is no internationally agreed operational definition for suicide clusters, difficulty remains in determining the minimum number of cases that constitute a cluster. Two distinct approaches are proposed to identify a cluster. In identifying a *statistical cluster*, the rise in cases of suicide must be statistically significant, as opposed to a simple rise above the mean. For that reason, a predefined number cannot be used because the presence of a cluster will depend on the base suicide rate and the population size under observation (96). In identifying a *contagious cluster*, the minimum number of cases constituting a cluster is suggested as three. Geographical boundaries are of less significance because of the effect of mass media and contemporary communication technology enabling rapid spread of information relating to high-profile deaths globally, hence facilitating mass clusters and thereby discounting geographical relevance (96,100,101).

In recent years, strong emphasis has been placed on the importance of detection and surveillance of suicide clusters (102,103). Cluster detection increases the knowledge on the aetiology of suicide clusters by establishing links between cases and identifying socioecological factors associated with the increased risk of clusters within the affected area or population (104). Policy makers and public health officials also benefit from detection of suicide clusters by means of implementing targeted interventions (104). Statistical cluster

detection of suicidal behaviour has been largely restricted to retrospective analyses, limiting its capacity as a tool for intervention (96). However, there have been significant advances in cluster detection in recent decades with the development of computer mapping and spatial scanning and their integration with robust statistical models (104).

The efficacy of suicide cluster detection is affected by suicide mortality data issues including data quality and timeliness in accessibility for surveillance purposes. The processes involved in verification, registration, and classification of deaths by suicide often take several months or sometimes years to finalize due to medico-legal or coronial investigations involving several parties, including legal authorities, certifiers, pathologists, and vital statistics registrars (105-107). Furthermore, suicide is one of the most underreported vital statistics and is seldom overestimated (108-110). The inaccuracy and underreporting of suicide may result from both deliberate and unintentional issues, including concealment associated with stigma in some countries, misclassification bias, and methodological differences in death registration (110-113).

Surveillance systems for suicidal behaviour provide an evidence base for cluster detection, trend analysis, and identification of at-risk subpopulations, emerging methods, or locations of concern (114). Incorporating real-time suicide surveillance would inform more prompt decision making in the context of suicide prevention. Access to real-time suicide data increases the capacity for early intervention when potential clusters are identified, facilitate implementation or activation of community response plans when emerging clusters are identified, assist with optimising resource allocation, and inform health service responses in geographical areas affected by increased suicide rates. In addition, reporting of real-time suicide data has strong implications for policy development, particularly in the evaluation of suicide prevention strategies and intervention programs (115). Despite the major benefits associated with real-time data, only a small number of real-time suicide surveillance systems exist globally, mainly in developed countries. Demand for real-time suicide data has grown

exponentially in recent years, particularly from the onset of the ongoing coronavirus (COVID-19) pandemic. The mental health implications of the pandemic and associated societal restriction measures have increased the need for real-time surveillance data to help track changes in suicide rates occurring alongside the pandemic and identify risk factors that may be heightened and vulnerable groups that may be disproportionately affected (116-118). Such data are vital to facilitate timely, targeted, public health responses during and after the crisis (119).

1.7. Theoretical context of this research

The following section provides a summary of the theoretical context which underpin the research methodology applied within this thesis. In the context of suicide, theoretical models provide a framework for prevention efforts by dissecting the complex factors relating to suicide and considering the causal mechanisms involved in an individual's trajectory towards suicidal behaviour. The research undertaken in this thesis is based on the Social-Ecological Model (SEM) (120), the Circles of Vulnerability Model (121), and the Social Learning Model (122).

1.7.1. The Socio-Ecological Model (SEM)

The SEM (Figure 1) examines the interplay between general and population-specific risk and protective factors using a 4-level model of overlapping rings to explore their interconnected influence on health and wellbeing (123). The model allows us to conceptualise the interaction between the multi-level factors and how they increase or decrease an individual's risk of suicidal behaviour (124). The first level of the SEM seeks to identify individual-level factors that influence one's vulnerability to suicidal behaviour, including demographic and biological factors, as well as personal history. A wealth of evidence proves that such factors can increase one's risk of suicidal behaviour (125-127). Secondly, relationship-level factors are considered

in the context of their impact on an individual's likelihood to engage in suicidal behaviour, focusing on interpersonal relations between family, friends, and intimate partners. Personal interactions such as social support and withdrawal, conflict among others may act as risk or protective factors for or against suicidal behaviour (128-131). The third level of the SEM explores the community settings wherein social relationships occur that may impact an individual's risk for suicidal behaviour including schools, workplaces, and neighbourhoods (132-134). Finally, the influence of societal factors on risk of suicidal behaviour are considered in the fourth level of the SEM. Social and cultural norms, as well as health, social, economic, and educational policies are all societal-level factors that have been associated with suicidal behaviour (135,136). The SEM highlights accessibility to means as a strong risk factor for suicidal behaviour at every level of the model, while restricting access is underlined as a protective factor against such behaviour (2, 124).

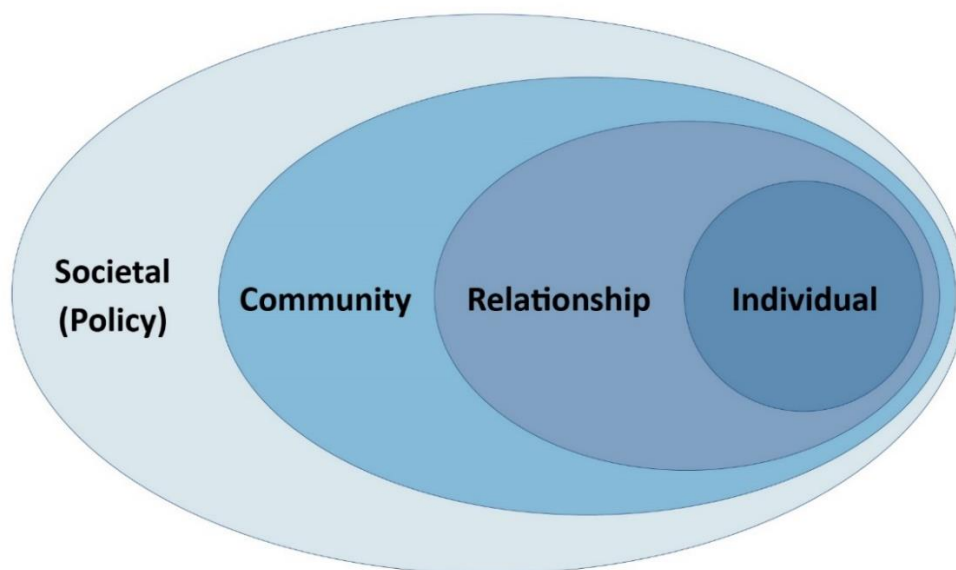


Figure 1. The Socio-Ecological Model; Dahlberg and Krug (120)

1.7.2. The Circles of Vulnerability Model

The Circles of Vulnerability Model (Figure 2) supports identification of vulnerable individuals who are most at risk within a community affected by a crisis, with greater effect expected closer to the point of impact (121). This model has important utility in suicide prevention by determining the extent of emotional ramification from a crisis by assessing those individuals who may be more vulnerable to the influence of suicide contagion (137). Vulnerability may be conceptualised as three intersecting circles representing three axes: geographical proximity, social proximity, and psychological proximity. *Geographical proximity* relates to the physical closeness to the person or event, capturing those who witnessed the event or were exposed to the immediate aftermath. Physical distance is a well-documented risk factor for transmission of suicide (75,138,139). *Social proximity* refers to the social connectedness with the individual who died by suicide. Family, peers, and intimate partners are those who are most vulnerable given their close relationship with the deceased; however, individuals linked via social media are also known to be at greater risk of suicide contagion (140). *Psychological proximity* relates to the level of identification one has to the deceased. Some people may connect with the deceased more closely than others through shared experiences, cultural or religion connectedness or the perception of some form of similarity (141). In the interest of practicality, psychological and social proximity may be combined into *psychosocial proximity* given the overlap between these groups. Collectively, individuals captured by each of the three axes are part of an at-risk population due to their increased pre-existing vulnerabilities such as mental illness, substance misuse, or family conflict which puts them at an increased likelihood of engaging in suicidal behaviour prior to exposure to the crisis (121,137). Figure 2 illustrates the variation in vulnerability based on proximity to the deceased using overlapping circles and a colour scale to signify the degree of possible vulnerability to suicide contagion.

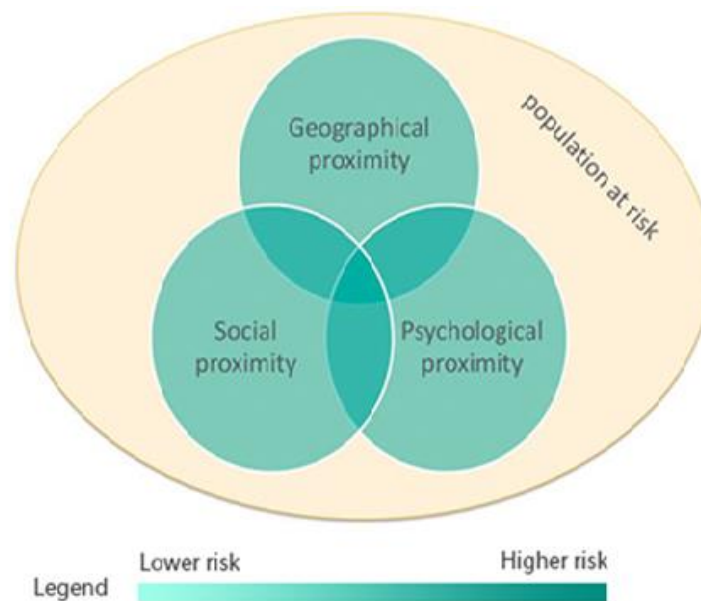


Figure 2. The Circles of Vulnerability Model; Lahad and Cohen (121)

The model facilitates early identification of individuals who are potentially most vulnerable to contagion in the wake of a suicide using a systematic approach based on the level of proximity to the deceased individual, thereby facilitating mitigation of secondary suicidal behaviour. The more vulnerability factors identified for an individual, the greater the risk of them engaging in secondary suicidal behaviour. The closer the individual is to the intersection of the circles, the greater their need for acute intervention and provision of support (142). Furthermore, it advocates screening those who were in geographical, social, or psychological proximity to the death so that those deemed to be vulnerable receive further assessment and increased monitoring, as well as intervention and support, where necessary (143). Grounded in the model, a vulnerability matrix approach has been recommended as a key component of suicide cluster response plans as a means of mapping interventions, identifying gaps, and monitoring ongoing need (141).

1.7.3. The Social Learning Model

The Social Learning Model (Figure 3) illustrates the concept that behaviour may, in part, be learned through a socialisation process known as modelling (122). The theory put forward by

Bandura (122) suggests that individuals develop an understanding of behaviours through the observation of others, hence providing the basis for imitation (75). In the context of suicide, the social learning model offers an insight into the reason why suicidal behaviour may spread. This model suggests that observational learning of suicidal behaviour is influenced by factors including internal mental state, memory, exposure, and identification with others (144). The likelihood of engaging in imitative suicidal behaviour increases when the behaviour feels appropriate to the observer and their circumstances, and when the observer closely identifies with the individual performing the behaviour, based on their perceived similarities (145).

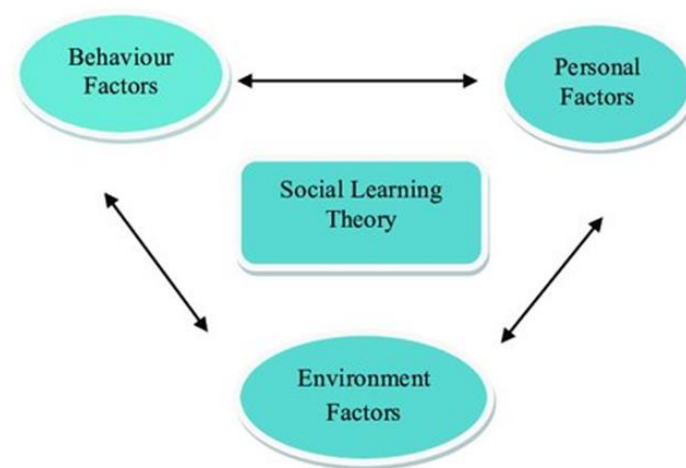


Figure 3. The Social Learning Model; Bandura (122)

Practical information that enables an individual to carry out a behaviour, such as the sharing of method-specific details of suicide behaviour, is also hypothesised to be driven by social learning (145). The social learning model suggests that the greater the exposure of an individual to a behaviour through their social network such as suicidal behaviour, the greater their acceptance of the behaviour and the less inhibitory control they possess to keep from engaging in such behaviour (146). In suicide clusters, modelling cues are believed to be transmitted through personal contact, community exposure and media exposure (75). Accordingly, the social learning model provides the theoretical grounds to understand the

vulnerability in individuals exposed to suicidal behaviour given that exposure to such behaviour can increase one's likelihood of subsequently imitating the behaviour.

Evidence-based suicide cluster detection and response including the identification of vulnerable individuals, supported by the Socio-Ecological Model, the Circles of Vulnerability Model and the Social Learning Model will be discussed later in the thesis.

1.8. Policy context of this research

The research documented within this thesis strongly aligns with both international and national policies. On a national level, it addresses several goals within *Connecting for Life, Ireland's National Strategy to Reduce Suicide in Ireland 2015-2024*, primarily **Goal 7**: To improve surveillance, evaluation and high-quality research relating to suicidal behaviour, specifically fulfilling **Objective 7.2**: to improve access to timely and high-quality data on suicide and self-harm. This research also informs **Goal 1**: To improve the nation's understanding of and attitudes to suicidal behaviour, mental health and wellbeing, **Goal 3**: To target approaches to reduce suicidal behaviour and improve mental health among priority groups and **Goal 6**: To reduce and restrict access to means of suicidal behaviour (147). The current research also aligns with the recently published national mental health policy, *Sharing the Vision: A Mental Health Policy for Everyone*, which recommends review and revision of suicide mortality data collection and report procedures in Ireland, with a view to providing more timely data to inform targeted and improved community-based suicide prevention actions (148,149).

On an international level, this research aligns with policy outlined in the WHO Comprehensive Mental Health Action Plan 2013-2030, particularly **Global target 3.2** The rate of suicide will be reduced by one-third, by 2030 and **Objective 4**: To strengthen information systems, evidence, and research for mental health (150), as well as the WHO Global Report Preventing Suicide: A

Global Imperative, which signals the need for an increase in the quality and timeliness of national data on suicide and suicide attempts (pg. 57; 3). It further supports the United Nations' Sustainable Development Goals (SDGs) **Goal 3.4:** By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and wellbeing (151).

1.9. Thesis aims and objectives

Aim

The overall aim of this research is to provide a comprehensive understanding of the real-time surveillance and detection of suicide clusters to inform evidence-based responses to suicide contagion and clustering.

Objectives

The key objectives of this research are:

- To determine evidence-based quantitative methods for early identification of emerging suicide contagion and clustering.
- To develop a real-time surveillance system for early identification of emerging suicide contagion and clustering in Ireland.
- To develop an interactive dashboard prototype for real-time suicide mortality data.
- To determine the role of the media in suicide clustering and contagion.
- To establish recommendations for best practice in real-time suicide surveillance.
- To determine implications of real-time suicide surveillance for policy and practice at local, national, and international level.

Chapter 2. Methods

2.1 Research setting

This research was primarily conducted in the School of Public Health and the National Suicide Research Foundation (NSRF), University College Cork (UCC). The NSRF is an independent, multi-disciplinary research unit that investigates suicidal behaviour and mental health in Ireland, with registered charity status. The research conducted within the NSRF provides an evidence-base for policy development in suicide prevention and intervention, as well as management of patients presenting with self-harm to Emergency Departments. The NSRF is recognised as a centre of excellence in suicide research and prevention by the WHO and is an officially designated WHO Collaborating Centre (WHOCCC). As a WHOCC for Surveillance and Research in Suicide Prevention, it aims to develop and implement surveillance systems for suicidal behaviour. Within this context, the NSRF operates a number of data systems, including the National Self-Harm Registry Ireland (NSHRI), the Suicide Support and Information System (SSIS) and the Suicide and Self-Harm Observatory (SSHO), the latter two of which were used as data sources in this PhD research.

2.2. Data sources

The data used in this PhD research was sourced from the SSIS and the SSHO.

2.2.1. The Suicide Support and Information System

Since 2008, the SSIS has been successfully implemented by the NSRF in close collaboration with the Coroners of Cork City and County (152-155). Information on consecutive cases of suicide and undetermined deaths in Cork City and County is obtained following conclusion of the coroners' inquest using a psychological autopsy approach. Relevant data on factors associated with the death and the deceased is collated from sources including coroners,

family, peers, and health care professionals, particularly General Practitioners (GPs), who were providing care to the deceased prior to death. The psychological autopsy approach aims to develop the most complete sense of the deceased to strengthen the understanding of why the individual ended their life. It is considered the most direct method to study the link between specific risk-factors and suicide (26).

Minimal information on suicide is obtained at an earlier stage than the release of official national statistics, with data available once the inquest has concluded. A key objective of the SSIS is to enhance early identification of people at risk of suicide and early identification of emerging suicide clusters, an objective that links in with one of the principal functions of the Coroner Service: 9f, stating that “the Coroner Service shall contribute to the enhancement of public health and safety” (156). Due to the involvement of multiple information sources, one of the benefits of the system has been to encourage collaboration between coroners, health professionals, and bereaved families. As such, the SSIS is innovative as it involves a stepped approach by facilitating access to support for the bereaved, while at the same time obtaining in-depth information on risk factors associated with deaths by suicide and those classified as open verdicts that meet the criteria for probable suicide.

For the purpose of the current research, the data analysed from the SSIS is that which has been sourced exclusively from the coroners’ verdict records, collated using the coroner’s checklist (Appendix 1), which captures data relating to the circumstances surrounding the death, demographic information relating to the deceased, as well as their physical and mental health history and treatment. This data was extracted by the PhD candidate (RB) from an existing SSIS database of deaths that occurred during the period 2008-2012. This database was amalgamated with a second existing database of deaths which occurred during the period 2014-2016, built as part of a retrospective case-control study known as the SSIS-ACE that

investigated psychological, psychiatric, and work-related risk factors associated with suicide in Ireland and originated from the SSIS. The methodology of accessing data on suicide cases was similar for both the SSIS-ACE and the SSIS. As part of the current research, the PhD candidate collated further data based on the coroner's checklist from outstanding coroners' verdict records of deaths that occurred from 2017 onwards in a continuation of the SSIS.

Information on each case of suicide and open verdict is obtained from verdict records and post-mortem reports that are preserved by the coroner and made available to the public after the inquest has been concluded. Inclusion criteria for suicide cases includes: (a) the inquested death occurred within the catchment areas of the Coroners of Cork City and County coroners' defined catchment areas or (b) the verdict at conclusion of inquest being that of either 'suicide' or 'open' verdict in which the death is likely to have been a suicide. A verdict of death caused by suicide is concluded when it has been established by evidence that an individual has ended their own life beyond a reasonable doubt. To be considered a probable suicide, the death must have been self-inflicted and there must be evidence to suggest that the deceased intended to cause his/her death. Open verdict deaths are screened for probable suicides using internationally accepted operational criteria for suicide determination outlined later in this chapter (157).

2.2.2. The Suicide and Self-Harm Observatory

The SSHO was developed by the School of Public Health, UCC and the NSRF and established in County Cork in December 2018, with expansion to County Kerry taking place in April 2021. The Observatory has been developed with the main aim to obtain minimal data on suspected suicide cases as identified by the coroners on a real-time basis and prior to conclusion of the coronial inquest. Establishing this surveillance system was a priority to improve accuracy and efficiency in the calculation of suicide and self-harm statistics. So far, the focus of the SSHO

has only been on suicide statistics. The initiative stems from a need for real-time suicide data collection due to a delay in the availability of official governmental suicide mortality statistics that are released every two years by the CSO.

The main objectives of the Suicide and Self-Harm Observatory are:

1. To develop an observatory for identification of emerging suicide and self-harm clusters
2. To facilitate timely supports for people bereaved by suicide
3. To prevent contagion and clustering of suicide and self-harm within the population

Information collected by the SSHO:

- Increases the capacity for early intervention in instances where emerging suicide and self-harm clusters are identified.
- Facilitates implementation or activation of local plans to respond to emerging clusters.
- Assists with optimising resource allocation and location by means of spatial analysis.
- Informs health service responses in geographical areas with recurring clusters.
- Provides up-to-date data in relation to locations where people frequently take their lives.

The core concept of the Observatory represents the real-time access to data on suspected suicide cases from Coroners via updates on a fortnightly basis, obtained by the PhD Candidate and Resource Officers for Suicide Preventions (ROSP) of the HSE, via telephone consultation with the Coroners or via onsite manual data entry to an encrypted Microsoft Excel file in the Coroner's offices, depending on capacity levels of the coroner and their staff, as well as the level of public health measures implemented due to the COVID-19 pandemic. As a means of crosschecking data, the HSE Patient Mortality Register is accessed to collate data on deaths by suspected suicide of HSE service-users, either inpatient or outpatient. This type of

surveillance, known as active surveillance, is deemed to be the most accurate and timely approach, involves proactively contacting the data source to seek the required data.

Sources of suspected suicide data within the SSHO

1. The Coroners of Cork and Kerry

Given the legal responsibility of a coroner to independently investigate the cause of all sudden and unexplained deaths, the coroners for each jurisdiction across Ireland are regarded as the most reliable source to access information relating to deaths of unnatural causes in a timely manner. Cases of suspected suicide involve cases of premature deaths, in advance of the Coroner's inquest and meeting international screening criteria (157). For this reason, the coroners for each jurisdiction play a pivotal role in identifying cases which meet the criteria for inclusion in this Observatory and for providing the minimal information available at the early stage of investigation. In order to maintain real-time surveillance data on all cases of suspected suicide in Cork and Kerry, the PhD Candidate and the Resource Officer for Suicide Prevention (ROSP) in Kerry make contact with the office of the Coroners for the Cork and Kerry regions via phone on a fortnightly basis. Based on minimal data items, information that is available before coronial inquest is collected and input into the minimal database.

2. HSE Patient Mortality Register

For crosschecking purposes and to ensure completeness of data, the ROSP for the Cork region is contacted by phone on a biweekly basis by the PhD Candidate in order to gather data relating to service-users recorded in the HSE patient mortality register as having died as a result of suspected suicide. In County Kerry, the ROSP accesses the register for the same crosschecking purpose. This information aids in elucidating whether the deceased was in the care of the HSE at the time of death and provides clarification on the specific service that the deceased individual had been attending.

The Observatory database includes 16 data items that capture demographic information relating to the deceased, circumstances around the death and mental health service use (Table 1).

Table 1. Data items captured by the Suicide and Self-Harm Observatory

The Suicide and Self-Harm Observatory data items
Name/names
Date of birth
Gender
Marital status
Occupation
Address/addresses (including education institution)
Map coordinates of residential address(es)
Date of death
Method of death
Cause of death
Manner of death
Substance abuse
Domestic abuse
In the care of the HSE
Inpatient/outpatient of the HSE Mental Health Services in 12 months
Directly impacted by COVID-19

A systematic approach is applied to the data collection process. Due to the provisional nature of the data collated by the SSHO in the immediate aftermath of a death, operational screening criteria are applied to ensure that only cases which meet the criteria for suspected suicide are captured by the minimal database (157). These criteria, outlined under ‘operational criteria for determining suicide’, are used for the purpose of improving the validity and reliability of suicide reporting by forming common standards of practice in determining the manner of the death (152, 156).

2.2.3. Operational criteria for determining suicide

To classify a death by suicide, the death must have been self-inflicted without suspicion of interference from others and there must be evidence to suggest that the deceased intended to cause his/her death. In some cases, the means through which the deceased ended their life may unambiguously suggest that it was a probable suicide in the absence of indisputable evidence. Operational criteria have been developed by a working group of representatives of coroners' societies, medical officials, statistical agencies, and public health authorities to aid in determining a death by suicide in instances where there is an absence of indisputable evidence (157).

The application of these criteria seeks to explicate the criteria for decision-making of suicide determination, to increase the level of information considered in the decision-making process, to promote consistent and standard classification and to support death investigators in exercising their professional judgement (157). The coroner is more likely to identify a suicide correctly when the case file contains objective information regarding intent to die.

The criteria are as follows:

Self-Inflicted: There is evidence that death was self-inflicted. This may be determined by pathologic (autopsy), toxicological, investigatory, and psychological evidence and by statements of the decedent or witnesses.

Intent: There is evidence (explicit and/or implicit) that, at the time of injury, the decedent intended to kill himself/herself or wished to die and that the decedent understood the probable consequences of his/her actions. This evidence may include:

A. Explicit expression of intent to die:

1. Verbal statement
2. Handwritten note, unambiguous
3. Recorded statement, e.g., audio tape, word processor disk, typewritten note, video tape, email, text, and social media.

B. Implicit or indirect evidence of intent to die:

1. Expressions of farewell, desire to die or acknowledgement of impending death
2. Expressions of hopelessness
3. Expressions of great emotional or physical pain or distress
4. Expressions by the decedent that the decedent recognised high potential lethality of means of death
5. Efforts or actions to prepare for death, inappropriate to or unexpected in the context of his or her life.
6. Efforts or actions to procure or learn about means of death or rehearse fatal behaviour
7. Precautions to avoid rescue
8. History of previous suicide threat
9. History of stressful events or significant losses
10. History of serious depression or mental disorder

In anticipation of the implementation of the ICD-11, the ICD-10 classification of intentional self-harm has been applied to classification of cases of suicide in data researched in this thesis. Table 2 illustrates the coding of intentional self-harm (X60-X84) according to the ICD-10 classification system. A combination of codes may be recorded and applied to cases wherein multiple methods have been identified. The ICD-10 coding is applied in cases captured by the SSHO in the absence of post-mortem and toxicology report results. Upon conclusion of the coroner's verdict, this data may be revised to reflect the outcome of these reports.

Table 2. ICD-10 codes for intentional self-harm

International Statistical Classification of Diseases and Related Health Problems (ICD-10) Intentional self-harm (X60-X84)	
X60	Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics including:
	4-aminophenol derivatives
	nonsteroidal anti-inflammatory drugs [NSAID]
	pyrazolone derivatives
	Salicylates
X61	Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified, including:
	Antidepressants
	Barbiturates
	hydantoin derivatives
	Iminostilbenes
	methaqualone compounds
	Neuroleptics
	Psychostimulants
	succinimides and oxazolidinediones
	Tranquillizers
X62	Intentional self-poisoning by and exposure to narcotics and psychodysleptics [hallucinogens], not elsewhere classified, including:
	cannabis (derivatives)
	Cocaine
	Codeine
	Heroin
	lysergide [LSD]
	Mescaline
	Methadone
	Morphine
	opium (alkaloids)
X63	Intentional self-poisoning by and exposure to other drugs acting on the autonomic nervous system, including:
	parasympatholytics [anticholinergics and antimuscarinics] and spasmolytics
	parasympathomimetics [cholinergics]
	sympatholytics [antiadrenergics]
	sympathomimetics [adrenergics]
X64	Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances agents primarily acting on smooth and skeletal muscles and the respiratory system
	anaesthetics (general)(local)
	drugs affecting the:
	cardiovascular system
	gastrointestinal system
	hormones and synthetic substitutes
	systemic and haematological agents
	systemic antibiotics and other anti-infectives
	therapeutic gases
	topical preparations
	Vaccines
	water-balance agents and drugs affecting mineral and uric acid metabolism
X65	Intentional self-poisoning by and exposure to alcohol, including:
	alcohol:
	NOS
	butyl [1-butanol]
	ethyl [ethanol]
	isopropyl [2-propanol]
	methyl [methanol]
	propyl [1-propanol]
	fusel oil
X66	Intentional self-poisoning by and exposure to organic solvents and halogenated hydrocarbons and their vapours, including:
	benzene and homologues
	carbon tetrachloride [tetrachloromethane]
	Chlorofluorocarbons
	petroleum (derivatives)
X67	Intentional self-poisoning by and exposure to other gases and vapours
	carbon monoxide

	helium (nonmedicinal) NEC
	lacrimogenic gas [tear gas]
	motor (vehicle) exhaust gas
	nitrogen oxides
	sulfur dioxide
	utility gas
	Excluding: metal fumes and vapours (X69)
X68	Intentional self-poisoning by and exposure to pesticides, including:
	Fumigants
	Fungicides
	Herbicides
	Insecticides
	Rodenticides
	wood preservatives
	Excluding: plant foods and fertilizers (X69)
X69	Intentional self-poisoning by and exposure to other and unspecified chemicals and noxious substances, including:
	corrosive aromatics, acids and caustic alkalis
	glues and adhesives
	metals including fumes and vapours
	paints and dyes
	plant foods and fertilizers
	poisonous foodstuffs and poisonous plants
	soaps and detergents
X70	Intentional self-harm by hanging, strangulation, and suffocation
X71	Intentional self-harm by drowning and submersion
X72	Intentional self-harm by handgun discharge
X73	Intentional self-harm by rifle, shotgun, and larger firearm discharge
X74	Intentional self-harm by other and unspecified firearm discharge
X75	Intentional self-harm by explosive material
X76	Intentional self-harm by smoke, fire, and flames
X77	Intentional self-harm by steam, hot vapours, and hot objects
X78	Intentional self-harm by sharp object
X79	Intentional self-harm by blunt object
X80	Intentional self-harm by jumping from a high place, including:
	intentional fall from one level to another
X81	Intentional self-harm by jumping or lying before moving object
X82	Intentional self-harm by crashing of motor vehicle, including:
	intentional collision with:
	motor vehicle
	train
	tram (streetcar)
	Excluding: crashing of aircraft (X83)
X83	Intentional self-harm by other specified means, including:
	intentional self-harm by:
	caustic substances, except poisoning
	crashing of aircraft
	electrocution
X84	Intentional self-harm by unspecified means

2.2.4. Alternatively explored data sources

The geospatial analysis of national suicide mortality data was first intended to form part of this thesis. In the original research proposal, national suicide mortality data would be linked with data from the NSHRI to examine suicide and self-harm clustering on a national level across Ireland. Following discussion with senior staff of the Vital Statistics department of the Central Statistics Office (CSO) regarding the possibility to access suicide mortality data, an application was submitted by the PhD candidate to become an 'Officer of Statistics'. Due to an embargo on data sharing with external agencies that was imposed by the Department of Social Protection and the General Register Office in 2018 relating to the incoming General Data Protection Regulation 2016/679, as well as further revisions to Standard Operating Procedures (SOP) for external data sharing by the CSO, it was unfortunately not possible to access the required data in the timeframe of the research. Data from the NSHRI was unable to be linked to suicide mortality data for the purpose of geospatial analysis since residential details of cases collated by the system are recorded at small-area level, thereby incompatible with the residential address-level geocoded data collated by the SSIS.

In identifying data sources for the SSHO, An Garda Síochána pulse system data was considered as an additional source to provide real-time data on suspected suicide cases for crosschecking and accuracy purposes. Following extensive discussion with the Head of Data Analytics of An Garda Síochána during the development stage of the SSHO, it was agreed that it would be infeasible to include the pulse system as an additional data source. This decision is due to the temporary status of cases collated by the pulse system, affecting reliability of the data due to evolving case classification as new information becomes available in an investigation.

2.3. Data analysis

Statistical analyses conducted in this thesis were executed using SPSS version 27 and R 4.1.2. for Windows. SaTScan v10.0.2 was employed in the geospatial analysis. This is a free software that uses spatial, temporal or spatio-temporal scan statistics to detect disease clusters and determine their statistical significance and can be employed in both prospective and retrospective mode (158). SaTScan was executed using an R software package known as 'rsatscan' v0.3.9200, which acts as a wrapper for SaTScan ensuring easy automation, integration, and less computational intensity (159). To determine statistical significance, Monte Carlo hypothesis testing was employed, from which the p-value was calculated through a comparison of the maximum generalised likelihood ratio assessed from 999 simulated datasets to the maximum generalised likelihood ratio assessed from the analysed data. This approach involves repeated analysis on a daily, weekly, monthly, or yearly basis for early detection of emerging clusters (160). The scan statistic was executed as if it had been performed throughout the period of 2008-2017. Other than the use of the prospective space-time analysis mode, the parameters remained the same from the retrospective analysis mode. R version 4.0.4, a free and open-source statistical software, and the RStudio version 1.4.1106, an IDE interface provide an environment and programming language for data manipulation, calculation, and graphical display. Shiny, another R package, facilitates development of both static and interactive tools. The output of the rsatscan cluster analysis was plotted by means of an Environmental Systems Research Institute (ESRI) shapefile, produced to display the detected clusters in a map format. Specific methodologies and analyses applied to the studies forming this thesis are described in depth within chapters 3-7.

The main methodological approaches applied to the research in this thesis were:

- Systematic search of published scientific literature to develop a knowledge base of methods employed in the quantitative detection of suicide and self-harm clusters (study 1)
- Comparative review by means of a narrative synthesis of questionnaire responses relating to real-time suicide surveillance practices internationally (study 2)
- Application of the space-time scan statistic to suicide mortality data to investigate the presence of suicide clusters (study 3)
- Narrative review of academic literature based on media influences on suicide clustering (study 4)
- Descriptive statistical analysis of suspected suicide data to inform a policy brief (study 5)

2.4. Ethical considerations

2.4.1. Ethical approval

The SSIS was originally granted ethical approval by the Social Research Ethics Committee of University College Cork and the Coroners Society Ireland in January 2009 (Appendix 2). Ethical approval was also granted by the Clinical Research Ethics Committee in 2014 for the SSIS-ACE case-control study of the psychological, psychiatric, and work-related risk factors associated with suicide in Ireland, based on the SSIS (Appendix 3). Ethical approval for the research within this thesis was granted by the Clinical Research Ethics Committee (CREC) of the Cork University Teaching Hospitals (Ref: ECM 5 (1) 29/03/18 & ECM 3 (x) 12/01/2021; Appendix 4).

2.4.2. Data protection

Abiding by the Coroners Act 1962, information provided by the Coroners to the SSHO is under no circumstances used to communicate with any individual related to a suspected suicide. Data agreements were developed and agreed for data sharing purposes between the Coroners of Counties Cork and Kerry and the SSHO (Appendix 5). Close consultation with the legal department of the HSE supported development and agreement on data sharing procedures between the HSE and the SSHO (Appendix 6).

The protocol for this research complies with the Irish Data Protection Act of 1988, the Irish Data Protection (Amendment) Act of 2003 and the General Data Protection Regulation 2016/679. All efforts were made to ensure that the identity of those individuals of whom data was recorded on, remains confidential, thus avoiding distress to next of kin.

The database in which data relating to confirmed suicide cases and open verdict cases meeting the criteria for probable suicide was double password protected and stored within the offices of the NSRF, School of Public Health, UCC and during the COVID-19 in the home of the principal researcher. The database recording the details of family informants and health care professionals linked to the confirmed suicide cases and open verdict cases meeting the criteria for probable suicide was double password protected and stored within the office of the NSRF, School of Public Health, UCC.

For the SSHO, a password protected Masterfile was created and is stored on an encrypted laptop in the offices of the National Suicide Research Foundation in University College Cork. An additional double password protected data file was created for data collection in County Kerry. Access to this datafile has been restricted to the Resource Officer for Suicide Prevention in County Kerry who is responsible for the secure storage of the datafile on an encrypted laptop in the ROSP

office in the HSE Community Health Organisation Area 4 (County Cork and Kerry). Access to the SSHO Masterfile database is restricted to the researcher and the supervisors of the project. Telephone communication has been deemed the most secure method of contact to collect data from the data sources as it ensures data is protected and avoids potential interception of emails containing sensitive information.

Chapter 3. Quantitative methods to detect suicide and self-harm clusters: a systematic review

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3.1 Abstract

Suicide and self-harm clusters exist in various forms, including point, mass, and echo clusters. The early identification of clusters is important to mitigate contagion and allocate timely interventions. A systematic review was conducted to synthesise existing evidence of quantitative analyses of suicide and self-harm clusters. Electronic databases including Medline, Embase, Web of Science and Scopus were searched from date of inception to December 2020 for studies that statistically analysed the presence of suicide or self-harm clusters. Extracted data was narratively synthesised due to heterogeneity among the statistical methods applied. Of 7268 identified studies, 79 were eligible for narrative synthesis. Most studies quantitatively verified the presence of suicide and self-harm clusters based on the scale of the data and type of cluster. A Poisson-based scan statistical model was found to be effective in accurately detecting point and echo clusters. Mass clusters are typically detected by a time-series regression model, although limitations exist. Recently, the statistical analysis of suicide and self-harm clusters has progressed due to advances in quantitative methods and geospatial analytical techniques, most notably spatial scanning software. The application of such techniques to real-time surveillance data could effectively detect emerging clusters and provide timely intervention.

3.2 Introduction

Suicide clusters are commonly referred to as a higher number of suicide deaths, attempted suicides, or self-harm events that occur in a population, location or period than usually expected based on statistical probability or community expectancy (64). However, due to a lack of consensus regarding an operational definition of suicide clusters, particularly relating to the minimal number of cases that constitute a cluster, definitions are typically determined on an ad hoc basis in terms of the spatial and temporal limits of a cluster (65). Clusters are

suggested to be a product of a phenomenon known as contagion, whereby direct or indirect exposure to suicide results in subsequent suicide cases (62). Suicide clusters are mostly reported within the adolescent population, particularly 15–24-year-olds (71,72) and are estimated to account for between 1% and 5% of all adolescent deaths by suicide (73,74). Previous evidence suggests an increase in the incidence of suicide clusters in recent years, linked to the broadening of social connections through electronic communication systems and internet-based social sites (8), particularly in the form of suicide pacts (70). Geographical remoteness, economic deprivation and indigenous status are factors associated with suicide clusters (75-77). Furthermore, suicide clusters are more likely to occur in areas inhabited by disadvantaged cohorts as certain risk factors associated with suicide including unemployment, socio-economic deprivation and substance abuse occur more often in this population (85).

The patterns of suicide and self-harm mainly researched and documented within the literature are of two main types: mass clusters and point clusters. Mass clusters (or temporal clusters) involve a temporary increase in the total number of suicides within a population relative to the period before and after the cluster, with a lack of spatial relevance, typically observed in the aftermath of a real or fictional suicide documented in the media (70,75). In contrast, point clusters (or spatiotemporal clusters) are those that occur close together in both space and time within a given community or institution, and clusters of this nature can occur without the presence of media coverage (76). A third pattern of suicide (spatial clusters) has been identified in the literature (62,65,69-77), wherein deaths cluster by location but not time, known as 'locations where people frequently take their lives', often occurring at well-known public or historical sites. However, this pattern is not as extensively researched compared to mass and point clusters. A phenomenon known as echo clusters, wherein one or more successive suicide cluster occurs distinct from the initial cluster, has been statistically verified in indigenous populations in rural Australia, but there is a dearth of evidence of this phenomenon elsewhere (78,79).

In recent years, an increasing number of studies have addressed the identification and detection of suicide clusters at both national and local level (102,161,162). The detection of clusters enhances the knowledge on the aetiology of emerging suicide clustering by establishing links between confirmed or suspected suicide cases and identifying socioecological factors associated with the increased risk of clusters within the affected area or population (104). Policy makers and public health officials also benefit from early detection of suicide clusters by means of implementing targeted and timely interventions. Significant advances in spatial cluster detection have emerged in recent decades with the development of computer mapping and its integration with robust statistical models (104). Previous studies that investigated the presence of suicide clusters have applied different techniques that follow frequentist and Bayesian probability models and incorporate spatial scanning software (102,104,1561-163). Nonetheless, a standardised and systematic approach to the statistical ascertainment of suicide and self-harm clusters is still lacking in contemporary research.

To date, no systematic review of the quantitative methods to effectively detect suicide and self-harm clusters has been conducted. The main aim of this systematic review is to synthesise the existing evidence based on statistical techniques used in successfully detecting suicide and self-harm clusters. In this regard, this review seeks to determine an accurate and precise approach to quantitatively verify suicide and self-harm clusters within a population and to ensure that clusters of suicide and self-harm are detected in a timely manner, hence mitigating further cases.

3.3. Materials and Methods

In accordance with the PRISMA guidelines (164), a comprehensive search strategy was established, including Medical Subject Heading (MeSH) terms where relevant. The review protocol was registered with The International Prospective Register of Systematic Reviews (PROSPERO, registration number CRD42018100354) to avoid duplication. The search strategy

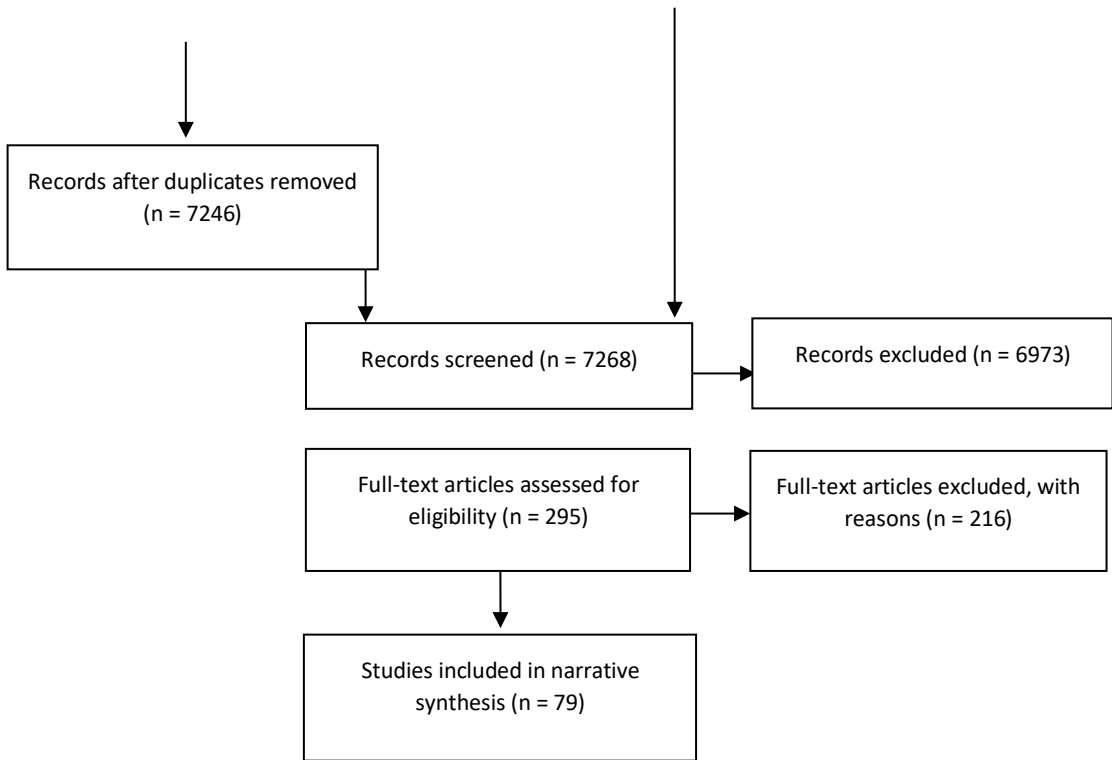
was applied to four major bibliography databases: Medline, Embase, Web of Science and Scopus from their inception to August 2018 using a comprehensive search strategy to identify as much relevant peer-reviewed literature as possible. The lead author conducted an updated search, applying the same search strategy in December 2020. The search terms included [(suicide (MeSH) OR suicid*) OR (self-injurious behaviour (MeSH) OR (self-injur* OR self-poison* OR self-mutilat* OR self-harm*))] AND [(cluster* OR imitat* OR contagion OR copycat OR werther effect)] OR (spatiotemporal analysis OR time-space analysis OR geospatial analysis OR statistical analysis*). Inclusion criteria included studies that a) have been published in a scholarly journal, b) have applied a statistical method to detect suicide or self-harm clusters in a population and c) have full-text available in English. Exclusion criteria eliminated a) narrative reports of suicide or self-harm clustering that were not statistically verified, b) grey literature including media reports relating to potential suicide or self-harm clusters and c) non-English language articles.

