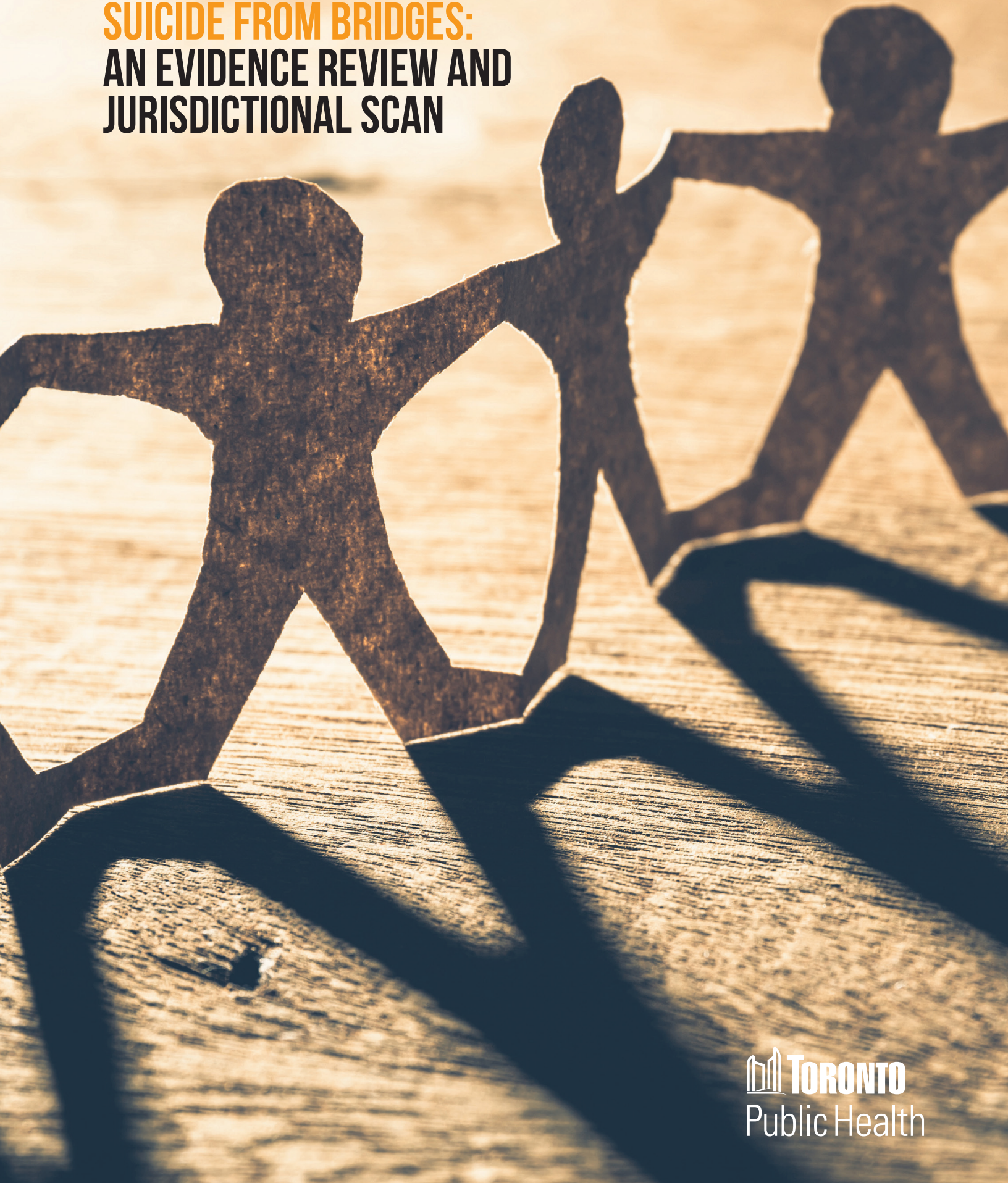


**INTERVENTIONS TO PREVENT  
SUICIDE FROM BRIDGES:  
AN EVIDENCE REVIEW AND  
JURISDICTIONAL SCAN**



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**Copies:**

This report and the staff report that was presented to the City of Toronto Executive Committee on May 14<sup>th</sup> 2018 and are available on the Toronto Public Health website at: <http://www.toronto.ca/health/>

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## Table of Contents

Executive Summary .....	3
Introduction.....	5
Overview.....	5
Definitions .....	6
Section 1: Bridge Suicides as a Public Health Issue in Toronto.....	7
Suicide deaths from bridges .....	7
Paramedic services responses to suicide.....	7
Other impacts of suicide deaths from bridges .....	7
Summary .....	8
Section 2: Research on the Effectiveness of Suicide Prevention Interventions .....	8
Types of interventions identified .....	8
Effectiveness of interventions .....	9
Suicide displacement and substitution .....	10
Summary of research findings.....	11
Section 3: Jurisdictional Review .....	12
Means restriction: barriers or nets .....	12
Crisis phones & signage .....	15
Surveillance .....	16
Multiple interventions .....	16
Key factors for decision-making and implementation .....	17
Aesthetic and heritage factors .....	17
Physical structure and reconstruction plans .....	18
Funds and cost-effectiveness .....	19
Public and political acceptability.....	21
Collecting and Reporting Suicide Statistics.....	22
Media and stakeholder engagement.....	22
Jurisdictional coordination .....	24
Discussion: Implementing Suicide Prevention Measures on Bridges.....	25
Conclusions.....	27
Appendix.....	28
Data limitations .....	28
Limitations of the research included in this review .....	28
Literature review methods summary – Effective interventions.....	29
Literature review methods summary – Substitution and displacement.....	29
Jurisdictional review – Methods summary.....	30
Jurisdictional Review – Additional Case Studies.....	32
References.....	39

## Executive Summary

Suicide is an important public health issue. While all suicide deaths are tragic, suicides that occur in public places, such as from bridges, also pose a risk to the public (pedestrians and motorists) and have potential health consequences for witnesses and first responders. From 2004-2015, there was a total of 125 suicide deaths from bridges in Toronto, an average of 10 suicide deaths per year. Although this represents a small proportion (about 4%) of the overall number of suicide deaths in Toronto, there are effective interventions that can be implemented at the municipal level to prevent these deaths.

Research has identified three types of interventions that can be implemented on bridges to prevent suicide deaths: restricting access to means (e.g., barriers), encouraging help-seeking behaviours (e.g., crisis phones and signage), and increasing the likelihood of intervention by a third party (e.g., surveillance cameras). Of these, means restriction interventions have been shown to be effective in preventing suicide deaths. Studies have found that means restriction interventions, such as bridge barriers, were associated with a 93% reduction in suicide deaths per year when implemented as a sole intervention. More evidence is needed to determine the effectiveness of other interventions (e.g., crisis phones, signage and surveillance cameras). However, non-physical interventions may be beneficial and could be considered and studied where means restriction interventions are not feasible.

Several jurisdictions have implemented suicide prevention measures on bridges. A number of factors influence the types of interventions implemented by jurisdictions. These factors include the impact of the intervention on the aesthetic and heritage features of the bridge, the physical structure of the bridge, and the costs associated with the intervention. Other considerations are the public and political acceptability of the intervention, which can be addressed through ongoing stakeholder consultation. Communication about suicide by the media and other sources also needs to be considered in order to decrease the risk of suicide contagion.

This report focuses on interventions to prevent suicide from bridges at the time of a suicide crisis. Mental health promotion, treatment, and supporting survivors of suicide are all important, complementary strategies to prevent suicide, but are beyond the scope of this report. The interventions included in this report should be considered as one component of an overall approach to prevent suicide deaths.

## **HELP IS AVAILABLE**

If you or someone you know may be experiencing signs of suicide risk, seek help as soon as possible. There is always help available. You are not alone.

Crisis Lines (24/7)

Toronto Distress Centre: 416-408-HELP (4357)

Gerstein Centre: 416-929-5200

If you are in crisis and require emergency assistance, please go to the nearest hospital or call 911.

## Introduction

### Overview

Suicide is an important public health issue, and a major cause of premature and preventable death in Canada. In 2010, there were 3,951<sup>1</sup> and 231<sup>2</sup> suicide deaths nationwide and in Toronto, respectively. Of these, a subset of suicide attempts or deaths (estimated at about one-third) occur outside of the home in public places,<sup>3</sup> through methods such as jumping from high places or in front of moving objects. In Toronto, there was a total of 125 deaths due to suicide from bridges from 2004-2015, which accounted for about 4% of all deaths due to suicide.<sup>4</sup> The impact of suicide extends beyond individuals and has lasting health effects for families, friends, observers, first responders and others.

Public health organizations and municipalities can play a role in preventing suicide in public places. Specific roles for public health have been described by national public health authorities, including the Public Health Agency of Canada's Framework for Suicide Prevention, which includes means restriction as a component of the suicide prevention continuum.<sup>5</sup> As another example, Public Health England's national strategy directs local public health authorities to develop suicide prevention plans, which include conducting surveillance and identifying interventions to prevent suicide in public places.<sup>3</sup> Local political action can also provide the impetus for actions to prevent suicide deaths from bridges. Toronto's Board of Health has made recommendations to its City Council supporting means restriction interventions, as has Vancouver Coastal Health in response to concerns about suicide deaths from bridges.<sup>6</sup>

Preventing suicide from bridges requires collaboration among multiple agencies with different mandates and areas of influence. Public health organizations can contribute by identifying locations of concern through the use of local surveillance data. They can also provide research on potential interventions to reduce suicide deaths at these locations. There is a growing body of research evidence on the effectiveness of interventions to prevent suicide on bridges. However, this evidence needs to be considered alongside the local context in order to determine the feasibility of implementing the intervention(s).

This report provides a summary of the burden of suicide from bridges in Toronto, research evidence on effective interventions to address suicide deaths from bridges, and a review of other jurisdictions that have implemented or considered implementing interventions to prevent suicide deaths from bridges. Challenges associated with the implementation process, and mitigation strategies to address these are described.

This report focuses on means restriction and other suicide prevention measures on bridges. It is recognized that suicide prevention requires a multi-component strategy involving a continuum of interventions, ranging from mental health promotion to support for suicide survivors. The interventions described in this report should be considered as one part a broader strategy to effectively prevent suicide deaths.

## Definitions

The following definitions outline key concepts used throughout this report:

**"Suicide"**: Death caused by self-directed injurious behavior with an intent to die as a result of the behavior.<sup>7</sup>

**"Suicidal ideation"**: Thinking about, considering, or planning suicide.<sup>7</sup>

**"Means restriction"**: Techniques, policies, and procedures designed to reduce access or availability to means and methods of suicide.<sup>8</sup> Examples of means restriction measures on bridges are barriers (e.g., fences, railings or plastic) and nets.

**"High risk location"**: A public site that is frequently used as a location for suicide, such as a particular bridge from which several suicidal jumps have occurred.<sup>3</sup> Other terms that are sometimes used instead are **"Frequently-used locations"** or **"Iconic site"**.

**"Contagion"**: A phenomenon whereby susceptible persons are influenced toward suicidal behavior, including specific methods, through knowledge of another person's suicidal acts.<sup>8</sup>

**"Displacement"/"Substitution"**: The possibility that, following a means restriction intervention, those at risk of suicide will go to another location, or another method of suicide. In this paper, "displacement" refers to suicides that are relocated to other bridges, and "substitution" refers to suicides that occur using other methods besides a jump or fall from a bridge.

## Section 1: Bridge Suicides as a Public Health Issue in Toronto

The purpose of this section is to describe suicide deaths, as well as emergency service responses to suicide-related behaviours and deaths that occur as a result of a jump or fall from a bridge in Toronto. The analysis used data from the Office of the Chief Coroner of Ontario on suicide deaths, and data from Toronto Paramedic Services to describe emergency service responses to suicide, suicide attempts and suicide ideation at bridges in Toronto. Research evidence has been used to describe other health impacts that are not captured in available data sources.

### Suicide deaths from bridges

From 2004-2015, there were a total of 125 suicide deaths from bridges in Toronto, an average of about 10 suicide deaths per year. Suicide from bridges accounted for about 4% of all suicide deaths, and approximately 6% of suicide deaths in youth, ages 10-24. The majority (83%) of those who died by suicide from bridges were males. About 48% of individuals who died by suicide from bridges were between ages 25-44, and 33% were between ages 45-64.<sup>4</sup>

About 64% of individuals who died by suicide from a jump/fall from a bridge in Toronto had a history of mental illness. Mental illness is a known risk factor for suicide; a 2014 report from Toronto Public Health identified a history of mental illness in 76% of individuals who died by suicide between 2007-2011<sup>9</sup>, and published literature utilizing a rigorous method of identifying risk factors (psychological autopsy) found that around 90% of individuals who died by suicide had a mental illness.<sup>10</sup> It is possible that those who died from bridges were less likely to suffer from a mental illness prior to death than those who died from suicide by other methods. However, this is unlikely given that research suggests that males with mental illness are overrepresented in suicide deaths from bridges.<sup>11</sup> Alternately, it is possible that cases of mental illness went undetected in this population.

### Paramedic services responses to suicide

From 2005-2016, there were a total of 409 incidents related to bridge suicides or suicide ideation that were responded to by Toronto Paramedic Services, an average of about 34 incidents per year. Of these, 29% were in response to a suicide attempt where an individual had jumped or fallen from a bridge. The remaining 71% were in response to perceived or identified suicide ideation (e.g. a person who appears to be, or who states that they are contemplating suicide).<sup>12</sup> Information provided by Paramedic Services should be considered as an underestimate of the total number of emergency services responses for suicide on bridges. For information on data limitations, please see the Appendix.

### Other impacts of suicide deaths from bridges

All suicide deaths are tragic and have health impacts that go beyond individual suicide deaths. The Public Health Agency of Canada estimates that for every suicide death, 7-10 people are profoundly affected by the loss.<sup>13</sup> Suicide deaths may also have mental health consequences for first responders who witness or attend to these events.<sup>14</sup> Qualitative research that has explored traumatic events experienced by ambulance paramedics has noted that responding to suicides was one of the most commonly



reported traumatic events identified by study participants.<sup>15</sup> Suicide deaths occurring in public places also have the potential to traumatize or injure pedestrians, cyclists or motorists.

### Summary

On average, there were 10 suicide deaths and 34 paramedic services incident responses per year related to suicide from bridges in Toronto. Nearly half of those who died from suicide from bridges were between ages 25-44, and most of those who died were male. The health burden of suicide extends beyond individuals impacted by suicide, and includes witnesses, first responders, and family and friends of the deceased.

## Section 2: Research on the Effectiveness of Suicide Prevention Interventions

This section summarizes the results of a review of systematic reviews and meta-analyses on the effectiveness of interventions to prevent suicide from bridges.

The research question used to guide this review was: What interventions are used to prevent suicide from bridges, and what is the evidence of their effectiveness?

Details regarding the search strategy, methods, evidence quality and limitations are available in the Appendix.

### Types of interventions identified

One systematic review / meta-analysis (Pirkis *et al*, 2015)<sup>16</sup>, and one systematic review (Zalsman *et al*, 2016)<sup>17</sup> were included in the review. The following table summarizes the interventions identified in these studies, which included means restriction interventions, interventions intended to promote help seeking behaviour, and interventions that increased the likelihood of third-party intervention.

Table 1: Interventions to prevent suicide from bridges

<b>Intervention type</b>	<b>Research designs included in review articles</b>	<b>Number of individual studies</b>	<b>Examples of interventions</b>
Means restriction	Before and after, interrupted time series	13 (7 studies on bridge locations)	Barriers, fencing, nets, blocking road access
Encourage help-seeking behaviour	Before and after	6 (3 studies on bridge locations)	Signage, crisis telephones
Increase the likelihood of intervention by a third party	Before and after	4 (2 studies on bridge locations)	Monitoring by bridge staff, police patrols, CCTV cameras, gatekeeper training

## Effectiveness of interventions

### **(i) Means restriction**

Of the interventions identified, means restriction was the most widely studied. Findings consistently showed a substantial decrease in suicide deaths at locations where the interventions were implemented. Pirkis (2015) found that restricting access to means was associated with a 93% reduction\* in suicide deaths per year when implemented as a sole intervention, and a 91% reduction\* in suicide deaths per year when implemented in combination with other types of interventions. This review considered the effect of means restriction by combining all studies, and did not report those specifically at bridge sites. All but one of the studies of bridge sites reported a statistically significant decrease in suicide deaths following the intervention. The one study that did not report a statistically significant decrease was likely underpowered, as it reported zero deaths in the two-year post-intervention period.<sup>16</sup>

A 2016 systematic review conducted by Zalsman *et al* also notes that placing barriers at jumping sites was shown to be effective in the studies included.<sup>17</sup> This review included two recent studies on bridge barriers that had been conducted on the Jacques Cartier bridge in Montreal Canada<sup>18</sup> and in Brisbane, Australia.<sup>19</sup> Both studies identified a decrease in suicide by jumping following the implementation of bridge barriers at the study locations.

### **(ii) Encouraging help-seeking**

There is less evidence on the effectiveness of encouraging help seeking by implementing crisis telephones or signage at high risk locations for suicide deaths. Studies usually had fewer years of follow up than those involving means restriction interventions. This can reduce statistical power and decrease the likeliness of finding a significant reduction in suicide deaths. It also made it difficult to discern whether any short-term effects identified persisted in the longer term.

Pirkis *et al* (2015) was the only review article identified that included studies of help-seeking interventions. This article included three studies of bridge locations, two of which evaluated the effectiveness of interventions at the same bridge at different time periods.<sup>20,21,22</sup> Three other studies included examined isolated car parks, a cliff top, and a holiday resort that was known as a high-risk location for suicide. Like means restriction, this review considered the effect of help-seeking interventions for all of the studies overall, and did not report those specifically at bridge sites. The findings were positive but not statistically significant, showing an overall reduction in suicide deaths per year of 21%<sup>†</sup> if delivered alone and 36%<sup>‡</sup> if delivered in combination with other interventions.

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\* This was measured using a pooled incidence rate ratio (IRR), comparing the incidence rate of suicide deaths before and after the implementation of the interventions, and taking the number of years observed before and after the intervention into account. If means restriction was implemented as a sole intervention, the pooled IRR was 0.07, with a 95% confidence interval of 0.03-0.27). If means restriction was implemented in combination with other interventions, the pooled IRR was 0.09, 95% CI 0.03-0.27

<sup>†</sup> IRR 0.79, 95% CI 0.27-2.27

<sup>‡</sup> IRR 0.64, 95% CI 0.33-1.26

One study in Pirkis *et al* (2015) that evaluated the effectiveness of crisis phones on a bridge location reported a substantial increase in deaths by suicide from the bridge in the 13 years following the intervention compared to the pre-intervention period.<sup>20</sup> It was noted, however, that during the post-intervention period a website containing information about suicide from the bridge became increasingly popular, and may have been a contributor to the increase in deaths seen in this period.

The limited research available and the inconsistency of this evidence makes it difficult to ascertain the effectiveness of help seeking interventions to prevent suicide deaths at bridges.

### **(iii) Increasing the likelihood of intervention by a third party**

There is some evidence that increasing the likelihood of intervention by a third party can reduce suicide deaths. However, this intervention has not been studied in isolation, and thus can only be assessed in combination with other interventions. Pirkis *et al* (2015) reported a 47%<sup>§</sup> reduction in the annual number of suicide deaths at the sites where a camera, police patrol, or bridge staff patrol was in place in combination with other interventions.<sup>16</sup> Of the two studies included that involved a bridge location, one reported a statistically significant decrease in suicide deaths, and this intervention also involved the installation of 2-metre high fencing at the intervention site.<sup>23</sup> While it is possible that increasing the likelihood of third party intervention prevents suicide deaths on bridges, further study of these types of interventions is required in order to determine their effectiveness.

### **Suicide displacement and substitution**

An important area to assess when evaluating the effectiveness of interventions to prevent suicide on bridges is the possibility of displacement to other jumping locations, or substitution to another method of suicide. An additional review of systematic reviews and meta-analyses was undertaken in order to assess this risk.

The research questions used to guide this review were:

What is the risk of, displacement to other jumping locations, and substitution to other methods, following an intervention to prevent suicide from bridges?

Details regarding the search strategy, methods, evidence quality and limitations are available in the Appendix.

Three articles were identified, which included a meta-analysis (Pirkis *et al*, 2013)<sup>24</sup> and two systematic reviews (Zalsman *et al*, 2016; Cox *et al*, 2013)<sup>17,25</sup>. All of the reviews explored substitution and displacement following the implementation of a means restriction intervention.