The title and abstracts of all references generated by the search and imported to Endnote reference management software were independently screened for relevance by three authors (RB, GC, LST) to avoid content bias. Discrepancies between the reviewers were resolved by consensus. For those articles of which full texts were not available, the full text was requested from the lead author. Additional hand searches of reference lists of relevant systematic reviews were also conducted to identify other eligible studies. Only published scholarly articles were included to obtain the most robust methodological approach possible, thereby excluding grey literature from data extraction. Data extraction in table format was used to summarize study results. A meta-analysis was not considered due to the heterogeneity of statistical methodology applied in the included studies; hence, the data was narratively synthesised as a result. Subgroup analysis was conducted on four study groups based on commonalities in cluster type identified during preliminary analysis. For the purpose of the current research and to avoid misinterpretation, suicide clusters will henceforth refer to

clusters of death by suicide, while self-harm clusters will describe the clustering of self-harm events including attempted suicide.

3.4. Results

The electronic searches identified 7246 publications, excluding duplicates. Based on the records identified through database searching (n =16094) generated by the data Additional records identified through other sources (n = 22) ant publications were identified. Of those publications selected for full text screening, 216 did not meet the eligibility criteria, resulting in 79 relevant articles applicable for review (Figure 4). The relevant studies were sub-divided based on their primary focus into point suicide clusters (n=51), point self-harm clusters (n=8), mass suicide clusters (n=19), and echo suicide clusters (n=1).



The literature in this area predominantly originates from the Oceania continent, Europe, and the Americas. Considerably less research on the topic has been published in Asia and in the African region to date. In terms of the level of geographic samples analysed, approximately

half of all studies were based on a national sample (n=39), almost a third involved a regional sample (n=25), while the remaining studies focused on state, city and investigations into locations associated with frequently occurring suicides or self-harm acts. The statistical analysis of point suicide and self-harm clusters commenced in 1975, with over two thirds of studies published in the last 5 years (n=35). While mass suicide cluster statistical detection was first documented within the literature in 1986, almost two thirds of studies have been conducted within the last 5 years (n=12).

The majority of identified publications (n=51) primarily focused on the statistical analysis of point suicide clusters (Table 3). Those studies with alternative primary objectives predominantly evaluated clusters in the context of their association with demographic, socio-economic, cultural variables and risk factors associated with suicide clusters (60,165-167). A Poisson model incorporating the Monte Carlo simulation is the most widely applied statistical model, applied in half of all point suicide clusters detection studies (n=28) (66,102,103,139,161,165,167-189). This test determines the significance of likely clusters, most commonly at 5% spatial parameter and three-month temporal parameter, as well as detecting the relative risk of cluster. Geospatial analysis was conducted in three quarters of point suicide cluster detection studies (75%, n=38), by means of spatial scanning using SaTScan and FleXScan software, as well as hotspot analysis, spherical trigonometry, Nearest Neighbour Analysis Exploratory Spatial Data Analysis methods (102,103,161,162,165,166,168-174,178,179,181-187,190-195). ArcGIS was the most predominantly employed data visualisation tool, while a small number of studies utilised alternate tools such as QGis, GeoDa and Teraview. A minority of studies applied alternative statistical analyses including a regression model (n=10) (165,169,171,179,183,184,190,196-199), the Knox procedure (n=1; 74), descriptive network analysis (n=1; 183), Bayesian hierarchical modelling (n=2; 167,168,188,189,199,200), the Kernel Density estimator (n=2; 191,198), Nearest Neighbour Analysis (n=1; 186), Ripley's K function (n=1; 188), Moran's I (n=4; 190, 199-201), Chi-square

(n=5; 190,191,195,202,203), Fisher's exact test (n=1; 204) and the Anderson Darling test (n=1; 205). Specific numerical details of detected clusters were undocumented in the results of those studies that applied alternative statistical techniques without the application of geospatial analysis. Comparing different statistical methods, a discrete Poisson based scan statistical approach will capture most parameters to identify point suicide clusters since suicide mortality data tends to be in a Poisson distribution.

A small number of studies (n=8) focused on the detection of self-harm clusters within populations (Table 4). Almost a third of self-harm cluster detection studies were based on national samples (n=3), with the remainder focusing on cluster detection at regional (n=2), county (n=1) and city level (n=2). Most studies reported significant detection of self-harm clusters (n=7), with over half of the studies (n=5) indicating the specific number of self-harm clusters detected within the population, ranging from one to twenty-five clusters. Scan statistics were applied in over half of all self-harm cluster detection studies (80,206-208), with an alternative temporal scanning method applied in one investigation (209). Those studies that excluded geospatial techniques from the statistical analysis applied a Regression model or Chi-square test (210-212); however, detailed information relating to identified clusters was not explicated from such analyses. Based on a comparison of the statistical methods applied, a regression-based scan statistical model will capture most parameters to detect point self-harm clusters.

Table 3. Point suicide clusters													
Number of studies	51												
Level of data used in the study	National		Regional			State		City			Location		
	23		18			6		2			2		
Type of analysis ¹	Poisson model	Regression model	Anderson Darling	Bayesian hierarchical model	Morans I	Fishers Exact Test	Chi-square	Ripley's k function	Knox procedure	Descriptive network analysis	Spherical Trigonometry	Kernel density estimator	Nearest Neighbour Statistic
	28	10	1	6	4	1	5	1	1	1	1	2	1
Geospatial analysis conducted	Yes					No			No				
	38												
Clusters detected	Yes					No			No				
	48												
Addressed analysed	Residence			Location of death			Not specified						
	34												
SaTScan spatial applied	Yes			No			Not specified						
	20												
Number of clusters reported	No clusters detected			1-20			20+			Not specified			
	3			28			3						

¹ Studies that performed multiple statistical analyses are counted twice.

Table 4. Point self-harm clusters									
Number of studies	8								
Level of data used in	National	National	Regional	City	Regional	City	Regional	City	County
Location of studies	Sweden	New Zealand	New South Wales, Australia	Edinburgh, Scotland	Kwai Tsing, Hong Kong	Hamadan, Iran	Denmark	Meru, Kenya	
Aggregated data used	No	No	Yes	No	Yes	No	Yes	No	
Type of statistical analysis conducted	Logistical regression	SaTScan and Knox Procedure	SaTScan, Hotspot analysis Gi* and ArcGIS for mapping	A scan interval test proposed by Naus 1966	Chi square & SaTScan	Logistic regression & Chi-square, SaTScan and	Multi-level regressions and log likelihood ratio tests	Multiple logistic regression	
Geospatial analysis	No	Yes	Yes	No	Yes	Yes	No	No	
Clusters detected	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	
Number of clusters reported	Not specified	Not specified	25 spatial cluster regions identified	1 cluster	4 spatial clusters, one spatiotemp	2 clusters	N/A	Not specified	

Within the identified studies, over one third (35%, n=19) reported on mass suicide clusters (Table 5). Over two-thirds of mass suicide cluster research were based on national samples (68%, n=13), relating to high-profile suicides reported within the media in their countries. The remaining studies investigated mass clustering with regional (n=4), provincial (n=1) and continental samples (n=1). The primary aim of all the identified studies was the statistical verification of increased suicides within a population, i.e., the detection of mass clusters. The most employed statistical analyses include a time-series model such as the Seasonal Autoregressive Integrated Moving Average (SARIMA) model (n=11; 213-222), a regression model (n=8; 221-226), a Poisson model (n=4; 223,226-228), and non-parametric tests (n=3; 226,229,229). When comparing statistical models to detect mass clusters, a time-series regression model will capture the parameters of mass clustering as accurately as possible, based on temporal data.

One study based on the statistical analysis of echo clusters, conducted in Australia, was identified within the literature (230). The application of a Poisson scan statistic method to data based on the same geographical area but from two different periods, effectively detected several clusters in each period. Although there are no additional studies of this kind to compare this methodological approach against, the identified literature applies the same methodology as point suicide clusters with an additional time dimension.

Table 5. Mass clusters				
Number of studies	19			
Level of data used in the study	Continental	National	Regional	Provincial
	1	13	4	1
Type of statistical analysis conducted ²	Poisson model	Regression analysis	Non-parametric tests, i.e., Mann -Whitney U test, Kolmogorov-Smirnov test	Time-series models, e.g., SARIMA
	4	8	3	11
Geospatial analysis conducted	Yes		No	
	0		19	
Mass cluster(s) detected	Yes		No	
	17		2	

3.5. Discussion

3.5.1. Main findings

This systematic review provides unique insights into the scope of quantitative methods used to detect suicide and self-harm clusters. The findings of this review indicate that quantitative analysis of suicide and self-harm clusters continues to advance, in line with enhancements in statistical models of verification and spatial scanning methods. Developments in geographical cluster detection have coincided with a greater availability of spatial data (231). Open-source Geographical Information System (GIS) software was applied in all but one identified study of spatial suicide clusters, offering strengths including cost-effectiveness, reproducibility, online support forums and tutorials (232).

² Studies that performed multiple statistical analyses are counted twice

As corroborated by the results of the current review, the quality of geographical data captured in a GIS database is crucially important for geospatial analysis and depends on positional and attribute accuracy (e.g., latitude and longitude coordinates, health outcome), as well as completeness of data. An awareness of the specific criteria for what constitutes suicide and self-harm acts, the importance of data completeness and the precision required in the measurement of geographical coordinates are all critical components of accurate data recording and in turn, accurate cluster detection (233). The vast majority of research involved retrospective ecological studies of suicide or self-harm clusters based on aggregated geographical, mortality and census data. The implementation of active surveillance involving proactive contact with data providers to access and record complete, accurate and timely public health data, including geographical identifier (233,235), is recommended to enhance the precision of cluster detection.

To date, probabilistic model-based spatial scan statistics are the most widely applied and reliable methods employed in the detection of point suicide and self-harm clusters. Despite a dearth of literature within the area, research investigating echo clusters of suicide has followed the same quantitative methodology as point cluster detection, i.e., a Poisson based spatial scan statistic, integrating an additional time dimension to account for analysis of at least two different time periods. The Poisson approach models how many times the event is likely to occur within a specific period, while the Monte Carlo simulation is used to evaluate the statistical significance of the likelihood ratio for each circle. Based on the significance test, the scan statistic can identify the most likely cluster, as well as secondary clusters for which the likelihood ratios are less, but still of importance (236).

SaTScan, software using a cylindrical scan statistic involving a moving circular geographical-based scan window and a time-based height dimension of continuously varying radius appears to be the most used scan approach within the reviewed literature (163). This tool evaluates the statistical significance of point clusters with no prior assumptions of the data. Although

this software has been extensively applied within epidemiological studies, a limitation of SaTScan is its inability to detect non-circular shaped clusters or hotspots, such as the shapes of roads or rivers (236).

To detect irregularly shaped clusters, alternative approaches have been proposed and applied within the reviewed research (237-239). FlexScan (192), based on an adjustable spatial scan window, is effective in detecting clusters that assume arbitrary shapes (236-239). However, the efficacy of this software is limited to detection of small to moderate clusters of approximately 30 cases (192). Echelon scanning using EcheScan, also identified within the literature, is used to detect non-circular shaped hotspots based on their spatial hierarchical structure, visually represented by a dendrogram that is scanned from top to bottom (240,241). Similar to the traditional spatial scan statistic, echelon scanning is based on the Poisson model with Monte Carlo simulation; however, the scan window is smaller. EcheScan software, developed in R, is easily accessible and incorporates open-source mapping tools. However, limitations exist in some instances wherein the shape of the detected hotspot may be too complex, or large to be easily interpreted (241).

The results of this review suggest that analysis window parameters of scan statistic algorithms should be manipulated to determine the appropriate population and duration thresholds, calibrating the optimal parameter combination since the precision of results can be affected by scale. Future research should seek to compare the performance of the scan statistic algorithms via a simulation study and examine the spatial congruence and sensitivity of the models. Based on the unique purposes of the scan statistics, the robustness and sensitivity of a Poisson-based spatial scan hybrid approach should also be explored by future research.

Mass cluster detection fundamentally concerns itself with an increase in cases during a specific period, irrespective of spatial relevance. Quasi-experimental research designs, such as time-series forecasting based on a regression model, measure how many future observations are predictable based on past behaviour (226,242). In mass cluster detection,

media coverage of a fictional or real high-profile suicide is correlated with an increase in cases of suicide in the aftermath by means of comparing frequencies of suicide in an experimental time frame during and after the death was reported against the frequency of suicide in a control period. Such studies involve a crucial limitation that must be considered when interpreting findings; that is, the difficulty to accept observed increases in suicide and self-harm rates as a direct link to the high-profile case with absolute confidence.

3.5.2. Strengths and Limitations

This review sought to identify and synthesise literature relating to suicide and self-harm cluster detection, demonstrating inclusivity in systematically reviewing all published studies to date, addressing all types of suicide and self-harm clusters. The primary focus of the review was on examining the most robust global evidence on statistical methods to detect suicide and self-harm clusters within a population as accurately as possible. Therefore, non-peer reviewed reports have been excluded from the synthesis which may bias and limit the results. Excluding non-English studies has not limited the review since most research in this area have been conducted in English speaking countries.

3.5.3. Implications for suicide prevention and future research considerations

The findings of this review has implications for suicide prevention. Specifically, this review has synthesized all empirical studies of suicide and self-harm clusters in a population, arriving at the most comprehensive standardized approach to suicide and self-harm cluster detection currently available in the absence of a gold-standard method. Innovatively, the conclusive approach of geospatial probabilistic modelling for point suicide cluster detection has been incorporated in the development and evaluation of a community-response to a suicide cluster, demonstrating the utility of this technique for suicide prevention purposes (187). The

comprehensive study identified in the review applied spatiotemporal analysis to suicide mortality data and socioeconomic aggregated data by way of identifying suicide clusters and spatial variations of risk-factors in Hong Kong for the purpose of informing the development of the targeted program and evaluating its efficacy post-program, using changes in suicide incidence and cluster patterns as the outcome. The findings of the study emphasise the value of a temporal and spatial monitoring surveillance system based on the methodology described here in prioritizing suicide prevention measures. The outcome of the novel study further suggests a use for such techniques in the monitoring and evaluation of population-level interventions implemented as components of national suicide prevention strategies.

Official suicide mortality records can take up to two years post-death to be released due to delays resulting from prolonged medico-legal cause of death investigations and late registered deaths (105). The application of the cluster detection methods identified in this review to provisional, real-time suspected suicide data would support the detection of emerging clusters, providing an advanced opportunity to effectively intervene and mitigate further contagion (115). Early identification of emerging suspected clusters would also facilitate acceleration of an evidence-based crisis response in vulnerable communities wherein screening and referral of susceptible individuals to appropriate clinical and support services could occur in a timelier manner. Future research should consider the investigation of self-harm clusters and suicide clusters within a population to determine whether clusters of self-harm proceed clusters of suicide, thereby offering the opportunity for targeted clinical intervention in populations wherein emerging self-harm clusters are detected as a prevention strategy to possible subsequent suicide clustering.

Real-time active surveillance of suicide and self-harm would facilitate prospective studies of suicide and self-harm clusters using prospective geospatial probabilistic modelling (160). The findings of such prospective studies would subsequently inform suicide prevention strategies, action plans, policy planning and service provision in a timely manner. While unexplored in

the studies including in this review, temporal analysis of suicide data using a calendar approach based on date of death may detect temporal clusters relating to significant dates such as the anniversary of the death of a loved one or high-profile individual, and seasonal trends when peaks are commonly observed. The detection of this phenomenon should be incorporated as a key objective of a real-time suicide surveillance system by way of indicating high-risk dates and periods that could require deployment of additional resources to respond to possible increases in imitative behaviour.

3.6. Conclusions

The synthesised results of this systematic review demonstrate advances made in epidemiological cluster detection, relevant to suicide and self-harm data, within the forty-five-year period since statistical investigations into clusters of suicide and self-harm were first published. Most notably, the evolvement of open-source GIS software, which has effectively contributed to point cluster detection, by means of geospatial probabilistic modelling. Mass suicide cluster detection traditionally employs a time-series regression analysis to verify temporal clustering within a population. However, the use of retrospective aggregated data in these studies compromises the accuracy and efficiency of cluster detection.

Chapter 4. Real-time suicide surveillance: comparison of international surveillance systems and recommended best practice

Authors

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4.1. Abstract

Objective: Some countries have implemented systems to monitor suicides in real-time. These systems differ because of the various ways in which suicides are identified and recorded. The main objective of this study was to conduct an international comparison of major real-time suicide mortality surveillance systems to identify joint strengths, challenges, and differences, and thereby inform best-practice criteria at local, national, and international levels.

Methods: Five major real-time suicide mortality surveillance systems of various coverage levels were identified and selected for review via an internet-based scoping exercise and prior knowledge of existing systems. Key information including the system components and practices was collated from those organisations that developed and operate each system using a structured template. The information was narratively and critically synthesised to determine similarities and differences between the systems.

Results: The comparative review of the five established real-time suicide surveillance systems revealed more commonalities than differences overall. Commonalities included rapid, routine surveillance based on minimal, provisional data to facilitate timely intervention and postvention efforts. Identified differences include timeliness of case submission and system infrastructure.

Conclusion: The recommended criteria could promote replicable components and practices in real-time suicide surveillance, while offering flexibility in adapting to regional/local circumstances and resource availability.

4.2. Introduction

Suicide is a significant public health issue across the world, with the latest statistics published by the World Health Organization (WHO) indicating an estimated 703,000 deaths annually (16). Although deaths by suicide have reportedly declined worldwide between 2000-2019 (15), it is challenging to determine if this trend has continued considering the lag between suicide incidence and published national mortality data by official statistical agencies. Verifying, registering, and classifying deaths by suicide often takes several months or even years due to medico-legal or coronial investigations involving several parties, including legal authorities, certifiers, pathologists, and vital statistics registrars (105,106,243). Furthermore, although reliable mortality data are essential for surveillance, research and targeted prevention efforts, suicide is one of the most underreported vital statistics and is seldom overestimated (108-110). The inaccuracy and underreporting of suicide may result from deliberate and unintentional issues, including concealment associated with stigma in some countries, misclassification bias, and methodological differences in death registration (110-113).

The public health model of suicide prevention begins with and relies heavily on surveillance data (106,244). Monitoring a public health phenomenon such as suicide requires continuous, systematic data collection, analysis and interpretation, and dissemination to those involved in prevention efforts (113). Several public health surveillance systems currently collect and store data on confirmed suicides, such as the National Confidential Inquiry into Suicide and Safety in Mental Health in England, the Norwegian Surveillance System for Suicide in Mental Health and Substance Misuse Services, the Suicide Mortality Review Committee in New Zealand and the Queensland Suicide Register in Australia (245-28). These systems facilitate trend analysis, risk profiling, and examining the circumstances surrounding deaths by suicide. However, data recording for such systems is contingent on the prolonged coronial or medico-legal processes, which impacts on the timeliness of reporting.

Provisional suicide mortality data, verified according to validated criteria, may facilitate timely prevention work (113), which can then be measured against official mortality statistics to determine accuracy, once the latter are released (249). Having rapid access to real-time data is essential for many reasons, including early identification of emerging suicide clusters (95), new methods amenable to means restriction measures, and locations of concern, as well as timely responses to individuals bereaved by suicide, evidence-based policy planning and targeted service provision (115).

Based on recommendations for improving national data systems for surveillance of suicide-related events (243), The Data and Surveillance Task Force of the National Action Alliance for Suicide Prevention in the United States emphasised the value of collecting real-time data to provide an evidence-based framework for rapid action by crucial decision-makers in suicide prevention (106). The World Health Organization has endorsed the value of real-time surveillance frameworks for mental health issues, including suicide, and highlights the need for reliable data to inform decision-making, to determine matters requiring immediate action and to verify if and where progress has been made (2, 250-252). The United Nations Sustainable Development Goals echo this concept through target 3.4, which aims to reduce premature mortality from non-communicable diseases by one third by 2030 (151). This target identifies the suicide mortality rate per 100,000 people as an indicator of progress and relies on timely monitoring of suicide rates internationally to assess the efficacy of suicide prevention strategies.

While there have been calls for real-time suicide surveillance data in the past, the demand for such data has increased significantly recently. The coronavirus (COVID-19) pandemic has had significant implications for the mental health of the population (253). However, it remains a challenge to determine whether this has led to a rise in cases of suicide globally. Anecdotal and unsubstantiated reports of increasing suicide rates have circulated in the media during this global health crisis (254), but it is difficult to verify such statements with certainty due to the limited availability of current data in many areas. In some high and middle-income countries, these reports have been verified as untrue through accessible real-time suicide mortality data (249, 255-259), while a rise in suspected suicide cases was observed in Japan following an initial decline during the first wave of the pandemic (260,261). Ultimately, the COVID-19 pandemic has reinforced the need for real-time surveillance data to help track changes in suicide rates occurring alongside the pandemic and identify risk factors that may be heightened and vulnerable groups that may be disproportionately affected (262-264). Such data are vital to facilitate timely, targeted, public health responses during and after the crisis (265).

Variations in data collection and dissemination models within and between regions and countries limit a comprehensive approach to real-time suicide surveillance. The main objectives of this study were to review and compare the components of established real-time suicide surveillance systems. Enhanced consistency across real-time suicide surveillance globally will contribute to improved accuracy and comparability of international suicide statistics.

4.3. Methods

4.3.1. Study design

Five real-time surveillance systems for suicide data functioning at various levels of data coverage were selected based on existing knowledge, inquiries within our network and a systematic internet search of existing systems worldwide that have been pilot-tested and in operation for at least two years, as of January 2021. Information was sourced from key personnel involved in developing and operating each system, using a structured instrument (Appendix 8) to gather data on specific components, based on the Centers for Disease Control and Prevention guidelines for evaluating public health surveillance systems (266,267), including:

- System description (i.e., purpose and use of the system, and system stakeholders).
- System characteristics (i.e., data custodians, data items, data format, data security, privacy, and confidentiality).
- System operation (i.e., data collection, case classification, data processing, statistical and epidemiological analysis).
- System practices (i.e., timeliness, data quality, usefulness, simplicity, flexibility, sensitivity, applicability to suicide prevention efforts).

The selected systems were narratively synthesised, and critical attributes collated in tables to facilitate comparisons between the principles and practices of the systems.

4.4. Results

Five real-time surveillance systems of suicide data were identified and selected for inclusion in this study, namely the Coronial Suspected Suicide Data Sharing Service, New Zealand; The interim Queensland Suicide Register, Queensland, Australia; the Victorian Suicide Register, Victoria, Australia Thames Valley Real-Time Suicide Surveillance System, Buckinghamshire, Berkshire & Oxfordshire, United Kingdom; and the Suicide and Self-Harm Observatory, Cork, Ireland.

Table 6 displays the specific attributes of each real-time surveillance system. Table 7 highlights common data items across the systems. Appendix 9 lists system experiences. Each system is described as follows:

4.4.1. Coronial Suspected Suicide Data Sharing Service; New Zealand

The New Zealand Ministry of Health, Coronial Services New Zealand and Clinical Advisory Services Aotearoa established the national Coronial Suspected Suicide Data Sharing Service (CDS) in 2014. This implementation actioned section 11.2 of the New Zealand Suicide Prevention Action Plan (2013-2016), to establish a function to analyse and share up-to-date provisional coronial data on suicide deaths with agencies working in local areas to help prevent further suicides (268). Clinical Advisory Services Aotearoa, which delivers the CDS, is responsible for delivering the National Community Postvention Response Service. The Community Postvention Response Service has access to CDS data on suspected suicides to support the early detection of emerging suicide clusters and contagion and the resulting coordination of community responses. The CDS securely and swiftly notifies the 20 regional District Health Boards across the country of recent suspected suicides in their regions. Uniquely, the CDS uses an encrypted email system to securely send data to District Health Boards, of which registered authorised recipients with their unique passwords can decrypt the notifications. The CDS system works within the parameters of an agreed Memorandum of Understanding between the Coronial Services New Zealand, the Ministry of Health, Clinical Advisory Services Aotearoa and all 20 District Health Boards in New Zealand. The CDS's functions and processes meet the required standards of all relevant New Zealand privacy legislation and frameworks.

4.4.2. The interim Queensland Suicide Register; Queensland, Australia

The Australian Institute for Suicide Research and Prevention (AISRAP) developed the state-based interim Queensland Suicide Register (iQSR) in 2011 to provide real-time information about suspected suicides in Queensland as an addition to the existing Queensland Suicide Register. The iQSR is used for trend analysis; regional breakdowns of age, sex, and motives/triggers for suspected suicides; and investigation of suicide clusters and locations of concern (e.g., locations where individuals frequently take their lives, Hospital and Health Service catchment areas, and Primary Health Networks), to inform targeted suicide prevention activities. Queensland Police Service officers share reports of suspected suicides by email while sending them to the Coroners Court of Queensland. Based on the evidence, two independent assessors examine the probability of each death being a suicide, which a third assessor then validates and resolves any outstanding discrepancies. Most information from the police report is automatically extracted tri-weekly using macros in Microsoft Word and Excel. Data are then added to a dataset to be cleaned, stored, and analysed. The Coroners Court of Queensland has custody of the police reports and provides case-by-case approval for data releases outside state government agencies. Upon approval, AISRAP independently prepares and disseminates the requested data in the relevant format, including email communications, spreadsheets, or formal reports. The iQSR contains 107 core variables covering demographic items, 'motives/triggers' for suicide, next-of-kin details (dependent on consent to contact for research purposes), circumstances of death, internet use, communications of intent, prior suicide attempts and incident summaries.

4.4.3. Victorian Suicide Register; Victoria, Australia

The Victorian Suicide Register (VSR), developed by the Coroners Court of Victoria (CCOV), Australia, commenced operation in 2012. The system consists of a core dataset to collect and record real-time suspected suicide data that is updated each weekday, and an enhanced

dataset to record more in-depth data following conclusion of coronial investigations. The primary purposes of the VSR are to inform coroners' investigations; to identify trends in suicide over time; to disseminate timely information on suicide to government bodies, health services, and the public; and to evaluate the effectiveness of local suicide prevention strategies. Data items recorded in the VSR core dataset include the deceased's demographic information and circumstances of death, which typically take ten minutes to enter. Deaths based on circumstances consistent with suicide are identified for inclusion primarily via surveillance of all deaths reported to the CCOV. Also, regular, systematic searches of CCOV databases and the National Coronial Information System occur to identify any possible or probable suicides classified as 'intentional self-harm', 'undetermined intent', or 'still enquiring', that may have been missed during initial surveillance. VSR contents are regularly reviewed as coroners' investigations progress.

The VSR is integrated within the CCOV's broader case management system and stored on secure servers accessible to Court employees only, with record editing restricted to VSR coders. Since the VSR is a coronial investigation tool, data is retained indefinitely for this purpose. Access to VSR data is dependent on approval granted by the CCOV, which considers requests from some community or non-profit organisations, public sector agencies and researchers. Ethics approval is not required for government bodies and non-government organisations seeking VSR data to inform their work. However, research-based data requests are granted after initial endorsement from the Court's Research Committee and the State Coroner, followed by the approval of an appropriately constituted human research ethics committee.

4.4.4. Thames Valley Police Real-Time Suicide Surveillance System; Thames Valley, United Kingdom

Thames Valley, in the South-East region of the United Kingdom established a police-led real-time suicide surveillance system in 2015 to ensure timely support to bereaved families, early

identification of suicide clusters, and information gathering to inform local suicide prevention strategies. The Thames Valley Police area comprises three counties (Buckinghamshire, Berkshire, and Oxfordshire), each with separate coroners, public health departments and healthcare systems. Police leadership of the Thames Valley Police Real-Time Suicide Surveillance System (TV-RT-SSS) is vital as the single police force covers all three counties. Police officers attending the scene of a suspected suicide collect information via a sudden-death form and email this to the TV-RT-SSS police lead. The police lead establishes contact with bereaved families to provide a support resource, refer to relevant local charities and offer referral to dedicated suicide bereavement support. Data are collated from the sudden death forms using a Microsoft Excel spreadsheet, which is stored confidentially on the Thames Valley Police computer system. The TV-RT-SSS contains 11 variables: the deceased's demographic information, possible triggers, mental health history, health service use and circumstances of death. Although complete data may not be available at the time of completing the sudden death form, the TV-RT-SSS police lead maintains regular communication with all Thames Valley coroners to assist with data collection and validation and links with Public Health Suicide Prevention Leads to share and cross-reference data, and to highlight potential cluster concerns within or across county borders. Formal agreements are in place with the region's National Health Service mental health providers to enable additional data sharing where required, for example to understand mental health history, check for possible connections between individuals or identify common service provision issues.

4.4.5. Suicide and Self-Harm Observatory, South-West Ireland

The Suicide and Self-Harm Observatory (SSHO) was established in County Cork, Ireland, by the National Suicide Research Foundation (NSRF) and the School of Public Health, University College Cork, in 2018. The SSHO collates real-time data on suspected suicides to identify emerging clusters, provide a timely response to people affected by suicide, and verify

unfounded statements on suicide and self-harm disseminated via traditional and social media outlets. The SSHO consists of a core database, including 16 variables that capture demographic information relating to the deceased, circumstances of the death, history of abuse and mental health service use. The SSHO captures all deaths of which the circumstances are consistent with a suspected suicide, based on operational screening criteria (157). NSRF-UCC researchers collect data fortnightly from the Coroners of the Cork and Kerry counties via onsite manual data entry to an encrypted Microsoft Excel spreadsheet. Coded, de-identified data are transferred to SPSS for trend analysis purposes. Both data files are stored on an encrypted laptop in the NSRF offices. The Resource Officer for Suicide Prevention in the Health Service Executive provides data relating to service user deaths by suspected suicide from the Health Service Executive Patient Mortality Register via fortnightly telephone contact with the researchers. A two-way pathway exists with the Health Service Executive, as data captured by the SSHO are shared with the Resource Officer for Suicide Prevention to initiate a crisis response plan to emerging suicide clusters and provide timely support to bereaved communities.

Table 6. Attributes of existing real-time surveillance systems of suicide mortality data

Name of System	Coronial Suspected Suicide Data Sharing Service (CDS)	Interim Queensland Suicide Register (iQSR)	Victorian Suicide Register (VSR)	Thames Valley Police Real-Time Suicide Surveillance (TV-RT-SSS)	Suicide and Self-Harm Observatory (SSHO)
Location	New Zealand	Queensland, Australia	Victoria, Australia	Buckinghamshire, Berkshire, and Oxfordshire, England	County Cork, Ireland
Data coverage	National	Statewide	Statewide	Regional	Regional
Type of system	Electronic (encrypted)	Electronic	Electronic	Electronic	Electronic
Method of data collection	Email	Email	Manual review of an electronic case management system	Manual input to a spreadsheet	Telephone and onsite manual input to Excel spreadsheet.
Case submission interval	Within 6-12 hours after a death was first attended by Police	Triweekly updates of deaths that have occurred within this timeframe	Within 24-48 hours after a death has occurred	Within 24-72 hours after a death has occurred	Fortnightly updates of deaths that have occurred within this timeframe
Statistical analysis	Statistical analysis is undertaken by the national Community Postvention Response Service which accesses the data to help determine emerging suicide clusters and contagion. Deaths are also reviewed by the Suicide Mortality Review Committee.	Routine epidemiological analysis and regressions conducted in-house by the research team.	Statistical analysis of data is undertaken in particular projects rather than as a matter of course. External statisticians typically analyse the data.	Routine epidemiological analysis conducted in-house by central police resource in Thames Valley Police.	De-identified data transferred to SPSS for statistical analysis. SaTScan analysis conducted on geographical data to analysis the presence of clusters.
Data source(s)	The National Initial Investigation of Coronial Services New Zealand.	The Coroners Court of Queensland.	Victoria Police and The Coroners Court of Victoria.	Thames Valley Police [Sudden death Form (Gen 19) completed by police]	The Coroners of Cork and HSE Patient Mortality Register
Terminology, classification, definitions, and operational criteria used to select cases recorded in the system	Deaths are recorded as suspected self-inflicted deaths (SSIDs). Data are provisional. Notifications may be sent as 'identity not yet confirmed' or 'believed to be' if identity of the deceased has not been officially confirmed.	Applying a decision-tree classes suspected deaths received as suspected suicides that are 'possible', 'probable' or 'beyond reasonable doubt'. Those in the latter two categories are considered 'suspected suicides'. Cases are rereviewed when the coronial investigation is completed.	Cases of probable suicide are classified as 'intentional self-harm' and cases of possible suicide are classified as 'unable to be determined' while the coronial investigation is underway. Cases are reviewed when the coronial investigation is completed.	Data initially relates to cases of 'suspected suicide' as identified by attending police officers or suspected by the coroner's team. Then later confirmed and validated with coroner records following inquest outcomes.	Data related to instances of 'suspected suicide', classified by the coroner based on evidence from various sources, including the police, witnesses, and family accounts. Cases are reviewed once the inquest has concluded.

System access	CDS and Community Postvention Response Service staff and a minimum of two authorised staff recipients per District Health Board.	Principal researchers, senior research assistant, four research assistants	All members of the Coroners Prevention Unit and all Victorian Coroners.	Police and coroner county teams and Local Authority Prevention Leads.	PhD researcher, Chief Scientist, Head of Research, HSE ROSP for the Cork region.
Data security and ethical considerations	Memorandum of Understanding between Coronal Services New Zealand, the Ministry of Health, CASA (Clinical Advisory Services Aotearoa who developed and deliver CDS on behalf of the other parties to the MoU) and all 20 regional District Health Boards. The CDS system meets all requirements of relevant New Zealand privacy legislation and frameworks, including the Privacy Act (1993) and the Health Information Privacy Code (1994) as determined through a formal Privacy Impact Assessment.	Data analysts added to the ethics application for the Victorian Department of Justice and Community Safety Human Research Ethics Committee. The Griffith University ethics committee is the secondary review body. Data stored on a secure password-protected network drive with restricted access rights.	Ongoing data sharing agreements are in place with state and Commonwealth government health bodies. Additionally, we have project-based data sharing agreements with other government bodies, health services and academic researchers mediated by a memorandum of understanding and (where required) approved human research ethics applications.	Data collated by Thames Valley Police is shared with National Health Service, Public Health England, the Coroners' Officers and local authorities, based on partner agreements.	A double encrypted laptop in NSRF offices stores data. Data sharing agreements with both data sources. The Clinical Research Ethics Committee for the Cork Teaching Hospitals grants ethical approval. System development and operation is EU GDPR compliant. Legal approval granted by the legal department for the HSE.
Use of data	Data are provided to the CDS on the basis that it will be used by: - the national Community Postvention Response Service in the early detection and management of suicide clusters and contagion and - by all 20 District Health Boards across New Zealand to support of their timely local postvention responses to suspected suicides.	Cluster investigation, specific subgroups (e.g., small towns, missing people, homeless, migrants, people impacted by specific natural disasters), emerging geographical trends, investigation of frequently used locations.	Informs local suicide prevention planning; dispels or confirms community concerns around the vulnerability of at-risk individuals, identifying priorities for coronial investigation; educating the public about suicide; monitoring suicide trends based on location, method and deceased socio-demographics; and alerting local health services to potential emerging issues.	Real-time aberration identification in suspected suicide cases. Links to Police Negotiator Database to identify vulnerable individuals. Data is shared with the Local Authority Leads to facilitate early response to linked suicides, clusters, or contagion.	Real-time aberration detection of suspected suicide cases. Data is shared with the ROSP to facilitate early response to suicide clusters by providing support to schools and communities.

Dissemination to stakeholders	The CDS disseminates data to authorised recipients of impacted District Health Boards. Based on District Health Boards' privacy protocols, suspected suicide data from CDS is only on-shared with other agencies if such sharing helps to prevent or lessen a serious threat to an individual or public health or safety and fulfils one of the purposes of obtaining the data.	QSR staff produce fortnightly updates for the QMHC (funding agency) and the AIHW and quarterly reports for the QMHC and the MHAoDB within Queensland Health. Annual reports are released publicly.	Real-time data is disseminated to Victorian and Commonwealth health authorities. Monthly update reports on suicides are published publicly. Data access for other purposes is contingent on approval from the CCOV.	Information is shared with relevant partners in aggregated form to inform service responses to emerging suicide links, identify clusters, increase capacity for early intervention, assist with optimising resource allocation and facilitate implementation or activation of local plans.	Information is shared with the HSE ROSP to inform bereavement support and community prevention activities. Aggregated information is periodically shared with key stakeholders involved in suicide prevention plans in the region on a need-to-know basis.
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AIHW = Australian Institute for Health and Welfare; CCOV = Coroners Court of Victoria; CDS = Coronial Suspected Suicide Data Sharing Service; CPU = Coroners Prevention Unit; DHBs = District Health Boards; EU GDPR = General Data Protection Regulation; HSE = Health Service Executive; MHAoDB = Mental Health, Alcohol and Other Drugs Branch; NIIO = National Initial Investigation Office of Coronial Services; QMHC = Queensland Mental Health Commission; ROSP = Resource Officer for Suicide Prevention; SSIS = Suicide Support and Information System; SSIDs = suspected self-inflicted deaths; TV-RT-SSS = Thames Valley Police Real-Time Suicide Surveillance System.

Table 7. Data items in real-time surveillance systems of suicide data

Data item	Coronial Suspected Suicide Data Sharing Service	Interim Queensland Suicide Register	Victorian Suicide Register	Thames Valley Police Real-Time Suicide Surveillance	Suicide and Self-Harm Observatory
Unique file number		✓	✓		✓
Number assigned by police		✓		✓	
Name of the deceased	✓	✓	✓	✓	✓
Date of death	✓	✓	✓	✓	✓
Sex/gender	✓	✓	✓	✓	✓
Date of Birth/age	✓	✓	✓	✓	✓
Religion		✓		✓	
Residential address	✓	✓	✓	✓	✓
Geocoding of residential address		✓	✓		✓
Ethnicity	✓	✓			
Education level		✓			
Marital status		✓	✓	✓	✓
Method of death	✓	✓	✓		✓
Cause of death					✓
Location of death/fatal incident	✓	✓	✓		✓
Geocoding of location of death/fatal incident		✓	✓		
Employment status		✓	✓		
Occupation		✓		✓	✓
Country of birth		✓	✓	✓	
Medical history including mental & physical health		✓		✓	

Substance abuse history		✓			✓
Domestic abuse history		✓			✓
General practitioner details				✓	
Medications		✓			
Prior suicide attempts		✓			
Suicidal intent		✓			
Suicide note		✓			
Motives/triggers for suicide		✓			
Mental Health Service user prior to death (inpatient/outpatient)					✓
Next of kin details		✓			
Incident summary		✓			

4.4.6 Comparative real-time suicide surveillance system components

Both commonalities and differences exist between the components of the five systems, as presented in Table 6. All systems have an electronic database, typically a password-protected Microsoft Excel file, with one system collating data at national level employing an encrypted web-based portal to store data and automatically notify key stakeholders of a death. The number of data items per system ranges between eight to 107, and averages at 31. Common data items among the systems are listed in Table 7. A high level of data security is applied to the systems, ensuring compliance with all relevant data protection legislation and access limited to trained and ethically cleared personnel in the organisations that operate the systems. The terminology varies considerably between the systems, from ‘suspected suicide’, ‘suspected self-inflicted death’, ‘intentional self-harm’, ‘probable suicide’ or a suicide ‘beyond reasonable doubt’, and a death of ‘undetermined intent’ or ‘still enquiring’, depending on the availability of evidence at the time of case submission to the database. Data collated by all of the systems is either primarily or secondarily sourced from the coroner. One system, embedded within the police force, directly extracts the data from the police report and cross checks this information with the coroner. Another system verifies data coming from the coroner with a health service patient mortality register for suspected suicide deaths of service users. Data collection approaches vary between systems from onsite manual data entry or

telephone communication with the source to email notification. Data dissemination predominantly occurs on a need-to-know, periodic basis via aggregated-level data reports shared with relevant stakeholders involved in suicide prevention efforts, with ad hoc reports and briefings prepared in the event of emerging clusters, contagion or concerning trends to inform a timely response. However, one system reports to both state and national health departments on a regular weekly, fortnightly, and quarterly basis and has recently commenced monthly public reports.

4.4.7 Comparative real-time suicide surveillance system practices

The range of timeliness of case submission varies across the systems from immediately upon notification to fortnightly and averages between 24 to 72 hours after a death has occurred (Table 6). Disparity in system infrastructure (integrated in legislated organisation vs. unintegrated) impacts data quality given that unintegrated systems rely on the completeness of externally sourced death reports. Using secondary data sources has demonstrated benefits of cross-checking data completeness. Furthermore, review of cases collated by most systems ranged from continuous to every second month to capture any missing cases that meet inclusion criteria.