Displacement was assessed by determining the number of deaths that occurred by jumping from height following the implementation of a means restriction intervention. The Pirkis *et al* (2013) meta-analysis included 6 studies, of which 4 were bridge locations, 1 involved a clifftop, and 1 involved a building. The analysis identified a

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<sup>§</sup> IRR 0.53, 95% CI 0.31-0.89

statistically significant 28%\*\* decrease in suicide deaths by jumping from a height following the implementation of means restriction interventions.

These findings are consistent with the Cox *et al* (2013) systematic review, which noted that the overall number of suicides by jumping remained the same or decreased for the total population, or for males, in seven of the eight studies which examined this outcome. The eighth study assessed the effectiveness of the Bloor Viaduct and initially found that although the barrier was effective in reducing deaths at the bridge, there was an increase in deaths at other bridge locations.

However, a more recent study of this site by the same author, which used additional years of follow-up, found that in the years after the barrier was implemented, suicide deaths from bridges decreased from 18.8 to 10.0<sup>††</sup> deaths per year, and suicide deaths from jumping from height decreased from 57.0 to 51.3<sup>‡‡</sup> deaths per year.<sup>26</sup> This study indicates that the barriers at the Bloor Viaduct did not displace suicide deaths to other jumping locations in the long term. The study also found that media articles citing suicides at the Bloor Street Viaduct, or the costs of the barrier, were associated with a small but statistically significant increase in suicide deaths by jumping from bridges in the year following the media report. It is possible that the large amount of media attention in the years following the implementation of the barrier may have contributed to the increase in suicide deaths at nearby bridges that was noted in the original article.

The risk of substitution to other methods following the implementation of bridge barriers was more difficult to identify, in part due to the small number of suicide deaths from bridges that occur in comparison to other suicide methods. This made it more difficult to discern whether a change in the overall number of suicide deaths occurred because of the intervention, random variation, or other factors that may influence the incidence of suicide.<sup>27</sup> Cox *et al* (2013) identified two studies which assessed the overall rate of suicide deaths before and after a means restriction intervention at a location deemed high risk for suicide. Both studies found a small decrease in the overall suicide rate following the implementation of means restriction initiatives. One of the articles included in the Zalsman (2016) systematic review noted that the total number of suicides in Montreal decreased following the implementation of barriers on the Jacques-Cartier Bridge. However, another article in the Zalsman (2016) systematic review did not find an overall reduction in suicide deaths in the 19-year period following the implementation of a bridge barrier on the Gateway Bridge in Brisbane, Australia, though there was a significant decrease in the number of suicides from jumping in Brisbane.<sup>17</sup>

### Summary of research findings

Means restriction interventions have been more thoroughly studied than interventions encouraging help seeking or increasing the likelihood of third-party intervention, with findings consistently showing a decrease in suicide deaths following their installation on bridges. More recent studies of means restriction interventions on bridges strengthen the evidence base by providing longer periods of follow-up and assessing the possibility

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\*\* This is measured using a risk ratio (RR), which calculates the change in the expected number of suicides following an intervention, in comparison to before. The RR was 0.72 (95% CI 0.60-0.87).

†† IRR 0.53, 95% CI 0.40-0.71

‡‡ This approached, but did not reach statistical significance - IRR 0.90, 95% CI 0.80-1.01

of substitution and displacement. In some cases, time series analyses are used, which provide a more rigorous assessment of the effectiveness of the intervention.

While additional, high-quality evidence would further strengthen the case for means restriction interventions, the effectiveness of these interventions can be upheld with reasonable confidence, given that this finding has been replicated numerous times in different jurisdictions, including in the local context (Toronto).

The research for the other two types of interventions is more limited. Given the mixed results from the research on crisis phones and signage, it is difficult to determine the effectiveness of these interventions. It is also challenging to assess the contribution of increasing the likelihood of third party intervention, as this type of intervention has not been studied in isolation. Strengthening the evidence base for these interventions would be beneficial. Notwithstanding the current state of the evidence, it is still possible that these interventions could be of benefit to vulnerable individuals, and could be considered in situations where means restriction interventions are not feasible. These types of situations are discussed in the next section.

Finally, this review identified two studies where social or news media was believed to be a potential contributor to an increase in suicide deaths, and potentially circumvented some of the positive effects of the intervention.<sup>20,26</sup> This highlights the need for careful consideration of media engagement in order to avoid the potential for suicide contagion. This is discussed in more detail in Section 3.

Information on the limitations of the research included in this analysis are available in the Appendix.

### Section 3: Jurisdictional Review

The previous section identified means restriction interventions as a potential strategy to prevent suicide deaths. However, many other factors influence decision-making regarding whether to implement these or other interventions. This section complements the research evidence by identifying and summarizing examples of suicide prevention measures at specific bridges, and exploring key factors to consider when implementing these interventions.

Internet searches were conducted to identify jurisdictions that had implemented or were in the process of implementing suicide prevention measures on a bridge. Jurisdictions were selected to allow for diversity in the type of intervention, features of the bridge, public reception, and history of suicide on the bridge.<sup>§§</sup> Information about the methods for the scan are available in the Appendix. The interventions identified are also listed in Tables 2–4 in the Appendix.

#### Means restriction: barriers or nets

##### Burrard Street Bridge, Vancouver, Canada (0.836 kilometres in length)

In 2008, the British Columbia (B.C.) Coroner's Service recommended that a number of bridges within the Metro Vancouver area, including the Burrard Street Bridge, be

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<sup>§§</sup> See Appendix for summaries of additional case studies.

retrofitted with some form of suicide prevention barrier or netting. This was partly prompted by concerns from the Child Death Review Unit of the Coroner's office, which noted a significant proportion of the suicide deaths occurred in people under age 30 (27% were between 20 and 29 years old).<sup>28</sup> Five locations accounted for 50 percent of bridge suicide deaths between 1991 and 2007 (others were the Ironworkers Memorial, Granville, Lions Gate and Pattullo bridges).<sup>29</sup>

Barriers were installed in the form of higher fencing at the nearby 2<sup>nd</sup> Narrows/Iron Workers Memorial Bridge in 2015. That same year, the City of Vancouver announced that the Burrard St. Bridge would undergo reconstruction.<sup>30</sup> The reconstruction plan involved improvements for pedestrians and cyclists and intersection redesign. Potential suicide prevention options, including increased loading to support the weight of fencing and electrical connection points for crisis phones, were also a consideration. A barrier option was approved with the support of working groups and external agencies, including the Vancouver Coastal Health Authority.<sup>31,32</sup>

The Burrard St. Bridge, erected in 1932, is one of several landmark bridges that traverse water within the harbour system in Vancouver, British Columbia.<sup>33</sup> Due to its heritage value, it was recognized that means prevention fencing could change the appearance of the bridge. The City held public consultations and formed a stakeholder committee to inform the reconstruction process, including selection of the final design. The stakeholder group included organizations representing heritage preservation, active transportation, urban design, health care, mental health, policing, and the film and television sector.<sup>31</sup>

The group considered several means restriction design options, including netting, glass and fencing. The selected design, completed in October 2017, was a metal picket vertical fence with heritage style pedestrian lamp posts to preserve heritage elements, maximize views for pedestrians, and lower construction and maintenance costs. The design observed the Standards and Guidelines for the Conservation of Historic Places in Canada.<sup>6</sup> The City of Vancouver also installed crisis phones at four locations on the bridge. The City paid for the installation, and covers the cost of inspection and ongoing maintenance of the phones, and the B.C. Crisis Centre responds to calls from the phones. As of writing, there have been no reports of suicide incidents from the bridge.

#### Ithaca Gorge Bridges, New York, United States (between 60 and 70 metres in length)

The City of Ithaca is located within a gorge system that is home to seven bridges, four of which are owned by Cornell University and three are owned by the City. The bridges are a mixture of pedestrian and traffic bridges, constructed between 1900 and 1960 with reconstruction and rebuilds following these dates. The bridges have a history as sites for suicide deaths, beginning around the 1970s. Since the 1990s, nearly half of Cornell student suicides had been as a result of jumping from the bridges. From 1990-2010, there were a total of 29 suicide incidents from the bridges, and 26 suicide deaths. Between 2009 and 2010 the university experienced a cluster of six student suicides on campus, three of which were from the bridges.<sup>34</sup>

These events were reported widely by media outlets, receiving considerable attention at the local, national and international levels. Cornell University worked quickly to address

the crisis and urged the City to declare a public health emergency. The request was granted and a number of temporary fences were erected as barriers in March 2010. Cornell initiated a local "Long-term Means Restriction Study for Bridges" to inform possible interventions. The early report from suicide prevention experts concluded that based on available evidence the temporary barriers should remain until they were replaced by permanent ones. Cornell advocated to implement a system-wide approach by introducing means restriction at all seven bridges, as there were concerns that multiple bridges within the gorge system had been, or could be, used as suicide sites.<sup>35</sup>

There was some controversy around the temporary barriers due to their physical obstruction of the natural landscape. Detailed site analyses were completed for each of the seven bridges, and criteria for consideration around bridge barrier interventions included the following: visual Impacts; historical resources evaluation; natural resources impacts; construction impacts; stormwater impacts; and traffic impacts. The decision-making process involved public consultation, including public deputations at City of Ithaca meetings.<sup>35</sup>

Experts deliberated on possible design options throughout the study process. Nets were chosen primarily because they were effective in preventing deaths from another iconic location, Muenster Terrace in Switzerland, where aesthetic preservation was required.<sup>36</sup> The City of Ithaca began installing nets in 2012 and the initiative was completed in 2013. The design for all bridges, except one, was a low-visibility horizontal mesh net system attached to the bottom side of the bridge structure located on both sides of the structure. The seventh bridge, which is a suspension bridge, has a vertical net system that uses a sock design around the center, and opening at the top at either end. Motion sensors were attached to the nets to provide alerts if someone has jumped onto them. There have been several media reports of a suicide death since the nets were installed; however, it is not clear if these deaths have occurred directly from the bridges or from the surrounding Gorges.<sup>37,38</sup> A multi-year evaluation of the suicide nets in Ithaca is underway, but has not been completed, and thus it is currently not possible to assess whether the netting resulted in a reduction in suicide deaths.

#### High Level Bridge, Edmonton, Alberta (0.777km in length)

The High Level Bridge was built in 1913 and spans the North Saskatchewan River in Edmonton. In 2012, there were 14 suicide deaths on or near the bridge, and the City of Edmonton began efforts to implement suicide prevention measures at the site.<sup>39</sup> In 2013, signage including the distress line phone number was installed. Increased lighting, help phones that connected directly to emergency services, additional fencing at 'vulnerable' points along the bridge sidewalk, and a suicide prevention barrier were also explored as options.<sup>40</sup> Following review of the evidence by the City of Edmonton, with input from local and international experts on the efficacy of barriers, City Council chose to pursue the implementation of barriers in addition to non-means restriction options.