Many common uses were identified among the systems, particularly the ability to identify emerging trends, locations/suicide methods of concern and opportunities to implement means restriction. Additionally, the systems have collectively reported value in refuting unfounded claims and concerning reports within the media and community by establishing the facts, as well as informing provision of support and other postvention services to the bereaved and outreach to those identified as vulnerable.

Crossover exists in system practices based on applicability to suicide prevention and their utility, with additional reported benefits including offering the most reliable and evidence-based source of data to inform postvention activities, target prevention initiatives and inform

response plans by identifying potential contagion, clusters, or linked incidents, thereby supporting those at-risk.

Accessibility varies across the systems depending on their infrastructure, with integrated systems facilitating access to personnel within their legislated organisation and external bodies on a 'need to know' basis. Most systems disseminate aggregated data to stakeholders, as well as governmental bodies and researchers upon request. Two systems notify health service providers in affected districts to facilitate timely bereavement support and outreach to impacted communities, with one system adopting an automated notification approach and the other designing an encrypted web-based interface to store and display the data for those with authorised access.

A high level of flexibility exists among most systems, with three declaring adaptations to the original model to meet the needs of the system and requirements of the stakeholders for whom the system exists to service. Such adjustments include expansion of the surveillance area, modifications to IT infrastructure and the addition of further data items.

The systems collectively reported a high level of sensitivity, with comparisons of provisional data captured by the systems against official mortality statistics reported to average between five to seven percent by two systems. Stakeholder feedback relating to the systems detailed high levels of satisfaction, a model that is fit for purpose and worthy of replication in other areas.

4.5. Discussion

4.5.1. Main findings

This study identified more similarities than differences exist among the systems. The shared purpose of all systems is to assist and inform suicide prevention efforts, particularly by providing an evidence-based data source to invalidate misinformation, inform response plans,

and to detect emerging trends, links, and clusters, thereby mitigating further detrimental impacts on affected communities. These common aims demonstrate consistency within the primary functions of the systems. Most systems collate geographical data based on residential address, location of death, or in some cases, both. This data informs aberration detection which is typically conducted using an algorithm that evaluates the presence of spatial, temporal and spatio-temporal clusters, usually involving scan statistic software (163).

All systems apply a legal approach whereby data is sourced from a coronial service. Most systems include the coronial service as the primary data source, with two systems sourcing data from the police primarily and incorporating coronial data as a secondary cross-checking source. A health service patient mortality register was documented as an alternative cross-checking source; however, data is limited to service users at the time of death. Despite some systems involving a secondary source, one is evidently sufficient when case reporting to the data source is mandatory under legislation and thereby data is of high quality and complete. Fundamentally, suicide registration is not always based on a coronial system, with many countries implementing a medico-legal system (105). Thus, surveillance must always be based on the most reliable and comprehensive source available.

Though the terminology applied across all systems to capture relevant cases lacks consistency, the classifications demonstrated homogeneity in their recognition of the provisional status and limitations of this determination, since the coronial investigation is ongoing at the time of case identification. Review of case classification, either on a continuous or periodical basis, depending on capacity, can improve data quality, completeness, and sensitivity by ensuring only those correctly classified deaths are detailed in the system. Standardised guidelines and training on criteria to identify relevant cases for inclusion is required to inform staff involved in determining cases to be recorded in a system of this kind. Caveated information relating to the interpretation of provisional data is typically included in reports and presentation slides, highlighting the possibility of changes to the death classification at conclusion of the cause of

death investigation. While information on deaths by suspected suicide is not routinely publicised in the media, the added value of the real-time suicide surveillance systems is the ability to confirm minimal details relating to case numbers or verify unsubstantiated reports relating to suicide rates upon request. The systems include a fact checking function whereby unsubstantiated reports may be verified in advance of publication; however, individual case details are not disclosed. In addition, aggregated data from some systems have contributed to international projects examining the impact of the COVID-19 pandemic on suicide (257), with opportunities to compare data with other countries, although data from some regions and countries have been accessed from preliminary data sources on an ad hoc basis. Comparative research at a national level has been possible for one regional system in this study which feeds into a recently developed national real-time suicide surveillance system that is being used to examine differences in rates of suspected suicide between both areas and countries within the UK (259).

Timeliness, the cornerstone of real-time surveillance, tends to be influenced by system infrastructure. The most significant difference identified between the reviewed systems was the case submission interval, ranging from immediately upon notification of a death to fortnightly routine submission. Those systems embedded within the original data source agency have the advantage of instant data access, while external systems typically rely on added resources and capacity to ensure timely data collection. The speed of data entry impacts system utility due to the need for prompt notification to inform rapid response. Case submission for a suicide surveillance system averages at two hours, but can range between 15 minutes to eight hours, depending on the size of the database and the information available (269). As evidenced, a core database facilitates the objective of real-time suicide surveillance by collating minimal data, swiftly. Flexibility in adapting system components, such as the inclusion of additional variables if required, is crucial to ensure a system continues to meet the needs of those it exists to serve.

4.5.2. Strengths and limitations

This study compared and synthesised information from national, state-wide, and regional systems, demonstrating the international adaptability of the recommended best practice criteria. It involved a systematic assessment of existing established real-time suicide mortality monitoring systems, examining their practices and components in close detail to identify joint strengths and challenges that contribute to a system of this kind. This study is timely due to the limitations in the availability and accuracy of current suicide data, particularly in low- and middle-income countries, as previously highlighted by the WHO (2). It is further well-timed in providing an experience-based template in response to a call for real-time surveillance of suicide data to monitor the ongoing impact of the COVID-19 pandemic on suicide and the effects of natural population-based experiments and exposures. Member States of the UN may adopt the comprehensive approach outlined in this study to evaluate their progress in achieving a significant reduction in the suicide rate, as per target 3.4 of the SDGs (151). This study is limited by a lack of representation of systems outside developed countries. However, while recent data has been sourced from 21 countries to monitor suicide trends during the early months of the COVID-19 pandemic (257), information on established real-time suicide surveillance systems that have been either piloted or evaluated in low- and middle-income countries was unavailable. Future research should address the impact of real-time suicide surveillance systems on prevention practices in the relevant areas to determine the usefulness of such systems from a broader stakeholder perspective. Furthermore, the surveillance systems included in this study are inadvertently restricted to English-speaking countries. Efforts were made to include the Japanese real-time suicide system and contact was made directly with individuals involved in the operation of the system who indicated that the system

was undergoing modifications at the time of the data collection for this study and the information would be soon outdated.

4.6. Conclusion

Real-time suicide surveillance represents an emerging area of public health research, of which there is a lack of established real-time suicide surveillance systems globally. Based on the consistent application of specific components and practices across the limited existing systems identified and reviewed within this study, in order to establish a real-time suicide surveillance system in line with current international best practice, we conclude that the following criteria should be met: rapid, routine collection of provisional data sourced from at least one reliable data source to facilitate timely prevention efforts, ongoing data review to ensure high sensitivity; the development of a core, automated machine learning system to assist rapid data entry and quick transition to analysis, visualisation and reporting of emerging spatial, temporal or spatio-temporal clusters, as well as risk factors and vulnerable populations on a need-to-know basis.

Chapter 5. The development and validation of a dashboard prototype for real-time suicide mortality data

Authors

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5.1 Abstract

Introduction/Aim: Data visualisation is key to informing data-driven decision-making, yet this is an underexplored area of suicide surveillance. By way of enhancing a real-time suicide surveillance system model, an interactive dashboard prototype has been developed to facilitate emerging cluster detection, risk profiling and trend observation, as well as to establish a formal data sharing connection with key stakeholders via an intuitive interface.

Materials and Methods: Individual-level demographic and circumstantial data on cases of confirmed suicide and open verdicts meeting the criteria for suicide in County Cork 2008-2017 were analysed to validate the model. The retrospective and prospective space-time scan

statistics based on a discrete Poisson model were employed via the R software environment using the 'rsatscan' and 'shiny' packages to conduct the space-time cluster analysis and deliver the mapping and graphic components encompassing the dashboard interface.

Results: Using the best-fit parameters, the retrospective scan statistic returned several emerging non-significant clusters detected during the 10-year period, while the prospective approach demonstrated the predictive ability of the model. The outputs of the investigations are visually displayed using a geographical map of the identified clusters and a timeline of cluster occurrence.

Discussion: The challenges of designing and implementing visualizations for suspected suicide data are presented through a discussion of the development of the dashboard prototype and the potential it holds for supporting real-time decision-making.

Conclusions: The results demonstrate that integration of a cluster detection approach involving geo-visualisation techniques, space-time scan statistics and predictive modelling would facilitate prospective early detection of emerging clusters, at-risk populations, and locations of concern. The prototype demonstrates real-world applicability as a proactive monitoring tool for timely action in suicide prevention by facilitating informed planning and preparedness to respond to emerging suicide clusters and other concerning trends.

5.2. Introduction

Approximately 703,000 lose their life to suicide each year worldwide (16). Reducing the global incidence of suicide is an international priority (150,151,270). The Comprehensive Mental Health Action Plan 2013–2030 of the World Health Organization (WHO) and The United Nations Sustainable Development Goal 3 includes the specific target to reduce premature mortality by non-communicable diseases by one third, basing the rate of suicide mortality per 100,000 of the population as an indicator (150,151). To monitor progress towards this target,

it is pertinent to obtain and collate suicide mortality data in a timely manner to inform the implementation, adaption, and evaluation of suicide prevention strategies to ensure their efficiency and efficacy in achieving the important objective of reducing deaths by suicide (115). To optimise utility, suicide mortality data should be disaggregated at least by gender, age, and method of death (252). Accessibility to current suicide mortality data has additional benefits including early identification of emerging suicide contagion and clusters, a timely response to people affected by suicide, and verification of anecdotal evidence and public statements that are disseminated via media outlets (95,115). Furthermore, real-time suicide surveillance facilitates timely action in response to emerging situations that may impact rates of suicide (115). The demand for such data has grown significantly since the onset of the Coronavirus (COVID-19) pandemic, during which many nations have depended on drawing inferences on the impact of the pandemic and relevant societal restrictions on suicide rates based on dated statistics, due to dearth of recent data (271). The WHO endorses the establishment of long-term, continuous, and sustainable surveillance of suicide and self-harm either prior to or upon commencing implementation of a national suicide prevention strategy, suggesting that countries wherein resources are limited, piloting may be conducted at regional level with the intent to scale up to continuous data collection for surveillance purposes (252).

Monitoring suicide on a national scale presents many challenges including geographical inconsistencies in investigative approaches and timeliness of mortality data made available by official statistical agencies (106). In Ireland, the process of verification, registration and classification of external causes of death, including suicides usually involves several months and, in some cases, up to two years due to the requirement of a Coroner's inquest and the involvement of An Garda Síochána, pathologists, and Vital Statistics Registrars, which can also result in late registered suicide deaths (272). In response to a specific objective of Ireland's national suicide prevention strategy Connecting for Life 2015-2024 (147), to improve access

to timely and high-quality data on suicide and self-harm, a real-time suicide surveillance system was established in the Southwest region of Ireland. The Suicide and Self-Harm Observatory (SSHO), a unique data system, collates provisional data on deaths by suspected suicide on a continuous basis in counties Cork and Kerry (273). De-identifiable, disaggregated data based on demographic details of the deceased individual and circumstantial information surrounding the death are collated for the purpose of trend analysis and aberration detection, including the emergence of suicide contagion and clusters. To support and enhance the objectives of the SSHO, an interactive dashboard has been developed to visually display the data and provide an analytic tool that has access restricted to key stakeholders within suicide prevention.

Dashboards have been used extensively within public health surveillance and serve as data visualisation and dissemination tools that facilitate exploratory data analysis and data-driven decision making (274). The tools support better interaction with data by compiling, aggregating, and filtering relevant information in an efficient manner, making it more readily consumable (275). Utilising real-time suspected suicide data can only enhance the functionality of a dashboard by disseminating suicide mortality data at the earliest opportunity from which trends, at-risk populations and geographic variability may be examined to inform tailored prevention efforts (271).

Considerable advances have been made in investigations of the presence of space-time of non-communicable diseases within a population (104). Both statistical and mapping techniques have been extensively applied to retrospective suicide mortality data (102,168,177). Prospective spatial scanning methodology has been used in geographical disease surveillance to detect emerging clusters (160), although it has not yet been applied to suicide mortality data. The prospective application of such techniques to real-time suicide mortality data, using parameters applicable to non-communicable diseases, would support the identification of emerging or active clusters, thereby offering the opportunity for early

intervention, mitigation of further cases and facilitation of targeted response efforts in affected communities. The incorporation of Geographical Information Systems (GIS) provides the means to perform such surveillance functions by geocoding cases for rate calculations and modelling space-time patterns (276). Furthermore, opensource GIS software offers the opportunity to develop a low-cost, sustainable surveillance system, ensuring that developing countries with restrained resources can also implement a sustainable surveillance model (277,278). To date, there is no available scientific literature to suggest the implementation of GIS in real-time suicide surveillance, demonstrating innovation in such an approach.

Employing the space-time scan statistic, this study aims to demonstrate a workable dashboard prototype by determining the performance of the modelling feature based on retrospective suicide mortality data collated by the Suicide Support and Information System (SSIS; 152-155) in County Cork, Ireland, over a ten-year period. To our knowledge, this is the first study to investigate the presence of suicide clusters in a population on an ongoing basis using the prospective space-time scan statistic. In validating the dashboard prototype, we aim to establish an evidence-based model that provides predictive analytics in a user-friendly web-based interface to inform suicide prevention interventions.

5.3. Methods and materials

5.3.1. Data

Suicide Support and Information System

A dataset including a total of 388 cases of confirmed suicide and open verdicts that meet the criteria for death by suicide (156) which occurred in County Cork between 1 January 2008 and 31 December 2017 were collated by means of psychological autopsy of coronial records by the SSIS (152-155). The geographical boundary on which the data have been collated for this study is that imposed by Cork County and City Councils up until 2018 at which time the county and city boundaries were revised. Residential address geographical co-ordinates and data on the date of death of the decedents were included for all cases, as well as additional data

including the date of birth, gender, method of death, presence of note, history of self-harm, history of psychiatric inpatient care and employment background. To generate the required geographical coordinates data for spatial analysis, the latitude and longitude of the residential address of each case were extracted, using the `taRifx.geo` R package, and Microsoft Bing's geocoding facility.

Census data

Small-area level population density data was sourced from the Central Statistics Office (279), facilitating analysis at the smallest unit possible. To generate the required population file, the data reflects population counts for each small-area level in County Cork from the most recently available Census data in 2016.

5.3.2. Data analysis

SaTScan v10.0.2, a free software that uses spatial, temporal or spatio-temporal scan statistics to detect disease clusters and determine their statistical significance was employed in both prospective and retrospective mode (158). SaTScan was executed using an R software package known as 'rsatscan' v0.3.9200, which acts as a wrapper for SaTScan ensuring easy automation, integration, and less computational intensity (159). To determine statistical significance, Monte Carlo hypothesis testing was employed, from which the p-value was calculated through a comparison of the maximum generalised likelihood ratio assessed from 999 simulated datasets to the maximum generalised likelihood ratio assessed from the analysed data.

Retrospective spatiotemporal scan statistic mode

To detect clusters retrospectively, SaTScan was run in batch mode via the R *rsatscan* package using all 10-years of available surveillance data for the period 2008–2017. The spatiotemporal scan statistic, employing a moving circular geographical-based scan window and a time-based height dimension of continuously varying radius, was executed in batch mode. The parameters were repeatedly manipulated to determine the best-fit model of a 30-day temporal window, based on a one-day time aggregation. Standard Monte Carlo simulations (999) were employed to calculate the statistical significance of detected clusters with a p -value <0.05 deemed statistically significant. SaTScan computes the relative risk (RR) for each detected cluster.

Prospective spatiotemporal scan statistic mode

To simulate real-time cluster detection, we employed the prospective spatiotemporal analysis mode. This approach involves repeated analysis on a daily, weekly, monthly, or yearly basis for early detection of emerging clusters (280). The scan statistic was executed as if it had been performed throughout the period of 2008-2017. Other than the use of the prospective space-time analysis mode, the parameters remained the same from the retrospective analysis mode.

Output

R version 4.0.4, a free and open-source statistical software, and the RStudio version 1.4.1106, an IDE interface provide an environment and programming language for data manipulation, calculation, and graphical display. Shiny, another R package, facilitates development of both static and interactive tools. The output of the *rsatscan* cluster analysis was plotted by means of an Environmental Systems Research Institute (ESRI) shapefile, produced to display the detected clusters in a map format (Figure 5). To illustrate the utility of a data visualisation tool, a timeline feature was designed through which the user can select a cluster on the timeline to

display the cluster on the map (Figure 6). It can display outputs and build reactive plots and tables, offering timeseries and mapping features.

5.4. Results

The retrospective spatiotemporal analysis mode detected 12 clusters, none of which were statistically significant ($p < 0.05$; Table 8). Potential suicide clusters detected by the retrospective space-time analysis, and their numerical labelling is based on statistical significance in decreasing sequence, i.e., cluster “1” represents the most likely cluster, with the lowest p-value and highest test statistic. The mean number of cases in a detected cluster was 2, which was the minimum case count in the parameters applied in the scan statistic investigation. No clusters were detected by the prospective space-time analysis mode. Analytical outputs were produced by R, including a timeline and static map with plotted clusters detected by SaTScan, as well as percentage breakdowns of gender, age, and method of deaths by suicide in County Cork during the period 2008-2017 (Figures 7-9).

Table 8. Clusters detected during the period 2008-2017 in County Cork

Cluster	Start date	End date	Duration of cluster (days)	Expected number of cases	Observed number of cases	P value	Test statistic
1	2011/09/15	2011/09/15	0	0.010	2	0.111	8.551
2	2015/10/27	2015/11/2	6	0.010	2	0.498	8.551
3	2009/08/04	2009/08/05	1	0.015	2	0.852	7.745
4	2008/12/27	2009/01/01	5	0.015	2	0.852	7.745
5	2011/09/28	2011/10/10	12	0.103	3	0.854	7.226
6	2010/11/14	2010/12/11	27	0.021	2	0.934	7.175
7	2009/11/10	2009/11/23	12	0.023	2	0.956	6.942
8	2014/02/20	2014/02/25	5	0.023	2	0.956	6.942

9	2015/09/03	2015/09/05	2	0.026	2	0.978	6.733
10	2011/11/09	2011/11/11	2	0.026	2	0.978	6.733
11	2011/07/26	2011/08/11	16	0.039	2	0.998	5.936
12	2008/09/25	2008/10/22	27	0.046	2	0.998	5.579

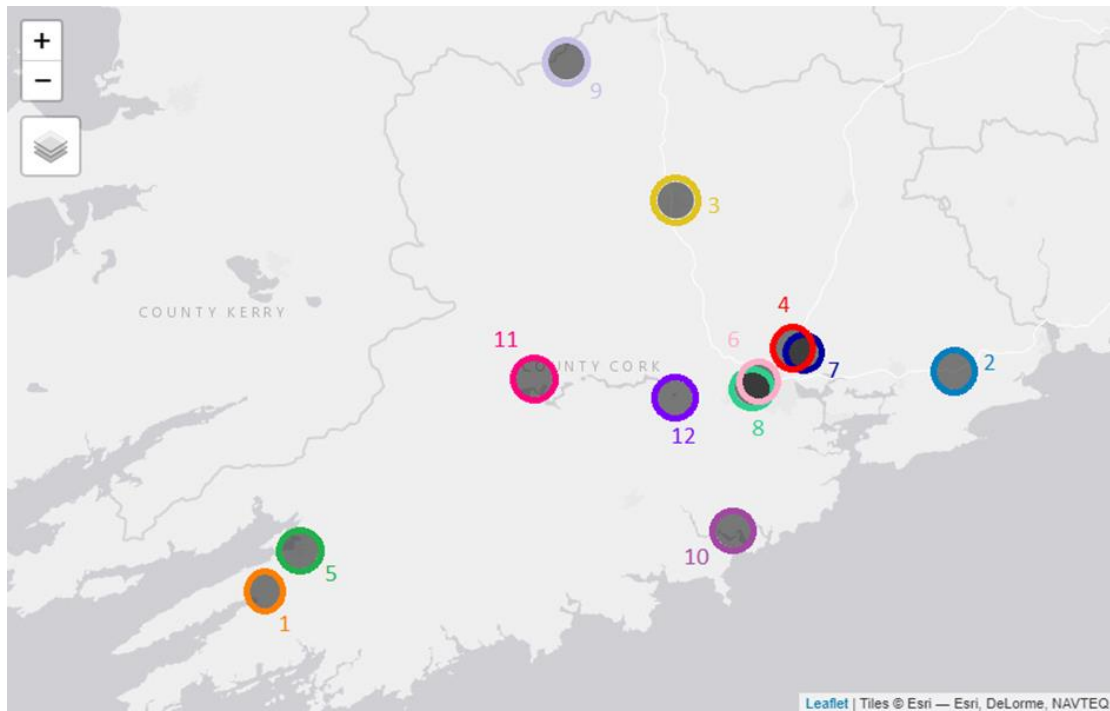


Figure 5. Map of suicide clusters occurring in County Cork during the period 2008-2017

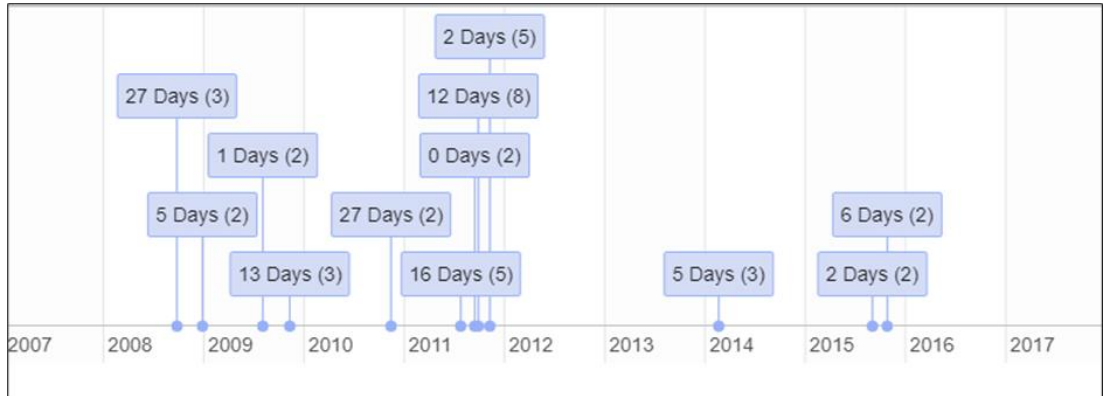


Figure 6. Timeline of suicide clusters occurring in County Cork during the period 2008-2017

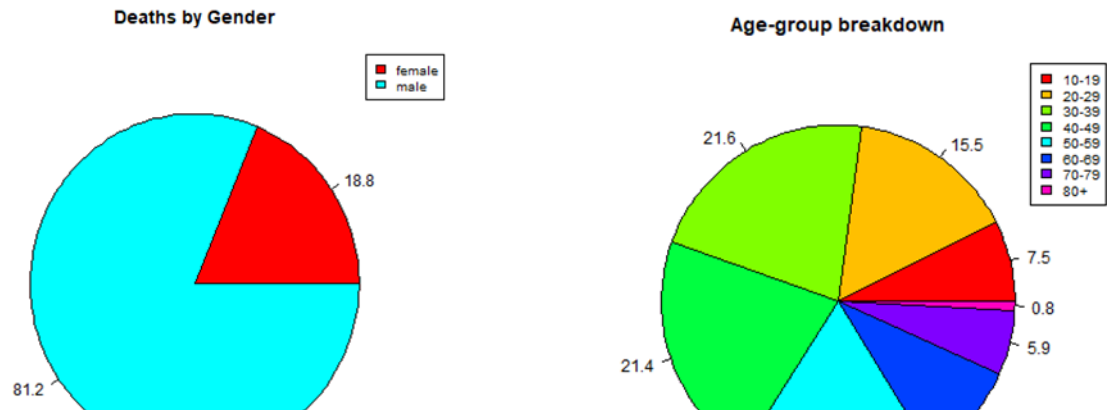


Figure 7. Gender breakdown of deaths by suicide during the period 2008-2017 in County Cork

Figure 8. Age-group breakdown of deaths by suicide during the period 2008-2017 in County Cork

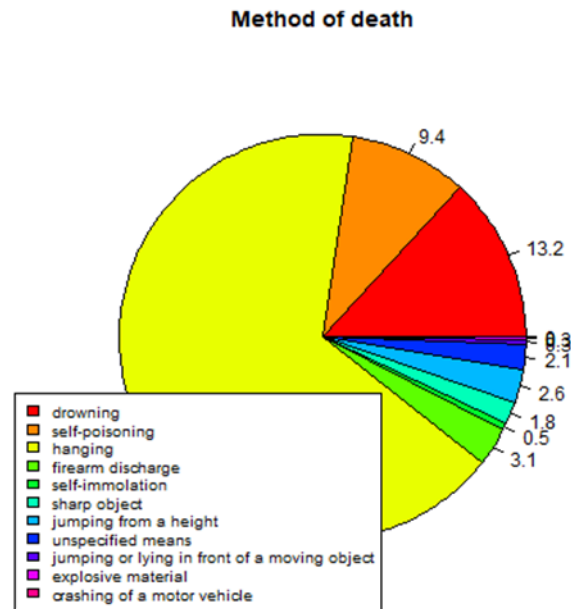


Figure 9. Methods of deaths by suicide during the period 2008-2017 in County Cork

5.5. Discussion

5.5.1. Main findings

The current study sought to demonstrate a workable prototype of a real-time public health surveillance model to detect suicide clusters or emerging clusters, employing space-time scanning techniques and graphic display means to disseminate data in a visually supportive manner to inform decision-making in suicide prevention. The findings prove that the retrospective space-time scan statistic has feasibility to detect emerging clusters using geocoded data. The results also prove the capability of R software and specifically the *rsatscan* and *shiny* packages in running the analysis and utilising the analytic output to produce data visualisations such as static and interactive cluster maps and timelines, as well as percentage breakdowns of gender, age, and methods of death by suicide in pie chart format, demonstrating its compatibility as a dashboard platform for the SSHO.

Irrespective of the income level of a country, a common challenge in conducting surveillance, particularly in real-time, is the availability of accurate data (159). This is particularly relevant in the context of spatio-temporal analyses which incorporate data on the population at risk as a divisor in risk estimates (280). In small-area level investigations of mortality, resident population counts are often sourced from national census data, which creates issues in intercensal estimate calculations, thereby inhibiting accurate data representations of the population. Furthermore, limitations in access to current, non-aggregated suicide mortality data result in outdated surveillance and cluster investigations that inform less effective response measures due to the retrospective nature of the data analysed. The SSHO overcomes this limitation by collating routine, individual-level data from the

primary source, using a strict criterion to ensure surveillance is based on complete and current data. As such, the SSHO serves as a reliable data source to verify unsubstantiated reports and dispel misinformation circulated by traditional and social media relating to suspected suicide rates and emerging suicide clusters in the region. Data displayed by the SSHO dashboard will represent a current profile of individuals who have died by suspected suicide in the region. In essence, the dashboard can provide graphic support to timely, data-driven policy development, implementation, and evaluation, thereby utilising existing resources effectively and allocating additional resources in identified priority areas.

The type of software employed in a surveillance system is integral to its functionality. While GIS can plot the spatial variation among cases, they are not designed to manage temporal data. Thus, statistical analysis of spatio-temporal data is essential to identify aberrations in underlying disease occurrence (281). Comparisons of space-time surveillance approaches have found SaTScan to be the least complex, most user-friendly, and best equipped package for automated surveillance purposes (281, 282). Data pre-processing, i.e., formatting data to fit the requirements of surveillance software package analysis can be time consuming. A key advantage of SaTScan is the option to aggregate data temporally, thereby reducing the data restructuring required when applying different parameters and accepting data input at its finest temporal resolution. This unique feature is particularly useful for prospective analysis which involves multiple time periodic analyses. In addition, SaTScan conducts cluster detection analysis at a higher speed than other surveillance software programs. One limitation of the software is the lack of inbuilt data exploration function and data outputs are limited to database and text files (281). This constraint has been overcome in the present research by employing SaTScan via the R *rsatscan* package to conduct the cluster detection investigation, and programming the visual display of the analytical output using the shiny package. The features of R shiny may be extended to deploy the surveillance system output to the stakeholders for which the dashboard has been built to serve. Utilising free and opensource software, as explored in the current research, provides a suitable and sustainable platform for a surveillance system. Sharing research code is standard practice in many fields of research and has many benefits, including promoting standardisation, and avoiding duplication and waste of resources (282). This approach ensures that the system framework is widely accessible to low-middle income countries and regions that may be lacking budgetary support to meet the resource needs for a well-functioning real-time suicide surveillance system (283).

Real-world investigations of space-time signals can be cumbersome and inefficient (283). A major challenge involved in analysing large and complex datasets that include space and time data items is the computational burden, especially in the amount of small-area level units examined which can vary depending on the spatial and temporal resolutions selected, even more so when more than one

outcome is analysed concurrently (280). Combining the standalone SaTScan software with R via `rsatscan` increases the processing speed of analysis (284). This also ensures the data is automatically updated on a defined periodical basis, avoiding delay in data input to the system and immediate reflection on the dashboard, thereby accelerating data collation to overcome time lags associated with official national statistic reports.

An understanding of R programming language is required to run an analysis of such complexity. However, development and incorporation of R code to conduct and display clusters means that the computational component may be readily implemented by the surveillance system developers and easily disseminated to and used by other researchers within the field, promoting standardisation for comparative analysis of data from other regions or countries – this is particularly facilitated by the use of the `shiny` package, which can create interactive interfaces allowing researchers or others involved in surveillance to query the data interactively. Sharing research code is standard practice in many fields of research and has many benefits, including promoting standardisation, and avoiding duplication and waste of resources (285). Since the data collated and presented by the dashboard is based on highly sensitive, provisional, data based on cases of suspected suicide that have yet to undergo coronial inquest, data protection, confidentiality and privacy issues must be considered. Encryption, user licence and authorisation requirements would ensure content is only available to stakeholders and research personnel with approved access rights on a need-to-know basis, while also preventing download of raw data underpinning the dashboard. One possibility may be to make analysis tools via web sites that are only available internally, and require secure access via a password, or other ID system such as fingerprint or facial recognition.

Data mining and machine learning approaches to geographical data are useful, however a gap exists between the analytics and the interpretation of results, particularly in anomaly detection (285). The data dashboard provides a functional solution to this issue by presenting analytical outputs through data visualisations including pie charts, time series graphs and maps, accompanied by drill down features, intended to help users comprehend the relationship between the spatial and temporal factors of an event by means of an intuitive interface (280). The current study demonstrate that data visualisations serve the purpose of providing more readily consumable analytical outputs, with the potential to positively impact decision-making in suicide prevention.

The incompatibility of the prospective space-time permutation scan statistic employed in the detection of clusters in this present research was anticipated given that the primary data on which the analyses was simulated on is retrospectively dated, with the most recent case occurring five years prior to the present-day application of the prospective analytic approach. Prospective scan statistic

focuses on detecting clusters that emerge or occur at any point during the study period, but remain active on the final day of analysis, thus the prospective analytical approach is conducive and confined to real-time analysis (160). In comparison, the retrospective approach is based on disease mapping of a predefined geographical area over a fixed period (158). This suggests that the prospective spatiotemporal approach would be compatible as a statistical tool for real-time surveillance of suspected suicide in the SSHO and should undergo piloting to determine its efficacy in regular time periodic surveillance of suspected suicide and detection of active or emerging clusters in the South-West region of Ireland.

5.5.2. Strengths and limitations

This study has both strengths and limitations. Firstly, it demonstrates innovation in its objective to design data visualisation components of an interactive dashboard prototype for real-time suicide surveillance and detection of emerging suicide clusters. While dashboards have been applied extensively to public health surveillance, this approach has not yet been explored in real-time suicide surveillance, particularly incorporating aberration detection and mapping components.

Although the application of the prospective space-time scan statistic did not detect statistically significant suicide clusters in this study, this finding was predicted early in the present research due to the lack of current suicide mortality data available, while prospective analysis is limited to the identification of clusters that are currently occurring. This issue is one of the fundamental reasons for the establishment of the SSHO, to provide real-time suspected suicide data to detect emerging clusters and conduct predictive modelling of cluster occurrence. The proof-of-concept testing would have benefited considerably from application to real-time suicide data to obtain a stronger sense of the validity of the prototype. However, due to the infancy of the SSHO at the time of this study, sufficient data has not been collated by the system to date. To further test the validity of the prototype, application of the model to data collated by an established real-time suicide surveillance system from elsewhere in the world may be considered in the future. In addition, there is a possibility that clusters that occurred over a prolonged period outside of the parameters applied within the present research were not detected. Furthermore, since SaTScan scan statistic is restricted to detecting circle-like clusters, clusters of irregular shapes may not have been detected. To overcome this obstacle, the possibility to employ a hybrid cluster detection method that integrates scanning techniques to detect both circular and irregularly shaped clusters in real-time could be explored in future research. Since no statistically significant cluster was detected by the scan statistic in the current study, the sensitivity and specificity of the statistical algorithm underpinning the dashboard must be further investigated

to determine the possibility for false positive results that may trigger the initiation of a crisis response and subsequent deployment of resources unnecessarily.

In terms of data visualisation features of the dashboard prototype, preliminary visualisation techniques were employed to assess the feasibility of presenting the spatiotemporal analytical output. While the figures presented in the current study adequately present the analytical output, more sophisticated possibilities could be explored with the support of a software engineer to further enhance the quality of the dashboard display. Lastly, possible changes in the spatial distribution of the population at small area level during the study period were not controlled for.

5.5.3. Implications for suicide prevention

The findings of this study have strong implications for suicide prevention. Firstly, the development and incorporation of an algorithmic intuitive interface for real-time suicide surveillance provides an early-warning system to facilitate implementation or activation of crisis plans to respond to emerging suicide clusters. It further provides an evidence-base to increase the capacity for early intervention when emerging clusters are detected, while also assisting with optimising resource allocation and informing health service responses in geographical areas with recurring clusters by means of the mapping feature.

An encrypted online platform housing real-time suspected suicide mortality data seeks to promote close collaboration between key stakeholders, not only for crisis response purposes, but to support longer-term suicide prevention initiatives such as means restrictions efforts at identified new methods or locations where individuals frequently take their lives, as well as targeted interventions for identified vulnerable subpopulations via longitudinal trend analysis.

In terms of policy implications, the development of a real-time suicide surveillance dashboard holds the potential to facilitate monitoring and evaluation of both suicide prevention strategies and wider mental health policies by providing the data infrastructure to track progress towards the aims and objectives of implementation plans (147-149).

5.6. Conclusion

Real-time suicide surveillance is a novel development in public health research and one that continues to evolve. Integration of a cluster detection approach involving space-time scan statistics, data visualisation techniques, and predictive modelling in a real-time suicide surveillance system would facilitate prospective detection of emerging clusters, at-risk populations, methods, and locations of concern. However, the validation of the system relies on current suicide mortality data availability.

Collectively, the components of the dashboard prototype demonstrate promising real-world applicability as a proactive monitoring tool for timely action in suicide prevention by facilitating informed planning and preparedness to respond to detected emerging suicide clusters, risk factors and other concerning trends identified by the SSHO.

Chapter 6. Suicide clustering and contagion: The role of the media

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6.1. Abstract

Internationally, there are indications of an increasing trend in suicide contagion and clustering, which has been associated with contemporary communication technology and continuous communication across jurisdictions. Research has indicated varying effects related to different types of media and media contents in terms of impacts on suicidal behaviour. A comprehensive literature search was conducted into research addressing different types of media and media contents and the impact on suicide contagion and clustering, covering January 2003-February 2021. Across the 41 selected studies, we identified consistency in terms of both increased quantity of media reports and portrayal of specific details of suicide cases, including celebrities and fictional cases, to be significantly associated with suicide contagion and increased suicide rates or mass clusters, with significant impacts on increased risk of suicide contagion within the first days up to the first three months following the media coverage. The impact of potentially harmful content and the portrayal of suicide and self-harm via internet sites and social media on suicide contagion and clustering was largely consistent with research into impacts involving traditional media. The findings underline the need to prioritise implementation and adherence to media guidelines for reporting suicide for media professionals, online and social media outlets.

6.2. Introduction

Internationally, there is growing public and professional interest in suicide clusters and contagion. There are indications of increasing clustering and contagion effects in suicidal behaviour, particularly among young people (95,140), owing to factors such as contemporary communication technology and continuous instant communication, devoid of geographic limitations (69,95,140).

Suicide clusters are relatively uncommon, yet they are a cause for community concern due to the potential impact of contagion linked with such phenomena (170). Whilst there are different types of suicide clusters, it is important to clarify these differences when considering the (potential) impact of

the media. There is consistent evidence supporting the notion that mass suicide clusters are clusters of suicides localised in time but not space and have been attributed to the dissemination of information concerning celebrity suicides via traditional mass media (68), online or social media (286). Point clusters are commonly referred to as clusters of suicides localised in both time and space and have been attributed to direct social learning from nearby individuals with limited or no impact via the media (68). Contagion is a concept derived from the study of infectious diseases and increasingly applied to cluster suicides. The underlying assumption is that suicidal behaviour may facilitate the occurrence of subsequent suicidal behaviour, either directly (via contact or friendship with the index suicide) or indirectly (via the media) (75).

Suicide clustering is estimated to be two to four times more common amongst the youth population (95). Furthermore, children and adolescents are the most susceptible age group for imitating suicidal behaviour, which could be further compounded by difficulties in self-regulation when confronted by potentially harmful media content (287). However, research has indicated varying effects associated with different types of media and media contents in terms of impacts on suicide contagion and clustering (288). Vulnerable young people have shown to be more susceptible to portrayal of suicide in the news media, compared to fictional reports (288). Research has also identified significant effects of televised or online suicide portrayals that have led to increased rates of suicidal behaviour, using the same methods displayed in the shows (288). In addition, in a Japanese study on the impact of media reporting of celebrity suicides on suicide contagion, Ueda and colleagues (289) identified significant increases in the total number of suicides immediately following the media coverage of celebrity suicides within 10 days after the publication of news reports, whilst controlling for seasonal effects and time-specific peaks.

Researchers have increasingly indicated that further exploration is needed to understand the association between the manner in which news is reported, the nature of the potentially harmful media content and the size of imitative effects in relation to suicide contagion and clustering (75,95,288). Within this context, the present review aims to 1) identify studies that addressed impacts

of media on suicide contagion and clustering, and 2) compare different types of media and media contents in terms of the impact on suicide contagion and clustering.

6.3. Methods

6.3.1. Study design

A narrative review of the academic literature was conducted using MEDLINE, PsycINFO, CINAHL and EBSCO databases. Journal articles (including original research, review articles, short reports, and letters) were the basis of the search, covering the period January 2003 - February 2021. The search terms included “suicid”, “self-injur”, “self-poison”, “suicidal behaviour”, “suicidal ideation”, “suicide planning”, “pro suicide”, “suicide pact”, “cluster”, “imitat”, “copycat”, “contag”, “social media”, “online social network”, “hashtag”, “internet”, “world wide web”, “online platform”, “online forum”, “online video”, “online image”, “blog”, “chatroom” and “online search engine”. We selected as starting point the article by Gould and colleagues (288), which provided a comprehensive overview of different types of media and its impact on suicide contagion and clustering. Primary and secondary articles addressing suicide clusters and/or contagion and different types of media impacts (media, tv, internet, social media, online social network, online video, online image, online forums or message boards, pro-suicide, and self-harm websites, online platform, online series) were selected. In total 41 articles were included. In synthesising the findings, subgroup analysis was conducted on each identified type of media to explore the independent impact of different types of media on suicide clustering.

6.4. Results

6.4.1. Types of media and media contents

Table 9 outlines the 41 selected studies which address different types of media and media contents. The identified subgroups include media reporting of characteristics of suicide cases and suicide

contagion and clustering, media reporting of celebrity suicides, social media use, potentially harmful content via social media and search engines, facilitation of suicide contagion via social media, fictional portrayals of suicide online and on television, online suicide pacts, pro-suicide and self-harm sites and suicide notes online.

Table 9. Article subgroups

Authors	Title	Study design
Media reporting of characteristics of suicide cases and suicide contagion and clustering		
Stack (2005)	Suicide in the media: A quantitative review of studies based on nonfictional stories.	Quantitative review
Cheng et al. (2007)	The influence of media coverage of a celebrity suicide on subsequent suicide attempts.	Time-series study
Fu & Yip (2009)	Estimating the risk for suicide following the suicide deaths of 3 Asian entertainment celebrities: a meta-analytic approach.	Time-series study and meta-analysis
Niederkrotenthaler et al. (2010)	Role of media reports in completed and prevented suicide: Werther v. Papageno effects.	Ecological study
¹ Niederkrotenthaler et al. (2012)	Changes in suicide rates following media reports on celebrity suicides: A meta-analysis.	Meta-analysis
Sisack & Värnik (2012)	Media Roles in Suicide Prevention: A Systematic Review	Systematic review
Gould et al. (2014)	Newspaper coverage of suicide and initiation of suicide clusters in teenagers in the USA, 1988–96: a retrospective, population-based, case-control study	Case-control study
John et al. (2016)	Newspaper Reporting on a Cluster of Suicides in the UK	Narrative review
Media reporting of celebrity suicides		
Pirkis et al. (2006)	The relationship between media reporting of suicide and actual suicide in Australia	Time-series study
Liu et al. (2007)	Charcoal burning suicides in Hong Kong and urban Taiwan: an illustration of the impact of a novel suicide method on overall regional rates	Trend analysis
Niederkrotenthaler et al. (2009)	Copypat effects after media reports on suicide: a population-based ecologic study	Population-based ecological study
¹ Niederkrotenthaler et al. (2012)	Changes in suicide rates following media reports on celebrity suicides: A meta-analysis	Meta-analysis
Ladwig et al. (2012)	The railway suicide death of a famous German football player: impact on the subsequent frequency of railway suicide acts in Germany.	Time-series study
Hegerl et al. (2013)	One followed by many? Long-term effects of a celebrity suicide on the number of suicidal acts on the German railway net.	Time-series study
Ueda, Mori & Matsubayashi (2014)	The effects of media reports of suicides by well-known figures between 1989 and 2010 in Japan.	Time-series study
Jang et al. (2016)	Copypat Suicide Induced by Entertainment Celebrity Suicides in South Korea	Time-series study
Ueda et al. (2017)	Tweeting celebrity suicides: Users' reaction to prominent suicide deaths on Twitter and subsequent increases in actual suicides	Time-series study
Pirkis et al. (2020)	Suicides in Australia following media reports of the death of Robin Williams	Time-series study
Social media use		
Fu et al. (2013)	Responses to a self-presented suicide attempt in social media: a social network analysis	Case-series study

Howard & Surtees (2016)	A case series review of suicides associated with social media use in South Tyneside, England	Case-series study
Padmanathan et al. (2020)	Social media use, economic recession and income inequality in relation to trends in youth suicide in high-income countries: a time trends analysis	Time-series study
Potentially harmful content via social media and search engines		
Bell et al. (2018)	Suicide-related internet use among suicidal young people in the UK: Characteristics of users, effects of use, and barriers to offline help-seeking	Cross-sectional study
Sinyor et al. (2021)	The association between Twitter content and suicide	Time-series study
Facilitation of suicide contagion via social media		
Birbal, Maharajh & Birbal (2009)	Cybersuicide and the adolescent population: Challenges of the future?	Narrative review
Robertson et al. (2012)	An adolescent suicide cluster and the possible role of electronic communication technology	Case study
Li, Huang & Zhu (2018)	A systematic analysis of online broadcasts of suicidality in China	Systematic review
Poonai et al. (2017)	The association of exposure to suicide-related Internet content and emergency department visits in children: A population-based time series analysis	Time-series study
Swedo et al. (2021)	Associations between social media and suicidal behaviors during a youth suicide cluster in Ohio	Cross-sectional study
Fictional portrayals of suicide online and on television		
Niederkrotenthaler et al. (2019)	Association of increased youth suicides in the United States with the release of 13 Reasons Why	Time-series study
Sinyor et al. (2019)	Suicides in Young People in Ontario Following the Release of "13 Reasons Why"	Time-series study
Bridge et al. (2020)	Association between the release of Netflix's 13 Reasons Why and suicide rates in the United States: An interrupted time series analysis	Time-series study
Online suicide pacts		
Jiang et al. (2016)	Analysis of internet suicide pacts reported by the media in mainland China	Time-series study
Sinyor et al. (2018)	The association between suicide deaths and putatively harmful and protective factors in media reports	Observational study
Lee & Kwon (2018)	Twitter as a place where people meet to make suicide pacts	Trend analysis
Pro-suicide and self-harm sites		
Shah (2009)	The relationship between general population suicide rates and the Internet: a cross-national study	Cross-national study
Mitchell et al. (2014)	Exposure to websites that encourage self-harm and suicide: Prevalence rates and association with actual thoughts of self-harm and thoughts of suicide in the United States	Cross-sectional study
Till et al. (2017)	Beneficial and harmful effects of educative suicide prevention websites: randomised controlled trial exploring Papageno v. Werther effects	Randomised-controlled trial
Suicide notes online		
Ruder et al. (2011)	Suicide announcement on Facebook	Case study
Belfort, Mezzacappa & Ginnis (2012)	Similarities and differences among adolescents who communicate suicidality to others via electronic versus other means: a pilot study.	Case-series study
Fu et al. (2013)	Responses to a self-presented suicide attempt in social media.	Exploratory study employing quantitative content analysis
Cheng et al. (2015)	Suicide Communication on social media and Its Psychological Mechanisms: An Examination of Chinese Microblog Users	Cross-sectional study

¹ Article included in more than one subgroup

Media reporting of characteristics of suicide cases and suicide contagion and clustering

Cheng and colleagues (226) examined the impact of media reporting on suicide contagion and clustering in relation to suicides by staff members of a giant electrical manufacturing company, Foxconn. Relevant articles were collected from representative newspapers published in three major cities in mainland China. A temporal suicide clustering effect was identified, whereby reporting and the occurrence of a Foxconn suicide/attempt were found to be associated with an elevated chance of a further Foxconn suicide three days later. The occurrence of a Foxconn suicide also immediately influenced the intensity of both internet-based searching and newspaper reporting. Gould and colleagues (290) conducted a retrospective, population-based, case-control study, and they identified suicide clusters in young people aged 13-20 years in the United States (US) from 1988 to 1996 (preceding social media) using the time-space Scan statistic. Newspapers within each cluster community were examined for stories about suicide published in the days between the first and second suicide in the cluster. The mean number of news stories about suicidal individuals published after an index cluster suicide (7.42) was significantly greater than the mean number of suicide stories published after a non-cluster suicide (5.14). Several story characteristics, including front-page placement, headlines containing the word suicide, or a description of the method used, and detailed descriptions of the suicidal individual and act, appeared more often in stories published after the index cluster suicides, than after non-cluster suicides.

Following a suicide cluster among young people in Bridgend, United Kingdom (UK), John and colleagues (291), examined the quantity and quality of newspaper reporting for six months before and after the defined cluster (June 26, 2007, to September 16, 2008). Among the total of 577 identified newspaper articles, one in seven articles included the suicide method in the headline, 47.3% referred to earlier suicides, and 44% used phrases that guidelines suggest should be avoided, while only 13% included sources of information or support. The authors conclude that a high level of poor-quality and sensationalist reporting occurred during an ongoing suicide cluster. A strong body of evidence suggests that lack of adherence to the media guidelines for reporting suicide can have copycat and

imitation effects, particularly for vulnerable people, such as individuals with depression and those who have engaged in self-harm (90,292-296). The literature indicates that one instance of intense or substantial media coverage of a novel method can increase the incidence of suicide by that method (297), with this increase remaining after the media coverage decreases (298).

Media reporting of celebrity suicides

Evidence exists to support the notion that suicide clustering and contagion is more prominent when media coverage is extensive and when suicides are glamorised and reported upon in detail (294,299), with a greater impact on suicides that are similar to the respective model in terms of age group, gender and suicide method (300). In this regard, Ladwig et al. (225) found an 81% increase in railway suicides during a six-week period following the death of a well-known German football goalkeeper who jumped in front of a train. Hegerl et al. (301) studied the long-term effects and identified an 18.8% increase in railway suicides during the two years after this event, compared to the two years before. Regarding the impact of the media, the authors concluded that media reports followed the media guidelines to some extent, although, it remains uncertain as to what the extent of the increase in railway suicides may have been if the media had followed the guidelines more thoroughly (225). Following the death by suicide of Robin Williams on 11th August 2014, Pirkis et al. (218) identified an 11% increase in suicides in Australia in the five-month period following Williams' death, which was highly publicised in the Australian media, the majority involving men aged 30-64 and by people who died by hanging, the same method used by Robin Williams.

In Japan, Ueda et al. (289) found that media reports on celebrity suicides were associated with an immediate increase in total suicides, which increased by 4.6% on the day that media reports of celebrity suicides were published. The increase lasted for approximately 10 days after the publication of news reports. This study also identified variation across different types of celebrities in terms of impact on suicide contagion, with the highest impact following reports of nationally recognised

politicians (14.8%), while deaths of entertainment celebrities were followed by a 4.7% increase in the total number of suicides.

In South Korea, Jang et al. (222) identified a significant association between the portrayal of celebrity suicide and the number of suicides immediately post-event, especially in people of the same gender and age group, with many even applying the same reported method.

An examination of Twitter posts and deaths by suicide in Japan identified an increase in suicides only when suicide deaths provoked a significant response from users (302). In addition, deaths of younger celebrities generated a higher number of posts on Twitter. The authors suggest that it is necessary to examine social, as well as traditional news media when examining the impact of media reports on suicides (302).

Media reports covering details of less well-known people, but elaborating on specific details of suicide methods, such as carbon monoxide poisoning by burning barbecue charcoal and inhaling hydrogen sulphide gas were also associated with significant increases in subsequent suicides (83).

Social media use

A recent study of suicide rates among 15-24-year-olds in eleven high-income countries, with populations of more than 20 million from 2000-2017, discovered some evidence of an association between daily social media use and youth suicide trends (303). A case-series review of suicides associated with social media use in South Tyneside, England, where evidence from social media was cited at inquest, concluded that the deceased were more likely to be over 45, to have been single and in employment, but less likely to have been diagnosed with mental illness, than those in which social media evidence was not cited. The authors note that public health campaigns around safe use of social media may need to be directed at middle aged people, in addition to the identified target audience of younger generations (304). The above studies used trend analyses and case series to examine the relationship between social media use and suicide trends and profiles of the deceased but did not examine a direct association between the social media exposure and suicide contagion and clustering.

It should be noted that social media may also have a positive role in supporting people at risk for suicide (305).

Potentially harmful information via social media and search engines

Sinyor et al. (306) examined suicide-related tweets geolocated to Toronto, Canada, and originating from the highest-level influencers over a one-year period (July 2015 to June 2016), coding for general, putatively-harmful and putatively-protective content, and assessing whether tweet characteristics were associated with increases or decreases in suicide deaths. They identified an independent association between tweets about the suicide of a local newspaper reporter, social causes of suicide, including cultural, relational and legal problems, advocacy efforts and suicide death, and subsequent increases in suicide within the seven days post-reporting.

A study of suicide-related internet use among suicidal young people in the UK identified two predominant drivers of suicide-related internet use among suicidal young people: to connect with others and to seek information. The authors note that both concepts had positive and negative effects and suggest that websites containing information about suicide methods and their lethality can be perceived as helpful or harmful, contingent moderately on “masculine” or “feminine” mode of expressions (307).

Facilitation of suicide contagion via social media

A recent study of associations between social media and suicidal behaviours during a suicide cluster involving young people in the US found that engagement with suicide cluster-related social media was associated with increased suicide ideation and suicide attempts during a suicide cluster in Ohio (308). Memorial pages may also facilitate contagion and copycat behaviour. An examination of the relationship between an adolescent suicide cluster and the role of electronic communications in New Zealand found that several cases were not linked to a single school, instead several were connected by social media websites, including websites created in memory of previous adolescents who had

taken their own lives. The authors remark that social media websites assisted the rapid spread of information about the deaths in the community and made the identification and management of a possible cluster more difficult (140). However, in contrast, a study of presentations to emergency departments in Ontario, Canada, found that an increase in suicides from October 2012 to December 2013 among 11–17-year-olds could not be attributed to a highly publicised adolescent suicide. The authors concluded that suicide-related internet content was not associated with the increase in ED visits for suicidal behaviour (309).

The possibility of livestream suicides (via social media) initiating a suicide contagion has been identified as a concern in the literature (310). While there is a lack of research on this area, a systematic analysis of online broadcasts of suicide in China found that the most commonly applied suicide method was cutting (57.5%), the location of death was most frequently at home (35.2%), and instant messaging apps (52.8%) were commonly used for broadcasting suicidal thoughts (311).

Fictional portrayals of suicide online and on television

We identified three studies that had examined the impact of online series portraying the suicide of an adolescent girl on suicide contagion and clustering. Bridge et al. (220) examined the impact of the release of *13 Reasons Why*, on March 31st 2017, on suicide rates in US. The Netflix series *13 Reasons Why* portrays the suicide death involving wrist cutting by the protagonist. The authors found that the overall suicide rate among 10–17-year-olds increased significantly in the month immediately following the release of *13 Reasons Why*, while accounting for seasonal effects and an underlying increasing trend in monthly suicide rates. No significant change in level or trend of suicide after the show's release was identified for 18–29-year-olds and 30–64-year-olds. Another study conducted in the US by Niederkrotenthaler and colleagues (312), based suicide mortality data from the Centers for Disease Control and Prevention's WONDER (Wide-ranging Online Data for Epidemiologic Research) database, used Twitter and Instagram posts as a proxy to estimate the amount of attention the show received via social media from April 1, 2017, to June 30, 2017. Public interest in the show was highest in April

2017 and decreased following June 2017. For 10–19-year-old adolescents, statistical models assessing three-month associated suicide mortality indicated 66 excess suicides among males (12.4%) and 37 (21.7%) among females. No excess suicide mortality was observed in other age groups, and the increase in the suicide method of hanging was particularly high (26.9%). Sinyor et al. (214) examined changes in the number of suicides in young people aged below 30 years old in the province of Ontario, following the release of *13 Reasons Why*. Time-series analyses were performed using data from January 2013 to March 2017 to predict expected deaths from April to December 2017, with modelling results predicting 224 suicides. However, 264 suicides were observed representing an 18% increase. Other fictional portrayals of suicide have been broadcast on television and online, for example, *It's My Party* and *'Night, Mother*. The influence of these two films on viewers have been explored by Till and colleagues (313,314). However, no other film, television or online series has received as much attention as *13 Reasons Why* in published literature.

Online suicide pacts

Sinyor and colleagues (315) examined the association between specific article characteristics and fluctuations in suicide deaths in the seven days following publication, compared with a control window. Among the characteristics that were most strongly and independently associated with increased suicides were details of online suicide pacts, in addition to the inevitability of suicide, asphyxia other than car exhaust, suicide by jumping from a building and a headline including the suicide method. Based on the outcomes, the authors recommend that reporting on suicide can have a meaningful impact on suicide deaths and that media professionals and outlets should consider the specific content of reports before publication.

Jiang et al. (316) conducted an analysis of internet suicide pacts reported by the media in China. They reviewed 62 internet suicide pacts, involving 159 victims in mainland China before June 1, 2015. The people involved in internet suicide pacts were predominantly male (male-to-female ratio: 2.3:1) and more likely to be in the younger age group (84.1% were in their 20s to 30s). Most internet pact suicides

(87.1%) took place in sealed hotels or rental housing, and charcoal-burning was the most prevalent suicide method (80.6%).

A Korean study of all tweets containing the term 'suicide pact' during a 43-day data collection period identified platform, specifically, as a potential attractive place where people attempt to meet others to make a suicide pact (298). The authors note that a significant proportion of tweets contained detailed information including the city of the user, their gender and age, favoured contact method, and preferred sex of an acquaintance. The authors claim the attractiveness of such platform for arranging suicide pacts may be due to specific features; for instance, a user can create several accounts with different names but without disclosing much personal information.

Pro-suicide and self-harm sites

A cross-national study among older adults, based on data from the World Health Organization and the United Nations website, found that internet use (including websites and chat rooms) for both males and females was significantly and positively associated with suicide rates in the 65–74 years and 75+ years cohorts (317).

A US-based study examining exposure to websites that encourage suicide discovered that young people who visited such websites were 'seven times more likely to say they had thought about killing themselves; and 11 times more likely to think about hurting themselves, even after adjusting for several known risk factors for thoughts of self-harm and thoughts of suicide' (318).

Nevertheless, in contrast to these findings, Till et al. (319) note that educative professional suicide prevention websites may increase suicide prevention related insight and may be associated with a decrease in suicidal ideation among vulnerable individuals.

Suicide notes online

No studies were identified that had examined the impact of posting suicide notes online on suicide contagion or suicide clusters. However, Ruder et al. (320) identified numerous reports of suicide notes on Facebook in the popular press, but none in the professional literature. Therefore, evidence of copycat suicides induced by suicide notes on social networking websites is unclear. In terms of suicide prevention, four studies were identified, which suggested that suicidal communications or suicide notes posted online may have positive impacts in that they may facilitate immediate intervention from other users (305,320-322).

6.5. Discussion

6.5.1. Main findings

Considering the limited number of available reviews that have addressed the impact of different types of media and media contents on suicide contagion and suicide clustering, this review provides a detailed update on specific features of traditional media, online and social media associated with suicide contagion and clustering.

Overall, we identified consistency in terms of both increased quantity of media reports and portrayal of specific details of suicide cases, including celebrities and fictional cases, to be significantly associated with suicide contagion and increased suicide rates or mass clusters, with significant impacts on increased risk of suicide contagion within the first days up to the first three months following the media coverage.

The studies by Cheng et al (226) and Gould et al (290) provided further evidence for temporal clustering effects whereby the occurrence of a suicide and subsequent widespread and frequent media reporting increased the risk of further suicides within the following days, which is consistent with previous research in this area (288). In addition, continued sensationalism and poor-quality media reporting whilst an emerging suicide cluster had been identified, may have contributed to further suicide cases during an ongoing cluster (291).

The studies addressing the impact of media reporting following the suicide death involving a celebrity, consistently revealed increases in suicides or mass clusters, with increased risk of suicide contagion and mass clusters when suicides are glamorised and reported in detail. Across the studies, there was a stronger impact on suicides involving persons with similar characteristics compared to the respective celebrity or model in terms of gender, age group and suicide method (294,299,300). However, research addressing the impact of the portrayal of suicide in fictional stories, such as the Netflix series 13 Reasons Why, also revealed evidence of increased suicides involving other suicide methods compared to the method used by the protagonist (312).

A possible explanation for increases in suicides or mass suicide clusters following the suicide death of a celebrity is grounded in the social learning theory (68), which clarifies that identification of the imitator with the model is a necessary prerequisite of imitative behaviour. Niederkrotenthaler et al. (300) showed that the celebrity status was the major predictor of a post-report increase of suicidal acts. However, there is increased risk of suicide contagion among young people who are more susceptible to imitation, in particular when the amount and duration of the exposure is intensified and ongoing (82,323). Additional risk-factors for suicide contagion include male gender, substance abuse, indigenous status, history of suicidal behaviour or experience of a traumatic life event have all been documented in the literature (62,75,95). However, less is known about the influence of pre-existing mental health conditions, warranting further research in this area to inform suicide prevention and postvention efforts.

This review demonstrates that the impact of potentially harmful content and the portrayal of suicide and self-harm via internet sites and social media on suicide contagion and clustering is largely consistent with research into impacts involving traditional media. Implementation of media guidelines for reporting of suicide has been associated with a reduction in suicide rates (324) and use of highly lethal methods of suicide (325). The introduction of guidelines has also been associated with improvement in reader's capacity to use coping resources to overcome suicidal behaviour and

ideation (90). Therefore, greater priority should be given to the implementation of and adherence to media guidelines for reporting of suicide for online and social media as well.

While much of the identified research focus on the harmful effects of media reports of suicide, we must acknowledge the role that mass media can play in suicide prevention, particularly through responsible reporting and portrayal of suicide. Traditional media content that encourages help-seeking and contains messages of hope and healing in the subject matter are considered protective effects (326).

Social media has been found to negatively impact the psychological health of users, particularly levels of anxiety and depression (327). However, it also exists as a mechanism for connectivity, offering a protective role in combating loneliness and social isolation. Although young people are typically less engaged with traditional media, given their increasing consumption of social media, there is potential for it to be used as a targeted suicide prevention tool (328). Social media platforms offer the possibility to intervene when suicidal ideation is expressed, and the availability of community support via online forums. However, challenges exist among privacy, consent, management of user behaviour and accurate risk assessment; therefore, research investigating the safety and efficacy of social media as a suicide prevention strategy is advised (329).

This review has identified several gaps in knowledge around the role, and impact, of media on suicide clustering and contagion, which would benefit from further research. Early detection of novel online risks to mental health, such as virtual suicide 'games' targeting young people, is required and further research to identify emerging harms in real time is needed (330). Most articles regarding clusters identified as part of this review, related to suicide contagion and clusters. There is a paucity of research concerning the role of media in self-harm clusters and further research is warranted. Online and social media are constantly evolving, creating new influences and risks to mental health, often quite rapidly. Real-time research to identify the role, and risk to mental health, of these new media is needed. This review highlights that media may mediate the development of point clusters, and therefore, further research is required to explore the impact of the media on point clusters.

6.5.2. Strengths and limitations

Both strengths and limitations exist within this review. While a systematic approach was employed to the study design, the authors acknowledge that it is not a systematic review. As a result, the quality and completeness of the evidence may limit the overall conclusion of this review. A formal systematic review of this specific topic may be considered in the future to minimise biases and increase the reliability of findings. Furthermore, non-peer reviewed reports were excluded from this review, representing a limitation of the synthesised literature. One major challenge is that this research area is rapidly evolving, to the extent that research is constantly chasing new technological developments and methods of usage. Conducting literature reviews within such a fast-paced field of research poses difficulties, insofar as the literature can become outdated rather quickly. A strength of this review represents the comprehensive literature search, addressing different types of media and media contents and the impact on suicide contagion and clustering. However, a number of studies may have been missed, in particular non-peer reviewed research reports, which is a limitation.

6.5.3. Implications

Guidelines and protocols to support communities in managing clusters should be updated to reflect the extensive use of communication technologies in modern society (140,305). It would be beneficial for guidelines to include preventative measures that a community should implement to minimise the potential for contagion using mobile phones and the internet (140,308), in line with initiatives in the UK and Australia (141,331). Liaison with social media executives and search engine providers regarding opportunities for algorithmic detection of people engaging with pro-suicide websites and games, as well as increased promotion of support websites, would inform crisis intervention and facilitate help-seeking for people at risk (318,332,333).

While many jurisdictions have best practice guidelines for responsible reporting of suicide in the media, these alone, may not be sufficient in reducing contagion effects. Greater enforcement of the media guidelines and governance of breaches by broadcasting safety authorities, combined with focused training for media personnel would be beneficial in ensuring greater adherence to sensitive and factual media coverage of suicides, thus reducing the hysteria instigated by sensationalised reports. The inclusion of guidelines for the reporting of suicidal behaviour in press codes of conduct for journalists warrants consideration.

Chapter 7. Real-time suicide surveillance supporting policy and practice

Authors

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7.1. Abstract

Suicide mortality rates are a strong indicator of population mental-health and can be used to determine the efficacy of prevention measures. Monitoring suicide mortality rates in real-time provides an evidence-base to inform targeted interventions in a timely manner and accelerate suicide prevention responses. This paper outlines the importance of real-time suicide surveillance in the context of policy and practice, with a particular focus on public health and humanitarian crises.

7.2. Background

The suicide mortality rate of a country is a macro-indicator of the wellbeing and mental health and offers a baseline for evaluation of suicide prevention programme efficacy (114). However, the quality of suicide mortality data varies on a global level, due to stigma, limited resources, and misclassification in some countries where suicide is deemed a criminal offence (150,334). Furthermore, complex death investigations involving multiple parties result in delays in the release of official national suicide mortality statistics, averaging around two years (106). These issues impact on the timeliness, accuracy and reliability of suicide mortality data and hinder comparative analysis between countries (105,335).

The implementation of real-time suicide surveillance could greatly benefit suicide prevention strategies and policies. The World Health Organization (WHO) has repeatedly promoted the value of real-time surveillance frameworks for mental health issues including suicide and has emphasised the need for reliable and timely data to inform decision-making, determine matters requiring immediate action and to facilitate evaluation of intervention and prevention programmes (2450,251). Global policy outlined in the WHO Comprehensive Mental Health Action Plan 2013-2030, includes an objective to strengthen information systems, evidence, and research for mental health (150), building on the WHO Global Report 'Preventing Suicide: A Global Imperative', which signals the need for an increase in the quality and timeliness of national data on suicide and suicide attempts (pg. 57; 2).

Moreover, the United Nations Sustainable Development Goals target 3.4 calls for a reduction in premature mortality from non-communicable diseases by one third by 2030, identifying the suicide mortality rate per 100,000 people as an indicator of progress (151), thus relying on timely monitoring of suicide rates internationally to assess the efficacy of prevention strategies.

The release of the WHO 'Live Life: an implementation guide for suicide prevention in countries' provides a comprehensive framework to support countries in developing and implementing of national suicide prevention strategies (252). A core pillar of the guide is 'surveillance, monitoring, and evaluation', with a strong emphasis on publishing data based on rates and trends regularly to inform action towards reducing overall rates of suicidal behaviour. Without this information, it is difficult to measure progress towards key components of a national suicide prevention strategy. The interventions listed in the guide, particularly means-restriction, media liaison regarding responsible reporting, as well as early identification, assessment, management, and follow-up of those affected by suicidal behaviour all depend on the availability of real-time suicide surveillance to facilitate and direct such actions.

7.3. Real-time suicide surveillance facilitating identification of emerging suicide clusters

While broad aggregate-level data is important for implementation of national strategies, small area-level data is essential to local suicide prevention efforts, of which the use of spatial epidemiological methods can increase the reliability of such data (340,341). Furthermore, community responses to suicide clusters benefit from using such surveillance in pre- and post-intervention evaluation to determine its efficacy in mitigating further suicide contagion (106). Investigations of this kind, based on real-time suicide data, would serve to facilitate earlier detection of suicide clusters and timely responses in affected communities (95,141,338). The data would also facilitate reallocation of resources to impacted areas, communities, and settings, while geospatial analysis can effectively

identify geographical areas affected by recurring suicide clusters, which require a more intensive and targeted response.

Given that community perception of a suicide cluster has been found to contribute to the potential contagious effects (339), verification of speculative rumours of suicide clustering in a community is a critical feature of a real-time suicide surveillance system (340). Inappropriate and inaccurate reporting of suicide in the media can lead to sensationalism based on unfounded claims. While the data collated by a real-time suicide surveillance system is provisional given the immediacy of data entry, the availability of up-to-date information on suspected suicide cases provides an accurate source that can be used to validate unconfirmed reports of emerging trends. As a result, media professionals may refer to such a system to verify unsubstantiated statements prior to publication or modification of original published reports, thereby avoiding unwarranted community concern and negative escalating effects. This specific feature of real-time suicide surveillance has added value in promoting responsible media reporting of suicide, especially in the current era of predominantly unregulated, instant information sharing across jurisdictions via social media and contemporary communication technologies. Furthermore, media coverage of a high-profile case of suicide has been linked with an increase of between 8-18% in the 1-2 months following the media reports and an increase of 30% of cases by the same method of suicide wherein details of the method of suicide were reported (341). A real-time suicide surveillance system provides the basis to monitor fluctuations in suicide rates with only a slight lag, facilitating prompt tracking of cases after a particular media report, communication of relevant findings to media personnel, and guidance on subsequent actions (115).

7.4. Impact of the COVID-19 pandemic on suicide

Media sensationalism of suicide was intensified during the onset of the coronavirus (COVID-19) pandemic in many countries, resulting in the publication of recommendations and guidance for responsible media reporting of suicide in relation to the pandemic (115,342). Availability of recent suicide data to monitor international trends and identify at-risk sub-populations was severely limited in the early stages of the pandemic (118), emphasizing the urgency for real-time suicide surveillance to provide an up-to-date evidence-base to inform policy responses (271). Existing real-time surveillance systems had the benefit of conducting prompt trend analyses of routinely collated,

accurate data (261,343,344), while researchers in some countries searched rigorously on an ad hoc basis to obtain access to data of this type (257), raising concern around the reliability of such data.

Humanitarian crises such as pandemics, climate change and armed conflict are known to impact suicide rates (345-347). The confluence of global crises occurring during this unprecedented era, and beyond underlines the critical need for practical, systematic surveillance practices that remain functional during periods of instability to inform crisis response, service planning and preparedness. The ongoing pandemic has demonstrated the rate at which mental health services can be undermined in emergency situations, impacting continuity of care. Crises of such magnitude go above the decision-making and operational capabilities of regular crisis management and require a higher level of preparedness. Rapid action in an emergency is vital, however, it depends on effective contingency planning by mental health services which can be efficiently activated in anticipation of challenges and all eventualities (348). Such plan development would benefit from the availability of real-time suicide data to ascertain key areas of focus, while also providing the basis for predictive modelling of suicide rates to inform wider mental health and suicide prevention policies.

7.5. Impact of conflict and war on suicide among refugees

In the third year of this ongoing global pandemic, the sudden invasion by Russia on Ukraine has plunged the world into a renewed catastrophe. Significant armed conflict has engulfed the nation, forcing millions of civilians to immediately evacuate their native land to escape war. The mass exodus of abruptly displaced individuals resulting from this evolving crisis adds to an already record global level of internally displaced individuals, refugees, and asylum seekers that reached 82.4 million at the end of 2020 and will undoubtedly continue to dramatically increase over the coming months and years (349). The most recently recorded suicide mortality statistics in both Russia and Ukraine indicate that both countries rank among the highest suicide rates globally, even prior to the recent outbreak of armed conflict. Furthermore, nearby host countries of those escaping the war in Ukraine, such as Lithuania, Slovenia, and Hungary report the highest recorded suicide rates in Europe (15). The

concerning rates in those countries emphasise the need to monitor suicide rates in as timely a manner as possible to identify possible further increases stemming from the conflict and migration crises.

Individuals escaping conflict are at an elevated risk of experiencing a range of adverse mental health outcomes, resulting from exposure to extreme trauma (350-352). Despite the extensive evidence documenting increased vulnerability among those who experience armed conflict, humanitarian response efforts often overlook the mental health impacts and the necessity of psychosocial support for those affected (353). Displaced populations are understood to be at an elevated risk of suicide, especially those from countries with increased suicide risk, and particularly during the acute phase (354-356). Yet, data on suicide in refugees is both lacking and inconclusive, with most statistics based on high-income countries and limited data available for low- and middle-income countries who host approximately 85% of the globally displaced population (357). Research has identified that the psychological distress experienced by displaced individuals is not the sole cause of exposure to war-related violence. It is also strongly linked with displacement-related stressors including social isolation, unemployment, poverty, and perceived discrimination. Furthermore, such distress is compounded by issues including uncertainty surrounding legal status, the threat of deportation or lengthy periods stuck in detention centres for asylum seekers (358). A major gap exists in the literature to address the efficacy of interventions addressing such stressors, reaffirming the need to obtain current data to respond effectively to the mental health challenges affecting vulnerable subpopulations both in the short-term and long-term. Moreover, research investigating suicide prevention and responses to refugees is significantly sparse (356). Together, these issues provide a strong argument for the real-time surveillance of suicide mortality as a tool for advocacy which can support host countries in developing policy and strengthening mental health services to provide the essential components of timely diagnosis and treatment for mental illnesses, aligned with the objectives of the WHO Draft Global Action Plan 'Promoting the Health of Refugees and Migrants' 2019–2023 (359).

7.6. Impact of climate change on suicide

The climate crisis poses an increasing environmental threat to humanity, triggering climate and eco-anxiety in the global population, particularly among children and young people (360,361). Research based on global warming has revealed a link between rising temperatures and suicide mortality, a trend projected to continue in line with increasing temperature levels (346), warranting ongoing surveillance using real-time data to detect sudden changes. Natural disasters are also known to impact suicide rates, with fluctuations observed in affected populations both in the direct aftermath and recovery phases (362-364). Routinely collected suicide mortality can be used to inform immediate and long-term post-disaster suicide prevention responses to support those directly affected.

Seasonal variation in suicide rates have been detected, hypothesised to be the result of factors such as weather-related changes or shifts in social interaction (365,366). Real-time suicide surveillance lends itself to trend analysis, through which seasonal variation, emerging trends, and high-risk periods can be detected in real-time, providing the opportunity for early intervention. While providing an evidence-base for suicide prevention policy, the collation of real-time suicide data also serves to inform and support climate change and environmental-based policies by providing an insight into the influences of climate-related stressors on mental-health and suicidality by way of lobbying governments to act to reverse the harmful effects on the climate.

7.7. Impact of concurrent public health emergencies on suicide

The concurrence of armed conflict, a pandemic, and climate-related stressors, exacerbates the stressors experienced by individuals, resulting in increased anxiety and linked disorders such as anxiety disorders, in particular PTSD, which may lead to increased suicide risk. The link between disease outbreak and climate change indicates that future pandemics are unavoidable (367). While evidence indicates that climate change was not the root cause of the current COVID-19 pandemic,

global warming is a known risk factor for the spread of infectious diseases such as tropical disease outbreak in wetter, warming climates that offer optimal environments for disease vectors (360). Moreover, pandemics can escalate conflict risks through factors such as increased grievances, altered opportunity factors for organised armed groups and deteriorating levels of democracy (368).

The recently observed rise in armed conflict in some parts of the world is a concerning trend given the threat of combat to human safety, as well as the capacity of countries to deal with a public health crisis during warfare. These concerns are further heightened by the anticipated adverse economic impact of these co-occurring crises on suicide rates, particularly given the risk of financial recession stemming from armed conflict and public health emergencies independently, together with the existing suicide risk directly associated with economic crisis (369). The long-term effects of the present turbulent period should be considered and planned for in advance (370), making use of real-time data to inform targeted strategies that would ease the lasting impact on mental health and prevent suicide. The rapidity and simultaneity of these humanitarian crises should provide the impetus for governments to ensure their readiness to respond efficiently to future crises. It is evidently clear that now, more than ever, there is a valid requirement for real-time suicide surveillance to monitor the evolving situation and beyond, with the fundamental purpose to reduce suicide.

The implementation of recommended components and practices applied by established real-time suicide surveillance systems elsewhere in the world, while adapting to regional/local circumstances and resource availability, would support the development of real-time suicide surveillance. Networking and knowledge exchange would further facilitate the development of real-time suicide surveillance systems through a learning process from peers with both experience and expertise in the innovative area of research (115).

Chapter 8. Discussion

8.1. Chapter overview

This thesis examined suicide clustering and contagion in the context of cluster detection, surveillance, and response. This chapter provides an overview of the main findings arising from this body of research and interpretation within the context of existing literature. The implications of this research in the context of theory, policy, methodology, clinical practice, and suicide prevention will be addressed. The strengths and limitations of the research will be presented, and future research considerations will be discussed.

8.2. Summary and interpretation of main findings

What was the evidence before this research?

- Earlier quantitative studies of suicide and self-harm clustering have involved methodological variation in their cluster detection investigations.
- Previous research has highlighted methodological deficits relating to the surveillance of suicide, particularly concerning the accuracy, timeliness, and quality of suicide mortality data, with few suggestions on how to enhance surveillance practices and procedures.
- Existing research indicates the importance of real-time suicide data to support efficient decision-making in suicide prevention efforts. Despite this, availability of such data remains extremely limited, with hardly any reported collation of real-time suicide mortality data in low- and middle-income countries.
- To date, peer-reviewed research addressing the specific components and practices of real-time suicide surveillance systems in a regional, national, or international context is extremely scarce.

What is the added value of this research?

- Acknowledging an emerging field of research, this doctoral thesis demonstrates innovation in response to the growing demand for real-time suicide surveillance.
- Establishment of a standardised method to statistically verify the presence (or absence) of suicide and self-harm clusters within a population, contributing to the identification and protection of vulnerable or impressionable individuals at risk of contagion associated with suicide and self-harm clusters, mitigating possible further contagion.
- This thesis presents the first body of research in Ireland to offer a comprehensive framework for the development and implementation of a real-time suicide surveillance system with inbuilt cluster detection and interactive data visualisation features that can be scaled and adapted based on available resources and capacity, thus demonstrating international applicability.
- This research addresses a major gap in the scientific literature by providing evidence informed recommendations for current best practice in real-time suicide surveillance, based on an international comparison of established systems.
- Building on previous explorations of the impacts of the media on suicide contagion and clusters, this research identified significant impacts on increased risk of suicide contagion within the first days up to the first 3 months following the media coverage, underlining the need to prioritise implementation and adherence to media guidelines on reporting suicide for media professionals and outlets.
- The dashboard prototype demonstrates real-world applicability as a proactive monitoring tool for timely action in suicide prevention by facilitating informed planning and preparedness to respond to emerging suicide clusters and other concerning trends.

What are the implications of the research outcomes?

- The findings of this research will inform policy planning by providing the means to design, review and modify currently implemented suicide prevention strategies via data collated by an implemented real-time suicide surveillance system.
- Implementation of real-time suicide surveillance, based on the recommendations put forward by the current research will assist in rapid data-driven decision-making in the context of suicide prevention, particularly in terms of resource allocation and targeted interventions for identified at-risk populations.
- The research encompassing this doctoral thesis fulfils both national and international policy objectives to improve surveillance of suicide, as well as timely monitoring and evaluation of national suicide prevention strategy components.
- This research further facilitates national and international policy by providing a real-time indicator to measure progress towards key policy objectives to reduce suicide rates within the policy timeframe.
- The findings of this research provide the means to enhance statistical detection of suicide and self-clusters, by applying a standardised approach using the most advanced methodology.

8.2.1. Quantitative methods to detect suicide and self-harm clusters: a systematic review

The first study was a systematic review that synthesised the existing evidence of quantitative methods and analyses of suicide and self-harm clusters and examined the accuracy of cluster determination (Chapter 3). This was the first in-depth review of suicide and self-harm cluster detection methods, following a previous systematic review of suicide and self-harm clustering conducted in 2012 which identified predominantly narrative reports of singular clusters that were not statistically verified. The outcomes of the review showed an accumulation of studies over the 45-year period since quantitative investigations into clusters of suicidal behaviour were first published, demonstrating a growing interest in this research area. The outcomes assist in determining a standardised methodological approach to detect suicide and self-harm clusters in a population, with the findings separated into the different types of clusters investigated.

To detect point and echo clusters, a discrete Poisson-based scan statistical model was found to capture most parameters. The synthesised results reveal that continuous advances in statistical methods and geospatial analytical techniques have effectively contributed to point cluster detection by means of geospatial probabilistic modelling; most notably, the evolvement of open-source GIS and spatial scanning software (104). Furthermore, the type of scan statistic applied in the cluster analysis can affect the cluster shapes detected, wherein the traditional and most commonly used SaTScan scanning software detects clusters that are circular in shape due to the cylindrical scanning window, while FlexScan scanning software can detect irregularly shaped clusters involving up to approximately 30 cases, limiting the capability of both scanning methods. Echescan, an alternative scanning software identified in the literature effectively detects non-circular shaped ‘hotspots’, i.e., locations where individuals frequently take their lives. This method focuses on the spatial hierarchical structure of the hotspot which is visually represented by a dendrogram scanned from top to bottom but is limited to detecting average sized, non-complex shaped clusters. Crucially, the manipulation of the analysis window parameters of scan statistic algorithms to determine the appropriate population and duration

thresholds is key to calibrating the optimal parameter combination (235). This is a particularly important discovery given that the precision of results is affected by scale. The review further uncovered that precise detection of point and echo clusters depends on the level of the geographical data analysed, whereby geocoded residential address data provides the most optimal basis for precision, a finding supported by previous research (371).

A time-series regression model was found to capture most parameters of mass clusters, based on temporal data relating to the date of death of individuals who died by suicide. However, limitations exist in this analytical approach due to the use of retrospective aggregated data in studies of this kind that compromise the accuracy and efficiency of mass cluster detection investigations. Based on the findings of the review, it is reasonable to conclude that limitations exist in mass cluster detection due to the difficulty in interpreting observed increases in rates of suicidal behaviour as a direct link to a preceding high-profile case with absolute certainty, corroborating a similar conclusion made by Stack (61). The accuracy of mass cluster detection is further limited given the geographical distribution of linked cases which can extend across the world (141).

In conclusion, the synthesised findings of this review demonstrate advances made in epidemiological cluster detection of suicide and self-harm. Though, the use of retrospective aggregated data limits the accuracy and timeliness of cluster detection investigations. The application of such techniques prospectively to real-time data would enhance cluster detection capabilities through the investigation of emerging suspected clusters, providing an evidence-base for earlier intervention and mitigation of possible further contagion in identified vulnerable populations.

8.2.2. Real-time suicide surveillance: comparison of international surveillance systems and recommended best practice

The second study comprising this thesis involved a comparative review of the components and practices of five major real-time suicide surveillance systems internationally (Chapter 4). Based on the review, more commonalities than differences were identified among the components and practices

of the included systems. A key discovery was the shared purpose of the systems in informing suicide prevention efforts, through the provision of an evidence-based data source to invalidate misinformation, inform response plans, and detect emerging trends, links, and clusters. Furthermore, most systems gather geographical data based on residential address, location of death, or both, thereby facilitating aberration detection using an algorithm based on the scan statistic to determine the presence of spatial, temporal, and spatiotemporal clusters (160). The major difference identified between the systems is the case submission interval, which greatly impacts the speed at which emerging cluster detection can be performed and subsequent response initiated. In interpreting the findings of the systems' review, specific criteria were recognised as fundamental to the establishment of a real-time suicide surveillance system that aligns with current international best practice. As such, this study sought to promote replicable components and practices in real-time suicide surveillance, while offering flexibility in adapting to regional/local circumstances and resource availability. The findings of this study are pertinent for public-health surveillance and practice, even more so during this current turbulent period globally, given that the demand for real-time suicide surveillance to inform efficient decision-making has never been greater (257, 271). These findings have been substantiated by an unrelated study that also emphasises the benefits of real-time suicide surveillance for suicide prevention (115).

8.2.3. The development and validation of a dashboard prototype for real-time suicide mortality data

The third study underpinning this doctoral thesis sought to develop and validate a prototype for a real-time suicide surveillance dashboard, testing proof of concept (Chapter 5). At the time of writing, this unique research is the first empirical study to explore the possibility of incorporating an interactive data visualisation tool with an inbuilt cluster detection feature in an established real-time suicide surveillance system, whereby routinely collated suicide mortality data is statistically analysed and visually displayed through an intuitive interface, streamlining the interpretation of data. This study

builds on the research findings reported in chapters 4 and 5 of this thesis by utilising the research outcomes to inform the design of the methodology for this specific study.

The results indicate that the integration of a cluster detection approach involving geo-visualisation techniques, space-time scan statistics and predictive modelling could enable prospective detection of emerging suspected clusters, at-risk populations, and locations of concern. However, the need for current data is evident given that the data infrastructure fundamentally relies on the availability of real-time suicide mortality data to effectively run the prospective analytics and produce the required outputs to inform timely suicide prevention measures.

The findings of this research corroborate previous studies that have also detected suicide clusters through the application of retrospective space-time scan statistic to spatiotemporal data (168,172,178). While the prospective space-time scan statistic was unsuccessful in detecting clusters, this outcome was anticipated given the lack of current data available for analysis. The results of this study illustrate the capability of R software and its relevant packages to produce visualisations of analytic outputs, demonstrating the compatibility of the software as a platform for a real-time suicide surveillance dashboard. Overall, the findings prove that the retrospective space-time scan statistic has feasibility to detect emerging clusters using geocoded data.

8.2.4. Suicide clustering and contagion: The role of the media

The role of media in suicide clustering and contagion has long been considered an issue warranting intervention by researchers in the field of suicidology (94,372,373). Chapter 6 represents an in-depth examination of this matter through a comprehensive narrative review of the existing literature that addresses different types of media and media contents and their impact on suicide contagion and clustering. The distinctiveness of this study from other published research on this topic is the specific focus on several types of media and their independent influence on clustering and contagion. Consistency was identified in the increased amount of media reports of suicide and the explicit portrayal of case details including both high-profile and fictional cases to be associated with suicide

contagion and increased suicide mortality rates or mass clustering, with significant impacts on increased risk of suicide contagion taking hold within the first days until as far as three months post-media coverage of a high-profile case. The effect of potentially harmful content and the depiction of suicidal behaviour via social media and websites on suicide contagion and clustering was largely consistent with research into influences concerning traditional media. Confirming recommendations stemming from previous research on this topic (315,374,375), the findings strongly reinforce the importance of responsible reporting and coverage of suicide by media professionals and media outlets.