In fall 2014, four bridge barrier options were presented to city council, which ranged in cost from about \$1.2 million to \$7.5 million. A \$3 million design involving a guard rail with vertical pillars and horizontal tension cable barriers was eventually chosen over a more expensive design with vertical stainless steel tension cables, costing

approximately \$7.5 million.<sup>41</sup> Emergency phone boxes were also installed prior to the installation of the barriers.<sup>42</sup>

In 2017, some media outlets reported that the fence had reduced suicide attempts at the bridge. These reports drew from Alberta Health Services statistics which showed that Edmonton Emergency Medical Services responded to five suicide attempts in 2016, compared to 10 attempts in 2015, and police responded to 21 mental health occurrences in 2016, down from 41 in 2015.<sup>43</sup>

### [Crisis phones & signage](#)

#### Lions Gate Bridge, Vancouver (1.8 kilometers in length)

The B.C. Coroner's report, discussed above, recommended that means restriction suicide prevention measures be introduced at several bridges, one of which was the Lions Gate Bridge. Constructed in 1938, the Lions Gate Bridge has been compared to the Golden Gate Bridge in San Francisco in terms of its design and draw as a high risk location due to its height over a busy waterway. The Bridge has the highest number of suicide deaths among area bridges, and the province<sup>28</sup> with a total of 45 between 1991 and 2007.<sup>44</sup>

A means restriction option has not been implemented because of the suspension design of the bridge, which presents design challenges related to weight distribution and wind loading.<sup>45</sup> A net option has also reportedly been rejected because ships would be unable to pass underneath the bridge.<sup>46</sup>

As an alternative, the B.C. Crisis Centre led an initiative that installed six crisis phones on the bridge in 2009.<sup>44</sup> This was conducted in partnership with the Ministry of Transportation and Infrastructure, TELUS, Vancouver Police Department and West Vancouver Police. The B.C. Transportation Minister accelerated the process of implementing phones due to suicides on the bridge, which were causing hour-long closures to vehicles, cyclists and pedestrians.<sup>47</sup>

The effectiveness of the crisis phones is unclear, however there have been reports of suicide deaths from the bridge since installation. One media report quotes Coroner's data that shows the number of suicides from the bridge increased in the year after the phones were installed. In 2010, there were 8 deaths at the bridge site, which was the highest number in 20 years.<sup>47</sup> Means restriction advocates believe the phones are an inferior option to a barrier. The B.C. Crisis Centre is hopeful "that with new innovations in suicide prevention barrier technology that options [for the Lions Gate Bridge] will soon be available. The second best option is the installation of crisis phones on all remaining bridges."<sup>46</sup>

A final consideration is that cameras were installed at the bridge in 2008 to provide constant monitoring for the primary purpose of traffic surveillance.<sup>48,49</sup> It is unclear whether these cameras are used to monitor potential suicide events, but even traffic surveillance would presumably increase the possibility for third party intervention if it was able to detect suicide-related behaviours. Additional information is required to fully assess the impact of distress phones on the Lions Gate Bridge; however, the issue of suicide from the bridge continues to be a concern.



## Surveillance

None of the jurisdictions examined had implemented surveillance as a sole suicide prevention measure. Instead, measures such as closed-circuit television (CCTV) cameras or surveillance patrols are introduced in tandem with crisis phones and signage, or as supplemental to means restriction options. This does not account for CCTV cameras that are implemented for monitoring traffic, although they may serve dual functions, and are rarely acknowledged in discussion of suicide prevention at specific sites. There is little documentation of the process of implementing surveillance mechanisms for suicide prevention purposes. The government of the United Kingdom (UK) states that "[w]here several different measures have been introduced at a site, such as a combination of physical barriers, CCTV cameras and Samaritans signs, their individual effects will be difficult to measure and they are best treated as a single intervention."<sup>3</sup>

### Clifton Suspension Bridge, Bristol, England (0.41 kilometers in length)

The Clifton Suspension Bridge is an historic bridge, built in 1864, that spans the Avon Gorge in the UK.<sup>50</sup> It has been a site of considerable concern due to suicide attempts and deaths. The bridge is managed by the Clifton Suspension Bridge Trust, which uses the income from tolls to pay for bridge maintenance. In 1998, a partial barrier was installed on the bridge, followed by other surveillance measures.

The bridge employs several staff whose role includes around the clock monitoring and response to incidents as they arise. The bridge also has several CCTV cameras installed at points to assist in identifying such occurrences. While suicides decreased following the barrier installation, the number of suicide-related incidents remained the same, indicating that the barriers had stalled potential victims and allowed staff the opportunity to intervene.<sup>51</sup>

Detailed information about surveillance mechanisms to address suicide on bridges is limited, and challenges that arise from this type of intervention are rarely discussed. At the same time, the opportunity for surveillance at bridges might be greater than acknowledged given the frequent use of CCTV to monitor traffic flow, and advances in surveillance technology. Greater documentation and analysis of surveillance measures is required to draw conclusions about effective interventions and implementation processes.

## Multiple interventions

Jurisdictions often implement multiple measures on bridges to prevent suicide. However, less controversial and costly interventions may not be reported, and it is difficult to determine the exact intervention combination at specific bridges. The Golden Gate Bridge in San Francisco is an example of the use of multiple interventions at one site.

### Golden Gate Bridge, San Francisco, California (2.7 kilometres in length)

The Golden Gate Bridge was constructed in 1937 and is one of the most iconic bridges in North America and internationally. The bridge has been the site of a considerable number of suicide incidents over its history; as of 2012, media has reported that more than 1600 suicide deaths have occurred as a result of a jump or fall from the bridge.<sup>52</sup>

There have been multiple measures introduced at the bridge to try to address suicide. The Golden Gate Bridge has long been the subject of dialogue about whether barriers should be constructed on the bridge. Much of the controversy surrounding introduction of a barrier was due to concerns that the iconic structure would be adversely affected.

Surveillance measures were introduced in the 1960s in the form of foot patrols, and in the 1970s this measure was extended to include suicide prevention training for Golden Gate Bridge employees, and restricted pedestrian access at night. In the 1980s and 1990s, crisis phones and CCTV cameras (to monitor traffic flow) were installed, and more recently, signage with a crisis texting service have been installed. The Golden Gate Bridge authority estimates that 697 people were removed from the bridge by staff from 2000-2010, some of whom were contemplating suicide. Since 2010, there has been a rise in the number of interventions on the bridge by patrol staff, however, the annual number of deaths from suicide have stayed the same, at roughly 37 per year between 2011 and 2015.<sup>53,54</sup>

The bridge is subject to its own governing body and considerable resources are invested into its infrastructure and maintenance, including safety-related measures. Despite ongoing investment into suicide prevention measures, the number of suicide deaths from this iconic bridge has stayed the same over recent years.<sup>54</sup>

In 2005, the San Francisco Golden Gate Bridge Highway and Transportation District Board of Directors agreed to initiate the "Golden Gate Bridge Physical Suicide Deterrent System Project". As a result of this work and after many years of advocacy, safety nets are being installed on the Golden Gate Bridge. In 2015, the Bridge District issued a Request for Proposals to construct the barriers. The selected Net system will be made of stainless steel cable and extend 20 feet below and 20 feet from the side of the span. Construction on the bridge started in 2017, and is expected to be completed in 2021.<sup>55</sup>

### [Key factors for decision-making and implementation](#)

As illustrated by the case studies, many jurisdictions have implemented suicide prevention measures on bridges. Several factors were considered in decision-making and implementing these interventions. Each bridge and jurisdiction is unique and required distinct processes; however, there were common factors identified, especially in relation to means restriction interventions. These factors illustrate how contextual considerations shaped jurisdictions' experiences of implementing suicide prevention measures, and demonstrate how decisions about the most suitable measures extend beyond the issue of effectiveness.

### [Aesthetic and heritage factors](#)

Many bridges have historical value and hold significant meaning for people and communities. The introduction of means restriction interventions on bridges may cause conflict as it has the potential to compromise the aesthetic or historical integrity of the bridge or block scenic views. Opposition to means restriction interventions may be led by heritage groups, representatives of the film or tourism industry, or nature preservation groups, who might support measures that have less heritage or aesthetic impact.

In response to these concerns, many jurisdictions initiated stakeholder consultation early in the decision-making process. In Vancouver, the film and television industry and heritage organizations expressed concern about the impact of suicide prevention barriers on the Burrard Bridge. These concerns were addressed by including a heritage organization on the advisory committee and consulting industry representatives about the design.<sup>6</sup> Such actions facilitated consideration of potential aesthetic and heritage impacts, and promoted acceptance of the final design selection.

Disagreements about means restriction options on the Golden Gate Bridge were partly motivated by the desire to maintain its cultural image; the bridge is a national historic landmark, has countless representations in popular culture, and is a key tourist attraction in San Francisco. A net was selected as the final bridge design to minimize the impact on appearance, although not all jurisdictions with bridges of similar designs and histories selected the net option, as in some situations it can compromise the historical integrity of the bridge.<sup>56</sup>

An additional step to mitigate concerns about aesthetic features or heritage value of a bridge are environmental assessments, which are required for most historical bridges prior to the erection of barriers or nets. This process typically involves community or stakeholder consultation. An environmental and engineering assessment was conducted for the Golden Gate Bridge from 2008-2010 for a cost of \$2 million. The process included a wind study and addressed topics such as land use and recreation, historical value, visual and aesthetic elements, and cultural and biological resources.<sup>57</sup>

#### Physical structure and reconstruction plans

Suicide prevention options on bridges, particularly bridge barriers and nets, may be limited by the physical structure of the bridge. Each bridge requires an assessment of its design and structure in order to determine which interventions are feasible and appropriate. In the case of the Lions Gate Bridge in Vancouver, for example, distress phones instead of barriers or nets were installed because of its suspension design. Barriers or net options were deemed unfeasible because of the added weight and wind load, which would potentially compromise the structure of the bridge. Advances in barrier/net design and technology will likely increase opportunities to implement this option in the future.

Another consideration when introducing means restriction at bridges is the importance of ensuring that the actual design will be effective, by making it difficult or impossible to climb or pass through. Some sources suggest that in order for barriers to be effective they must have the following features:<sup>34,58</sup>

- height greater than 2.5 metres
- gaps between railings of less than 150 mm but ideally even less than this
- no foot or hand holds which might assist in climbing
- curved at the top of the barrier towards the pedestrian side
- predominantly smooth vertical parts/railings
- provide the impression of imperviousness
- structural and aerodynamic stability.

Some of these features would also apply to net structures, while others may be less relevant.

A study of 15 bridge locations frequently used for suicide in Switzerland found that both nets and barriers were effective, with a mean suicide death reduction of 68.7 (barriers) and 77.1% (safety nets) following implementation.<sup>59</sup> The results showed that barriers that did not secure the whole bridge and allowed people to jump more than 15 metres due to the bridge height were less effective. Additional suggestions are that safety-nets should be fixed significantly below pedestrian level to deter access and jumps.

The Edmonton High Level Bridge barrier has received some negative media coverage; one source suggested that a different design that is more difficult to scale may have been more effective for preventing suicide-related behaviours at the site.<sup>60</sup> Most of the controversy around the barriers related to the narrowing of the bridge's pedestrian and bike pathways. This example highlights the importance of consultation and deliberation in choosing the best barrier design before implementing means restriction measures.

A final consideration is the role of bridge reconstruction in facilitating means restriction options. Due to the costs (e.g., equipment, labour) and other disadvantages (e.g., road closures) associated with barrier or net construction, some jurisdictions have integrated means restriction implementation into existing bridge reconstruction plans. The Burrard St. Bridge and the Ironworkers Memorial Bridge in Vancouver are both examples of this approach.<sup>61</sup>

In 2013, the State of California approved legislation that requires reports on new bridge construction, or reconstruction on an existing bridge, to demonstrate that installation of a suicide prevention barrier was considered in the planning process.<sup>62</sup> It is considerably easier to incorporate a means restriction design into a new bridge design than to retrofit an existing bridge with barriers or nets. State- or region-wide policies also have the potential to increase efficiencies by building barrier construction into existing projects, thereby saving costs.

#### Funds and cost-effectiveness

The issue of cost was widely discussed in the case studies, and was a primary reason for opposition to means restriction projects. As well, the cost and labour associated with maintaining barriers and nets vary according to the design and should be included as a consideration in planning.<sup>34</sup> There are many considerations that determine costs of interventions, such as the length of the bridge, type of materials and the degree to which the design minimizes aesthetic impact. In cases such as the Golden Gate Bridge, the estimated costs for means restriction interventions were significantly less than the final budget.

Some examples of the approximate costs of suicide prevention measures are provided below.

- Golden Gate Bridge, San Francisco, California (length: 2.737km)
  - Net System Below Bridge – **\$200 million** (USD) (final cost includes assessment study cost, design, environmental expenses and maintenance)

- 7 Bridges, Ithaca, New York (various lengths between 60 and 70 metres)
  - Net System – **\$7.2 million** (USD) (does not include \$40,000 every two years for maintenance or insurance costs)
- Burrard Bridge, Vancouver, British Columbia (length: 0.836km)
  - Barrier with Picket Fence Design – **\$3.5 million** (part of a broader \$18 million bridge reconstruction project)
- High Level Bridge, Edmonton, Alberta (length: 0.777km)
  - Railing with horizontal tension cable barriers - **\$3.0 million**
- Lions Gate, Vancouver, British Columbia (length: 1.823km)
  - 6 Crisis Phones and Signage - **\$97,000** (plus operation and maintenance costs).

The cost of surveillance measures is more difficult to pinpoint. One US source estimates the cost of CCTV cameras to be between \$5,000 and \$15,000 each.<sup>63</sup> These costs do not account for the installation of the device or the ongoing communication of footage back to a central location. If surveillance mechanisms such as cameras are to be useful, there must be consistent monitoring of the footage to allow third parties to intervene, which would add to the cost of the above estimate. Cost estimates for interventions at the Edmonton High Level Bridge were approximately \$20,000 to install phones that connect to the Distress Line and the Edmonton Police Service, \$120,000 to light the pedestrian walkway, and \$400 for signs with distress line information.<sup>64</sup>

The potentially high cost of implementing means restriction interventions on bridges, has raised questions about their cost-effectiveness. There are both direct and indirect costs to consider when determining cost-effectiveness. Direct costs attributed to suicide-related events at bridges include expenditures for the first response rescue or recovery, including salaries of personnel especially if the rescue continues for an extended period, medical examiner costs, and costs of productivity lost through labour. Indirect costs involve emergency treatment, hospitalization and rehabilitation, counselling of traumatized witnesses and emergency personnel, bridge and road closures, as well as potential injury to rescuers and bystanders underneath the bridge.<sup>65</sup> While the total amount of these expenses due to bridge suicides is unknown, these costs can be quite considerable and one estimate calculated the total direct and indirect costs for all suicides in Ontario in 2004 to be \$842 million.<sup>9</sup>

The quality of cost-effectiveness studies of bridge barrier interventions has been poor to-date,<sup>66</sup> and conclusions about cost savings derived from this research should be assessed with caution. One case study calculated the cost-benefits of installing barriers at the Clifton Suspension Bridge in England. The authors acknowledge that while the suicide rates by jumping are relatively low at 3% (of all methods), the fatality rates of this method is 50%, and estimate the lifetime costs of all completed and attempted suicide by jumping to be £176 million (or roughly \$300 million CAD) in England.<sup>67</sup> They use the Clifton Bridge as an example of savings due to intangible (e.g., loss of life, pain and suffering) and tangible (e.g., lost output waged and unwaged, police resources) losses, to show that investment in barriers are likely to be a cost saving, with an estimated savings of £3 million (around \$5 million CAD) after the first year.<sup>\*\*\*</sup>

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\*\*\* This figure accounts for the cost of the barrier (£300,000 in 2009).

An analysis of the impending Golden Gate Bridge barrier estimated that over a 20-year period the barrier would save 286 lives and be about 30 times more cost-effective than the minimum threshold used by the World Health Organization to define a cost-effective intervention. The authors also concur that there are considerable savings not included in calculations, including the cost of surveillance, negotiation, and recovery actions "that involve bridge workers, first responders, Golden Gate Bridge Patrol, California Highway Patrol, and the United States Coast Guard."<sup>68</sup> Despite the poor quality of the studies, the findings suggest that there is an overall savings once the physical barrier is installed. Notwithstanding the capital investment and operational costs, it is responsible public policy to retrofit and design new bridges to prevent suicide amongst residents in Toronto.

#### Public and political acceptability

Public concern over specific sites is another important factor to consider when making decisions about suicide prevention interventions.<sup>69</sup> There are numerous arguments for why barriers or nets should not be implemented on bridges. Common opposing arguments include the relative costs of the intervention, the potential for displacement to nearby locations, and the threat to the heritage or aesthetic value of the bridge.<sup>58</sup> Consequently, the introduction of means restriction options on bridges has often occurred as a result of advocacy efforts by families, interest groups, mental health practitioners and other organizations.

Many bridges discussed in the review have a relatively long history of advocacy related to means restriction. The Golden Gate Bridge has been the focus of decades-long advocacy for means restriction interventions.<sup>70</sup> Advocacy strategies tend to focus on education about the increasing evidence of effectiveness of barriers, dispelling misinformation about displacement, and broadening understanding of the societal costs of suicide in public spaces.

Public health, healthcare professionals, and first responders are often part of advocacy efforts. While means prevention was a design consideration from the beginning of the Burrard Bridge reconstruction project, working groups with organizations such as the Vancouver Health Authority played an important role in lending credibility to the project and advancing the means restriction option. In 2017, police voiced concern over the frequency of calls about incidents on Vancouver-area bridges.<sup>45</sup> Their involvement may also enhance credibility of the importance of the issue and the effectiveness of means restriction interventions.

One of Cornell University's strategies to make the project more politically acceptable to the City of Ithaca, was to offer to pay for the costs associated with the nets, including installation, training, repair, maintenance and liability insurance.<sup>71</sup> In addition, means restriction advocates developed a list of the project's merits to increase public awareness about the importance of implementing a net system. These benefits included reducing risks for vulnerable people, bystanders and emergency personnel, reducing the general attraction of the gorges as a high risk location, and preserving the aesthetic value and benefits of the views from the bridges.<sup>72</sup> Despite some concerns related to

costs and the impact of restricting views of the natural surroundings, the efforts of means restriction advocates were successful, and the project was approved.<sup>35</sup>

#### Collecting and Reporting Suicide Statistics

Jurisdictions may keep surveillance data or records of suicide deaths that occurred from bridges. These data may be collected by local emergency response, transportation, or public health authorities, as well as by coroner's offices. The quality and timeliness of this information can vary considerably. In the case of Edmonton, the issue of reliable data on suicides has been a priority for the City, and one of the recommendations of the *Edmonton Suicide Prevention Strategy* was to enhance data collection and data sharing protocols to ensure effective policy responses based on surveillance and monitoring.<sup>73</sup> In the UK, Public Health England directs local public health agencies to conduct local suicide surveillance for the purposes of informing local prevention and evaluation efforts, with preventing suicide in public places as one area of focus.<sup>3</sup>

None of the jurisdictions explored routinely reported statistics on suicide from bridges. Organizations that collect statistics on bridge suicides may be hesitant to release this information due to concerns about influencing vulnerable individuals through suicide contagion. These concerns are substantiated by evidence of an increase in suicide deaths following media or social media reporting which describes a specific suicide method or location.