8.2.5. Real-time suicide surveillance for policy and practice

The fifth and final study encompassing this thesis involves a research report detailing the implications of real-time suicide surveillance for policy and practice (Chapter 7). This chapter builds on the outcomes of preceding chapters by drawing inferences from their findings to determine the applicability of real-time suicide surveillance in various contexts including policy, emerging suspected suicide contagion and clustering, public health emergencies, and crisis planning and response. The pertinence of real-time suicide mortality data can be understood in the context of public health emergencies including the current COVID-19 pandemic and the co-occurring armed conflict engulfing the world at this time, which has resulted in the highest number of displaced individuals ever recorded globally since World War 2 (349). The mental-health fallout of such simultaneous crises will likely be colossal, yet, without a live evidence-base of high-quality data, both policy and practice will not be tailored or targeted towards those who are in most need. This study aligns with previous research that underlines the value of employing real-time suicide mortality rates as an indicator to monitor progress of national suicide prevention strategies (115), while reporting a fresh perspective on the value of conducting predictive modelling on real-time suicide data to inform strategies to respond to future crises such as possible new pandemics and the rising climate catastrophe. The findings underline the

importance of real-time suicide surveillance to facilitate preparedness to act in anticipation of public health emergencies and humanitarian crises.

8.3 Theoretical implications of this research

A number of theoretical implications have evolved from the research in this thesis. The outcomes of this thesis can be considered in the context of the Social Learning model (122). Chapter 6 highlighted the role of the media in suicide contagion and suicide clustering. The findings of this research solidify previous research which has also concluded that the magnitude of media coverage on suicide is linked with increased suicide rates (61,92,374). The notion that cultural transmission (68,376), i.e., the process by which a network distributes a message to multiple recipients simultaneously, provides a vehicle for mass clustering is corroborated by the findings of this research. Ultimately, these results demonstrate the harmful impacts of sensationalised media coverage of suicide and further strengthen the need for efforts to counter the phenomenon, with the most accessible population-level intervention taking the form of media guidelines for reporting on suicide, which seek to limit the circulation of harmful content that idealises suicide (374).

Theoretically informed interventions are considered superior because they recognize key mediator mechanisms of change (376). The Circles of Vulnerability hypothesises that those individuals for which risk is heightened in the wake of a crisis are those in close proximity to the event (122). Guidance based on good practice in intervening in suicide clusters to mitigate further contagion consistently highlights the circles of vulnerability model as a framework to support identification of vulnerable individuals who may need support (95,141,143,377). The findings of this thesis complement this theoretical framework through the development of real-time suicide surveillance data infrastructure to facilitate ongoing, proactive monitoring of suicide with the aim of detection of emerging suspected clustering and identifying vulnerable individuals accordingly. Where vulnerable individuals and subpopulations are identified, the opportunity to implement targeted interventions consequently

exists. However, there remains a possibility that not all vulnerable individuals may be identified using this framework and might be better reached through population-level approaches to suicide prevention.

In this respect, the Socio-Ecological model offers an alternative framework to identify risk and protective factors that can inform corresponding suicide prevention strategies based on societal, community, relational, and individual levels, thereby employing a holistic approach to address the complexities of suicide (120). The outcomes of the research within this thesis align with the socio-ecological framework through the provision of surveillance tools to examine emerging risk-factors that can support identification of at-risk subpopulations, for which targeted interventions may be implemented at the relevant level.

8.4. Methodological implications of this research

This thesis presents methodological implications for the field of suicide research. The research presented in Chapter 3 presents a proposed standardised approach to suicide and self-harm cluster detection informed by the findings of a systematic review of previous cluster detection investigations. The results imply that the quantitative analysis of suicide and self-harm clusters has progressed due to advances in statistical methods and geospatial analytical techniques, most notably, spatial scanning software. The application of such techniques in prospective mode to real-time surveillance data could effectively detect emerging suspected clusters and inform timely intervention, while also providing the methodology for predictive modelling and simulation.

As indicated in the research detailed in chapters 4, 5, and 7 of this thesis, a consistently underlined area for improvement in the field of suicidology is the real-time surveillance of suicidal behaviour. Research on the topic has outlined how a lack of high quality, reliable and timely surveillance data impacts the provision of comparative statistics internationally (378). The absence and poor quality of surveillance in some regions of the world emphasises the importance of encouraging and supporting low- and middle-income countries to establish functional suicide surveillance systems in their

countries. In this thesis, the challenges of suicide surveillance are discussed, particularly in relation to delays in the release of official mortality statistics in Ireland and many other countries (105,257). The surveillance of provisional data based on deaths by suspected suicide or equivalent terminology provides the opportunity for timelier decision-making in suicide prevention, particularly in the context of crisis planning and response. The proposed framework outlined in Chapter 4 seeks to promote replicable practices and components of real-time suicide surveillance systems, offering flexibility in adapting to local circumstances and resource availability. In order to facilitate international comparative research in the area, the adoption of the recommended criteria for best practice in real-time suicide surveillance would be a significant methodological implication for the field of suicidology. Chapter 5 describes the unique development and validation of a dashboard prototype with inbuilt cluster detection features that visually display analytical output by means of an intuitive interface. This research presents an innovative approach to data reporting, providing additional insights and evidence of patterns in deaths by suicide that are readily visible, streamlining data interpretation. This prototype has been developed using free, opensource software, hence ensuring accessibility of the methodological infrastructure for real-time suicide surveillance for all countries by diminishing the financial constraints that commonly occur in lower income countries.

The dashboard template presented in this thesis can strategically improve data-driven decision making for stakeholders and policy makers, with key methodological implications for exploratory data analysis and subsequent situational awareness of current suicide rates. As a result, this dashboard prototype fills a major gap between researchers and decision makers through the enhancement of suicide data infrastructure. Applying the dashboard template to real-time suicide surveillance overcomes delays in data reporting through the regular input of new data, which is immediately visually reflected on the dashboard, consequently facilitating proactive monitoring and informed, timely action upon aberration detection.

8.5. Implications for clinical practice

In the context of clinical practice, a key feature of the real-time suicide surveillance system outlined in Chapter 4 of this thesis is the collation of data on mental-health service use of individuals who die by suspected suicide, including details of the period between psychiatric inpatient discharge and death. The psychiatric hospitalisation post-discharge period is known to be one of elevated suicidal risk, indicating a vulnerable service user group (379,380). Adherence and engagement with treatment plans post-discharge are known to reduce suicidal behaviour, particularly attempted suicide (379). Information captured by real-time suicide surveillance system that is communicated to key stakeholders such as senior management of mental health services provides the opportunity to identify possible gaps in service provision that may be swiftly addressed by means of reviews of mental health service admission and discharge codes of practice to protect vulnerable service users, as well as modifications to pre-discharge education, follow-up contact and outreach.

In addition, real-time suicide data provides an evidence-based source to identify emerging novel methods of suicide, with ongoing trend analysis affording the opportunity to observe changes in the demographic, psychosocial and psychiatric profile of people at risk of suicide. This information may be used to guide clinical care provision to individuals from identified at-risk subpopulations. Furthermore, the data collated by the recommended framework for real-time suicide surveillance presented in this research can facilitate early detection of suicide contagion and clusters related to mental health settings, providing the grounds for means restriction and other interventions.

8.6. Implications for policy and suicide prevention

The findings of this novel body of research have strong implications for suicide prevention with specific applicability to policy, means restriction, crisis planning and response, and media coverage of suicide. This thesis is the first study to focus on real-time suicide surveillance in Ireland. This research was born out of a growing demand for current data to accelerate decision-making in suicide prevention and mental-health care provision.

An encrypted online platform housing real-time suspected suicide mortality data seeks to promote close collaboration between key stakeholders, not only for crisis response purposes, but to also support longer-term suicide prevention initiatives such as means restrictions efforts at identified locations where individuals frequently take their lives and novel methods of suicide, as well as targeted interventions for identified vulnerable subpopulations via longitudinal trend analysis.

8.6.1. Implications for policy frameworks for suicide prevention

The development, implementation, and piloting of the real-time suicide surveillance system in the South-west region of Ireland fulfils both national and international objectives based on the need for real-time suicide mortality data, including Ireland's National Strategy to Reduce Suicide 2015-2024 Connecting for Life, objective 7.2: to improve access to timely and high-quality data on suicide (147). It also fulfils suicide prevention priorities outlined in Ireland's current national mental health policy, 'Sharing the Vision – A Mental Health Policy for Everyone', specifically by providing more timely data to inform targeted and improved community-based suicide prevention actions (148,149). The development and validation of a real-time suicide surveillance dashboard holds the potential to facilitate monitoring and evaluation of both suicide prevention strategies and wider mental health policies by providing the data infrastructure to track progress towards the aims and objectives of national policy implementation plans (147-149).

In the international context, this research fulfils objective 4 of WHO's Comprehensive Mental Health Action Plan 2013–2030, to strengthen information systems, evidence, and research for mental health and facilitates progression towards the global target 3.2 to reduce suicide by one third by 2030 (150). The research within this thesis also facilitates the United Nations' Sustainable Development Goal 3, target 2.4 to reduce by one third premature mortality from non-communicable diseases through prevention, treatment and promotion of mental health and well-being by 2030, of which suicide mortality rate is an indicator (151) through the provision of a real-time suicide surveillance framework outlined in Chapters 4 and 5 of this thesis to monitor progress towards these targets.

8.6.2. Implications for means restriction

Means restriction has been proven as an effective strategy for suicide prevention strategy (381). While some individuals consider alternative methods to take their life when restrictions have been imposed on certain means, many do not and in those instances where substitute means are explored, they are typically less lethal and associated with less deaths than where more fatal means are accessible (382). This form of deterrent strategy has been previously shown to reduce suicide rates (383), with examples including physical barrier erection at locations where individuals frequently take their lives such as bridges and train stations (384,385). The collation of real-time data on suspected suicide deaths including details of the location of death provide the basis for ongoing trend analysis, amounting to a reliable evidence-base for identification of locations where individuals frequently take their own lives which can be subsequently used to inform means restriction efforts. Locations of concern typically include cliffs, railways, bridges, tall buildings, and secluded areas (77). Deaths by suicide that occur at publicly accessible locations often attract media attention (386), a factor that can contribute to further cases at those locations. While installation of physical barriers has been found to be effective in reducing suicides at locations of concern (387), strategies such as frequent patrolling aimed at increasing the possibility of third-party intervention and signage aimed at promoting help-seeking have undergone less scientific evaluation. The identification of sites where means restriction mechanisms should be implemented can be informed by real-time suicide surveillance, incorporating pre- and post-intervention suicide rates as an indicator in the evaluation of the implemented measures, with ongoing monitoring advised to verify whether the restrictions measures are fit for purpose (77). Using the data dashboard tool demonstrated in Chapter 5 to share significant information with key stakeholders would guarantee a cohesive, multisectoral approach to suicide prevention strategies of this nature. Real-time suicide surveillance is also crucial to the early identification of novel or rare methods of suicide that could go undetected for some years without close monitoring (383). Timely detection of atypical methods provides the chance to mitigate further spread in the community and eradicate the method before it becomes common; an ever-increasing

challenge of this digital era of online social connectedness in which information can be widely shared in an instant (383).

8.6.3. Implications for crisis planning and response

Bereavement by suicide is an extremely traumatic experience that affects people in different ways, ranging from those who are mildly impacted in an affected community, to those directly bereaved by a loved one. Given the number of deaths and the consequential number of individuals grieving, the impact of suicide clusters is far reaching across a community (388). The key components of a crisis response in suicide prevention are preparedness, intervention, postvention and follow up (389). Prospective development of suicide cluster response plans prevents panic and impromptu responses in the event of an actual cluster (95). Pre-planned responses and evidence-based interventions are essential to identify vulnerable individuals and provide support both in the acute phase and in the longer-term. In responding to suicide clusters, an extensive range of resources and supports are required to meet the needs of all those impacted in any given community (142). As such, the crisis response must be tailored to the circumstances of the event as it will differ depending on the scale of the crisis, the community fallout and the availability of capacity and resources. Identification of those affected within the community is central to the response effort, and the speed at which those vulnerable individuals are identified influences the timely provision of appropriate support.

The development and incorporation of an algorithmic intuitive interface for real-time suicide surveillance as demonstrated in Chapter 5 provides an early-warning system to facilitate initiation of crisis plans in response to emerging suspected suicide clusters. It further provides an evidence-base to increase the capacity for early intervention when emerging suspected clusters are detected, while also assisting with optimising resource allocation and informing health service responses in geographical areas with recurring clusters based on the mapping feature. The encrypted dashboard provides a powerful tool to share clear information about the crisis in order to determine the specific form of response required from key stakeholders.

In the context of Ireland, the implementation of the updated “Standardised suicide bereavement resource guide with accurate, relevant, up-to-date and consistent information for individuals and families that have lost a loved one to suicide or suspected suicide” (389), produced by the HSE requires access to real-time suicide mortality data for effective implementation of these guidelines. A further HSE resource, “Developing a Community Response to Suicide: A resource to guide those developing and implementing an inter-agency Community Response Plan for incidents of suspected suicide, particularly where there is a risk of clusters and/or contagion” (338), also indicates a dependency on real-time suicide mortality data by the HSE Resource Officers for Suicide Prevention to effectively carry out their roles. The functions of a real-time suicide surveillance system support the appropriate implementation of these resources and validate the scale up to national level to ensure a standardised approach across the country.

Crisis response preparedness goes beyond suicide cluster response planning. The findings of this research further demonstrate the need for readiness to activate a response in the emergence of crises of a larger scale. The relevance of crisis response has never been greater than during the concurrence of humanitarian crises taking place across the globe currently. The ongoing COVID-19 pandemic increased the demand for real-time suicide mortality data as an indicator of the impacts of the pandemic and the related societal restriction measures on population mental health and wellbeing (253). Real-time suicide data collated by the Observatory has been used to inform multiple briefings, as requested by the Department of Health and the National Office for Suicide Prevention on deaths by suspected suicide, in particular meeting an increasing number of requests from a wide range of stakeholders during the COVID-19 pandemic (344). The data reports of the Observatory represent the only source of real-time suicide related data in Ireland currently, underlining the vast need for this type of system on a national level. The findings of this thesis not only highlight the importance of real-time data to prepare for and monitor the impact of a public health emergency, but also co-occurring crises including armed conflict and climate-related stressors. Such data is vital to facilitate timely,

targeted, public health responses during and after such emergencies. The recommended criteria for best practice in real-time suicide surveillance proposed by the research in this thesis seek to promote standardisation in suicide surveillance internationally, with the intention to enhance international comparability of suicide rates.

8.6.4 Implications for media reporting on suicide

Media coverage of a crisis can influence how individuals react and their understanding of the supports available to them (392). Insensitive media reporting practices can glorify suicide and contribute to an elevated risk of imitative suicidal behaviour in vulnerable individuals. Poor media practices include those which disclose unnecessary details of high-profile suicide deaths, those that describe suicide clusters or rare methods of suicide, those that include imagery or details of the method of death, and those that debate suicide as a reasonable response to crisis (2). The findings of this thesis demonstrate the powerful role that different types of media play in suicide clustering and contagion, particularly in the manner and extent to which suicide is portrayed. Despite concern surrounding the harmful impacts of the media on suicide through the spread of misinformation and sensationalised coverage of suicide, if used in a responsible manner, the media can be useful tool to highlight the preventability of suicide, and to share support information and protective guidance with individuals affected by suicide (315,383).

Real-time suspected suicide data from the Observatory has been used in multiple instances to validate unverified media reports of contagion in the South-west region of Ireland. This validation feature has proven to be effective in fulfilling requests from the media for verification of anecdotal information, hence preventing the spread of misinformation relating to perceived contagion/clustering. Based on the outcomes of the research in this thesis, real-time suicide surveillance encourages more accurate reporting of suicide rates and trends, contributing to less sensationalism by dispelling speculation through the provision of a validated source from which to verify unsubstantiated reports prior to

dissemination in the media or via social media channels. Thus, real-time suicide surveillance facilitates reliable reporting of suicide. Media guidelines have been developed in many countries to support responsible and sensitive reporting of suicide (390-393). Such guidelines are informed by extensive international evidence and lay out working principles for media professionals to draw on in their coverage of suicide (390). While these guidelines are intended to provide advice as opposed to restrict freedom of information, they do seek to reinforce media industry codes of practice and journalism policies by way of supporting professionals and media outlets to meet appropriate standards of reporting on suicide. In the absence of strict regulations on media coverage of suicide, it is essential that these guidelines are reinforced and distributed to all media personnel and outlets. Furthermore, close monitoring of adherence to the media guidelines must be prioritised by broadcasting safety authorities and governing bodies such as the Press Ombudsman and the Press Council of Ireland who should seek to investigate all breaches by way of strengthening compliance with factual and responsible media coverage. Focused training would also serve to increase awareness and understanding among media professionals of the possible consequences of incautious coverage of suicide, encouraging safer communication around the topic.

Based on the findings of the research detailed in Chapter 6 of this thesis, the need for safer dialogue on suicide extends beyond the role of media professionals. An unprecedented challenge of this digital era is the lack of regulations on cyber communication, resulting in the instant spread of unfettered information which can reach thousands of people instantly across social media platforms and the wider internet. Since social media is a rapidly advancing online arena, there is still a dearth of evidence to understand online peer-to-peer communication around the topic of suicidal behaviour. Young people are especially vulnerable to the media coverage of suicidal behaviour and may not be aware of how to manage unsafe content. The development of #chatsafe, evidence-informed guidelines that encourage safer online communication about self-harm and suicide among young people (394) must

be promulgated through pathways that reach young people such as educational, community and care settings.

Frameworks for suicide cluster response emphasise the need to monitor social media in the wake of a death by suicide or during a suspected suicide cluster. Guidance has also been developed, to assist in establishing the type of content that requires monitoring, how to respond to individuals who may be at risk, and how to promote safe dialogue around suicide and is specifically targeted at policy makers, service providers, and community networks (331). Resources such as this guidance tool are highly useful and should be adopted by crisis response groups to increase preparedness to respond.

8.7 Future research considerations

The findings of this thesis provide a comprehensive understanding of the surveillance, detection, and response to suicide clusters. The range of methodological and theoretical approaches applied in this research warrant greater consideration by other academics researching this area of suicidology. This body of research has led to the identification of several key areas for future research. The first consideration for future methodological research is the further enhancement of suicide and self-harm cluster detection methods. Based on the findings of Chapter 3, future research should seek to compare the performance of the scan statistic algorithms via a simulation study and examine the sensitivity of the models. Based on the unique purposes of the scan statistics, the robustness and sensitivity of a Poisson-based spatial scan hybrid approach should also be explored by future research. Although inferential approaches for the detection of suicide clusters have many empirical advantages such as the facilitation of evidence based-decision making, the accuracy and precision of suicide clusters detected using the scan statistic depends on pre-determined spatial and temporal parameters, for which there is currently no-gold standard. Future research should seek to determine the efficacy of incorporating psychological autopsy in a mixed method point cluster detection approach whereby point clusters statistically detected by geospatial probabilistic modelling are investigated further using

psychological autopsy including qualitative interviews with individuals identified as close to the deceased or self-harm event. This type of approach would adopt the Circles of Vulnerability framework (121) to identify individuals in close proximity to the event and could establish further links between cases and possible identification and screening of other individuals affected by the cluster who may require clinical intervention and support. This future research consideration would build on a recent study by John and colleagues (395) who investigated suicide clusters through semi-structured interviews with individuals presenting with self-harm during a suicide cluster, who were identified retrospectively through the primary quantitative analysis of a suicide cluster. On a related topic, another future research consideration is an investigation to determine whether suicide clusters proceed self-harm clusters or vice versa in the Irish population, an occurrence previously identified by an Australian study conducted by Too and colleagues (66) and further supported by Hawton and colleagues (141) who postulate that linked self-harm events may be a precursor for suicide clusters. The results of such an investigation would have strong implications for suicide prevention in terms of informing the appropriate crisis response for communities experiencing independent suicide and self-harm clusters preceding other another or simultaneous clusters of suicidal behaviour.

A relatively unexplored area of research that warrants further scientific assessment is the impact of the media on murder-suicide and possible contagion or 'copycat' cases. Murder-suicide events involve a perpetrator unlawfully taking the life of an individual and subsequently taking their own life. Extensive media attention is often directed at murder-suicide events, by which the emphasise on the homicide can mask the element of suicide involved in the act (142). The need for sensitive and responsible reporting of such events has been previously highlighted to minimize sensationalism of the topic (390,396,397). Future research should seek to investigate whether the media is influential in subsequent murder-suicide events by means of the temporal analysis of murder suicide cases and examination of the media coverage of the events around the time of their occurrence.

A further area of future research arising from this thesis is the proposal to incorporate real-time suicide surveillance in the monitoring of a community response to suicide clusters. To date, only one

empirical study has evaluated a community-based response to suicide clusters (180). However, the evaluation was based on retrospective data collated after the cluster had occurred. Using current data to monitor interventions on a real-time basis during an identified suspected suicide cluster would offer the opportunity to actively adapt the community response based on the identified needs, permitting prompt refinement to the intervention, postvention and follow-up components of the response. On a related topic, future research should also address the impact of real-time suicide surveillance systems on prevention practices to determine the utility of such systems from a broader stakeholder perspective.

8.8 Strengths and limitations

8.8.1 Strengths of this research

This thesis addressed a major gap relating to real-time suicide surveillance. Not only does the research in this thesis represent the first efforts to develop a real-time suicide surveillance in Ireland, but it also accounts for one of the first established real-time suicide surveillance systems in Europe, demonstrating strong innovation in a significantly under-explored area of suicidology. As such, the real-time suicide surveillance system developed, implemented, and piloted within this research represents the only source of real-time suicide related data in Ireland currently, with regular requests from the Department of Health to inform population-level strategies in the context of the ongoing COVID-19 pandemic (344). In this respect, an official evaluation of the system is reasonable to determine the possible commission of the initiative for scale-up to national roll-out.

In addition, this research is timely given limitations in the availability and accuracy of current suicide data, particularly in low- and middle-income countries, as previously highlighted by the WHO (149). It is further well-timed in providing an evidence-based template in response to a call for real-time surveillance of suicide data to monitor the ongoing impact of the COVID-19 pandemic on suicide and the effects of natural population-based experiments and exposures. Member States of the United Nations may adopt the comprehensive approach put forward by this research to evaluate their

progress towards achieving a significant reduction in the global suicide rate, as per target 3.4 of the SDGs (151).

The research in this thesis demonstrates further innovation in its objective to design data visualisation components of an interactive dashboard prototype for real-time suicide surveillance and detection of emerging suicide clusters. While dashboard tools have been incorporated in public health surveillance and particularly communicable disease surveillance, they have yet to be incorporated in real-time suicide surveillance with the addition of aberration detection and interactive mapping features.

8.8.2 Limitations of this research

A number of limitations related to this body of research must be considered when interpreting the collective findings. For several reasons, significant challenges were experienced in attempting to access suitable national data sources of suicide mortality, attempted suicide, and self-harm data to be analysed by this thesis research. Originally, it was hoped that data from the Irish Central Statistics Office (CSO) could be accessed and used to examine suicide clustering on a national level in this thesis. However, due to data protection related factors with accessing CSO data, it was ultimately impossible to do so. It was also originally anticipated that data from the National Self-Harm Registry Ireland (NSHRI) would be incorporated as a national data source of hospital presenting self-harm cases to investigate self-harm clustering in this thesis. The plan for this study originally involved data-linkage of a national CSO suicide mortality dataset with a national NSHRI self-harm dataset to determine whether self-harm clusters proceeded suicide clusters in the Irish population during a fifteen-year period (2003-2016) by means of geospatial analysis. Following discussions with the NSHRI Manager, this option was ruled out on the grounds that the residential data captured by the NSHRI is coded to small-area unit level, of which the results would impact the precision of the analysis. The NSHRI was also planned for inclusion as a data source for self-harm cases in the South-west region of Ireland. Data reporting by the NSHRI currently take places on a quarterly basis, hence limiting the periodical basis on which the Observatory would be updated with self-harm data. Efforts are currently being

implemented to increase the pace at which self-harm data is reported by the NSHRI, with the intention to include this source in the Observatory going forward.

In addition, national-level current data based on cases of suspected suicide and attempted suicide were anticipated to be included in the Observatory from An Garda Síochána 'pulse system', a live police surveillance system that includes information relating to each case investigated by the Irish police force. Following exploratory discussions with the Head of Data Analytics at An Garda Síochána, this option was ruled out due to inconsistencies in classification of cases collated by the pulse system in the early stages of police investigations. As a result, the HSE patient mortality register has been included as the one crosschecking source of suspected suicide data for the Observatory. However, this brings with it limitations since the register only captures data on deaths by services users, restricting the crosschecking feature. The possibility to include data on cases of attempted suicide as a data source for the Observatory going forward is still under discussion in the context of data protection and data sharing issues.

This research also experienced challenges resulting from the ongoing COVID-19 pandemic which caused significant disruption to data collection processes that subsequently required adaptations to arrive at more feasible means of data collection. These setbacks resulted in a limited dataset for analysis for the research reported in Chapter 5 due to significant time constraints on data collection that was affected by the government-imposed societal restrictions. This issue made it impossible to further update the Suicide Support and Information System with recent cases that had occurred in late 2018 that were still undergoing coronial inquest at the onset of the pandemic and were subsequently postponed for inquest, resulting in a significant backlog of deaths requiring inquest that could not be included in this research. As a result, the results of the research reported in Chapter 5 may be slightly limited due to the moderately-sized dataset.

Finally, the methodology of the research reported in Chapter 6 is limited by the lack of a systematic review, resulting in possible omission of relevant literature that may have been identified through a more systematic screening process.

8.9 Conclusion

The findings of this research are of relevance in furthering our knowledge of monitoring, detecting, and responding to suicide clusters. Collectively, the findings from this thesis suggest that we can work more efficiently and collectively to mitigate further suicidal behaviour by utilising real-time, provisional suicide data to guide quicker action. The outcomes of this research have methodological implications in terms of suicide and self-harm cluster detection and real-time suicide surveillance. The implications of this research further extend to suicide prevention and mental health policy, clinical practice, means restriction, crisis planning and response, and media coverage and reporting of suicide.

References

1. De Leo D, Burgis S, Bertolote JM, Kerkhof AJ, Bille-Brahe U. Definitions of suicidal behaviour: Lessons learned from the WHO/EURO Multicentre Study. *Crisis*. 2006;27(1):4-15.
2. World Health Organization. Preventing suicide: a global imperative. 2014.
3. World Health Organisation. Practice manual for establishing and maintaining surveillance systems for suicide attempts and self-harm. 2016.
4. Silverman M, de Leo D. Why There Is a Need for an International Nomenclature and Classification System for Suicide. *Crisis*. 2016; 37(2):83–87
5. Holley JM, Fox KR, Boccagno C. Nonsuicidal Self-Injury: Diagnostic Challenges and Current Perspectives. *Neuropsychiatr. Dis. Treat.* 2020;16101-112.
6. Goodfellow B, Kolves K, De Leo D. Contemporary definitions of suicidal behavior: a systematic literature review. *Suicide Life Threat Behav.* 2019;49(2):488-504.
7. World Health Organisation. Seventy Second World Health Assembly; Eleventh revision of the International Classification of Diseases: Report by the Director-General. 2019.
8. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 3rd ed. Washington, DC: American Psychiatric Publishing; 1980.
9. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington, VA: American Psychiatric Publishing; 2013.
10. De Leo D. DSM-V and the future of suicidology. Hogrefe Publishing; 2011.
11. Bergmans Y, Langley J, Links P, Lavery JV. The perspectives of young adults on recovery from repeated suicide-related behaviour. *Crisis*. 2009;30(3):120-7.
12. Bergmans Y, Gordon E, Eynan R. Surviving moment to moment: The experience of living in a state of ambivalence for those with recurrent suicide attempts. *Psychol Psychother.* 2017;90(4):633-648.
13. Joiner TE, Conwell Y, Fitzpatrick KK, Witte TK, Schmidt NB, Berlim MT. Four studies on how past and current suicidality relate even when “everything but the kitchen sink” is covaried. *J. Abnorm. Psychol.* 2005;114,291–303.
14. Platt S, Bille-Brahe U, Kerkhof A, Schmidtke A, Bjerke T, Crepet P, et al. Parasuicide in Europe: the WHO/EURO multicentre study on parasuicide. I. Introduction and preliminary analysis for 1989. *Acta Psychiatr. Scand.* 1992;85(2):97-104
15. World Health Organization. Suicide worldwide in 2019: Global Health Estimates. 2021.

16. World Health Organization. Global Health Estimates 2020: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2019. 2020.
17. Burrows S, Laflamme L. Assessment of accuracy of suicide mortality surveillance data in South Africa: Investigation in an urban setting. *Crisis*. 2007;28:74–81.
18. Hagaman AK, Maharjan U, Kohrt BA. Suicide surveillance and health systems in Nepal: A qualitative and social network analysis. *Int. J. Ment. Health Syst*. 2016;10(46).
19. Central Statistics Office. Published Suicide Deaths and Late Registered Deaths. Available at: <https://data.cso.ie/table/VSD33> [Accessed 10/01/2022].
20. Eurostat. Causes of death – Crude suicide death rate by age group. Available at: <https://ec.europa.eu/eurostat/databrowser/view/tps00202/default/table?lang=en> [Accessed 10/01/2022].
21. Joyce M, Daly C, McTernan N, Griffin E, Nicholson S, Arensman E, Williamson E, Corcoran P. National Self-Harm Registry Ireland Annual Report 2019. 2020.
22. Griffin E, McTernan N, Wrigley C, Nicholson S, Arensman E, Williamson E, Corcoran P. National Self-Harm Registry Ireland Annual Report 2018. 2019.
23. Griffin E, Dillon CB, McTernan N, Arensman E, Williamson E, Perry IJ, Corcoran P. National Self-Harm Registry Ireland Annual Report 2017. 2018.
24. Griffin E, Dillon CB, Arensman E, Corcoran P, Williamson E, Perry IJ. National Self-Harm Registry Ireland Annual Report 2016. 2017.
25. Griffin E, Arensman E, Dillon CB, Corcoran P, Williamson E, Perry IJ. National Self-Harm Registry Ireland Annual Report 2015. 2016.
26. Cavanagh JTO, Carson AJ, Sharpe M, Lawrie SM. Psychological autopsy studies of suicide: a systematic review. *Psychol Med*. 2003;33:395–405.
27. Ness J, Hawton K, Bergen H, Waters K, Kapur N, Cooper J, et al. High-volume repeaters of self-harm. *Crisis*. 2016;37:427-37.
28. Chan MK, Bhatti H, Meader N, Stockton S, Evans J, O'Connor RC, et al. Predicting suicide following self-harm: systematic review of risk factors and risk scales. *Br J Psychiatry*. 2016;209(4):277-83.
29. Cheng AT, Chen TH, Chen CC, Jenkins R. Psychosocial and psychiatric risk factors for suicide. Case-control psychological autopsy study. *Br J Psychiatry*. 2000;177:360-5.
30. Hawton K, van Heeringen K. Suicide. *Lancet*. 2009; 373(9672):1372-81.
31. Harris EC, Barraclough BM. Suicide as an outcome for medical disorders. *Medicine (Baltimore)*. 1994;73:281–96.

32. Stenager EN, Stenager E. Physical illness and suicidal behaviour. In: Hawton K, Van Heeringen K, eds. *The international handbook of suicide and attempted suicide*. Chichester: Wiley, 2000: 405–20.
33. Tang NKY, Crane C. Suicidality in chronic pain: a review of the prevalence, risk factors and psychological links. *Psychol Med*. 2006;36:575–86.
34. Brent DA, Oquendo M, Birmaher B, et al. Peripubertal suicide attempts in offspring of suicide attempters with siblings concordant for suicidal behaviour. *Am J Psychiatry*. 2003;160:1486–93.
35. Beautrais AL. Further suicidal behaviour amongst medically serious suicide attempters. *Suicide Life Threat Behav*. 2004;34(1):1-11.
36. Bhugra, D. Suicide and gender: cultural factors. *Harvard Health Pol Rev*. 2006; 7, 166–80.
37. Brent DA, Mann JJ. Familial pathways of suicidal behaviour, understanding and preventing suicide among adolescents. *N Engl J Med*. 2006;355(26):2719-2721.
38. Calati R, Ferrari C, Brittner M, Oasi O, Olié E, Carvalho AF, Courtet P. Suicidal thoughts and behaviors and social isolation: A narrative review of the literature. *J. Affect. Disord*. 2019;245:653-667.
39. Joiner TE, Van Orden KA, Witte TK, Selby EA, Ribeiro JD, Lewis R, Rudd DM. Main predictions of the interpersonal-psychological theory of suicidal behaviour: Empirical tests in two samples of young adults. *J. Abnorm. Psychol*. 2009;118(3):634-646.
40. Hirsch JK. A Review of literature on rural suicide: Risk and protective factors, incidence, and prevention. *Crisis*. 2006; 27(4): 189-199.
41. O’Farrell IB, Corcoran P, Perry IJ. The area level association between suicide, deprivation, social fragmentation and population density in the Republic of Ireland: a national study. *Soc. Psychiatry Psychiatr. Epidemiol*. 2016; 51(6):839–847.
42. Farrelly S, Jeffery D, Rüsch N, Williams P, Thornicroft G, Clement S. The link between mental health-related discrimination and suicidality: service user perspectives. *Psychol. Med*. 2015;45:2013-2022.
43. Gomez J, Miranda R, Polanco L. Acculturative stress, perceived discrimination, and vulnerability to suicide attempts among emerging adults. *J Youth Adolesc*. 2011;40:1465–1476.
44. Cleary A. Suicidal action, emotional expression, and the performance of masculinities. *Soc. Sci. Med*. 2012;74:498–505.
45. Clements-Nolle K, Marx R, Katz M. Attempted suicide among Transgender persons. *Journal of Homosexuality*. 2006; 51: 53–69.
46. Pitman A, Osborn D, King M, Erlangsen A. Effects of suicide bereavement on mental health and suicide risk. *Lancet Psychiatry*. 2014;1(1):86-94.

47. Chan S, Denny S, Fleming T, Fortune S, Peiris-John R, Dyson B. Exposure to suicide behaviour and individual risk of self-harm: Findings from a nationally representative New Zealand high school survey. *Aust N Z J Psychiatry*. 2017; 52(4):349-356.
48. Campos RC, Holden RR, Santos S. Exposure to suicide in the family: Suicide risk and psychache in individuals who have lost a family member by suicide. *J Clin Psychol*. 2018; 74(3):407-417.
49. Andriessen K, Rahman B, Draper B, Dudley M, Mitchell PB. Prevalence of exposure to suicide: A meta-analysis of population-based studies. *J. Psychiatr. Res*. 2017; 88:113-120.
50. Cerel J, Brown MM, Maple M, Singleton M, van de Venne J, Moore M, Flaherty C. How many people are exposed to suicide? Not six. *Suicide Life Threat Behav*. 2019;49(2):529–534.
51. Feigelman W, Cerel J, McIntosh JL, Brent D, Gutin N. Suicide exposures and bereavement among American adults: evidence from the 2016 general social survey. *J. Affect. Disord*. 2017;227(2018):1-6.
52. Berman AL. Estimating the population of survivors of suicide: seeking an evidence base. *Suicide Life Threat Behav*. 2011;41(1):110-116.
53. Erlangsen A, Runeson B, Bolton JM, et al. Association Between Spousal Suicide and Mental, Physical, and Social Health Outcomes: A Longitudinal and Nationwide Register-Based Study. *JAMA Psychiatry*. 2017;74(5):456-464.
54. Agerbo E. Midlife suicide risk, partner's psychiatric illness, spouse and child bereavement by suicide or other modes of death: a gender specific study. *J Epidemiol Community Health*. 2005;59:407 –12.
55. Garssen J, Deerenberg I, Mackenbach JP, Kerkhof A, Kunst AE. Familial risk of early suicide: variations by age and sex of children and parents. *Suicide Life Threat Behav*. 2011;41:585 –93.
56. Calderaro M, Baethge C, Bempohl F, Gutwinski S, Schouler-Ocak M, Henssler J. Offspring's risk for suicidal behaviour in relation to parental death by suicide: systematic review and meta-analysis and a model for familial transmission of suicide. *Br J Psychiatry*. 2021;1-9.
57. Qin P, Mortensen P. The impact of parental status on the risk of completed suicide. *Arch Gen Psychiatry*. 2003;60:797–802.
58. Pitman AL, Osborn DPJ, Rantell K, King MB. Bereavement by suicide as a risk factor for suicide attempt: a cross-sectional national UK-wide study of 3432 young bereaved adults. *BMJ Open*. 2016;6(1).
59. Crepeau-Hobson MF, Leech NL. The impact of exposure to peer suicidal self-directed violence on youth suicidal behaviour: A critical review of the literature. *Suicide Life Threat Behav*. 2014;44(1):58-77.

60. Gould MS, Wallenstein S, Kleinman MH, O'Carroll P, Mercy J. Suicide clusters: An examination of age-specific effects. *Am. J. Public Health.* 1990;80:211-212.
61. Stack S. Media coverage as a risk factor in suicide. *J Epidemiol Community Health.* 2003;57:238-240.
62. Bohanna I. Suicide "contagion": what we know and what we need to find out. *Can. Med. Assoc. J.* 2013;185(10):861-862.
63. Cheng Q, Hong Li, Silenzio V, Caine ED. Suicide contagion: A systematic review of definitions and research utility. *PLoS One.* 2014;9(9):1-9.
64. O'Carroll PW, Mercy JA, Steward JA. CDC recommendations for a community plan for the prevention and containment of suicide clusters. *MMWR Supp.* 1988;37(S6):1-12.
65. Niedzwiedz C, Haw C, Hawton K, Platt S. The definition and epidemiology of clusters of suicidal behaviour: a systematic review. *Suicide Life Threat Behav.* 2014;44(5):569-81.
66. Too LS, Pirkis J, Milner A, & Spittal M. Clusters of suicide and suicide attempt: detection, proximity, and correlates. *Epidemiol. Psychiatr. Sci.* 2017; 26(5), 491-500.
67. Luxton DD, June JD, Fairall JM. Social media and suicide: a public health perspective. *Am. J. Public Health.* 2012;102(S2):S195- S200.
68. Mesoudi A. The cultural dynamics of copycat suicide. *PLoS One.* 2009; 30;4(9):e7252.
69. Larkin G, Beautrais A. Geospatial mapping of suicide clusters. Auckland: Te Pou o Te Whakaaro Nui. 2012.
70. Biddle L, Donovan J, Hawton K, Kapur N, Gunnell D. Suicide and the internet. *BMJ (Clinical research ed).* 2008;336(7648):800-2.
71. Hazell P. Adolescent suicide clusters: Evidence, mechanisms, and prevention. *Aust. N. Z. J. Psychiatry.* 1993;27(4):653-65.
72. Gould MS, Wallenstein S, Kleinman M. Time-space clustering of teenage suicide. *Am. J. Epidemiol.* 1990;131(1):71-8.
73. Gould M, Wallenstein S, Kleinman N. A study of time-space clustering of suicide: Final report. Atlanta: Centers for Disease Control and Prevention (CDC). 1987.
74. Gould MS, Wallenstein S, Kleinman MH, O'Carroll P, Mercy J. Suicide clusters: an examination of age-specific effects. *Am. J. Public Health.* 1990;80(2):211-2.
75. Haw C, Hawton K, Niedzwiedz C, Platt S. Suicide clusters: a review of risk factors and mechanisms. *Suicide Life Threat Behav.* 2013;43(1):97-108.
76. Joiner Jr TE. The clustering and contagion of suicide. *Curr Dir Psychol Sci.* 1999;8(3):89-92.
77. Cox GR, Owens C, Robinson J, Nicholas A, Lockley A, Williamson M, et al. Interventions to reduce suicides at suicide hotspots: a systematic review. *BMC Public Health.* 2013;13(1):214.

78. Hanssens L. 'Echo Clusters'-Are they a Unique Phenomenon of Indigenous Attempted and Completed Suicide? *Aborig Isl Health Work J.* 2010;34(1):17.
79. Hanssens L. Suicide Echo Clusters: Are they Socially Determined, and the Result of a Pre-existing Vulnerability in Indigenous Communities in the Northern Territory? *Aborig Isl Health Work J.* 2011;35(1):14.
80. Gould MS, Petrie K, Kleinman MH, Wallenstein S. Clustering of attempted suicide: New Zealand national data. *Int. J. Epidemiol.* 1994;23:1185–1189.
81. Insel BJ, Gould, MS. Impact of modelling on adolescent suicidal behaviour. *Psychiatr. Clin. N. Am.* 2008;31:293–316.
82. Hill NT, Spittal MJ, Pirkis J, Torok M, Robinson J. Risk factors associated with suicide clusters in Australian youth: Identifying who is at risk and the mechanisms associated with cluster membership. *EClinicalMedicine.* 2020, 29, 100631. doi: 10.1016/j.eclinm.2020.100631
83. Liu KY, Beautrais A, Caine E, Chan K, Chao A, Conwell Y, Law C, Lee D, Li P, Yip P. Charcoal burning suicides in Hong Kong and urban Taiwan: an illustration of the impact of a novel suicide method on overall regional rates. *J Epidemiol Community Health.* 2007;61(3):248-53.
84. Chi YL, Jhou MS, Hsieh YS, & Wen TH. The correlation between availability of high-rise buildings and suicide by jumping in Taiwan. *Taiwan J. Public Health.* 2011;30(6):533-546.
85. Hsu CY, Chang SS, Yip P. Individual-, household- and neighbourhood-level characteristics associated with life satisfaction: A multilevel analysis of a population-based sample from Hong Kong. *Urban Stud.* 2017;54(16):3700-17.
86. McKenzie N, Keane M. Contribution of imitative suicide to the suicide rate in prisons. *Suicide Life Threat Behav.* 2007;37: 538–542.
87. Haw CM. A cluster of suicides at a London psychiatric unit. *Suicide Life Threat Behav.* 1994;24:256–266.
88. Poland S, Ferguson S. Youth suicide in the school context. *Aggress Violent Behav.* 2021;e101579.
89. Brent DA, Kerr MM, Goldstein C, Bozigar J, Wartella M, Allan MJ. An outbreak of suicide and suicidal behaviour in a high school. *Child Adolesc. Psychiatry Ment. Health.* 1989;28(6):918-924.
90. Niederkrotenthaler, T, Voracek, M, Herberth, A, et al. Role of media reports in completed and prevented suicide: Werther v. Papageno effects. *Br J Psychiatry.* 2010;197:234–243.
91. Till B, Niederkrotenthaler T. Media and suicide: the current state of research on the Werther and Papageno effect - a review. *Psychotherapy Forum.* 2019;23:120-128.
92. Phillips DP. The influence of suggestion on suicide: Substantive and theoretical implications of the Werther Effect. *Am Sociol Rev.* 1974;39(3):340-54.
93. Gould MS. Suicide and the media. *Ann. N. Y. Acad. Sci.* 2001;932(1):200–224.

94. Ortiz P, Khin Khin E. Traditional and new media's influence on suicidal behaviour and contagion. *Behav Sci Law*. 2018;36(2):245-256.
95. Hawton K, Hill NMT, Gould M, John A, Lascelles K, Robinson J. Clustering of suicides in children and adolescents. *Lancet Child Adolesc. Health*. 2020;4(1):58–67.
96. Johansson L, Lindqvist P, Eriksson A. Teenage suicide cluster formation and contagion: Implications for primary care. *BMC Family Practice*. 2006;7:32.
97. Rimal RN, Real K. Understanding the influence of perceived norms on behaviours. *Commun Theory*. 2003;13:184–203.
98. O'Connor RC, Rasmussen S, Hawton K. Distinguishing adolescents who think about self-harm from those who engage in self-harm. *Br J Psychiatry*. 2012;200(4):330-5.
99. Reyes-Portillo JA, Lake AM, Kleinman M, Gould MS. The relation between descriptive norms, suicide ideation, and suicide attempts among adolescents. *Suicide Life Threat Behav*. 2019; 49: 535–46.
100. Hawton K, Harriss L, Simkin S, Juszcak E, Appleby L, McDonnell R, Amos T, Kiernan K, Parrott H. Effect of death of Diana, Princess of Wales on suicide and deliberate self-harm. *Br J Psychiatry*. 2000;177:463-466.
101. Jobes DA, Berman AL, O'Carroll PW, Eastgard S, Knickmeyer S. The Kurt Cobain suicide crisis: Perspectives from research, public health, and the news media. *Suicide Life Threat Behav*. 1996;26:260-264.
102. Jones P, Gunnell D, Platt S, Scourfield J, Lloyd K, Huxley P, John A, Kamran B, Wells C, Dennis M. Identifying probable suicide clusters in Wales using national mortality data. *PLoS One*. 2013;8(8):e71713.
103. Qi X, Hu W, Page A, Tong S. Spatial clusters of suicide in Australia. *BMC Psychiatry*. 2012;12(1):1-1.
104. Mclafferty S. Disease cluster detection methods: recent developments and public health implications. *Ann. GIS*. 2015;21(2):127-33.
105. Värnik P, Sisask M, Värnik A, Laido Z, Meise U, Ibelshäuser A, Van Audenhove C, Reynders A, Kocalevent RD, Kopp M, Dosa A. Suicide registration in eight European countries: A qualitative analysis of procedures and practices. *Forensic Sci. Int*. 2010;202:86–92.
106. Ikeda R, Hedegaard H, Bossarte R, Crosby AE, Hanzlick R, Roesler J, Seider R, Smith P, Warner M. Improving national data systems for surveillance of suicide-related events. *Am. J. Prev. Med*. 2014;47:S122.

107. Siri MJ, Cork DL. National Research Council. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press; 2009. Vital Statistics: Summary of a Workshop. Rapporteurs.
108. Tøllefsen IM, Hem E, Ekeberg Ø. The reliability of suicide statistics: a systematic review. *BMC Psychiatry*. 2012;12:1–11.
109. Sainsbury P, Jenkins JS. The accuracy of officially reported suicide statistics for purposes of epidemiological research. *J Epidemiol Community Health*. 1982;36:43–8.
110. De Leo D. Can we rely on suicide mortality data? *Crisis*. 2015;36:1–3.
111. O'Donnell I, Farmer R. The limitations of official suicide statistics. *Br J Psychiatry*. 1995;166:458–61.
112. Bakst SS, Braun T, Zucker I, Amitai Z, Shohat T. The accuracy of suicide statistics: are true suicide deaths misclassified? *Soc Psychiatry Psychiatr Epidemiol*. 2016;51:115–23.
113. Thacker SB, Qualters JR, Lee LM, Centers for Disease Control and Prevention. Public health surveillance in the United States: evolution and challenges. *MMWR*. 2012;61:3–9.
114. Värnik P, Sisask M, Värnik A, Arensman E, Van Audenhove C, van der Feltz-Cornelis CM, Hegerl U. Validity of suicide statistics in Europe in relation to undetermined deaths: Developing the 2-20 benchmark. *Inj Prev*. 2012;18(5):321–325.
115. Baran A, Gerstner R, Ueda M & Gmitrowicz A. Implementing real-time data suicide surveillance systems. *Crisis*. 2021;42(5):321-327.
116. John A, Pirkis J, Gunnell D, Appleby L, Morrissey J. Trends in suicide during the covid-19 pandemic. *Br. Med. J*. 2020;371:m4352.
117. Gunnell D, Appleby L, Arensman E, Hawton K, John A, Kapur N, Khan M, O'Connor RC, Pirkis J, Caine ED, Chan LF. Suicide risk and prevention during the COVID-19 pandemic. *Lancet Psychiatry* 2020;7:468–71.
118. Niederkrotenthaler T, Gunnell D, Arensman E, Pirkis J, Appleby L, Hawton K, John A, Kapur N, Khan M, O'Connor RC, Platt S. Suicide research, prevention, and COVID-19. *Crisis*. 2020; 41: 321–330.
119. Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, Ballard C, Christensen H, Silver RC, Everall I, Ford T. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry*. 2020;7:547–60.
120. Dahlberg LL, Krug EG. Violence: a global public health problem. In: Krug E, Dahlberg LL, Mercy JA, Zwi AB, Lozano R, eds. *World Report on Violence and Health*. Geneva, Switzerland: World Health Organization; 2002:1-21.

121. Lahad M, Cohen A. 25 years of community stress prevention and intervention. In O Ayalon, A Cohen, M Lahad (Eds.) *Community Stress Prevention Vol.5*. Kiryat Shmona, Israel: The Community Stress Prevention Centre, 2004.
122. Bandura A, Walters RH. *Social learning theory*. Prentice Hall: Englewood Cliffs; 1977.
123. Centers for Disease Control and Prevention. *The Social-Ecological Model: A Framework for Prevention*. Available at: <https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html> [Accessed 22/01/2022].
124. Cramer RJ, Kapusta ND. A socio-ecological framework of theory, assessment, and prevention of suicide. *Front. Psychol.* 2017;8:1756.
125. Berkelmans G, van der Mei R, Bhulai S, Gilissen R. Identifying socio-demographic risk factors for suicide using data on an individual level. *BMC Public Health.* 2021;21:1702.
126. Almasi K, Belso N, Kapur N, Webb R, Cooper J, Hadley S, Kerfoot M, Dunn G, Sotonyi P, Rihmer Z, Appleby L. Risk factors for suicide in Hungary: a case-control study. *BMC Psychiatry.* 2009; 9(1):1-9.
127. Turecki G, Brent DA. Suicide and suicidal behaviour. *Lancet.* 2016;387(10024):1227-39.
128. Zhu S, Lee PH, Wong PWC. Investigating prolonged social withdrawal behaviour as a risk factor for self-harm and suicidal behaviours. *BJPsych Open.* 2021;7(3):e90.
129. Kleinman E, Liu RT. Social support as a protective factor in suicide: findings from two nationally representative samples. *J. Affect. Disord.* 2013;150(2):540-545.
130. Till B, Tran US, Niederkrotenthaler T. Relationship Satisfaction and Risk Factors for Suicide. *Crisis.* 2017;38(1):7-16.
131. Frey LM, Cerel J. Risk for Suicide and the Role of the Family: A Narrative Review. *J. Fam. Issues.* 2015;36(6):716-736.
132. Rossen LM, Hedegaard H, Khan D, Warner M. County-Level Trends in Suicide Rates in the U.S., 2005–2015. *Am. J. Prev. Med.* 2018;55(1):72-79.
133. Milner A, Page K, Spencer-Thomas S, Lamotagne AD. Workplace suicide prevention: a systematic review of published and unpublished activities. *Health Promot Int.* 2015;30(1):29-37.
134. Evans R, Hurrell C. The role of schools in children and young people's self-harm and suicide: systematic review and meta-ethnography of qualitative research. *BMC Public Health.* 2016;16:401.
135. Quigley J, Rasmussen S, McAlaney J. The Social Norms of Suicidal and Self-Harming Behaviours in Scottish Adolescents. *Int J Environ Res Public Health.* 2017;14(3).
136. Law CK, Kölves K, de Leo D. Influences of population-level factors on suicides in older adults: a national ecological study from Australia. *Int. J. Geriatr. Psychiatry.* 2016;31(4):384-391.

137. Zenere FJ. Suicide clusters and contagion. *Principle Leadership* 2009;10:12-6.
138. Edwards AC, Ohlsson H, Mościcki EK, Sundquist J, Sundquist K, Kendler KS. Geographic proximity is associated with transmission of suicidal behaviour among siblings. *Acta Psychiatr Scand*. 2019;140(1):30-38.
139. Exeter DJ, Boyle PJ. Does young adult suicide cluster geographically in Scotland? *J Epidemiol Community Health*. 2007;61(8):731-736.
140. Robertson L, Skegg K, Poore M, Williams S, Taylor B. An adolescent suicide cluster and the possible role of electronic communication technology. *Crisis*. 2012;33(4):239-45.
141. Hawton K, Lascelles K, Ferrey A. Identifying and responding to suicide clusters and contagion: A practice resource. 2015.
142. Arensman E, McCarthy, S. Emerging survivor populations: Support after suicide clusters and murder-suicide events. In K. Andriessen, K. Krynska, & O. T. Grad (Eds.), *Postvention in action: The international handbook of suicide bereavement support* (pp. 225–236). Göttingen: Hogrefe Publishing, 2017.
143. Clinical Advisory Services Aotearoa. Screening Using Circles of Vulnerability - A model for identifying individuals with increased vulnerability after a death by suicide. 2016. Available at: <https://www.casa.org.nz/resources/3-circles-of-vulnerability-vr2/file> [Accessed 02/02/2022].
144. Bell J, Stanley N, Mallon S, Manthorpe Pridmore J. Insights into the processes of suicide contagion: Narratives from young people bereaved by suicide. *Suicidol Online*. 2015;6(1):43-52.
145. Mueller AS, Abrutyn S. Suicidal disclosures among friends: using social network data to understand suicide contagion. *J Health Soc Behav*. 2015;56(1):131-48.
146. Joiner, Thomas. *Why People Die By Suicide*. Cambridge, MA: Harvard University Press; 2005.
147. Health Service Executive. Connecting for Life, Ireland's National Strategy to Reduce Suicide 2015-2020. 2015. Available at: <https://www.hse.ie/eng/services/list/4/mental-health-services/connecting-for-life/>. [Accessed 02/02/2020].
148. Department of Health. *Sharing the Vision: A Mental Health Policy for Everyone*. 2020. Available at: <https://www.gov.ie/en/publication/2e46f-sharing-the-vision-a-mental-health-policy-for-everyone> [Accessed 25/02/2022].
149. Department of Health. *Sharing the Vision: Implementation Plan 2022–2024*. 2022. Available at: <https://www.hse.ie/eng/about/who/mentalhealth/sharing-the-vision/> [Accessed 23/03/2022].
150. World Health Organisation. *Comprehensive Mental Health Action Plan 2013–2030*. 2021. Available at: <https://www.who.int/publications/i/item/9789240031029> [Accessed 25/03/2022]

151. United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. 2015.
152. Arensman E, McAuliffe C, Corcoran P, Williamson E, O' Shea E, Perry IJ. Arensman E, First report of the suicide support and information system. 2012.
153. Arensman E, Wall A, McAuliffe C, Corcoran P, Williamson E, O' Shea E, Perry IJ. Second report of the suicide support and information system. 2013.
154. Arensman E, Bennardi M, Larkin C, Wall A, McAuliffe C, McCarthy J, Williamson E, Perry IJ. Suicide among young people and adults in Ireland: Method characteristics, toxicological analysis and substance abuse histories compared. PLoS One. 2016;11(11):e0166881.
155. Leahy D, Larkin C, Leahy D, McAuliffe C, Corcoran P, Williamson E, Arensman E. The mental and physical health profile of people who died by suicide: findings from the Suicide Support and Information System. Soc. Psychiatry Psychiatr. Epidemiol. 2020;55(11):1525-33.
156. Coroners Review Group. Coroners Bill. 2007. Available at: <https://www.justice.ie/en/JELR/CoronersBill2007Memo.pdf/Files/CoronersBill2007Memo.pdf> [Accessed 27/02/2022].
157. Rosenberg ML, Davidson LE, Smith JC, Berman AL, Buzbee H, Gantner G, Gay GA, Moore-Lewis B, Mills DH, Murray D, O'carroll PW. Operational criteria for the determination of suicide. J. Forensic Sci. 1988;33(6):1445-56.
158. Kulldorff M. SaTScan User Guide for version 10.0. 2021. Available at: https://www.satscan.org/cgi-bin/satscan/register.pl/SaTScan_Users_Guide.pdf [Accessed 14/12/2021].
159. Kleinman K. Rsatscan. 2017. Available at: <https://cran.r-project.org/web/packages/rsatscan/> [Accessed 16/12/2021].
160. Kulldorff M. Prospective time periodic geographical disease surveillance using a scan statistic. J. R. Stat. Soc. Series A (Statistics in Society). 2001;164(1):61-72.
161. Bando DH, Moreira RS, Pereira JC, Barrozo LV. Spatial clusters of suicide in the municipality of Sao Paulo 1996–2005: an ecological study. BMC Psychiatry. 2012;12(1):124.
162. Larkin G, Beautrais AL, Xu H. Geospatial mapping of suicide clusters in Canterbury New Zealand. Inj Prev. 2010;16(Suppl 1):A258-A.
163. Kulldorff M. A spatial scan statistic. Commun. Stat. - Theory Methods. 1997;26(6):1481-96.
164. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Ann. Intern. Med. 2009;151(4):264-9.

165. Bando DH, Brunoni AR, Bensenor IM, Lotufo PA. Suicide rates and income in Sao Paulo and Brazil: a temporal and spatial epidemiologic analysis from 1996 to 2008. *BMC Psychiatry*. 2012, 12, 127. doi: 10.1186/1471-244X-12-127
166. Carcach C. A spatio-temporal analysis of suicide in El Salvador. *BMC Public Health*. 2017, 17(1), 339. doi: 10.1186/s12889-017-4251-656
167. Ngui AN, Apparicio P, Moltchanova E, Vasiliadis HM. Spatial analysis of suicide mortality in Québec: spatial clustering and area factor correlates. *Psychiatry Res*. 2014;220(1-2):20-30.
168. Cheung YTD, Spittal, MJ, Williamson MK, Tung SJ, Pirkis J. Application of scan statistics to detect suicide clusters in Australia. *PLOS ONE*. 2013;8(1):e54168.
169. Johnson AM, Woodside JM, Johnson A, Pollack JM. Spatial patterns and neighborhood characteristics of overall suicide clusters in Florida from 2001 to 2010. *Am J Prev Med*. 2017;52(1):e1-e7.
170. Robinson J, Too LS, Pirkis J, Spittal MJ. Spatial suicide clusters in Australia between 2010 and 2012: a comparison of cluster and non-cluster among young people and adults. *BMC Psychiatry*. 2016;16(1):417.
171. Núñez-González S, Lara-Vinueza AG, Gault C, Delgado-Ron JA. Trends and spatial patterns of suicide among adolescent in Ecuador, 1997-2016. *Clin Pract Epidemiol Ment Health*. 2018;14:283.
172. Sy KTL, Shaman J, Kandula S, Pei S, Gould MS, Keyes KM. Spatiotemporal clustering of suicides in the US from 1999 to 2016: a spatial epidemiological approach. *Soc Psychiatry Psychiatr Epidemiol*. 2019;54(12):1471-82.
173. Milner A, Too LS, Spittal MJ. Cluster Suicides Among Unemployed Persons in Australia Over the Period 2001-2013. *Soc. Indic. Res*. 2018;137(1):189-201.
174. Gibbons RD, Clark DC, Fawcett J. A statistical method for evaluating suicide clusters and implementing cluster surveillance. *Am. J. Epidemiol*. 1990;132(Suppl 1): S183-S91.
175. Kirch MR, Lester D. Suicide from the Golden Gate Bridge: do they cluster over time? *Psychol. Rep*. 1986.
176. Cox B, Skegg K. Contagious suicide in prisons and police cells. *J Epidemiol Community Health*. 1993;47(1):69-72.
177. Fontanella CA, Saman DM, Campo JV, Hiance-Steelesmith, DL, Bridge JA, Sweeney HA, et al. Mapping suicide mortality in Ohio: A spatial epidemiological analysis of suicide clusters and area level correlates. *Prev. Med*. 2018;106:177-84.
178. Qi X, Tong S, Hu W. Spatial distribution of suicide in Queensland, Australia. *BMC Psychiatry*. 2010;10(1):106.

179. Strauss MJ, Klimek P, Sonneck G, Niederkrotenthaler T. Suicides on the Austrian railway network: hotspot analysis and effect of proximity to psychiatric institutions. *R. Soc. Open Sci.* 2017;4(3):160711.
180. Tomita M, Kubota T, Ishioka F. Spatial Clustering Properties in the Temporal Variation of Suicide Rates/Numbers among Japanese Citizens: A Comprehensive Comparison and Discussion. *PLOS ONE.* 2015;10(7):e0127358-e.
181. Too LS, Pirkis J, Milner A, Bugeja L, Spittal MJ. Railway suicide clusters: how common are they and what predicts them? *Inj. Prev.* 2017;23(5):328-33.
182. Sugg MM, Woolard S, Lawrimore M, Michael KD, Runkle JD. Spatial Clustering of Suicides and Neighborhood Determinants in North Carolina, 2000 to 2017. *Appl Spat Anal Policy.* 2020;1-9.
183. Lai C, Law YW, Shum AK, Ip FW, Yip PS. A community-based response to a suicide cluster: A Hong Kong experience. *Crisis.* 2020; 41(3):163-171.
184. Too LS, Spittal MJ. Suicide Clusters Among Top 10 High-Risk Occupations: A Study From 2001 to 2016 in Australia. *J Nerv Ment Dis.* 2020;208(12):942-6.
185. Hill NT, Too LS, Spittal MJ, Robinson J. Understanding the characteristics and mechanisms underlying suicide clusters in Australian youth: a comparison of cluster detection methods. *Epidemiol Psychiatr Sci.* 2020;29(e151):1–10.
186. Yamaoka K, Suzuki M, Inoue M, Ishikawa H, Tango T. Spatial clustering of suicide mortality and associated community characteristics in Kanagawa prefecture, Japan, 2011–2017. *BMC Psychiatry.* 2020;20(1):1-5.
187. Hsu CY, Chang SS, Lee ES, Yip PS. Geography of suicide in Hong Kong: spatial patterning, and socioeconomic correlates and inequalities. *Soc. Sci. Med.* 2015;130:190-203.
188. Yoshioka E, Hanley SJ, Sato Y, Saijo Y. Geography of suicide in Japan: spatial patterning and rural–urban differences. *Soc Psychiatry Psychiatr Epidemiol.* 2020;7:1-6.
189. Vaz E, Shaker RR, Cusimano MD. A geographical exploration of environmental and land use characteristics of suicide in the greater Toronto area. *Psychiatry Res.* 2020;1;112790.
190. Pérez-Costillas L, Blasco-Fontecilla H, Benítez N, Comino R, Antón JM, Ramos-Medina V, et al. Space–time suicide clustering in the community of Antequera (Spain). *Rev Psiquiatr Salud Men (English Edition).* 2015;8(1):26-34.
191. Kassem AM, Carter KK, Johnson CJ, Hahn CG. Peer Reviewed: Spatial Clustering of Suicide and Associated Community Characteristics, Idaho, 2010–2014. *Prev Chronic Dis.* 2019;16.
192. Takahashi K, Yokoyama T, Tango T. *FlexScan v3. 1: Software for the Flexible Scan Statistic.* 2010.

193. Lersch KM. Exploring the geography of suicide threats and suicide attempts: An application of Risk Terrain Modeling. *Soc. Sci. Med.* 2020;249:112860.
194. Ceccato V, Uittenbogaard A. Suicides in commuting railway systems: The case of Stockholm county, Sweden. *J. Affect. Disord.* 2016;198:206-2157.
195. Tidemalm D, Runeson B, Waern M, Frisell T, Carlström E, Lichtenstein P, et al. Familial clustering of suicide risk: a total population study of 11.4 million individuals. *Psychol. Med.* 2011; 41(12):2527-34.
196. Dos Santos AD, Guimarães LML, Carvalho YFd, Viana, LdC, Alves GL, Lima ACR, et al. Spatial analysis and temporal trends of suicide mortality in Sergipe, Brazil, 2000-2015. *Trends Psychiatry Psychother.* 2018;40(4):269-76.
197. Bando DH, Barrozo LV, Volpe FM. Geographical clusters and social risk factors for suicide in the city of São Paulo, 2006–2015: An ecologic study. *Int J Soc Psychiatry.* 2020;0020764020918618.
198. Beringuel BM, de Barros Canuto IM, Silva AP, do Bonfim CV. Epidemiology and Spatiotemporal Clustering of Suicides in the State of Pernambuco (1999–2018). *Trends Psychol.* 2020;8:1-6.
199. Guo Y, Chau PP, Chang Q, Woo J, Wong M, Yip PS. The geography of suicide in older adults in Hong Kong: An eco-logical study. *Int. J. Geriatr. Psychiatry.* 2020;35(1):99-112.
200. Santos EG, Barbosa IR, Severo AK. Space-time analysis of mortality by suicide in the State of Rio Grande do Norte, Brazil, in the period from 2000 to 2015. *Cien Saude Colet.* 2020;25(2):633-43.
201. Reser JP. Australian Aboriginal suicide deaths in custody: Cultural context and cluster evidence. *Aust. Psychol.* 1989;24(3):325-42.
202. Lazzarini TA, Gonçalves CCM, Benites WM, Silva LFd, Tsuha DH, Ko AI, et al. Suicide in Brazilian indigenous communities: clustering of cases in children and adolescents by household. *Rev. Saúde Públ.* 2018;52(56).
203. Austin AE, van den Heuvel C, Byard RW. Cluster hanging suicides in the young in South Australia. *J. Forensic Sci.* 2011;56(6):1528-30.
204. Mackenzie DW, Lester D, Manson R, Yeh C. Do suicides from the Golden Gate Bridge cluster? *Psychological reports.* 2016;118(1):70-3.67.
205. Torok M, Konings P, Batterham PJ, Christensen H. Spatial clustering of fatal, and non-fatal, suicide in new South Wales, Australia: implications for evidence-based prevention. *BMC Psychiatry.* 2017;17(1):339.
206. Leung, M., Chow, C.B., Ip, P., Yip, S.. Pure spatial and space-time clusters of self-harm in Kwai Tsing 2004 to 2012. *Spat Spa-tiotemporal Epidemiol.* 2018;27:1.

207. Karami M, Yazdi–Ravandi S, Ghaleiha A, Olfatifar M. Comparison of the clusters and non-clusters areas of attempted suicide cases in Hamadan Province, western Iran: findings from a pilot study (2016-2017). *J Res Health Sci.* 2018, 18(3).
208. Smeeton N, Wilkinson G. The identification of clustering in parasuicide. *Br J Psychiatry.* 1988;153(2):218-21.
209. Mittendorfer-Rutz E, Rasmussen F, Wasserman D. Familial clustering of suicidal behaviour and psychopathology in young suicide attempters. *Soc Psychiatry Psychiatr Epidemiol.* 2008; 43(1):28-36.
210. Pisinger VS, Hawton K, Tolstrup JS. School-and class-level variation in self-harm, suicide ideation and suicide attempts in Danish high schools. *Scand. J. Public Health.* 2019;47(2):146-56.
211. Goodman ML, Puffer ES, Keiser PH, Gitari S. Suicide clusters among young Kenyan men. *Health Psychol.* 2020;25(7):1004-13.
212. Queinec R, Benjamin C, Beitz C, Lagarde E, Encrenaz G. Suicide contagion in France: an epidemiologic study. *Inj. Prev.* 2010;16(Suppl 1):A241-A.
213. Jonas, K. Modelling and suicide: a test of the Werther effect. *Br J Soc Psychol.* 1992;31(4):295-306.
214. Sinyor M, Williams M, Tran US, Schaffer A, Kurdyak P, Pirkis J, Niederkrotenthaler T. Suicides in Young People in Ontario Following the Release of “13 Reasons Why”. *Can J Psychiatry.* 2019;64(11):798-804.
215. Niederkrotenthaler T, Stack S, Till B, Sinyor M, Pirkis J, Garcia D, et al. Association of increased youth suicides in the United States with the release of 13 Reasons Why. *JAMA Psychiatry.* 2019;76(9):933-40.
216. Whitley R, Fink DS, Santaella-Tenorio J, Keyes KM. Suicide mortality in Canada after the death of Robin Williams, in the context of high-fidelity to suicide reporting guidelines in the Canadian media. *Can J Psychiatry.* 2019;64(11):805-12.
217. Fink DS, Santaella-Tenorio J, Keyes KM. Increase in suicides the months after the death of Robin Williams in the US. *PLOS ONE.* 2018;13(2).
218. Pirkis J, Currier D, Too LS, Bryant M, Bartlett S, Sinyor M, Spittal MJ. Suicides in Australia following media reports of the death of Robin Williams. *Aust N Z J Psychiatry.* 2020;54(1):99-104.
219. Sinyor M, Tran US, Garcia D, Till B, Voracek M, Niederkrotenthaler T. Suicide mortality in the United States following the suicides of Kate Spade and Anthony Bourdain. *Aust N Z J Psychiatry.* 2020;0004867420976844.
220. Bridge JA, Greenhouse JB, Ruch D, Stevens J, Ackerman J, Sheftall AH, Horowitz LM, Kelleher KJ, Campo JV. Association between the release of netflix’s 13 Reasons Why and suicide rates in

- the United States: An interrupted time series analysis. *J Am Acad Child Adolesc Psychiatry*. 2020;59(2):236-243.
221. Romer D. Reanalysis of the Bridge et al. study of suicide following release of 13 Reasons Why. *PLOS ONE*. 2020;15(1):e0227545.
 222. Jang SA, Sung JM, Park JY, Jeon WT. Copycat suicide induced by entertainment celebrity suicides in South Korea. *Psychiatry Investig*. 2016;13(1):74
 223. Chen YY, Tsai PC, Chen PH, Fan CC, Hung GCL, Cheng AT. Effect of media reporting of the suicide of a singer in Taiwan: the case of Ivy Li. *Soc Psychiatry Psychiatr Epidemiol*. 2010; 45(3):363-9.
 224. Phillips DP, Carstensen LL. Clustering of teenage suicides after television news stories about suicide. *N Engl J Med*. 1986;315(11):685-9.
 225. Ladwig KH, Kunrath S, Lukaschek K, Baumert J. The railway suicide death of a famous German football player: impact on the subsequent frequency of railway suicide acts in Germany. *J. Affect. Disord*. 2012;136(1-2):194-8.
 226. Cheng Q, Chen F, Yip PS. The Foxconn suicides and their media prominence: is the Werther Effect applicable in China? *BMC Public Health*. 2011;11(1):841.
 227. Lee SY. Media Coverage of Adolescent and Celebrity Suicides and Imitation Suicides among Adolescents. *J. Broadcast. Electron. Media*. 2019;63(1):130-43.
 228. Koburger N, Mergl R, Rummel-Kluge C, Ibelshäuser A, Meise U, Postuvan V, et al. Celebrity suicide on the railway network: Can one case trigger international effects? *J. Affect. Disord*. 2015;85:38-46.
 229. Etzersdorfer E, Sonneck G, Nagel-Kuess S. Newspaper reports and suicide. *N Engl J Med*. 1992.
 230. Too LS, Pirkis J, Milner A, Robinson J, Spittal MJ. Clusters of suicidal events among young people: do clusters from one time period predict later clusters? *Suicide Life Threat Behav*. 2019;49(2): 561-71.
 231. Lawson AB, Kleinman K. Spatial and syndromic surveillance for public health: John Wiley & Sons; 2005.
 232. Maurya SP, Ohri A, Mishra S, editors. Open-source GIS: a review. Proceedings of National Conference on Open-Source GIS: Opportunities and Challenges. Varanasi (India); 2015.
 233. Crosby C. Monitoring Infections: Active vs. Passive Surveillance: Epidemiology. 2012.
 234. Cromley EK, McLafferty SL. GIS and public health: Guilford Press; 2011.
 235. Ishioka F, Kurihara K, editors. Evaluation of hotspot detection method based on echelon structure. 59th ISI World Statistics Congress. 2013; 5366.

236. Tango T, Takahashi K. A flexibly shaped spatial scan statistic for detecting clusters. *Int. J. Health Geogr.* 2005;4(1):11.
237. Patil GP, Taillie C. Upper-level set scan statistic for detecting arbitrarily shaped hotspots. *Environ. Ecol. Stat.* 2004;11(2):183-97.
238. Kurihara K. Hotspots Detection for Cellular Surface Data. *Bull. Int. Stat. Inst.* 2003;54(2): 115-116.
239. Tango T, Takahashi K. A flexible spatial scan statistic with a restricted likelihood ratio for detecting disease clusters. *Stat Med.* 2012;31(30):4207-18.
240. Myers W, Patil GP, Joly K. Echelon approach to areas of concern in synoptic regional monitoring. *Environ. Ecol. Stat.* 1997;4(2):131-52.
241. Kurihara K, Ishioka F, Kajinishi S. Spatial and temporal clustering based on the echelon scan technique and software analysis. *JJSD.* 2020;3(1):1-20.
242. Terrell C. Predictions in Time Series Using Regression Models. *Scientific e-Resources*; 2019.
243. Hynes MM. Sociology, health data, and health equity: One state agency as a site of social change. *Curr Sociol.* 2012;60(2):161-177.
244. Potter LB, Powell KE, Kachur SP. Suicide prevention from a public health perspective. *Suicide Life Threat Behav.* 1995;25:82–91.
245. The National Confidential Inquiry into Suicide and Safety in Mental Health. (2021). Annual Report: England, Northern Ireland, Scotland and Wales 2021. 2021. Available at: <https://documents.manchester.ac.uk/display.aspx?DocID=55332> [Accessed 17/11/2020].
246. Walby FA, Myhre MØ, Kildahl AT. The Norwegian Surveillance System for Suicide in Mental Health and Substance Misuse Services: Project Draft. Oslo: National Centre for Suicide Research and Prevention at University of Oslo. 2019. Available at: https://www.med.uio.no/klinmed/english/research/centres/nssf/norwegian-surveillance-system/documents/projectdraft_norwegiansurveillancesystemforsuicide.pdf. [Accessed 17/11/2020].
247. Suicide Mortality Review Committee. Ngā Rāhui Hau Kura: Suicide Mortality Review Committee Feasibility Study 2014–15. 2016. Available at: <https://www.hqsc.govt.nz/assets/SUMRC/PR/SuMRC-full-report-May-2016.pdf> [Accessed 17/11/2020].
248. Australian Institute for Suicide Research and Prevention. Suicide in Queensland: Annual Report 2020. 2020. Available at: https://www.griffith.edu.au/__data/assets/pdf_file/0035/1196855/QSR_Annual_Report_2020.pdf. [Accessed 17/11/2020].

249. Leske S, Kölves, K, Crompton D, Arensman E, de Leo D. Real-time suicide mortality data from police reports in Queensland, Australia, during the Covid-19 pandemic: an interrupted time-series analysis. *Lancet Psychiatry*. 2020;8:58–63.
250. World Health Organization. World health statistics 2019: monitoring health for the SDGs, sustainable development goals. 2019.
251. World Health Organization. National suicide prevention strategies: Progress, examples, and indicators. 2018.
252. World Health Organization. Live life: an implementation guide for suicide prevention in countries. 2021.
253. O'Connor RC, Wetherall K, Cleare S, McClelland H, Melson AJ, Niedzwiedz CL, O'Carroll RE, O'Connor DB, Platt S, Scowcroft E, Watson B. Mental health and well-being during the COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study. *Br J Psychiatry*. 2020;21:1–8.
254. FactCheckNI. Has the suicide rate increased 200% during the COVID-19 lockdown period? [Internet] 2020[cited 2021]. Available at: <https://factcheckni.org/articles/has-the-suicide-rate-increased-200-during-the-covid-19-lockdown-period>. [Accessed 17/11/2020].
255. Coroners Court of Victoria. Coroners Court monthly suicide data report. Report 2–5 October 2020. 2020.
256. The Office of the Chief Coroner of New Zealand. Media Release: Chief Coroner Releases Annual Provision Suicide Figures. Available at: <https://coronialservices.justice.govt.nz/assets/Documents/Publications/Chief-Coroner-Suicide-Stats-2020-Media-Release.pdf>. [Accessed 17/11/2020].
257. Pirkis J, John A, Shin S, et al. Suicide trends in the early months of the covid-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. *Lancet Psychiatry*. 2021;8(7):579-588.
258. Qin P, Mehlum L. National observation of death by suicide in the first 3 months under COVID-19 pandemic. *Acta Psychiatr. Scand*. 2020;143:92–93.
259. Appleby L, Richards N, Ibrahim S, Turnbull P, Rodway C, Kapur N. Suicide in England in the COVID-19 Pandemic: Early Figures from Real Time Surveillance. *Lancet Regional Health - Europe*. 2021;4:100110.
260. Ueda M, Nordström R, Matsubayashi T. Suicide and mental health during the COVID-19 pandemic in Japan. *J Public Health (Oxf)*. 2021;fdab113.
261. Tanaka T, Okamoto S. Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. *Nature Human Behaviour*. 2021;5:229–38.

262. John A, Pirkis J, Gunnell D, Appleby L, Morrissey J. Trends in suicide during the covid-19 pandemic. *BMJ*. 2020;371:m4352.
263. Gunnell D, Appleby L, Arensman E, Hawton K, John A, Kapur N, Khan M, O'Connor RC, Pirkis J, Caine ED, Chan LF. Suicide risk and prevention during the COVID-19 pandemic. *Lancet Psychiatry* 2020;7:468–71.
264. Niederkrotenthaler T, Gunnell D, Arensman E, Pirkis J, Appleby L, Hawton K, John A, Kapur N, Khan M, O'Connor RC, Platt S. Suicide research, prevention, and COVID-19. *Crisis*. 2020;41:321–330.
265. Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, Ballard C, Christensen H, Silver RC, Everall I, Ford T. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry*. 2020;7:547–60.
266. Centers for Disease Control and Prevention. Updated guidelines for evaluating public health surveillance systems: recommendations from the Guidelines Working Group. *MMWR*. 2001;50(RR-13):1–35.
267. Centers for Disease Control and Prevention. Framework for Evaluating Public Health Surveillance Systems for Early Detection of Outbreaks: recommendations from the CDC Working Group. *MMWR*. 2004;53(RR-05):1–11.
268. Ministry of Health. New Zealand Suicide Prevention Action Plan 2013–2016. Available at: <https://www.health.govt.nz/system/files/documents/publications/new-zealand-suicide-prevention-action-plan-2013-2016-v2.pdf>. [Accessed 12/01/2021].
269. Sutherland G, Milner A, Dwyer J, Bugeja L, Woodward A, Robinson J, Pirkis J. Implementation and evaluation of the Victorian Suicide Register. *Aust N Z J Public*. 2018;42:296–302.
270. World Health Organisation. Thirteenth General Programme of Work 2019–2023. 2019.
271. Ramchand R, Colpe L, Claassen C, Brinton S, Carr C, McKeon R, Schoenbaum M. Prioritizing Improved Data and Surveillance for Suicide in the United States in Response to COVID-19. *Am J Public Health*. 2021;111(S2):S84–S88.
272. Corcoran P, Arensman E. A Study of the Irish System of Recording Suicide Deaths. *Crisis*. 2010; 31(4):174–82.
273. Benson R, Rigby J, Brunsdon C, Corcoran P, Dodd P, Ryan M, et al. Real-time suicide surveillance: comparison of international surveillance systems and recommended best practice. *Arch Suicide Res*. 2022;13:1–27.
274. Matheus R, Janssen M, Maheshwari D. Data science empowering the public: Data-driven dashboards for transparent and accountable decision-making in smart cities. *Gov. Inf. Q*. 2020;37:101284.

275. Franklin A, Gantela S, Shifarrow S, Johnson TR, Robinson DJ, King BR, Mehta AM, Maddow CL, Hoot NR, Nguyen V, Rubio A. Dashboard visualizations: Supporting real-time throughput decision-making. *J. Biomed. Inform.* 2017;71:211-21.
276. Cromley EK, McLafferty SL. Analyzing the risk and spread of infectious diseases. In: Cromley EK, McLafferty SL, editors. *GIS and Public Health*. New York: Guilford Press; 2002.
277. Fisher, R.P., Myers, B.A. Free and simple GIS as appropriate for health mapping in a low resource setting: a case study in eastern Indonesia. *Int J Health Geogr.* 2011;10(15):1-11.
278. Fletcher-Lartey SM, Caprarelli G. Application of GIS technology in public health: successes and challenges. *Parasitology.* 2016;143(4):401-15.
279. Central Statistics Office. Census 2016 Small Area Population Statistics. 2016. Available at: <https://cso.maps.arcgis.com/apps/webappviewer/index.html?id=4d19cf7b1251408c99ccde18859ff739> [Accessed 21/11/ 2021].
280. Blangiardo M, Boulieri A, Diggle P, Piel FB, Shaddick G, Elliott P. Advances in spatiotemporal models for non-communicable disease surveillance. *Int J Epidemiol.* 2020;49(Suppl 1):i26-i37.
281. Robertson C, Nelson TA. Review of software for space-time disease surveillance. *Int. J. Health Geogr.* 2010;9(16):1-8.
282. Hamlyn M, Piel, FB. Comparing spatio-temporal methods of non-communicable disease surveillance. *Online J. Public Health Inform.* 2019;11(1).
283. Blischak JD, Carbonetto P, Stephens M. Creating and sharing reproducible research code the wrokflowr way. *F1000Res.* 2019;8:1749.
284. Song X, Li Y, Xiao X, Cai L, Liu W, Cui W, Yue L. Visualization the dynamic interactive maps for results of spatio-temporal scanning. *Online J Public Health Inform.* 2018 May 30;10(1):e68.
285. Zhang T, Liao Qi, Shi L, Dong W. Analyzing spatiotemporal anomalies through interactive visualization. *Informatics.* 2014;1:100-125.
286. Robinson J, Rodrigues M, Fisher S, Bailey E, Herrman H. Social media and suicide prevention: findings from a stakeholder survey. *Shanghai Arch Psychiatry.* 2015;27(1):27-35.
287. van Deursen AJAM, Bolle CL, Hegner SM, Kommers PAM. (2015). Modeling habitual and addictive smartphone behavior: The role of smartphone usage types, emotional intelligence, social stress, self-regulation, age, and gender. *Comput. Hum. Behav.* 2015;45:411-420.
288. Gould M, Jamieson P, Romer D. Media Contagion and Suicide Among the Young. *Am Behav Sci.* 2003;46(9):1269-84.
289. Ueda M, Mori K, Matsubayashi T. The effects of media reports of suicides by well-known figures between 1989 and 2010 in Japan. *Int. J. Epidemiol.* 2014;43(2):623-629.

290. Gould MS, Kleinman MH, Lake AM, Forman J, Middle JB. Newspaper coverage of suicide and initiation of suicide clusters in teenagers in the USA, 1988–96: a retrospective, population-based, case-control study. *Lancet Psychiatry*. 2014;1(1):34-43.
291. John A, Hawton K, Gunnell D, Lloyd K, Scourfield J, Jones PA et al. Newspaper Reporting on a Cluster of Suicides in the UK. *Crisis*. 2016;38(1):17-25.
292. Cheng ATA, Hawton K, Chen THH, Yen AM, Chen CY, Chen LC, Teng PR. The Influence of Media Coverage of a Celebrity Suicide on Subsequent Suicide Attempts. *J Clin Psychiatry*. 2007;8:862–866.
293. Fu KW, Yip PS. Estimating the Risk for Suicide Following the Suicide Deaths of 3 Asian Entertainment Celebrities: A Meta-Analytic Approach. *J Clin Psychiatry*. 2009;70(6):869–878.
294. Niederkrotenthaler T, Fu KW, Yip PS, Fong DYT, Stack S, Cheng Q, Pirkis J. (2012). Changes in suicide rates following media reports on celebrity suicides: a meta-analysis. *J Epidemiol Community Health*. 2012; 66(11):1037–1042.
295. Sisask M, Värnik A. Media Roles in Suicide Prevention: A Systematic Review. *Int. J. Environ. Res*. 2012;9(1):123–138.
296. Stack S. Suicide in the Media: A Quantitative Review of Studies Based on Nonfictional Stories. *Suicide Life Threat Behav*, 2005;35(2):121–133.
297. Chang SS, Gunnell D, Wheeler BW, Yip PS, Sterne JAC. The Evolution of the Epidemic of Charcoal-Burning Suicide in Taiwan: A Spatial and Temporal Analysis. *PLOS Medicine*. 2010;7(1):e1000212.
298. Lee SY, Kwon Y. Twitter as a place where people meet to make suicide pacts. *Public Health*. 2018;159:21-26.
299. Pirkis JE, Burgess PM, Francis C, Blood RW, Jolley DJ. The relationship between media reporting of suicide and actual suicide in Australia. *Soc. Sci. Med*. 2006;62(11):2874-2886.
300. Niederkrotenthaler T, Till B, Kapusta ND, Voracek M, Dervic K, Sonneck G. Copycat effects after media reports on suicide: a population-based ecologic study. *Soc Sci Med*. 2009;69(7):1085-90.
301. Hegerl U, Koburger N, Rummel-Kluge C, Gravert C, Walden M, Mergl R. One followed by many? Long-term effects of a celebrity suicide on the number of suicidal acts on the German railway net. *J. Affect. Disord*. 2013;146(1):39-44.
302. Ueda M, Mori K, Matsubayashi T, Sawada Y. Tweeting celebrity suicides: Users' reaction to prominent suicide deaths on Twitter and subsequent increases in actual suicides. *Soc. Sci. Med*. 2017;189:158-66.