However, as this also reduces the opportunity for education to increase awareness about the problem, some experts have suggested that reporting suicide deaths and attempts that occur in a jurisdiction in a more general manner, without revealing specific details about the method or location, may help enhance public awareness of the issue. Experts urge that the reporting of statistics should also occur with discussion of the social causes and impacts of suicide, and that these numbers should not be included with other stigmatized activities, such as crime statistics.<sup>74</sup>

In June 2017, media reported that the City of Edmonton had measured a 50% decline in suicide incidents since the implementation of a barrier on the High Level Bridge in July 2016.<sup>42</sup> A partnership approach was employed to facilitate the release of statistics, which included input from Edmonton Police Service, Alberta Health Services and Fire Rescue Services, and the Canadian Mental Health Association. A consensus was reached about how and when this information was communicated and what indicators were cited.<sup>75</sup>

#### Media and stakeholder engagement

Due to concerns about contagion, media engagement is an important area to consider when planning suicide prevention strategies. It is increasingly recognized that media can contribute to suicide behaviours, and that this contribution can be positive or negative, depending on how suicide is portrayed. For example, while reporting that sensationalizes suicide can negatively influence vulnerable individuals, media reporting that emphasizes positive coping behaviours, such as overcoming suicidal thoughts and seeking help, may have a positive effect on reducing suicide.<sup>76</sup> There may be a need to connect with media representatives in order to prevent risk for vulnerable people.<sup>77</sup>

Media guidelines have been developed to support responsible reporting of suicide and prevent the potential for suicide contagion. The World Health Organization (2017)<sup>76</sup> and the United States Centers for Disease Control and Prevention (CDC)<sup>78</sup> both have evidence-informed guidance documents. Jurisdictions in the United States often refer to the recommendations for reporting on suicide published by the American Foundation for Suicide Prevention (AFSP).<sup>79</sup> In Canada, sources include the Canadian Psychiatric Association's "Media Guidelines for Reporting on Suicide"<sup>80,81</sup> and the Canadian Association for Suicide Prevention.<sup>82</sup>

These guidelines each provide recommendations to: avoid sensationalist or normalizing messages and prominent placement or repetition of stories; withhold specific detail about the method used and location; avoid speculation about the reason for the suicide; report on suicide as a public health issue; and provide messages of hope and sources of support (e.g., crisis hotline numbers). Variations in media reporting on suicide at bridges suggest that there may be a need for greater media engagement in order to create an understanding of the importance of careful communication and to convey the reporting options, to balance the autonomy of journalists with the prevention of further health risks.

Some media representatives have voiced concern that limiting media reporting on suicide could contribute to an increased taboo about the subject.<sup>83</sup> Media reporting will ideally balance the public's right to information, with the risk of harm to vulnerable individuals.<sup>84</sup> This review revealed relatively little detailed documentation of specific media engagement strategies. Cornell University's response to the suicide clusters in Ithaca included detailed consultation with a number of parties, and a key area of their response was their communication plan which aimed to address the concerns of students, faculty, staff, parents and alumni about the suicides, and reduce contagion. This included reaching out to media outlets to share strategies for how to avoid contagion due to media coverage of suicide.<sup>85</sup>

A crucial strategy for resolving challenges related to suicide prevention at bridges, has been to engage relevant stakeholders, and facilitate intersectoral collaboration.<sup>58</sup> The City of Vancouver engaged in extensive consultation with key stakeholders in May and June 2015 including numerous transportation groups, special interest groups representing seniors, women and persons with disabilities, business improvement associations, the Vancouver Board of Trade, Heritage Commission, Vancouver Taxi Association, Film Industry, BC Trucking Association, and Heritage Vancouver. The City responded to concerns by replying to queries, explaining the specifics of the project, and in some cases inviting formal submissions to City Council should groups wish to express official positions on aspects of the project.<sup>6</sup>

In response to the negative feedback about the temporary barriers that were erected in 2010, the City of Ithaca and Cornell University engaged in intensive public consultation at the pre-decisional and design development stages. The consultation was intended to be highly inclusive with presentations of design options made at a number of public forums. As well as seeking this broader input, the City/Cornell University set up a bridge means restriction study committee that included representatives from student, staff and



faculty member groups at the university, as well as from City Public Works and Public Safety.<sup>35</sup>

Other public health sources indicate that public consultation is a proactive approach that can provide key groups with the opportunity to explain concerns, and in turn, have these concerns addressed throughout the process. It may also increase the likelihood that objections are raised before the main decisions are finalized. At the same time, an approach that includes public consultation should also carefully consider the potential for risk of contagion associated with this practice.<sup>3</sup>

#### Jurisdictional coordination

The coordination of issues such as design decisions, funding, and liability, are all factors that should be considered in relation to the local context. Similar to other factors identified in the case studies, the governance of bridges can add or reduce complexity in decision-making regarding suicide prevention options. This review found that bridges can be solely the responsibility of government, or owned by a private party but subject to jurisdictional zoning laws for additions such as barriers.

For example, bridges in Vancouver can be under the jurisdiction of the municipality or the provincial government. The Burrard Street Bridge is governed by the City of Vancouver, whereas the Lions Gate Bridge is maintained by the Province of British Columbia. By contrast, some bridges have an independent governing body. The Golden Gate Bridge, Highway and Transportation District is a special-purpose district agency that owns and operates three regional transportation structures in the San Francisco Bay Area, including the Golden Gate Bridge. The District is an independent, special-purpose unit, and is governed by a board of directors with some elected and non-elected members.<sup>86</sup>

When there are multiple parties involved, such as in Vancouver or Ithaca, there is a need to coordinate suicide prevention efforts, especially when suicide from bridges has been identified as a regional issue rather than an isolated issue at one bridge location. This also involves delineating responsibility for initiating an intervention, some costs, and some maintenance of the structure. In Ithaca, the responsibility for the seven bridges was shared between the City and Cornell University. The challenges related to shared jurisdiction was overcome by ongoing negotiation between both parties about whether a barrier would be installed, the kind of measure chosen and how the costs would be divided.<sup>87</sup> In B.C., a working group was convened with various representatives, including those from the City of Vancouver and the Province of British Columbia, to help define the parameters for implementing means prevention on bridges.

Funding sources for suicide prevention measures will also depend on the jurisdiction. One of the catalysts for implementing the Golden Gate Bridge intervention was that funds were made available for bridge safety nets under a 2012 US federal bill that authorized money for highway safety and transit programs. It is a major source of funding for the net installation, in addition to funds from other parties such as the Metropolitan Transportation Commission, Caltrans and the bridge district.<sup>88</sup>

Finally, there might be differences in legal contexts between jurisdictions, which dictate liability. In the US there have been several wrongful death lawsuits over suicide prevention on bridges. A civil trial was initiated in 2011 against the city of Ithaca and Cornell University, by the father of a student who jumped from a bridge in 2010. The father claimed that both parties failed to exercise reasonable care in designing, constructing and maintaining the bridge, which underwent reconstruction between March 2006 and November 2007 to include wider sidewalks, bicycle lanes and new customized railings. During this construction project, the railings were lowered. A settlement between all parties was reached in 2014.<sup>89</sup>

### Discussion: Implementing Suicide Prevention Measures on Bridges

Suicide deaths from bridges are a public health concern, given the lethality of the method, potential to traumatize and/or injure pedestrians, cyclists and motorists and burden to first responders.

Several potential interventions have been identified in the academic and grey literature. Of the interventions identified, means restriction interventions such as bridge barriers and nets are the most commonly researched. A growing evidence base consistently suggests that these are an effective intervention to prevent suicide deaths, with published studies showing a 93% reduction in suicide deaths at the site in which they are implemented.

Evidence also shows an overall significant decrease in total suicide deaths from jumping in the jurisdictions in which they are implemented, suggesting that displacement to other bridges or jumping locations is minimal. There is also no evidence to suggest that substitution to other methods (i.e. methods other than jumping from a high place) has occurred, acknowledging that this is difficult to discern given the small number of suicide deaths that occur from jumping from a bridge location.

Evidence on the effectiveness of other types of interventions is less robust, and currently is not sufficient enough to conclude that these interventions would be effective in preventing suicide deaths. Only two studies were identified that explored the effectiveness of crisis phones and signage at bridge locations, with the most long-term of these studies identifying an increase in suicide deaths following the implementation of crisis phones. More studies exploring the effects of crisis phones and signage on the number of suicides occurring at bridge locations are required in order to determine whether they are effective in preventing suicides.

Similarly, the review of academic literature identified only two studies on the effectiveness of surveillance and CCTV cameras at bridge locations, and both of these were combined with other types of interventions. One study showed a statistically significant reduction in suicide deaths. However, at the study site a 2 metre high fence was also implemented. At this time, there is insufficient evidence to understand the effect that crisis phones, signage, or surveillance activities, either as sole interventions, or in combination with other interventions, have on bridge suicide deaths. Increasingly, international and Canadian jurisdictions have erected barriers or nets on bridges for the purpose of preventing suicide deaths. Challenges may occur with different stakeholder interests regarding the design of the barrier and its impact on the

aesthetic features of the bridge. An important strategy for addressing this complexity is to draw on local knowledge of stakeholders to facilitate agreement on key decisions. This process of gathering input focuses on evidence and best practices, as well as specific details about the bridge site. Stakeholder consultation will add to the length of project, which may be difficult when action is perceived to be urgent, but may result in better acceptability of a decision. Clusters of suicides inevitably prompt community concern, political action and investment; however, an ideal situation would to balance the urgency of the situation with the time necessary for careful planning and implementation.

Due to the fact that there can be misinformation about the effectiveness of barriers which reinforces ideas about displacement and substitution, clear public health messaging of evidence and rationale for why means restriction is important may be useful. At the same time, consultation processes and communication about suicide by the media and other sources should take care to follow guidelines to avoid contagion.

In jurisdictions that have been unable to implement means restriction on bridges, secondary measures such as crisis phones or surveillance have often been introduced. Further research and evaluation studies will be required in order to determine whether these are effective, either as stand-alone measures, as interim measures prior to retrofitting bridges with barriers or nets, or as a supplement to these measures. It is possible that they may encourage health seeking behaviours in vulnerable individuals, and increase the likelihood that a third party could intervene.

There is general recognition that suicide prevention approaches in communities should be multi-faceted and include means restriction measures, in addition to other strategies such as investment into mental health services and the development of policies to promote social inclusion. Examples of more upstream approaches used by Toronto Public Health and other local agencies include suicide prevention campaigns, training for professionals who interact with individuals at high risk for suicide, organizing a media forum to discuss sensitive approaches and messaging for suicide that mitigate risks of contagion, undertaking research and surveillance to understand and respond to the issue, and promoting social inclusion and other initiatives that support positive mental health. Each approach contributes to meaningful and sustainable efforts to reduce the burden of suicide on society.

Finally, future research may help strengthen the evidence base for means restriction and other types of interventions. While there is a need for more research on the effectiveness of crisis phones, signage and surveillance activities at bridge locations, there may also be additional ways to strengthen the evidence base for means restriction interventions. This could be done in several ways, including using control sites in order to compare suicide deaths across comparable locations with and without bridge barriers, or slowly introducing bridge barriers in a stepwise fashion across multiple locations in a jurisdiction and evaluating any changes in suicide deaths that subsequently occur.

Exploring the effectiveness of gradually introducing multiple components of an intervention (e.g. crisis phones, followed by surveillance, followed by barriers) may also

provide additional insights as to the relative contributions of these interventions on suicide deaths. Studies that explore other outcomes besides suicide deaths (e.g. the effect of interventions on suicide attempts, contemplations, and first responder interventions) may also be helpful in establishing the utility of these interventions to additional outcomes besides suicide deaths.