303. Padmanathan P, Bould H, Winstone L, Moran P, Gunnell D. Social media use, economic recession and income inequality in relation to trends in youth suicide in high-income countries: a time trends analysis. *J. Affect. Disord.* 2020;275:58-65.
304. Howard SJ, Surtees W. A case series review of suicides associated with social media use in South Tyneside, England. *JRSM Open.* 2016;7(2).
305. Fu KW, Cheng Q, Wong PWC, Yip PSF. Responses to a Self-Presented Suicide Attempt in Social Media: A Social Network Analysis. *Crisis.* 2013;34(6):406-412.
306. Sinyor M, Williams M, Zaheer R, Loureiro R, Pirkis J, Heisel MJ et al. The association between Twitter content and suicide. *Aust N Z J Psychiatry.* 2021;55(3):268-276.
307. Bell J, Mok K, Gardiner E, Pirkis J. Suicide-Related Internet Use Among Suicidal Young People in the UK: Characteristics of Users, Effects of Use, and Barriers to Offline Help-Seeking. *Arch. Suicide Res.* 2018;22(2):263-277.
308. Swedo EA, Beauregard JL, de Fijter S, Werhan L, Norris K, Montgomery MP et al. Associations Between Social Media and Suicidal Behaviors During a Youth Suicide Cluster in Ohio. *J Adolesc Health.* 2021;68(2):308-316.
309. Poonai N, Mehrotra S, Mamdani M, Patmanidis A, Miller M, Sukhera J, Doan Q. The association of exposure to suicide-related Internet content and emergency department visits in children: A population-based time series analysis. *Can. J. Public Health.* 2017;108(5-6):462-467.
310. Birbal R, Maharajh HD, Birbal R, Clapperton M, Jarvis J, Ragoonath A, Uppalapati K. Cybersuicide and the adolescent population: Challenges of the future? *Int J Adolesc Med Health.* 2009;21(2):151–159.
311. Li A, Huang X, Zhu T. A systematic analysis of online broadcasts of suicidality in China. *Asia-Pac. Psychiatry.* 2018;10(3):e12302.
312. Niederkrotenthaler T, Stack S, Till B, Sinyor M, Pirkis J, Garcia D et al. Association of Increased Youth Suicides in the United States with the Release of 13 Reasons Why. *JAMA Psychiatry.* 2019;76(9):933-940.
313. Till, B, Vitouch, P, Herberth, A, Sonneck, G, Niederkrotenthaler, T. Personal suicidality in the reception of and identification with suicidal film characters. *Death Stud.* 2013; 37: 383–92.
314. Till B, Strauss M, Sonneck G, Niederkrotenthaler T. Determining the effects of films with suicidal content: A laboratory experiment. *Br J Psychiatry.* 2015;207(1):72-78.
315. Sinyor M, Schaffer A, Nishikawa Y, Redelmeier DA, Niederkrotenthaler T, Sareen J, Levitt AJ, Kiss A, Pirkis J. The association between suicide deaths and putatively harmful and protective factors in media reports. *CMAJ.* 2018;190(30):E900-E907.

316. Jiang FF, Xu HL, Liao HY, Zhang T. Analysis of Internet Suicide Pacts Reported by the Media in Mainland China. *Crisis*. 2016;38(1):36-43.
317. Shah, A. (2010). The Relationship between General Population Suicide Rates and the Internet: A Cross-National Study. *Suicide Life Threat Behav*. 2010;40(2):146-150.
318. Mitchell KJ, Wells M, Priebe G, Ybarra M. Exposure to websites that encourage self-harm and suicide: Prevalence rates and association with actual thoughts of self-harm and thoughts of suicide in the United States. *J. Adolesc*. 2014;37(8):1335-1344.
319. Till B, Tran US, Voracek M, Niederkrotenthaler T. Beneficial and harmful effects of educative suicide prevention websites: randomised controlled trial exploring Papageno v. Werther effects. *Br J Psychiatry*. 2017;211(2):109-115.
320. Ruder TD, Hatch GM, Ampanozi G, Thali MJ, Fischer N. Suicide Announcement on Facebook. *Crisis*. 2011;32(5):280-282.
321. Belfort EL, Mezzacappa E, Ginnis K. Similarities and Differences Among Adolescents Who Communicate Suicidality to Others via Electronic Versus other Means: A Pilot Study. *Adolesc. Psychiatry*. 2012;2(3):258–262.
322. Cheng Q, Kwok CL, Zhu T, Guan L, Yip, PS. Suicide Communication on Social Media and Its Psychological Mechanisms: An Examination of Chinese Microblog Users. *Int. J. Environ. Res*. 2015;12(9):11506–11527.
323. Santos M, Gago E. P03-310-Imitation suicide: the Werther effect. *Eur. Psychiatry*. 2010;25(S1):1-1.
324. Niederkrotenthaler T, Sonneck G. Assessing the Impact of Media Guidelines for Reporting on Suicides in Austria: Interrupted time Series Analysis. *Aust N Z J Psychiatry*. 2007;41(5):419–428.
325. Barker E, Kolves K, De Leo D. Rail-suicide prevention: Systematic literature review of evidence-based activities. *Asia-Pac. Psychiatry*. 2016;9(3):e12246.
326. Hill N, Robinson J, Rice S. Safe Communication About Suicide in the Digital Age. *Psychiatr. Times*. 2019;36(1):18-19.
327. Karim F, Oyewande AA, Abdalla LF, Ehsanullah RC, Khan S. Social Media Use and Its Connection to Mental Health: A Systematic Review. *Cureus*. 2020;12(6):e8627.
328. Rice S, Robinson J, Bendall S, Hetrick S, Cox G, Bailey E, Gleeson J, Alvarez-Jimenez M. Online and Social Media Suicide Prevention Interventions for Young People: A Focus on Implementation and Moderation. *J Can Acad Child Adolesc Psychiatry*. 2016;25(2):80–86.
329. Robinson J, Cox G, Bailey E, Hetrick S, Rodrigues M, Fisher S, Herrman H. Social media and suicide prevention: a systematic review. *Early Interv Psychiatry*. 2016;10(2):103–121.

330. Sumner SA, Galik S, Mathieu J, Ward M, Kiley T, Bartholow B, Dingwall A, Mork, P. Temporal and Geographic Patterns of Social Media Posts About an Emerging Suicide Game. *J Adolesc Health*. 2019;65(1):94–100.
331. Orygen. A guide for communities: Using social media following the suicide of a young person and to help prevent suicide clusters. 2020.
332. Lavis A, Winter R. #Online harms or benefits? An ethnographic analysis of the positives and negatives of peer-support around self-harm on social media. *J Child Psychol Psychiatry*. 2020;61(8):842-854.
333. Biddle L, Derges J, Mars B, Heron J, Donovan JL, Potokar J, Piper M, Wyllie C, Gunnell D. Suicide and the Internet: Changes in the accessibility of suicide-related information between 2007 and 2014. *J. Affect. Disord*. 2016;190:370-5.
334. Mishara BL, Weisstub DN. The legal status of suicide: A global review. *Int J Law Psychiatry*. 2016;44:54-74.
335. Platt S, Arensman E, Rezaeian M. National Suicide Prevention Strategies - Progress and Challenges. *Crisis*. 2019;40(2):75-82.
336. Bommersbach TJ, Rosenheck RA, Everett AS. Suicide Hot Spots: Leveraging County-Level Data and Local Agencies to Target Prevention in High-Risk Areas. *Public Health Rep*. 2021; 1-6.
337. Torok M, Shand F, Phillips M, Meteoro N, Martin D, Larsen M. Data-informed targets for suicide prevention: a small-area analysis of high-risk suicide regions in Australia. *Soc Psychiatry Psychiatr Epidemiol*. 2019;54(10):1209-1218.
338. Health Service Executive. Developing a Community Response to Suicide: A resource to guide those developing and implementing an Inter-Agency Community Response Plan for incidents of suspected suicide, particularly where there is a risk of clusters and/or contagion. Dublin: Health Service Executive; 2021. Available from: <https://www.hse.ie/eng/services/list/4/mental-health-services/connecting-for-life/publications/developing-a-community-response-to-suicide.html> [Accessed 10/03/2022].
339. O'Carroll PW, Mercy JA. Responding to community-identified suicide clusters: statistical verification of the cluster is not the primary issue. *Am. J. Epidemiol*. 1990;132(1 Suppl):S196-202.
340. Knipe D, Hawton K, Sinyor M, Niederkrotenthaler T. Researchers must contribute to responsible reporting of suicide. *BMJ*. 2021;372:n351.
341. Niederkrotenthaler T, Braun M, Pirkis J, Till B, Stack S, Sinyor M, Tran US, Voracek M, Cheng Q, Arendt F, Scherr S. Association between suicide reporting in the media and suicide: systematic review and meta-analysis. *BMJ*. 2020; 368:m575.

342. Hawton K, Marzano L, Fraser L, Hawley M, Harris-Skillman E, Lainez YX. Reporting on suicidal behaviour and COVID-19—need for caution. *Lancet Psychiatry*. 2021;8(1):15-7.
343. Clapperton AJ, Spittal MJ, Dwyer J, Garrett A, Kölves K, Leske S, Millar C, Edwards B, Stojcevski V, Crompton OAM DR, Pirkis J. Patterns of suicide in the context of CoViD-19: evidence from three Australian states. *Front. Psychiatry*. 2021;2207.
344. Arensman E. Briefing: Findings from the Suicide and Self-Harm Observatory during the COVID-19 pandemic. Cork: School of Public Health, College of Medicine and Health, National Suicide Research Foundation, University College Cork; 2021. Available at: https://www.nsrfl.ie/wp-content/uploads/2021/06/SSHO_briefing_19-04-2021-Final-1-1.pdf [Accessed 10 March 2022].
345. Sakamoto H, Ishikane M, Ghaznavi C, Ueda P. Assessment of suicide in Japan during the COVID-19 pandemic vs previous years *JAMA Netw. Open*. 2021;4(2):e2037378.
346. Burke M, González F, Baylis P, Heft-Neal S, Baysan C, Basu S, Hsiang S. Higher temperatures increase suicide rates in the United States and Mexico. *Nat. Clim. Change*. 2018;8(8):723-9.
347. Bell V, Méndez F, Martínez C, Palma PP, Bosch M. Characteristics of the Colombian armed conflict and the mental health of civilians living in active conflict zones. *Confl. Health*. 2012;6(1):1-8.
348. Conseglieri A, Del Alamo C, Suárez C. Contingency plan of the Clinical Management Unit for Psychiatry and Mental Health (CMUPMH) of the Infanta Cristina University Hospital (ICUH) for the COVID-19 pandemic. *Actas Esp. Psiquiatr*. 2021;49(2):81-4.
349. United Nations High Commissioner for Refugees. Global Report 2020. Geneva: UNHR; 2021. Available at: <https://www.unhcr.org/en-ie/the-global-report.html> [Accessed 5 March 2022].
350. Silove D, Ventevogel P, Rees S. The contemporary refugee crisis: an overview of mental health challenges. *World Psychiatry*. 2017;16(2):130-139.
351. Steel Z, Chey T, Silove D, Marnane C, Bryant RA, van Ommeren M. Association of torture and other potentially traumatic events with mental health outcomes among populations exposed to mass conflict and displacement: a systematic review and meta-analysis. *JAMA*. 2009;302(5):537-49.
352. Blackmore R, Boyle JA, Fazel M, Ranasinha S, Gray KM, Fitzgerald G, Misso M, Gibson-Helm M. The prevalence of mental illness in refugees and asylum seekers: A systematic review and meta-analysis. *PLoS Medicine*. 2020;17(9):e1003337.
353. International Federation of Red Cross and Red Crescent Societies Reference Centre for Psychosocial Support. Scoping report: Integrating Mental Health and Psychosocial Support within Noncommunicable Disease Prevention and Care in Humanitarian Response; An explanatory Review. Available at: <https://pscentre.org/?resource=scoping-report-integrating-mental-health->

and-psychosocial-support-within-non-communicable-disease-prevention-and-care-in-humanitarian-response&selected=single-resource [Accessed 07/03/2022].

354. Spallek J, Reeske A, Norredam M, Nielsen SS, Lehnhardt J, Razum O. Suicide among immigrants in Europe—a systematic literature review. *Eur. J. Public Health*. 2015;25(1):63-71.
355. Forte A, Trobia F, Gualtieri F, Lamis DA, Cardamone G, Giallonardo V, Fiorillo A, Girardi P, Pompili M. Suicide risk among immigrants and ethnic minorities: a literature overview. *Int. J. Environ. Res*. 2018;15(7):1438.
356. Haroz EE, Decker E, Lee C, Bolton P, Spiegel P, Ventevogel P. Evidence for suicide prevention strategies with populations in displacement: a systematic review. *Intervention (Amstelveen)*. 2020;18(1):37-44.
357. Ager W, El Chammay R, Lechner J, Ventevogel P, Vijayakumar L. Displaced, Dispossessed and Silenced: The Need for Suicide Prevention and Response for Conflict-affected Populations. *Intervention*. 2021;19(2):145.
358. 41. Miller KE, Rasmussen A. The mental health of civilians displaced by armed conflict: an ecological model of refugee distress. *Epidemiol Psychiatr Sci*. 2017;26:129-138.
359. World Health Assembly, 72. Promoting the health of refugees and migrants: draft global action plan, 2019–2023: report by the Director-General. World Health Organization; 2019. Available at: <https://apps.who.int/iris/handle/10665/328690> [Accessed 11/03/2022].
360. Taylor S. Anxiety disorders, climate change, and the challenges ahead: Introduction to the special issue. *J. Anxiety Disord*. 2020;76:102313.
361. Hickman C, Marks E, Pihkala P, Clayton S, Lewandowski RE, Mayall EE, Wray B, Mellor C, van Susteren L. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet. Health*. 2021;5(12):e863-73.
362. Kölves K, Kölves KE, de Leo D. (2013). Natural disasters and suicidal behaviours. *J. Affect. Disord*. 2013;146:1–14.
363. Orui M. Re-increased male suicide rates in the recovery phase following the Great East Japan Earthquake. *Crisis*. 2020; 41(6):422-428.
364. Horney JA, Karaye IM, Abuabara A, Gearhart S, Grabich S, Perez-Patron M. The Impact of Natural Disasters on Suicide in the United States, 2003–2015. *Crisis*. 2020;42(5):328–334.
365. Bando DH, Volpe FM. Seasonal variation of suicide in the city of São Paulo, Brazil, 1996–2010. *Crisis*. 2014;35:5–9.
366. Fester D. The Environment and Suicide – Why Suicidologists Should Support Climate Change Policies. *Crisis*. 2021;42(2):89-91.

367. Taylor S. The psychology of pandemics: Preparing for the next global outbreak of infectious disease. Cambridge Scholars Publishing; Newcastle upon Tyne: 2019.
368. Ide T. COVID-19 and armed conflict. *World Dev.* 2021;140:105355.
369. Oyesanya M, Lopez-Morinigo J, Dutta R. Systematic review of suicide in economic recession. *World J. Psychiatry.* 2015;5(2):243-54.
370. Sinyor M, Knipe D, Borges G, Ueda M, Pirkis J, Phillips MR, Gunnell D; International COVID-19 Suicide Prevention Research Collaboration. Suicide Risk and Prevention During the COVID-19 Pandemic: One Year On. *Arch. Suicide Res.* 2021;1-6.
371. Hart TC, Zandbergen PA. Effects of Data Quality on Predictive Hotspot Mapping. 2012.
372. Velting DM, Gould MS (1997). Suicide contagion. In R. W. Maris, M. M. Silverman, & S. S. Canetto (Eds.), *Review of suicidology, 1997* (pp. 96–137). Guilford Press.
373. Gould M. Suicide and the Media. *Ann. N. Y. Acad. Sci.* 2006;932(1):200-224.
374. Colman I. Responsible reporting to prevent suicide contagion. *CMAJ.* 2018;190(30):E898-9.
375. Cavalli-Sforza LL, Feldman MW. Cultural transmission and evolution. Princeton: Princeton; 1981.
376. Baranowski T, Lin LS, Wetter DW, Resnicow K, Hearn MD. Theory as mediating variables: Why aren't community interventions working as desired? *Ann. Epidemiol.* 1997;7(7):S89-95.
377. HSE National Office for Suicide Prevention. Developing a Community Response to Suicide. 2021. Available at: <https://www.hse.ie/eng/services/list/4/mental-health-services/connecting-for-life/publications/community-response-to-suicide.pdf> [Accessed 27/02/2022].
378. Kőlves K, Mathieu S, Fleischmann A. Suicide and self-harm surveillance across the Western Pacific: A call for action. *Lancet Regional Health: Western Pacific.* 2022;19.
379. Bojanić L, Hunt IM, Baird A, Kapur N, Appleby L, Turnbull P. Early Post-Discharge Suicide in Mental Health Patients: Findings from a National Clinical Survey. *Front. Psychiatry.* 2020;11:502.
380. Chung D, Hadzi-Pavlovic D, Wang M, Swaraj S, Olfson M, Large M. Meta-analysis of suicide rates in the first week and the first month after psychiatric hospitalisation. *BMJ Open.* 2019;9(3):e023883.
381. Sarchiapone M, Mandelli L, Iosue M, Andrisano C, Roy A. Controlling access to suicide means. *Int J Environ Res Public Health.* 2011;8(12):4550-4562.
382. Yip PS, Caine E, Yousuf S, Chang SS, Wu KC, Chen YY. Means restriction for suicide prevention. *Lancet.* 2012; 23;379(9834):2393-9.
383. Mann JJ, Michel CA, Auerbach RP. Improving suicide prevention through evidence-based strategies: A systematic review. *Am. J. Psychiatry.* 2021;178(7):611-624.

384. Pirkis J, Spittal MJ, Cox G, et al: The effectiveness of structural interventions at suicide hotspots: a meta-analysis. *Int J Epidemiol*. 2013;42:541–548.
385. Law CK, Yip PS, Chan WS, Fu KW, Wong PW, Law YW. Evaluating the effectiveness of barrier installation for preventing railway suicides in Hong Kong. *J Affect Disord*. 2009;114(1-3):254-62.
386. Hamilton S, Metcalfe C, Gunnell D. Media reporting and suicide: A timeseries study of suicide from Clifton Suspension Bridge, UK, 1974–2007. *J Public Health*. 2011;33(4):511–517.
387. Ueda M, Sawada Y, Matsubayashi T. The effectiveness of installing physical barriers for preventing railway suicides and accidents: evidence from Japan. *J Affect Disord*. 2015;178:1-4.
388. Arensman E, McAuliffe C. Clustering and contagion of suicidal behaviour. In U. Kumar (Ed.), *Suicidal Behaviour: Underlying dynamics* (pp.110- 120). London: Routledge; 2015.
389. HSE National Office for Suicide Prevention. You are not alone; Support for people who have been bereaved by suicide. Available at: <https://www.hse.ie/eng/services/list/4/mental-health-services/connecting-for-life/news/national-suicide-bereavement-support-guide.pdf> [Accessed 27/02/2022].
390. Samaritans. Media guidelines for reporting suicide. 2020. Available at: https://media.samaritans.org/documents/Media_Guidelines_FINAL.pdf. [Accessed 24/02/2022].
391. Nepon J, Fotti S, Katz LY, et al. Canadian Psychiatric Association Policy Paper: Media guidelines for reporting suicide. *Can J Psychiatry*. 2009;5(Suppl):1–5.
392. Pirkis J, Blood W, Beautrais A, et al. Media guidelines on the reporting of suicide. *Crisis*. 2006;27:82–7.
393. Everymind. Reporting suicide and mental ill-health: A mindframe resource for media professionals. 2020. Available at: <https://mindframemedia.imgix.net/assets/src/uploads/MF-Media-Professionals-DP-LR.pdf> [Accessed 08/03/2022].
394. Orygen. #chatsafe: A young person’s guide for communicating safely online about suicide. 2018.
395. John A, Marchant A, Hawton K, Gunnell D, Cleobury L, Thomson S, Spencer S, Dennis M, Lloyd K, Scourfield J. Understanding suicide clusters through exploring self-harm: Semi-structured interviews with individuals presenting with near-fatal self-harm during a suicide cluster. *Soc. Sci. Med*. 2022;292:114566.
396. Arensman E. Briefing: Murder-suicide and media reporting School of Public Health, College of Medicine and Health, National Suicide Research Foundation, University College Cork; 2021.
397. Joiner T, Lieberman A, Stanley IH, Reger MA. Might the COVID-19 pandemic spur increased murder-suicide? *J. Aggress. Confl. Peace Res*. 2020;12(3):177-182.

Appendix 1.

Coroner's Checklist for data collection in the Suicide Support and Information System

SSIS Checklist for accessing Verdict Records and Post-Mortem Reports

**National Suicide Research Foundation
School of Public Health
April 2017**

Ms Ruth Benson
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Professor Jan Rigby
Centre for Geoinformatics
National Centre for Geocomputation
Maynooth University

Professor Chris Brunsdon
National Centre for Geocomputation
Maynooth University

The study is funded by Health Research Board

GENERAL INFORMATION

ID number

1. Date of completion of checklist

____/____/____
Day Month Year

2. Completion of checklist

- 1. Completed
- 2. Partially completed
- 3. Not completed

3. If not completed or only partially completed please indicate reason for checklist not being completed or partially completed

6. Files contain:

- a. Toxicology report ☐ 1. No ☐ 2. Yes
- b. Postmortem report ☐ 1. No ☐ 2. Yes
- c. Record of verdict ☐ 1. No ☐ 2. Yes
- d. Garda report ☐ 1. No ☐ 2. Yes

No. of statements: Family: _____ Date: ____/____/____
Gardai: _____ Date: ____/____/____
Witnesses: _____ Date: ____/____/____
GP: : _____ Date: ____/____/____

TO BE FILLED IN WHEN THE CHECKLIST IS COMPLETED

Gardai

Name of Investigating Garda.....

Station.....

Phone number.....

Next of Kin

Person 1

Name.....

Relationship to deceased.....

Address.....

.....
Phone number

.....

Person 2

Name.....

Relationship to deceased.....

Address.....

.....
Phone number

.....

Person 3

Name.....

Relationship to deceased.....

Address.....

.....
Phone number

.....

Person 4

Name.....

Relationship to deceased.....

Address.....

.....
Phone number

.....

Person 5

Name.....

Relationship to deceased.....

Address.....

.....
Phone number

.....

SOCIO-DEMOGRAPHIC INFORMATION AT TIME OF DEATH

1. **Date of birth** ____/____/____
2. **Date of death** ____/____/____
7. **Full address** _____
4. **Gender**
☐ 1. Male
☐ 2. Female
5. **Nationality** (please specify).....
6. **Ethnic Origin**
A White ☐ Irish
☐ Irish Traveller
☐ White Other

B Black or Black Irish ☐ African
☐ Any other background

C Asian or Asian Irish ☐ Chinese
☐ Any other Asian background

D Other including mixed background (Please specify).....

E Not specified ☐ 99.
7. **Religion** ☐ Roman Catholic ☐ Other (Please specify).....
8. **Marital status**
☐ 1. Single
☐ 2. Married/co-habiting
☐ 3. Long-term relationship
☐ 3. Widowed
☐ 4. Divorced..... if yes, how many times: ____
☐ 5. Separated.....if yes, how many times: ____
☐ 99. Not specified
9. **Accommodation** (for inpatients give accommodation prior to admission)
☐ 1. Homeless/no fixed abode ☐ 2. Supervised hostel

- ☐ 3. Unsupervised hostel ☐ 4. House or flat
☐ 5. Prison ☐ 99. Not specified
☐ 6. Other (please specify).....

10. **Living arrangements**

- ☐ 1. Alone
☐ 2. With family of origin
☐ 3. With partner/wife only
☐ 4. With partner and children
☐ 5. With child(ren) only
☐ 6. Other shared (e.g. friends)
☐ 8. Other (please specify).....
☐ 99. Not specified

11. **Number of children** (please specify)

_____ ☐ 99. Not specified

12. **Was the deceased providing care for any children under the age of five years?**

- ☐ 1. No ☐ 2. Yes. ☐ 99. Not specified

13a **Employment status**

- ☐ 1. In paid employment (including part-time)
☐ 2. Unemployed ☐ 3. Self-employed
☐ 4. Housewife/husband ☐ 5. Full-time student
☐ 6. Long term disability ☐ 7. Retired
☐ 8. Other (please specify) ☐ 99. Not specified

13b. **Nature of employment contract**

- ☐ 1. Permanent ☐ 2. Temporary (e.g. agency work)
☐ 3. Fixed-term ☐ 4. Occasional
☐ 5. Sporadic-hourly

13c. **Sector of employment**

- ☐ A Agriculture, forestry and fishing
☐ B Mining and quarrying
☐ C Manufacturing
☐ D Electricity, gas, steam and air conditioning supply

- ☐ E Water supply; sewerage, waste management and remediation activities
- ☐ F Construction
- ☐ G Wholesale and retail trade: repair of motor vehicles and motorcycles
- ☐ H Transportation and storage
- ☐ I Accommodation and food service activities
- ☐ J Information and communication
- ☐ K Financial and insurance activities
- ☐ L Real estate activities
- ☐ M Professional scientific and technical activities
- ☐ N Administrative and support service activities
- ☐ O Public administration and defence: compulsory social security
- ☐ P Education
- ☐ Q Human health and social work activities
- ☐ R Arts, entertainment and recreations
- ☐ S Other service activities
- ☐ T Activities of households as employers; undifferentiated goods and services, producing activities of households for own use.
- ☐ U Activities of extra territorial organisation and bodies

13d. Skill discretion

- ☐ 1. Supervisory function
- ☐ 2. Without supervisory function

14. Profession (please specify; include last profession if retired or unemployed)

.....

- ☐ 99. Not specified

15. Place of work or school (please specify).....

- ☐ 99. Not specified

16. Highest level of education obtained

- ☐ 1. Primary
- ☐ 2. Secondary
 - ☐ Junior/Inter Cert
 - ☐ Senior/Leaving Cert

- ☐ 3. Third level ☐ 4. Other course e.g. PLC, apprenticeship
☐ 99. Not specified

17. History of residence in an industrial school, orphanage or foster care as a child?

- ☐ 1. No ☐ 2. Yes ☐ 99. Not specified

18. History of being in prison at any time before death (Includes being a remand prisoner)

- ☐ 1. No ☐ 2. Yes ☐ 99. Not specified

CAUSE(S) OF DEATH

Cause(s) of death (if more than one please give direct cause)

- | | |
|--|--|
| ☐ 01 Self-poisoning | ☐ 02 Carbon monoxide poisoning |
| ☐ 03 Hanging | ☐ 04 Drowning |
| ☐ 05 Firearms | ☐ 06 Cutting or stabbing |
| ☐ 07 Jumping from a height | ☐ 08 Jumping/lying before a train |
| ☐ 09 Jumping/lying before a road vehicle | ☐ 10 Suffocation |
| ☐ 11 Burning | ☐ 12 Electrocution |
| ☐ 13 Jumping/lying before an unspecified object | |
| ☐ 14 Strangulation | |
| ☐ 88 Other (please specify) _____ | ☐ 99 Not specified |

Unusual circumstances

- ☐ Yes (please specify) ☐ Yes (in appendix) ☐ No

.....

2. If self-poisoning, specify substance

(If more than one substance, select most likely cause of death)

- | | |
|---|---|
| ☐ 00 Method not self-poisoning | ☐ 01 Anti-psychotic drug |
| ☐ 02 Tricyclic anti-depressant | ☐ 03 SSRI/SNRI anti-depressant |
| ☐ 04 Lithium/Mood stabiliser | ☐ 05 Other anti-depressant |
| ☐ 06 Benzodiazepine/Hypnotic | ☐ 07 Paracetamol |
| ☐ 08 Paracetamol/Opiate compound | ☐ 09 Salicylate |
| ☐ 10 Other analgesic | ☐ 11 Opiate (heroin, methadone) |
| ☐ 12 Insulin | ☐ 13 Other poisons (eg weedkiller) |
| ☐ 14 Unspecified psychotropic drug | |

☐ 88 Other drug (please specify)
.....

☐ 99 Not specified

3. Where did the substance referred to in question 2 come from?

- ☐ 1. Prescribed for the subject
☐ 2. Prescribed for someone else
☐ 3. Not prescribed
☐ 99. Not specified
☐ Not applicable (method not self-poisoning)

Toxicology results in relation to levels of alcohol, drugs or poisons if any detected:

Toxicology Test Report attached? ☐ 1. No ☐ 2. Yes

Drug name: _____ Amount: ____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Drug name: _____ Amount: ____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Drug name: _____ Amount: ____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Drug name: _____ Amount: ____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Drug name: _____ Amount: _____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Drug name: _____ Amount: _____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Drug name: _____ Amount: _____ mg/l

☐ <Therapeutic ☐ Therapeutic ☐ >Therapeutic ☐ Toxic ☐ Lethal

Alcohol: ☐ 1. No ☐ 2. Yes Amount: _____ mg/l

.....

.....

4. Did the deceased commit homicide before dying?

☐ 1. No ☐ 2. Yes

5. Was alcohol consumed as part of the act?

☐ 1. No ☐ 2. Yes ☐ 99. Not specified

6. Was the death part of a pact?

☐ 1. No ☐ 2. Yes ☐ 99. Not specified

7. Did the death occur in a woman who was pregnant or post-natal?

☐ 0. No
☐ 1. Yes, woman was pregnant
☐ 2. Yes, death was less than one year after childbirth

8. Were any suicide notes or other messages (including text messages) left by the deceased?

☐ 1. No ☐ 2. Yes (If yes please give wording and circumstances of note)

.....
.....
.....
.....
.....

Is copy of suicide note available in file?

☐ 1. No ☐ 2. Yes ☐ Not applicable

Is a copy of the note hereby attached to the checklist?

☐ 1. No ☐ 2. Yes ☐ Not applicable

9. Last seen alive by:(specify relationship)

Location of body (please specify):

Circumstances in which the deceased was found

.....

.....

.....

.....

.....

.....

Verdict classification

- ☐ Suicide
- ☐ Open
- ☐ Misadventure
- ☐ Accidental
- ☐ Narrative

Descriptive verdict based on the inquest

.....

.....

.....

.....

Date of inquest: ____/____/____ Inquest held at

Name of Coroner: ☐ MC ☐ MK ☐ FC

Coroner district:

CIRCUMSTANCES AROUND DEATH

Please indicate the circumstances of the death by ticking the appropriate box. If not specified, please tick 99. Please answer all questions

- Isolation
 - ☐ 1. Somebody present
 - ☐ 2. Somebody nearby, or in visual or vocal contact
 - ☐ 3. No one nearby or in visual or vocal contact
 - ☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

1. Timing

- ☐ 1. Intervention is probable
☐ 2. Intervention is not likely
☐ 3. Intervention is highly unlikely
☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

3. Precautions against discovery/intervention

- ☐ 1. No precautions
☐ 2. Passive precautions (as avoiding other but doing nothing to prevent their intervention; alone in room with unlocked door)
☐ 3. Active precautions (as locked door)
☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

4. Acting to get help during/after attempt

- ☐ 1. Notified potential helper regarding attempt
☐ 2. Contacted but did not specifically notify potential helper regarding attempt ☐ 3. Did not contact or notify potential helper
☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

5. Final acts in anticipation of death (will, gifts, insurance)

- ☐ 1. None
☐ 2. Thought about or made some arrangements
☐ 3. Made definite plans or completed arrangements

☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

6. Active preparation for attempt

☐ 1. None

☐ 2. Minimal to moderate

☐ 3. Extensive

☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

7. Suicide Note

☐ 1. Absence of note

☐ 2. Note written, but torn up; note thought about

☐ 3. Presence of note

☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

8. Overt communication of intent before the attempt

☐ 1. None

☐ 2. Equivocal communication

☐ 3. Unequivocal communication

☐ 99. Not specified

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

To examine whether an open verdict are probable suicides, please note whether the following characteristics were present:

1. Explicit verbal or nonverbal expression of suicide intent

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

2. Inappropriate or unexpected preparations for death

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

3. Expression of farewell, desire to die, hopelessness, great emotional or physical pain

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

4. Precautions to avoid rescue

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

5. Previous deliberate self-harm acts or threat

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive

☐ Person who found the body ☐ GP statement ☐ Not applicable

6. Serious depression or mental health problems

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

7. Stressful events or significant losses

☐ 1. No ☐ 2. Yes ☐ Not known

Please specify:

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

PRECIPITANTS TO DEATH

Please answer all questions

1. Had the deceased recently experienced or was he/she anticipating:

(a) Becoming unemployed?

☐ Not specified ☐ Perceived possibility of becoming unemployed ☐ Dismissed from job ☐
Made redundant ☐ Became retired ☐ Not applicable

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe
unknown ☐ Not applicable

b) Significant (or perceived significant) disruption of a romantic relationship?

☐ No ☐ Not specified ☐ Separation ☐ Divorce ☐ Break-up ☐ Argument
☐ Not applicable

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe
unknown ☐ Not applicable

d) Legal troubles or difficulties with the Gardai?

☐ No ☐ Not specified ☐ Arrest ☐ Known to Gardai ☐ Pending court case
☐ Imprisoned at time of death ☐ Released from prison ☐ Other

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

c) Significant interpersonal conflict

☐ No ☐ Not specified ☐ Familial conflict ☐ Friend conflict ☐ Work conflict ☐ Other conflict

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

e) An event which was or was perceived as traumatic and caused psychological trauma to the individual?

☐ No ☐ Not specified ☐ Victim of violent or sexual assault ☐ Involved in significant vehicle collision ☐ Victim of abuse (sexual, physical, domestic, neglect) ☐ Witness of violent crime ☐ Directly witnessed sudden death ☐ Severe bullying, torture ☐ War, terrorism, or natural disaster ☐ Sudden, unexpected death of a loved one

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

f) The completed suicide of a family member or loved one?

☐ 1. No ☐ 2. Yes. ☐ 99. Not specified

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

g) The anniversary of an important death, an important other loss or another significant anniversary?

☐ 1. No ☐ 2. Yes. ☐ 99. Not specified

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

h) Exposure to the suicide of another through media or personal acquaintance? (modelling)

☐ No ☐ Not specified ☐ Media ☐ Personal acquaintance

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

(i) Major financial difficulties

☐ Not specified ☐ No ☐ Lost home ☐ Repossession of belongings, e.g. car ☐ Missed mortgage repayments ☐ Bankruptcy ☐ Business failure ☐ Repeated demands from a bank or debt collector

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

(j) Experience of humiliation or loss of face (An individual suffers humiliation when he makes a bid or claim to a certain social status and has this bid or claim fail publicly)

☐ No ☐ Not specified ☐ Yes in work ☐ Yes in family life ☐ Yes among friends ☐ Yes among social media ☐ Yes, local or national scandal

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

(k) Bereavement close family or friend

☐ No ☐ Not specified ☐ Yes- family ☐ Yes-friend ☐ Yes- other

Time before death

☐ <24 hours ☐ 24-72 hours ☐ 3-7 days ☐ 1-4 weeks ☐ Yes in last 4 weeks but timeframe unknown ☐ Not applicable

4. Were there any other major events that had occurred prior to the deceased's death?
(If yes, please give details of the event(s) and time of occurrence before the deceased's death)

HISTORY OF NON-FATAL SUICIDAL BEHAVIOUR

1. (a) Prior to his/her death, did the deceased ever before deliberately harm him/herself? For example, by taking an overdose of medication or drugs, by attempting to hang or drown him/herself?

- ☐ 1. Yes
☐ 2. No
☐ 99. Not specified

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

1. (b) If yes, how many times?

- ☐ 1. One ☐ 2. Two
☐ 3. Three ☐ 4. Four
☐ 5. Five ☐ 6. Six
☐ 7. Seven ☐ 8. Eight
☐ 9. Nine ☐ 10. Ten
☐ 11. More than ten ☐ 99. Not specified

2. Please indicate below what you know of the last previous episode of deliberate self-harm

7. Method

- ☐ 1. Poisoning ☐ 2. Hanging
☐ 3. Drowning ☐ 4. Cutting
☐ 5. Jumping from height ☐ 6. Jumping in front of moving vehicle
☐ 7. Burning ☐ 8. Other

B. Time lapse between episode of deliberate self harm and death

- ☐ 99. Not specified

.....years.....months.....days

C. Medical treatment following self harm

- ☐ 1. None
- ☐ 2. General Practitioner
- ☐ 3. General hospital
- ☐ 4. Other
- ☐ 99. Not specified

D. Psychiatric treatment following self harm

- ☐ 1. None
- ☐ 2. In-patient
- ☐ 3. Out-patient
- ☐ 99. Not specified

SUICIDAL BEHAVIOUR BY PERSON'S KNOWN TO THE DECEASED (MODELS).

Has the deceased's relatives or close friends ever deliberately harmed him or herself?

A. Relationship of model to subject (model was/is subject's.....)

MODEL NUMBER

8. Wife
9. Husband
10. Cohabitee
11. Daughter
12. Son
13. Mother
14. Father
15. Sister
16. Brother
17. Grandmother
18. Grandfather
19. Other relative
20. Close friend

1.	2.	3.	4.	5.

For each please identify in box as follows: Hanging= H; Overdose= OD; Cutting=SC; Firearms: F; Drowning=D; Poisoning=P; Other=O; Yes but method not specified = NK

B. Type of behaviour

- Deliberate self-harm
- Suicide

PSYCHIATRIC HISTORY

1. If the deceased was diagnosed with a psychiatric illness, who made this diagnosis? (doctor's name?)

2. Date of psychiatric diagnosis: _____/_____/_____
Month Year
☐ 99. Not specified

Primary Diagnosis

- ☐ 01 Schizophrenia and other delusional disorders
- ☐ 02 Bipolar affective disorder
- ☐ 03 Depressive illness
- ☐ 04 Anxiety/phobia/panic disorder/OCD
- ☐ 05 Eating disorder
- ☐ 06 Dementia
- ☐ 07 Alcohol dependence
- ☐ 08 Drug dependence
- ☐ 09 Personality disorder
- ☐ 10 Adjustment disorder/reaction
- ☐ 11 Organic disorder
- ☐ 12 Alcohol misuse, but not dependence
- ☐ 13 Drug misuse, but not dependence
- ☐ 77 No mental disorder
- ☐ 88 Other (please specify)
- ☐ 99 Not specified

Secondary Diagnosis (coding as above)

☐ _____

☐ _____

☐ _____

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

Duration of History (since clear onset of disorder coded under primary diagnosis above)

____ Years _____ months ☐ NA ☐ Not specified

Source: ☐ Garda report ☐ Family S ☐ Gardai S ☐ Witness S ☐ GP S ☐ NA

PHYSICAL HEALTH

This section examines the deceased's physical well-being.

1. Is there evidence that the deceased been diagnosed with any physical illness or disease? (Include conditions even if well controlled by treatment)

☐ 1. No ☐ 2. Yes (specify which physical illness(es))

.....
.....

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

2. Is there evidence that the deceased was in physical pain in the year prior to death?

☐ 1. No ☐ 2. Yes (Please give details e.g. duration)

.....
.....

3. Was this physical illness chronic? (i.e. duration over 12 months)

☐ 1. No ☐ 2. Yes ☐ 3. Not applicable ☐ 99. Not specified

4. Was there evidence that the deceased experienced a reduction in his/her physical capabilities prior to his/her death?

☐ 1. No ☐ 2. Yes (please give details e.g. duration)

.....
.....

5. Was there evidence that the deceased was on prescribed medication for a physical illness?

☐ 1. No ☐ 2. Yes

If **yes** is there evidence that he/she adhered to the instructions on the medication? ☐

1. No ☐ 2. Yes ☐ 99. Not specified ☐

.....
.....

SUBSTANCE ABUSE

This section explores the deceased's use, if relevant, of alcohol and drugs and asks about any recent changes in this behaviour in the year prior to death.

1. Did the deceased have a history of alcohol abuse?

☐ 1. No ☐ 2. Yes (please give details) ☐ 99. Not specified

.....
.....

2. Had the deceased made any recent attempts, (in the year prior to death) to stop abusing alcohol?

☐ 1. No ☐ 2. Yes (please give details e.g. timing) ☐ 99. Not specified

.....
.....

3. Was there a recent increase in the deceased's abuse of alcohol?

☐ 1. No ☐ 2. Yes (please give details, e.g. duration) ☐ 99. Not specified

.....
.....

4. Was there any evidence that the deceased had been drinking at the time of death?

☐ 1. No ☐ 2. Yes (please give details) ☐ 99. Not specified

.....
.....

5. Did the deceased have a history of drug abuse?

☐ 1. No ☐ 2. Yes (please give details) ☐ 99. Not specified ☐ NA

.....
.....

6. Had the deceased made any recent attempts, to stop abusing drugs?

☐ 1. No ☐ 2. Yes (please give details e.g. timing) ☐ 99. Not specified

.....
.....

7. Was there a recent increase in the deceased's abuse of drugs?

☐ 1. No ☐ 2. Yes (please give details,e.g. duration) ☐ 99. Not specified

.....
.....
8. Was there any evidence that the deceased had been taking drugs at the time of death?

- ☐ 1. No ☐ 2. Yes (please give details) ☐ 99. Not specified
-
.....

Source: ☐ Family Statement ☐ Gardai Statement ☐ Last person to see deceased alive
☐ Person who found the body ☐ GP statement ☐ Not applicable

TREATMENT HISTORY

This section refers to contacts with the deceased's General Practitioner

1. How many times did the deceased attend his or her GP during the last year?

- ☐ 1. Never in the past year
☐ 2. 1 time
☐ 3. 2-3 times
☐ 4. 4 or more times
☐ 99. Not specified

2. Please indicate in the spaces provided below when the deceased last attended his or her GP? What was his/her reason? Were any medicines prescribed?

Date of last contact: ____/____/____ ☐ 99. Not specified
 Day Month Year

Reason:

- ☐ 1. Physical
☐ 2. Psychological
☐ 3. Both physical and psychological
☐ 99. Not specified
☐ Not applicable

Medicines prescribed:

- ☐ 1. Yes
☐ 2. No
☐ 99. Not specified
☐ Not applicable

If medicines were prescribed did the deceased use any of the medicines prescribed in that contact for self-poisoning/overdose?