In addition, there are few sources that systematically document or evaluate the process of implementing means restriction options. Research that evaluates the entire process of erecting bridge barriers or nets, including rationale for decisions and the experience of stakeholders involved, has the potential to contribute substantially to practices in other jurisdictions. Also, very few jurisdictions have intentionally introduced means restriction options in multiple locations as a strategy for suicide prevention. Future research and policy work might consider how to systematically approach means restriction options on multiple bridges in one area, including exploring the merits and limitations of approaching multiple bridges within one strategy. This could include developing criteria to establish when bridges (existing or new) should be retrofitted/outfitted with barriers to prevent suicide, and methods for enforcement.

## Conclusions

This report provides an overview of suicide from bridges in Toronto, interventions to prevent suicide from bridges, and the experiences of other jurisdictions who have implemented these interventions.

Suicide deaths are a major cause of preventable deaths. This report acknowledges that suicide deaths from bridges typically comprise a small number of overall suicide deaths. Nevertheless, they are an important responsible public policy strategy for municipalities, particularly given that effective interventions are available that are within the authority of local government to implement.

While the best available evidence identifies means restriction as an effective intervention to prevent suicide deaths, implementing these interventions requires a collaborative effort between government, community, health and other stakeholders. This report has also emphasized the importance of understanding the local context in order to anticipate and respond to opposition. Interest groups, costs, design, environmental impacts, jurisdictional coordination and media engagement are all important factors for consideration.

It is beyond the scope of this report to provide in-depth information on engineering feasibility assessments or bridge design, as these are often specific to the bridge of concern and require the expertise of planning, engineering, and transportation departments. Collaborative efforts between these departments and public health stakeholders to detect and respond to high-risk locations is an important component of a suicide prevention strategy.

## Appendix

### Data limitations

All data sources have limitations, which can result in under-estimates and under-reporting of suicide deaths. It is possible that some suicide deaths from bridges in Toronto may have been misclassified as 'undetermined' deaths by the coroner, leading to an underestimate of suicide deaths by this method. Incidents that were not attended to by Toronto Paramedic Services were not included. In particular, data from Toronto Police Services, who commonly respond to mental health crises, was not included, as this was unavailable at the time this project was undertaken.

The data obtained from Toronto Paramedic Services classifies incidents according to information provided during the initial call to Paramedic Services dispatch. It is possible that incidents that were actually jumps/falls from a bridge may have been misclassified as suicide contemplation if this was indicated during the initial call to Paramedic Services dispatch. It is also possible that some cases of suicide or suicide ideation occurring from bridges were missed if the initial call to Paramedic Services dispatch did not identify a bridge as the location of the incident.

### Limitations of the research included in this review

There are a number of limitations to the research regarding effective interventions to prevent suicide on bridges. First, as noted in the Pirkis et al (2015) systematic review/meta-analysis, some of the bridges studied had other interventions present that were not evaluated. For example, studies of the Clifton Suspension Bridge focussed on the installation of barriers and training of bridge staff, whereas signage was also present. It is also not possible to identify the effectiveness of monitoring and surveillance as a sole intervention, as this was only studied in combination with other interventions.

There was heterogeneity in both of the meta-analyses included in the study, meaning that the effectiveness of the intervention (the change in the rate or number of deaths observed before and after the intervention) varied from study to study. This may be due to several factors. For example, the length of the follow up period used in the study may have affected the statistical power, particularly given that suicide deaths from bridges are a rare outcome. It is also possible that the design of the bridge barriers may have contributed to the variation seen between studies, as barriers that are extremely difficult to bypass may be more effective at preventing deaths than barriers which are easier to circumvent.

In terms of other methodological limitations, it is important to note that all of the studies exploring suicide prevention interventions on bridges are ecological studies with before and after designs. It is thus not possible to rule out that other factors may have contributed to the changes in suicide that occurred in these studies. This type of design does, however, allow temporality and applicability of the findings to different contexts to be established. While additional, high-quality evidence would further strengthen the case for means restriction interventions, the effectiveness of means restriction interventions can be upheld with reasonable confidence, given that this finding has been replicated numerous times in different jurisdictions, including in the local context (Toronto).

The studies included in the reviews focussed only on suicide deaths. While the use of one consistent measure enhances the internal validity of the findings, it also means that other significant outcomes, such as suicide attempts and suicide ideation, were not assessed.

#### Literature review methods summary – Effective interventions

A review of synthesized information identifying interventions to prevent suicide on bridges, and the effectiveness of each intervention, was performed. The research question used to guide this review was as follows: What interventions are available to prevent suicide from bridges, and what is the evidence of their effectiveness? The databases MEDLINE, CINAHL and Psych Info were searched to identify systematic reviews and meta-analyses. As our interest was in suicide prevention measures that could be conducted at bridges only, we removed terms that were not relevant to suicide prevention related to a jump / fall from height.

The following terms were used:

suicid\* or hotspot

combined with:

cliff or building or high-rise or multi-storey or viaduct or river or lake or sea or public\* or secluded or remote or woods or forest or magnet or location or bridge or skyscraper or car park or road or motorway or highway or reservoir or coast or jump\* or leap\* or fall or height or hang\* or drown\* or fenc\* or barrier\* or parapet or net\* or pit\* or sign\* or poster\* or helpline\* or surveillance\* or CCTV or patrol\*

Articles published up to August 30, 2017 were included. An initial search identified 932 review articles. After title screening, 20 articles remained for full text screening. Articles were included if they included interventions that could be applied to bridge locations, and included both pre and post intervention data. Two articles remained, and two additional articles were identified by hand searching, leaving a total of four articles. All articles were critically appraised using the Health Evidence Quality Assessment Tool for Review articles and deemed to be of moderate (score of 5-7) or high (score 8-10) evidence quality. Because three of the articles involved many of the same authors, used the same studies, and came to consistent conclusions in their assessment, only the most recent (Pirkis *et al*, 2015) of these three was included, leaving a total of two articles included in the analysis.

#### Literature review methods summary – Substitution and displacement

Systematic reviews and meta-analyses were searched using MEDLINE, CINAHL and Psych Info. This review attempts to answer the following question:

What is the risk of displacement to other jumping locations, and substitution to other methods, following an intervention to prevent suicide from bridges?

The following search terms were used:

Suicid\*

AND

displac\* OR substitut\*

Articles published up to August 30, 2017 were included. The initial search identified 75 review articles. After screening titles and abstracts for relevance, 8 articles remained for full-text review. Articles were included if they assessed interventions that could be applied to bridge locations, and included both pre and post intervention data on any of the following: suicide deaths and attempts from a jump/fall from a high place, suicide deaths and attempts from a jump/fall from a bridge, and the overall number of suicide deaths/attempts. One article remained after full text review, and hand searching revealed two additional articles, which left 3 articles for inclusion. All articles were screened using the Health Evidence Quality Assessment Tool for Review Articles, and received a moderate (2) or strong (1) rating.

## [Jurisdictional review – Methods summary](#)

### Purpose and Objectives

A scan of Canadian and international jurisdictions was conducted to identify suicide prevention interventions that have been implemented at a specific bridge site. The main objectives of the scan were to: 1) identify suicide prevention measures on bridges in other jurisdictions; 2) select case studies based on numerous factors, such as the type of intervention, features of the bridge, public reception, history of suicide and jurisdiction; and 3) analyze core features of the intervention design and implementation to inform decision-making and process in other jurisdictions.

### Methods

Internet searches were conducted to identify jurisdictions that had implemented suicide prevention interventions or where an intervention was in the process of being initiated on a bridge. Keywords and variations of these covered the concepts of: (1) suicide prevention or safety; (2) bridge (including concepts such as "high risk location", "hotspot" and "public location"); and (3) intervention, program or measure (including specific concepts such as "barriers", "nets", "crisis phones" and "closed circuit television" monitoring). Snowball methods were also used to identify additional cases and information from these sources. Initial searches were limited to a two-month period over May-June 2017, to identify other jurisdictions and specific case studies. Once case studies were identified, supplementary searches were performed to identify additional information about specific jurisdictions after this time period.

Sources of information about specific cases were identified from the grey literature (e.g., government documents or literature available on suicide prevention websites), media reports, and internet websites. Reports that contained information about specific suicide prevention measures at bridges were mined to verify existing results and identify other suicide prevention measures in different jurisdictions. Academic sources were used in some instances to supplement information about specific jurisdictions. Interventions were originally organized by type.

Following the initial inventory of bridge interventions, several initiatives were selected for more in-depth review and analysis around core areas of inquiry. These case studies were selected to allow for variation in the core features of the intervention, including the:

type of intervention – physical barriers (fence, netting), surveillance, signs and hotlines; features of the bridge; public reception; history of suicide on the bridge; and cost.

The focus of the in-depth review of specific cases was guided by the following questions and considerations:

- What initiated the development of suicide prevention on bridges in these jurisdictions (e.g. who, how and why did this issue get raised)?
- What criteria did the jurisdiction apply to select their option(s) for suicide prevention?
- What criteria was applied to select the location of the intervention?
- What were the associated costs?
- How publically and politically acceptable was the option initially? What additional steps were undertaken to increase public and political acceptability?
- What strategies were undertaken to engage media to ensure contagion does not occur?
- How effective was the intervention? Are published / unpublished evaluations available?

Initially, nine case studies were selected in order to analyze the relevant factors for implementing measures. The factors presented in this report were generated iteratively by moving between emerging themes and case study information. Once the relevant factors were identified, the case study selection was reduced in order to allow for a more focused discussion of key points. The excluded case studies were the Toronto Bloor Viaduct, Cold Spring Canyon Bridge in Santa Barbara, California, and Sunshine Skyway Bridge in Saint Petersburg, Florida. These cases are summarized below. The final case studies were selected for their relevance, and their value in shedding light on the diverse combination of factors identified.

Comprehensive information about all of these areas was generally unavailable for each case study. Case studies were augmented with some telephone and email consultations with key informants about specific cases and recommendations for other sources.

### Limitations

The results of the review are not intended to be exhaustive, but rather to provide examples of means restriction measures in other jurisdictions. Because the initial search to identify interventions was limited to a two-month period over May-June 2017, undoubtedly there were many more instances of suicide prevention measures that were not identified through the search.