- ☐ 1. Yes
☐ 2. No
☐ 99. Not specified
☐ Not applicable

3. At the time of the deceased's last contact with his or her GP, did he/she mention any thoughts of harming him/herself?

- ☐ 1. Yes
☐ 2. Vaguely referred to
☐ 3. No
☐ 99. Not specified
☐ Not applicable

4. Was the deceased ever treated as an inpatient at a psychiatric hospital or on the psychiatric ward of a general hospital?

- ☐ 1. No ☐ 2. Yes ☐ 99. Not specified ☐ Not applicable

If yes, please give details (e.g. number of admissions, reason for admission)

.....
.....

How often in the year prior to death?

- ☐ 1. never
☐ 2. 1 time
☐ 3. 2-3 times
☐ 4. 4 times or more
☐ 99. Not specified

PSYCHIATRIC TREATMENT

1. Psychiatric admissions (if one or more times in inpatient treatment):

Total number of admissions to psychiatric in-patient ward (including any current admission)

No. of times: _____

☐ 99. Not specified

As accurately as possible describe: when the patient was most recently discharged, how long the admission was for and what the reasons for admission were?

2. Out-patient psychiatric treatment and day care

Is there evidence that the deceased was ever in contact with any of the following professional services for treatment or advice?

- 21. Psychiatric service- public
- 22. Private psychologist/psychiatrist
- 23. Community mental health nurse
- 24. Alcohol/Drug Addiction services
- 25. Consultation service for relationship/sexual problems

1. Yes	2. No

3. Other treatment of emotional problems

Is there evidence that the deceased ever received treatment or assistance for emotional problems from anyone else? For example, Alcoholics Anonymous, helplines, etc.

☐ 1. No

☐ 2. Yes

If yes, please specify:.....

.....

.....

PSYCHOTROPIC MEDICATION

For each of the following drugs please specify whether the drugs were prescribed and whether the patient was compliant (i.e. taking drug(s) as prescribed)

- 1. Not prescribed
- 2. Prescribed and thought to be compliant
- 3. Prescribed and thought not to be compliant
- 4. Information not available as patient not currently in mental health service

- ☐ 1. Oral typical anti-psychotic drugs (e.g. chlorpromazine, haloperidol)
- ☐ 2. Oral atypical anti-psychotic drugs (e.g. clozapine, risperidone)
- ☐ 3. Depot typical anti-psychotic drugs (e.g. flupenthixol, zuclopenthixol)
- ☐ 4. Depot atypical anti-psychotic drugs (e.g. risperidone)
- ☐ 5. Lithium/mood stabilisers
- ☐ 6. Tricyclic anti-depressants
- ☐ 7. SSRI anti-depressants
- ☐ 8. SNRI anti-depressants
- ☐ 9. Other anti-depressants
- ☐ 10. Methadone
- ☐ 11. Other psychotropic drug (please specify)

Did the patient complain of distressing psychotropic drug side-effects?

☐ 1. No ☐ 2. Yes

Reason for incomplete compliance with treatment

- ☐ 1. Side effects
☐ 2. Lack of insight into illness
☐ 3. Dependence (e.g. persistent benzodiazepine use against medical advice)
☐ 4. Side effects and lack of insight
☐ 5. Not applicable as patient was compliant with drug treatment
☐ 6. Other (please specify).....

Source: ☐ Garda report ☐ Family S ☐ Gardai S ☐ Witness S ☐ GP S ☐ NA

HISTORY OF PHYSICAL MALTREATMENT AND/OR SEXUAL ABUSE/ FAMILY AND PERSONAL HISTORY

1. Was the deceased ever a victim of significant physical, sexual or emotional abuse?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

2. Was a family member of the deceased ever a victim of significant physical, sexual or emotional abuse?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

3. Was the deceased ever a perpetrator of significant physical, sexual or emotional abuse?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

4. Was a family member of the deceased ever a perpetrator of significant physical, sexual or emotional abuse?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

5. Was the deceased ever a victim of violent behaviour?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

6. Was a family member of the deceased ever a victim of violent behaviour?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

7. Was the deceased ever a perpetrator of violent behaviour?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

8. Was a family member of the deceased ever a perpetrator of violent behaviour?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

10. Was a family member of the deceased ever residing in an orphanage, industrial school or in foster care?

☐ 1. No ☐ 2. Yes (please give details below) ☐ 99. Not specified

.....
.....

ADDITIONAL INFORMATION

Please use this section to record any additional information that has not already been covered

.....
.....
.....
.....
.....

Appendix 2. Ethical Approval granted by the Social Research Ethics Committee, UCC for the Suicide Support and Information System

Direct line
+353 21 4904518

Email
r.swain@ucc.ie



UCC
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

30 January 2009

Dr. E. Arensman,
National Suicide Research Foundation,
Department of Epidemiology and Public Health,
UCC.

Coláiste na nEalaíon, an Léinn Chaitligh agus
na nEolaíochtaí Sóisialta
College of Arts, Celtic Studies and Social Sciences

Roinn an Síceolaíochta Feidhmi
Department of Applied Psychology

University College Cork,
Cork, Ireland

T +353 (0)21 490 4551/490 4552
F +353 (0)21 427 0439
E info@psych@ucc.ie
www.ucc.ie

Dear Dr. Arensman,

Social Research Ethics Committee

The Social Research Ethics Committee has now reviewed your project *The Development of a Suicide Support and Information System in Ireland: A Pilot Study*. There are a few minor concerns (references to Appendix and page numbers are to the SREC application form):

1. Appendices 1.4a and 1.4b (pp. 13-14): SREC has no connection with the Cork Teaching Hospitals.

2. Appendices 1.4c and 1.4d (pp. 15-16): the letter uses somewhat stilted language ("hereby", "objective", "facilitate"); the long clause commencing "who are affiliated" may interfere with comprehension of "will contact you..." - could the clause be presented in a subsequent sentence?

3. Appendices 1.5a and 1.5b (pp. 17-20):

(a) There is no objection to the use of the title "Dr". However the term "doctor" (which appears three times) would be taken by most people to imply "medical doctor". If this implication is not correct, then the term should not be used.

(b) Section A: "Along with the research" does not provide the intended connection - rephrase, please.

(c) Section B: "Confidentiality" should read "Confidentiality/Anonymity" or "Confidentiality and Anonymity"

(d) Section C: the three instances of the word "contact" in the first paragraph are confusing. So is the later phrase "who may be asked about my contact details".

4. Appendix 1.5c (p. 21):

(a) The term "doctor" - as in 3(a) above.

(b) "Confidentiality" - as in 3(c) above.

Subject to appropriate modification, this project is approved. There is no need to resubmit the application. Good luck with your research!

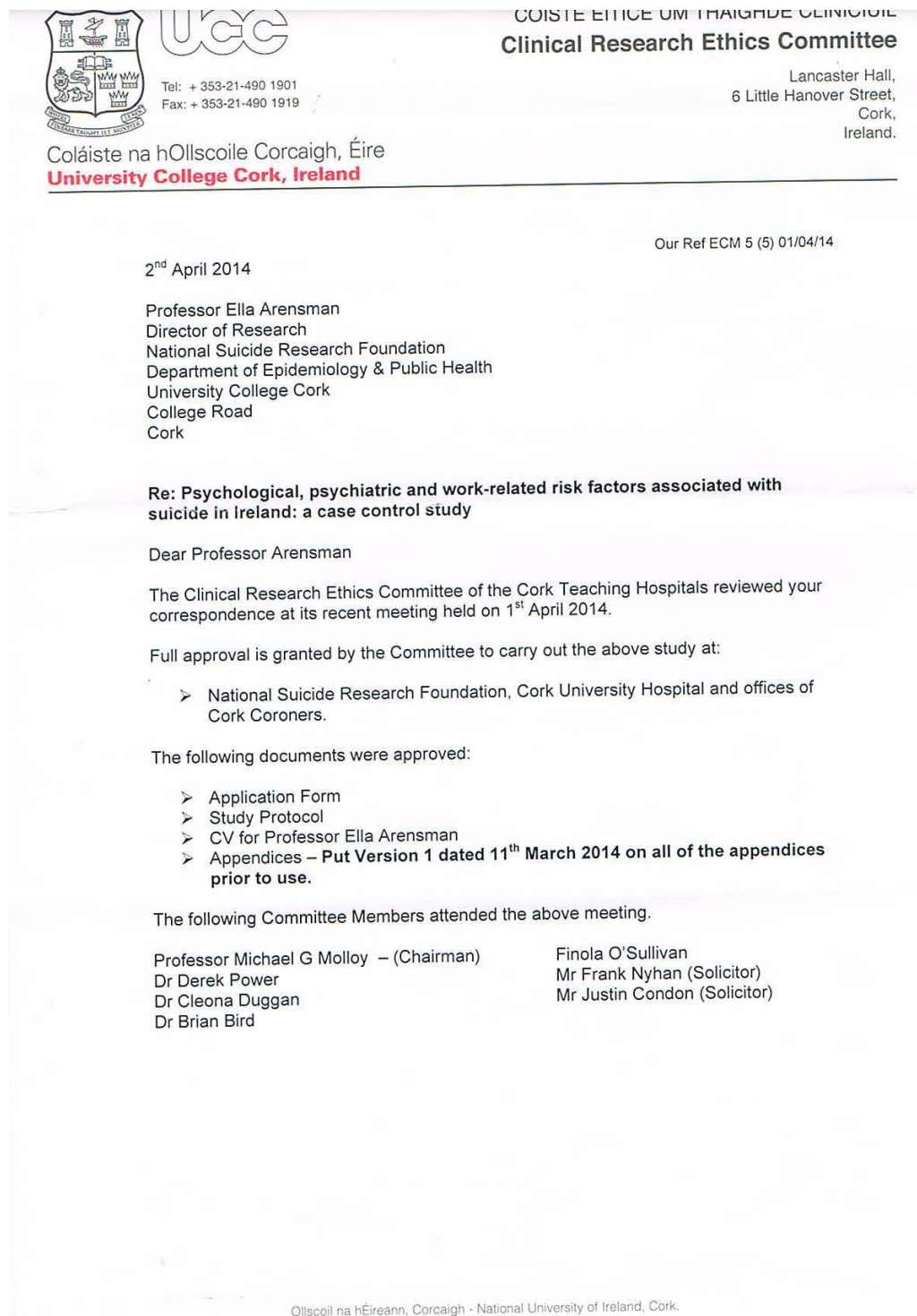
Yours sincerely,

Dr. R. B. Swain,
Chair, Social Research Ethics Committee.

Prof Eleanor O'Leary
Head of Department

Ólíscoil na hÉireann, Corcaigh
National University of Ireland, Cork

Appendix 3. Ethics approval granted by the Clinical Research Ethics Committee, UCC for the SSIS-ACE case control study





Tel: + 353-21-490 1901
Fax: + 353-21-490 1919

COISTE ÉITICE OM THAIGHDE CLINICÉIL
Clinical Research Ethics Committee

Lancaster Hall,
6 Little Hanover Street,
Cork,
Ireland.

Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

Yours sincerely

Professor Michael G Molloy
Chairman
Clinical Research Ethics Committee
of the Cork Teaching Hospitals

The Clinical Research Ethics Committee of the Cork Teaching Hospitals, UCC, is a recognised Ethics Committee under Regulation 7 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004, and is authorised by the Department of Health and Children to carry out the ethical review of clinical trials of investigational medicinal products. The Committee is fully compliant with the Regulations as they relate to Ethics Committees and the conditions and principles of Good Clinical Practice.

Ollscoil na hÉireann, Corcaigh - National University of Ireland, Cork.

Appendix 4. Ethics approval granted by the Clinical Research Ethics Committee, UCC for the current research



Tel: + 353-21-490 1901
Fax: + 353-21-490 1919

Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

COISTE EITICE UM THAIGHDE CLINICIÚIL
Clinical Research Ethics Committee

Lancaster Hall,
6 Little Hanover Street,
Cork,
Ireland.

9th July 2018

Our Ref ECM 5 (1) 29/03/18 & ECM 3 (yyyyy) 03/07/18

Professor Ella Arensman
Chief Scientist
National Suicide Research Foundation
School of Public Health
University College Cork
Room 4.2
Western Gateway Building
Western Road
Cork

Re: Establishing a suicide and self-harm observatory and continuation of the suicide support and information system.

Dear Professor Arensman

The Chairman approved the following:

- Agreement Template for Data Provision by the HSE
- Data Agreement for Data Provision from Coroner of South and West Cork
- Summary of Suicide and Self-Harm Observatory
- Bereavement Support Letter and Opt in Slip
- Bereavement Support Letter and Opt in Slip
- Participant Information Sheet
- Information Sheet for Parents of Participants aged under 18 years
- Consent Form For Participants
- Consent Form For Parents of Participants aged under 18 years
- Age Appropriate Information Leaflets for Children under 18 years
- Assent Forms for Children under 18 years
- Invitation Letters
- Letter to Health Care Professional
- Study Protocol dated May 2018
- CV for Chief Investigator
- Evidence of Insurance
- Garda Vetting Proof for Researchers involved in Interviewing Children.

Full approval is now granted to carry out the above study.

The date of this letter is the date of authorization of the study.

Please keep a copy of this signed approval letter in your study master file for audit purposes.

You should note that ethical approval will lapse if you do not adhere to the following conditions:

1. Submission of an Annual Progress Report/Annual Renewal Survey (due annually from the date of this approval letter)
2. Report unexpected adverse events, serious adverse events or any event that may affect ethical acceptability of the study
3. Submit any change to study documentation (minor or major) to CREC for review and approval. Amendments must be submitted on an amendment application form and revised study documents must clearly highlight the changes and contain a new version number and date. Amendments cannot be implemented without written approval from CREC.
4. Notify CREC of discontinuation of the study

The Clinical Research Ethics Committee of the Cork Teaching Hospitals, UCC, is a recognised Ethics Committee under Regulation 7 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004, and is authorised by the Department of Health and Children to carry out the ethical review of clinical trials of investigational medicinal products. The Committee is fully compliant with the Regulations as they relate to Ethics Committees and the conditions and principles of Good Clinical Practice.



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Fax: + 353-21-490 1919

COISTE EITICE UM THAIGHDE CLINICIÚIL
Clinical Research Ethics Committee

Lancaster Hall,
6 Little Hanover Street,
Cork,
Ireland.

Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

5. Submit an End of Trial Declaration Form and Final Study Report/Study Synopsis when the study has been completed.

Yours sincerely

Professor Michael G Molloy
Chairman
Clinical Research Ethics Committee
of the Cork Teaching Hospitals

The Clinical Research Ethics Committee of the Cork Teaching Hospitals, UCC, is a recognised Ethics Committee under Regulation 7 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004, and is authorised by the Department of Health and Children to carry out the ethical review of clinical trials of investigational medicinal products. The Committee is fully compliant with the Regulations as they relate to Ethics Committees and the conditions and principles of Good Clinical Practice.

Appendix 5. Data agreement with the Coroners of Cork County for the Suicide and Self-harm Observatory



Establishing a Suicide and Self-Harm Observatory and the Continuation of the Suicide Support and Information System

TEMPLATE FOR AGREEMENT BETWEEN THE CORONER OF SOUTH AND WEST CORK AND THE NATIONAL SUICIDE RESEARCH FOUNDATION, SCHOOL OF PUBLIC HEALTH, UNIVERSITY COLLEGE CORK AND THE NATIONAL CENTRE FOR GEOCOMPUTATION, MAYNOOTH UNIVERSITY CONCERNING THE SHARING AND USE OF DATA RELATING TO SUSPECTED SUICIDE CASES

The Coroner for South and West Cork agrees to make data relating to suspected suicide cases available to representatives of the National Suicide Research Foundation, The School of Public Health, University College Cork and The National Centre for Geocomputation, Maynooth University.

The representatives of the organisations involved agree to work with the shared data in line with the following conditions:

- Data accessed for the purpose of the Suicide and Self-Harm Observatory will be made available to the researcher, Ms Ruth Benson, by means of telephone communication with the Coroner for South and West Cork to ensure the secure transfer of confidential data.
- A standardised approach will be applied when accessing the data by the named representatives of the National Suicide Research Foundation, School of Public Health, University College Cork and the National Centre for Geocomputation, Maynooth University. The standardised approach includes the use of a double password protected non-networked laptop at all times, and only the required minimal data will be recorded and analysed.
- The encrypted and double password protected database will be stored within the offices of the National Suicide Research Foundation and historical data will be accessed for trend analysis only. All names and addresses will be stripped from the database.
- Data related to suspected suicide cases will only be presented or published in aggregated form in order to ensure that individuals and their families cannot be identified.
- Contact with bereaved family members will only be made after the conclusion of an inquest in which a verdict of suicide has been returned.
- Access to suspected suicide data will be restricted to the following named representatives of the organisations involved:

Mr. Frank O' Connell,
Coroner for South and West Cork
55 Grande Parade,
Cork City

Professor Ella Arensman
Chief Scientist / Research Professor
National Suicide Research Foundation
School of Public Health
University College Cork

Ms. Ruth Benson
PhD Researcher
School of Public Health
National Suicide Research Foundation
University College Cork

Dr. Paul Corcoran
Director of Research
National Suicide Research Foundation
School of Public Health
University College Cork

Ms Eileen Williamson
Chief Executive Officer
National Suicide Research Foundation
University College Cork

Professor Jan Rigby
Director
Centre for Health Geoinformatics
National Centre for Geocomputation
Department of Geography
Maynooth University

Professor Chris Brunson
Director
National Centre for Geocomputation
Department of Geography
Maynooth University

Martin Ryan
Resource Officer for Suicide Prevention
St Stephen's Hospital Campus
Glanmire
Cork

The Suicide and Self-Harm Observatory is funded by the Health Research Board Ireland



Appendix 6. Data agreement with the Health Service Executive for the Suicide and Self-Harm Observatory



AGREEMENT BETWEEN THE HEALTH SERVICE EXECUTIVE AND THE NATIONAL SUICIDE RESEARCH FOUNDATION, THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY COLLEGE CORK AND THE NATIONAL CENTRE FOR GEOCOMPUTATION, MAYNOOTH UNIVERSITY CONCERNING THE SHARING AND USE OF HEALTH SERVICE EXECUTIVE PATIENT MORTALITY REGISTER DATA RELATING TO SUSPECTED SUICIDE CASES

The Health Service Executive (HSE) agrees to share data from the HSE Patient Mortality Register with representatives of the National Suicide Research Foundation, The School of Public Health, University College Cork and The National Centre for Geocomputation, Maynooth University.

The representatives of the organisations involved agree to work with the shared data in line with the following conditions:

- For the purposes of the research outlined in appendix 5a, it will be necessary to access files relating to cases of suspected suicide recorded by the HSE Patient Mortality Register. However, the data will only be presented or published in aggregated form in order to ensure that individuals and their families cannot be identified.
- HSE Patient Mortality Register data accessed for the purpose of the research outlined in appendix 5a will be provided to the researcher by means of telephone communication with the Resource Officer for Suicide Prevention to ensure the secure transfer of confidential data.
- A standardised approach will be applied when accessing the data by the named representatives of the National Suicide Research Foundation, School of Public Health, University College Cork and the National Centre for Geocomputation, Maynooth University. The standardised approach includes a password protected non networked laptop must be used at all times, and only the required minimal data (as outlined in appendix 5a) will be recorded and analysed.
- The encrypted database will be stored within the offices of the National Suicide Research Foundation indefinitely and historical data will be accessed for trend analysis only. All names and addresses will be stripped from the database.
- The data will continue to be the property of the Health Service Executive.
- There must be consultation with the Health Service Executive before findings arising from the data are presented or published.
- Suitable acknowledgement as to the source of the data must be given in publications.
- Authorship rights to any publications arising from analysis of the data will be decided in accordance with internationally accepted publication guidelines.
- Access to the HSE Patient Mortality Register data will be restricted to the following named representatives of the organisations involved:

Martin Ryan
Resource Officer for Suicide Prevention
St Stephen's Hospital Campus
Glanmire
Cork

Professor Ella Arensman
Chief Scientist / Research Professor
National Suicide Research Foundation
School of Public Health
University College Cork

Ms. Ruth Benson
PhD Researcher
School of Public Health
National Suicide Research Foundation
University College Cork

Dr. Paul Corcoran
Director of Research
National Suicide Research Foundation
School of Public Health
University College Cork

The Suicide and Self-Harm Observatory is funded by the Health Research Board Ireland





Ms Eileen Williamson
Chief Executive Officer
National Suicide Research Foundation
University College Cork

Professor Jan Rigby
Director
Centre for Health Geoinformatics
National Centre for Geocomputation
Department of Geography
Maynooth University

Professor Chris Brunsdon
Director
National Centre for Geocomputation
Department of Geography
Maynooth University

The Suicide and Self-Harm Observatory is funded by the Health Research Board Ireland



Appendix 7. Structured questionnaire for study 2

Name of organisation	
----------------------	--

Please include all relevant details relating to each aspect of the real-time suicide surveillance system operated by your organisation.

- System description

Name of surveillance system	
Purpose of the system	
Use of data collected by the system	
Dissemination of outputs	
Personnel granted access to the system	

- System characteristics

Level of data collection, i.e. national, regional, etc.	
Data custodians, i.e. sources from where original data is obtained	
Number and description of data items comprising system	
Terminology, classification, definitions used to select cases	
Data format, i.e. email, hard file, etc.	
Ethical considerations in developing system	
Data storage, i.e. data security, access to database	
Data ownership and retention; existence of protocols and agreement with data custodians	

- System operation

Method of data collection	
Frequency of data collection, i.e., case submission interval	
Decision making on probability of death, operational criteria applied to determine relevancy of cases for inclusion	
Data input and output: automated or manual	
Rate of data processing	
Statistical analysis: software used; analysis applied	
Epidemiological analysis	

- **System practices**

Timeliness	
Data quality	
Usefulness	
Simplicity	
Flexibility	
Sensitivity	
Acceptability	
Applicability to suicide prevention efforts	

Appendix 8. Supplementary material for study 2

Name of System	Coronial Suspected Suicide Data Sharing Service (CDS)	Interim Queensland Suicide Register (iQSR)	Victorian Suicide Register (VSR)	Thames Valley Police Real-Time Suicide Surveillance (TV-RT-SSS)	Suicide and Self-Harm Observatory (SSHO)
Timeliness	The CDS receives data on suspected suicides from the National Coronial Services Processing Centre on a 24/7 basis, usually within a few hours of the death being attended by police. The CDS operates on standard business working days and hours, processing suspected suicide notifications and alerting impacted District Health Boards.	The iQSR is updated three times a week and updated before fulfilling any new data requests to ensure completeness. The count relative to previous years is provided fortnightly to stakeholders, and there are quarterly reports detailing counts and rates by geography and counts by Indigenous status by geography.	All suspected external cause deaths in the state of Victoria, Australia are required to be reported to the Coroners Court of Victoria. Reporting occurs immediately upon occurrence or notification of death. Every weekday morning the VSR team review Victorian deaths reported during the previous 24 hours (or 72 hours after the weekend) to identify new suspected suicides for immediate inclusion in the VSR.	The TV-RT-SSS is updated daily through the week, not on weekends. The timing of the report capture can vary and is subject to how quickly the report from the Police Officer or Coroners office is received centrally (usually within a few days of the death being reported). Once received it is added to TV-RT-SSS on the same day. Monitoring for links/trends etc. is continuous.	The fortnightly case submission interval applied by the SSHO is based on the capacity of the data custodians to facilitate data collection. In exceptional circumstances whereby notification of an unconfirmed media or community report of a potential cluster or contagion occurs, the coroner's office is immediately contacted to verify whether the unsubstantiated report is valid. Aggregated data is reported periodically to relevant stakeholders, as per the Standard Operating Procedure. The SSHO data has been used for multiple requests from policymakers during the COVID-19 pandemic.
Data quality (representativeness and completeness)	CDS receives data in notifications about all suspected suicides known to Coronial Services New Zealand. All cases of suspected suicide in New Zealand receive final classification of cause of death by Coronial determination. Some cases initially classified as suspected suicides may ultimately be determined to have had another	Reporting to the register is not mandatory, so a monthly cross-check occurs with the Coroners Court of Queensland's list of suspected suicides to obtain any missing cases. The completeness of the register depends on the availability and completeness of police reports but a high amount of missing data is tolerated for some variables as clusters may only relate to two to three people, for	The VSR is fully integrated with the Coroners Court of Victoria's death surveillance program. This integration enables cases to be reviewed continually as coroners' investigations progress, to remove wrongly-included deaths and add suicides missed during initial surveillance. The VSR's core dataset of basic information (socio-	The data is captured from police officer reports of suicide, recorded for coronial purposes, received centrally within the force. Coroners Offices equally send reports of suicide, especially where officers do not attend in the first instance i.e. hospital reported deaths following a suicide attempt. The data is audited every two months or so, via a cross check with each of the four area coroner's offices.	All suspected suicide deaths are reported to the local coroner of each jurisdiction. All coroners' records in Counties Cork and Kerry are reviewed for cases that meet the criteria for a suspected suicide, ensuring a high level of completeness. The cross-check feature based on the inclusion of a second data source, i.e. the HSE Patient Mortality Register which records deaths by health service users has been effective in capturing all cases of

	cause of death. There may also be a small number of cases not initially thought to be suicides, but ultimately are determined as a suicide. The data provided in suspected suicide notifications to CDS are provisional; data can be subject to inaccuracies and elements may be missing particularly ethnicity. All recipients of the data are advised of these limitations.	which there may be no missingness. Standard caveats for iQSR approved by the state coroner are issued in each annual report.	demographic, location, method) about each death is complete for every case, and is reviewed regularly as coroners' investigations progress. These processes ensure the VSR data is as representative and complete as possible.	Some cases initially classified as suspected suicide may ultimately be determined to have had another cause of death. There may also be a small number of cases not initially thought to be suicides, but ultimately are determined as a suicide. The data provided in suspected suicide notifications to TV-RT-SSS is provisional; some data points can be subject to inaccuracies and elements may be missed by the reporting officers. All recipients of the data are advised of these limitations.	suspected suicide accurately since the inception of the SSHO. The core dataset of minimal variables about each death is predominantly complete. Data relating to history of abuse may not be readily available at time of data collection for all cases, thus missing data for these fields is tolerated, with the intention to complete all data fields when data becomes available either during or post-coronial investigation. All data recipients are advised of these limitations. Given the provisional status of the data, ongoing review ensures that those cases that receive a verdict other than suicide at inquest are specified and documented appropriately.
Usefulness	Timely provisional coronial data on suspected suicides is an important element of local postvention responses. The CDS has been useful in: - verifying and informing the provision of timely and appropriate active outreach, support and other postvention services to families, friends and communities bereaved by suicide. - Facilitating the timely identification of potentially vulnerable individuals impacted by exposure to a suspected suicide. In turn, this helps ensure that such	The iQSR has been useful in identifying frequently used locations and providing the impetus for means restriction at those sites, and for refuting unsubstantiated claims made to state and federal governments.	VSR data informs Victorian coroners' investigations and has been used to formulate prevention-focused recommendations in a wide range of areas. VSR data is regularly provided to Victoria's Department of Health, and to Commonwealth government bodies, to assist in monitoring suicide and to inform suicide prevention initiatives. The VSR team notify emerging suicide trends and issues to government, and answer government questions about suicide (for	The TV-RT-SSS provides monthly statistics for internal force use and four Suicide Prevention Groups, plus relative comparable data month on month from January 2017 to date. The data is also shared with the national PHE RTSS database. The data is equally used for supporting those bereaved by suicide by facilitating the timely identification of those potentially vulnerable individuals impacted by exposure to a suspected suicide. In turn this helps ensure that such individuals are linked with appropriate supports and services.	The SSHO has been both effective and highly valuable in dispelling misinformation reported via both traditional and social media of unsubstantiated figures of suspected suicide that often contribute to community concern. The system has informed response plans, outreach and bereavement support for communities impacted by suicide. The SSHO provides a data source for ad hoc briefings to educate stakeholders, the media and the general public on the facts.

	individuals are linked with appropriate supports and services. - Helping establish the facts. Establishing the facts can reduce community rumours, distress and anxiety and minimise the risk contribution of this to further suicidal behaviour. - Assisting with the accurate assessment of current local patterns of suicides in order to discern possible suicide cluster(s) or suicide contagion. - The emergence of novel methods of suicide can be tracked and appropriate action taken.		example confirming or refuting concerns about reported clusters and trends). VSR data is published on a monthly basis by the Coroners Court of Victoria to inform and educate the Victorian public. The VSR has been the data source for multiple papers published in peer-reviewed journals.		
Applicability to suicide prevention efforts	Bereaved families and friends require care and support for their own health and wellbeing, and as suicide prevention. The utility of the CDS in priming postvention activities (above) is also of course priming prevention. Learnings from postvention activities will help District Health Boards further develop their district suicide prevention plans aimed at building community resilience and well-being and targeting modifiable risk factors evident in their communities.	The iQSR is the best source of information to inform the Queensland community about the characteristics of suspected suicides and therefore has high applicability to suicide prevention efforts.	Many Victorian coroners' suicide prevention recommendations informed by VSR data, have been accepted and implemented. These include recommendations addressed to means restriction; current and former serving defence force members; international students; perpetrators of intimate partner violence; and inpatients in mental health units. VSR data has informed multiple Victorian initiatives to intervene in communities where emerging suicide issues have been identified.	In terms of direct support for those bereaved and therefore being at greater risk of taking their own lives, the process cannot be judged as correlating to reduced suicide rates. However, the successive positive feedback from those affected is reassuringly convincing. The data is used extensively in the four area Suicide Prevention groups to inform suicide prevention strategies and direct actions. Where patterns, potential contagion, clusters or linked incidents are identified, then response plans and activities follow to support those at risk, communities or the organisations i.e. schools, linked to those incidents.	Data analyses have informed development of regional suicide prevention initiatives, including means restriction efforts at locations of concern and targeted media campaign on mental health support, based on the risk profiles identified via trend analysis.

Accessibility	Data received by the CDS about suspected suicides is disseminated to all impacted District Health Boards. District Health Boards have designated authorised recipients for receiving this sensitive personal data from CDS who ensure that it is managed according to national Privacy laws and frameworks.	Data is currently disseminated to those who 'need to know' and released publicly once a year. A current data request template is being formulated to more systematically capture and respond to data requests from government and non-government agencies.	VSR data is accessible to all Victorian coroners without restriction. VSR data is available upon request to government bodies and health services for prevention purposes, contingent on the VSR team having the resources and capacity to fulfil the request, and on the State Coroner's approval. VSR data is available to the Victorian Department of Health to inform its suicide prevention work. VSR data update reports are published for the public on a monthly basis. VSR data is available to researchers in approved collaborative projects that have a suicide prevention focus.	Data received by the TV RTSSS is widely disseminated to all partners within the area Suicide Prevention Groups. i.e. strategic and operational leads. It is further reviewed by the TV SPIN (Suicide Prevention Intervention Network).	SSHO data is available to the Health Services Executive Resource Officers for Suicide Prevention to inform their practice and ensure timely support in bereaved communities. Data is available upon request to government bodies for the purpose of informing development of prevention strategies and policies. A data visualisation tool is currently in development with the aim of augmenting data analysis and efficient dissemination of de-identified data via an encrypted interactive dashboard, accessible to key stakeholders only.
Flexibility	The main constraint to flexibility of the service has been the number of stakeholders that are party to the Memorandum of Understanding which sets out the purpose and process to provide data from Coronial Services New Zealand to District Health Boards. The parties to the MoU include the provider of CDS (Clinical Advisory Services Aotearoa), two government agencies (Coronial Services	The iQSR has been flexible in response to the need for reporting data by Local Government Area and doing additional coding when investigating clusters. There is a need to revise the code extracting information from the data source to capture additional information on a long-term basis.	The VSR design has been revised over time to meet emerging needs. Examples include the addition of latitude and longitude information for locations relevant to the suicide; and revisions to how information on cultural and linguistic diversity is captured. In 2020, the VSR implementation was shifted from Microsoft Access to the Microsoft Power Platform (Dynamics 365), demonstrating flexibility in	The system has demonstrated both flexibility and adaptability, as per demand for additional data. It has been particularly flexible in response to the need for reporting data by Local Government / Authority Areas. As far as possible meeting the needs of local stakeholders and bereavement support services.	The system has demonstrated both flexibility and adaptability, as per demand for additional data. Based on the outcomes of the pilot phase, the SSHO has been expanded from the original nine-item database to include an additional six data items. The amended database captures additional information to further assist in risk identification and detection of emerging clusters and locations of concern. Based on interest from key

	New Zealand & the Ministry of Health) and 20 District Health Boards. In 2021, a project is underway to expand the original eight item data set in notifications to include an additional six items: Unique identifier (NHI number), summary of the incident, next of kin details, discoverer details, employment status and occupation.		information technology infrastructure. VSR coding processes are also flexible and responsive, with the project team having the ability to assign coding resources based on current coroners' priorities, external project funding, and government need.		stakeholders, the SSHO has been extended also to include the County now covering the entirety of the Health Service Executive Community Health Organisation area four.
Sensitivity	The number of suspected suicides notified via CDS is typically slightly higher than the number of cases where there is a formal Coronal finding of suicide. The two sets of publicly available are slightly difficult to compare as one is based on calendar year, the other on financial year but between 2008-2015 the variance averaged 5%.	Sensitivity and specificity are similar compared to the final QSR, although the final QSR also locates additional misclassified suicides. Studies reporting sensitivity and specificity, and misclassification in greater detail are currently being considered.	As discussed above, the VSR is integrated with the Coroners Court of Victoria's broader death surveillance system. This system records initial death classification (intent and mechanism) upon report, and revised death classification as the coroner's investigation progresses to conclusion. Comparison of initial and revised death classifications shows that approximately 7% of deaths the VSR team initially classify as suicides are ultimately found not to be suicides. Additionally, approximately 5% of deaths ultimately confirmed to be suicides are missed in initial surveillance. Overdose (acute drug toxicity) is the mechanism most frequently implicated in misclassification.	The number of suspected suicides notified via TV-RT-SSS is typically slightly different than the number of cases where there is a formal coronial finding of suicide. The suspected data is most useful for immediate and medium term planning and response. The data available nationally through the Office of National Statistics is used more at a strategic level.	Internationally validated criteria are applied to each case screened for inclusion, demonstrating a high level of sensitivity for capturing all suicide cases. It has been difficult to determine variance in cases captured by the SSHO since its inception in late 2018 by comparing with official mortality statistics because of the lag in publication of national figures in Ireland associated with delays in conclusion of coronial inquests, further compounded by the COVID-19 pandemic.

Acceptability	Feedback received from all stakeholders about CDS has been entirely positive in respect of both its usefulness and satisfaction that the data in suspected suicide notifications is being received, analysed and disseminated by CDS in a timely and accurate way and following agreed protocols. CDS was found to be a fit for purpose by an external review 2020. CDS maintains strong effective working relationships with all stakeholders to ensure the ongoing fidelity and acceptability of the service.	The reporting structure for the project was revised from triennial reports to annual reports, including iQSR data, in response to the needs communicated by stakeholders when consulted by the funding agency.	The acceptability of the VSR was evaluated in a 2018. The primary strength of the VSR was found to be the quality of data it contains; the primary weakness was the variability in detail and quality of source information (police reports and coronial case files) that underpins the VSR coding.	The TV-RT-SSS is widely acknowledged, beyond the local force area, as a system worthy of replication and many areas have taken elements of the approach as the foundation of their own systems. Local stakeholders are very positive in relation to its usefulness and accuracy for the purposes for which it is applied.	Communication between the lead researcher and the data custodians works effectively. Capacity issues within the Coroners' offices contributed to some delays in data collection during the pilot phase. These issues have since been rectified by adjusting the approach from telephone communication to onsite data collection in some instances to meet the needs of the data custodians. Results of analyses have been effectively used to inform the implementation of additional community supports in vulnerable communities identified using trend analysis.
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Appendix 9.

Research output, dissemination and training

Academic papers based on the empirical research included in this thesis

Year	Published peer-reviewed papers
2022	Benson R , Brunsdon C, Rigby J, Corcoran P, Ryan M, Cassidy E, Dodd P, Hennebry D, Arensman E. (2022). Real-time suicide surveillance supporting policy and practice. <i>Global Mental Health</i> . 9:384-8.
2022	Benson R , Brunsdon C, Rigby J, Corcoran P, Ryan M, Cassidy E, Dodd P, Hennebry D, Arensman E. (2022). The development and validation of a dashboard prototype for real-time suicide mortality data. <i>Frontiers in Digital Health</i> . 4:909294.
2022	Benson R , Rigby J, Brunsdon C, Cully G, San Too, L, Arensman E. (2022). Quantitative methods to detect suicide and self-harm clusters: a systematic review. <i>International Journal of Environmental Research and Public Health</i> . 19(9):5313.
2022	Benson R , Rigby J, Brunsdon C, Corcoran P, Cassidy E, Ryan M, Dodd Ph, Hawton K, Lascelles K, Colchester D, Kolves K, Leske S, De Leo D, Crompton D, Adam G, Dwyer J, Pirkis J, Shave R, Fortune S, Arensman E (2022). Real-time suicide surveillance: comparison of international surveillance systems and recommended best practice. <i>Archives of Suicide Research</i> . 1–27.
2021	Benson R , McTernan N, Ryan F, Arensman E. (2021). Suicide clustering and contagion: The role of the media. <i>Suicidologi</i> . 26(2).

Other academic papers and reports based on research collaborations during the PhD

Year	Published peer-reviewed papers
2022	Hogg B, Moreno-Alcázar A, Tóth MD, Serbanescu I, Aust B, Leduc C, Paterson C, Tsantilla F, Abdulla K, Cerga-Pashoja A, Cresswell-Smith J, Fanaj N, Meksi A, Ni Dhalaigh D, Reich H, Ross V, Sanches S, Thomson K, Van Audenhove C, Pérez V, Arensman E, Purebl G, Amann BL; MENTUPP consortium members . (2022). Supporting employees with mental illness and reducing mental illness-related stigma in the workplace: an expert survey. <i>European Archives of Psychiatry and Clinical Neuroscience</i> . 22:1–15.
2022	Hill NTM, Bailey E, Kirtley O, Benson R , Purcell R, Rice S, Robinson J, Cully G, Walton CC. Researching the researchers: Psychological distress and psychosocial stressors according to career stage in mental health researchers. <i>BMC Psychology</i> . In Press.

2020	Arensman E, Troya MI, Nicholson S, Sadath A, Cully G, Costa APR, Benson R , Corcoran P, Griffin E, Williamson E and Eustace J. Study protocol for the implementation and evaluation of the Self-harm Assessment and Management for General Hospitals programme in Ireland (SAMAGH). BMC health services research. 2020; 20(1), pp.1-8.
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Presentations during the PhD

Date	Oral presentations
November 2021	Arensman E, Benson R . Self-Harm Surveillance Training Workshop, WHO-PAHO countries: Guyana, Suriname, Trinidad-Tobago (virtual).
October 2021	Arensman E, Benson R . Self-Harm Surveillance Training Workshop, WHO-PAHO countries; Guyana, Suriname, Trinidad-Tobago (virtual).
September 2021	Arensman E, Benson R , Hill N, Robinson J. Workshop on core components and requirements for the detection and prevention of suicide and self-harm clusters and suicide contagion at the 31st World Congress of International Association for Suicide Prevention, Gold Coast, Australia (virtual).
May 2021	Arensman E, Benson R . Upscaling and Implementation of the Suicide and Self-Harm Observatory. Presentation for Resource Officers for Suicide Prevention, Sligo (virtual).
April 2021	Arensman E, Benson R , Williamson E. Proposal for the implementation of a National Suicide Observatory in Ireland. Presentation for the National Office for Suicide Prevention, Dublin (virtual).
October 2019	Benson R , Rigby J, Brunsdon C, Cully G, Too LS, Arensman E. Suicide and self-harm clusters: Effective quantitative techniques to detect clusters & the value of real-time surveillance data in identifying and responding to them. The 26th British Isles Research Workshop on Suicide & Self-Harm, Oxford.
October 2019	Benson R , Arensman E. Suicide and self-harm surveillance – From local to global. National Suicide Research Foundation World Mental Health Day, Cork.
September 2019	Benson R , Rigby J, Brunsdon C, Cully G, Too LS, Arensman E. The quantitative analysis of suicide & self-harm clustering: A systematic review. International Association for Suicide Prevention World Congress 2019, Derry-Londonderry.
March 2019	Benson R , Rigby J, Brunsdon C, Corcoran P, Arensman E. The Suicide and Self-Harm Observatory: real-time surveillance data in Ireland. National meeting of the HSE Resource Officers for Suicide Prevention, Dublin.

November 2018	Benson, R , Arensman E. Contemporary Challenges in Suicide Prevention. The Social Pathologies of Contemporary Civilisation Conference, Cork.
September 2018	Benson R , Arensman E. The development of a real-time suicide surveillance system. The 17th European Symposium on Suicide & Suicidal Behaviour, Ghent, Belgium.

Poster presentations

Date	Poster presentations
December, 2018	Benson R , Rigby J, Brunsdon C, Cully G, Too LS, Arensman E. A systematic review of quantitative analysis of Suicide and self-harm clustering. New Horizons in Medical Research Conference, University College Cork.
December 2017	Benson R , Rigby J, Brunsdon C, Arensman E. The development of a Suicide and Self-Harm Observatory (SSHO)in Ireland. New Horizons in Medical Research Conference, University College Cork.

Training courses and workshops completed

Date	Course / workshop details	Location
March 2021	Epigeum Online Research Integrity Training	Online
March 2021	PG6015: An Introduction to Research Integrity, Ethics and Open Science	Cork
March 2021	PG6030: Reproducible Research Practices using R	Cork
February, 2019	Odyssey Workshop, Mary Kate O'Regan, University College Cork.	Cork
January, 2019	Good Clinical Practice Training, HRB Clinical Research Facility Cork.	Cork
December 2018	Children First Training, Health Service Executive.	Online
November 2018	An Introduction to R	Cork
May 2018	PG7016: Systematic Reviews for the Health Sciences	Cork
May 2017	An Introduction to Data Analysis with Stata	Cork
April 2017	Data for Decisions - An Introduction to GIS	Maynooth

Awards and achievements received

Year	Award / achievement
2019	Awarded a College of Medicine and Health, University College Cork doctoral student travel bursary of €650