The search was also limited by the fact that it was conducted in English, and therefore non-English speaking jurisdictions were likely missed/under-represented. The results are largely representative of North American jurisdictions, which could speak to the specific search engines used, or the lack of coverage of these issues in other jurisdictions. As well, the case studies are largely limited to jurisdictions which introduced measures in the last 20 years. This is likely a function of the availability of information on the internet, which in itself is a relatively new technology. There was a limited amount of in-depth grey literature available about specific interventions in



jurisdictions, with a few exceptions, especially for those that were not means restriction options, and most interventions were reported in the media, with little additional information available. It was, thus, difficult to answer all of the questions listed above.

The quality of the review was also limited by the fact that few jurisdictions have performed either formal or informal evaluations of the implementation of the intervention process or outcomes. Only two project jurisdictions identified by the search carefully documented the process of implementing barriers on bridges: San Francisco's Golden Gate Bridge (<http://www.ggbsuicidebarrier.org/>) and Cornell University/City of Ithaca (<https://meansrestrictionstudy.fs.cornell.edu/>).

Specific cases show that interventions are often not limited to one specific measure (e.g., barriers or crisis phones). As it was difficult to identify documentation about phones, signage or surveillance measures at bridges, many bridges that have barriers or nets may also have other measures. Most references to surveillance and phones on bridges were brief references within discussions about introducing means restriction on bridges. For this reason, the analysis of non-means restriction interventions is limited.

Finally, because the results are restricted to interventions that have appeared in grey literature and in the media, most of the examples in the findings have been the focus of varying levels of public or political interest. Consequently, it is quite possible that less contentious cases were not uncovered by the search. A related limitation of the findings is that the material gathered over-represents 'iconic bridges'; probably because these cases evoke the most interest and coverage. As such, a key limitation is that information about suicide prevention on "average" bridges is more difficult to uncover.

#### [Jurisdictional Review – Additional Case Studies](#)

##### **Means Restriction**

###### Prince Edward Viaduct, Toronto, Canada (0.494 kilometers in length)

Originally built in 1919, the Prince Edward Viaduct crosses a stretch of busy highway, known as the Don Valley Parkway that runs through the city of Toronto. The bridge became known as a location of concern due to the high number of suicide incidents at this location.

By the 1990s, the problem reached a peak; the bridge had one of the highest suicide rates in North America, second only to the Golden Gate Bridge, with more than 400 suicide deaths. A quarter of those occurred from 1990 onward.<sup>90</sup> Between 1997 and 1998 there was a cluster of suicides, 17 in the first year and 19 in the second, which received considerable attention throughout the city.<sup>91</sup> Around this time, payphones and signs with the local 24-7 Distress Centre number were installed on each end of the bridge,<sup>92</sup> and a group of key mental health providers and community organizations, known as the Bridge Committee, began advocating for a means restriction intervention at the site.

A means restriction intervention was initiated between 1998 and 2001.<sup>93</sup> In 1998, a national competition was announced for proposals to design and build the barrier. A central requirement of the design was that it preserve the structure's original features,

due to concerns from local Heritage groups. The cost estimates for barrier construction greatly exceeded the original budget set by the City of Toronto, but eventually a bid from a local architect and engineering firm was considered.<sup>90</sup> The construction of the barrier was approved by city council in June 2001, three years following the initial bid for proposals, and construction was completed in 2003.<sup>94</sup> The Bridge Steering Committee for the project consisted of a number of stakeholder groups, that weighed in on the barrier design and build options, including the Schizophrenia Society of Ontario, the Council on Suicide Prevention, the Toronto Historical Board/Heritage Toronto, City Planning, the Public Art Policy Advisory Committee, and the Toronto Works and Emergency Services Department.<sup>95</sup>

The "Luminous Veil" design is a railing that consists of over 9,000 rods, each 5 meters tall.<sup>90</sup> The final cost of the project was \$5.5 million. The Viaduct is in close proximity to a series of bridges that cross the Don Valley, and this initially raised questions about whether people who were contemplating suicide might move to other bridges once the barrier was erected. Recent research on the effectiveness of the barrier on the Bloor Viaduct has found that suicide deaths have declined at this location following the implementation of the barrier. Before the barrier, there were an average of 9 deaths per year. Since the barrier has been implemented, only 1 death has occurred at this location. There is no evidence of displacement to other bridges or substitution of other methods.<sup>26</sup>

#### Cold Spring Canyon Bridge, Santa Barbara, California, United States (0.371 kilometers in length)

The Cold Spring Canyon Bridge crosses a large canyon in California that links Santa Ynez with Santa Barbara, California. The bridge, which was constructed in 1964, is known for its remarkable views of the Santa Ynez Valley, as it is situated at a considerable height over the canyon.<sup>96</sup> As of 2011, it had been the site of 54 suicide deaths in total, with 38 of those occurring in the preceding 25 years. There was also a suicide cluster in 2009 with 8 deaths from the bridge. In 2005, the Cold Spring Canyon Arch Bridge Suicide Prevention Committee was formed due to concern about the frequency of suicide attempts and deaths, calls to emergency services, the cost of rescue and recovery, risk posed to emergency personnel, and road closures.<sup>56</sup>

The Committee considered a range of suicide prevention measures at bridges, which included signage, call boxes with direct lines, video cameras, lighting, safety barrier/fences, safety net, restricted pedestrian and cyclist access, restricting public parking/pull out areas near bridge, surveillance, and public education. These options were considered for their effectiveness, but also according to other factors such as feasibility and safety.<sup>56</sup>

Due to concerns that a barrier would obstruct scenic views and compromise the structure of the historic bridge, a net option was considered, but dismissed for a number of reasons. For example, the potential rescue and response required by the net option was thought to pose considerable risk to emergency personnel, the maintenance would be too difficult at that height, and there were concerns that the net may allure thrill-seekers and introduce new rescue liabilities related to unauthorized use. As well, an aesthetics design advisory committee composed of California Department of

Transportation (Caltrans) staff, members of the community and relevant organizations met regularly over a 6 month period to determine the best option for a barrier design.<sup>97</sup>

The governing authority over the bridge, Caltrans, proposed that a barrier be erected, and implementation was initiated in 2010. Following this date, Caltrans faced a civil suit from a citizens group called the Friends of the Bridge due to the lack of public review process, and the legal action delayed the project for over a year. While the courts eventually ruled in Caltrans' favour to erect the barrier, the State was required to publish certain environmental documents associated with the planning process and convene public consultations in January 2011.<sup>98</sup> In 2012, a 2.9 m tall barrier in the form of an inwardly-curved, finely-gridded mesh fencing was installed on the bridge. In order to reduce the cultural-aesthetic impact of the fence, several actions were taken, including careful attention to the distance between individual panels on the fence to minimize obstruction, and extensive illustration and documentation of the original before the barrier was erected.<sup>96</sup> The final cost of the barrier was \$3.2 million (USD). As of 2015, there were press reports of two suicides since completion of the barrier; however, sources were unclear about how victims climbed the barrier.<sup>99</sup>

## **Surveillance**

### Sunshine Skyway Bridge, St Petersburg, Florida (6.7 kilometers in length)

The Sunshine Skyway Bridge in Florida, which crosses a stretch of the Tampa Bay, was originally constructed in the 1950s and reconstructed again in the 1980s after the bridge collapsed. The bridge is a high risk location for suicides, and has been subject to numerous relatively high profile events over the years, which motivated the introduction of several suicide prevention interventions. According to reports there have been roughly 100 deaths from jumping in the last decade (2006-2016). In 1999, six crisis emergency telephones with signs, and a police presence on the bridge were established at the same time.<sup>25</sup> The bridge also holds 15 cameras that continually scan the structure and link to a traffic management centre in Tampa, approximately 40 km away. The cameras were upgraded around 2015; however, it has been reported that the patrol that monitored the bridge in the 1990s has been dismantled due to lack of investment.<sup>100</sup>

A study of the phones and bridge police patrol intervention, three years before and after the measures were implemented, found that the number of deaths decreased on average by two per year following the intervention. A later study that looked at suicide deaths 13 years before and after installation of the phones found that the number of deaths more than doubled following installation.<sup>20</sup> The authors suggest that this increase may be attributed to the phenomenon of contagion, spurred by a local website about suicides from the bridge that gained prominence during that time. The study does not make reference to the surveillance measures on the bridge, so it is unclear how these were thought to impact outcomes.

In 2000, a means restriction study for the bridge was conducted, but the proposal was rejected due to concerns that nets would pose a danger to traffic and people contemplating suicide, and ensnare traffic and wildlife. In 2015, there were reports that barriers were being considered again as a possible suicide prevention measure due to new funds that had been made available for such measures at the federal level. A

representative from the Florida Department of Transportation was quoted as saying that since technology has developed over the last fifteen years a new feasibility study would be required.<sup>101</sup>

**Table 2. Example of Bridges with Barriers or Nets<sup>†††</sup>**

<b>Bridge Name, Location and Date Completed</b>	<b>Type of Intervention Barrier (railing or fencing) and Nets</b>
<b>Canada</b>	
1. Bloor Viaduct (Prince Edward Viaduct), Toronto, Ontario, 2003	Barrier
2. Golden Ears bridge, Greater Vancouver, British Columbia, 2009	Barrier (higher railings installed)
3. High Level Bridge, Edmonton, Alberta, 2016	Barrier
4. Jacques Cartier, Montreal, Quebec, 2003	Barrier
5. Burrard bridge, Vancouver, British Columbia, 2017	Barrier
6. Ironworkers Memorial Bridge, Surrey, British Columbia Completed in 2015 – cost of \$20 million	Barrier
7. MacDonald Bridge, Halifax, Nova Scotia, 2009	Barrier
<b>United States</b>	
8. Golden Gate Bridge, San Francisco Intervention started in 2017	Net (stainless steel cable)
9. Aurora Bridge (George Washington Memorial Bridge), Seattle, Washington, 2011	Barrier
10. Bourne Bridge, Massachusetts, 1981	Barrier
11. Sagamore Bridge, Massachusetts, 1983	Barrier
12. Ithaca, New York – 7 bridges in total spanning City of Ithaca and Cornell University property, 2013	Nets
13. All-America Bridge (Y Bridge), Akron, Ohio, 2011	Barrier
14. Memorial Bridge, Augusta, Maine, 1983	Barrier
15. Arroyo Seco Bridge, Pasadena, California, 1993	Barrier
16. Duke Ellington Bridge, Washington, DC, 1986	Barrier
17. Cold Spring Canyon Arch Bridge, Santa Barbara, California, 2012	Barrier

<sup>†††</sup> Bridge may have other suicide prevention measures, such as phones or surveillance, installed in addition to means restriction.

<b>Bridge Name, Location and Date Completed</b>	<b>Type of Intervention Barrier (railing or fencing) and Nets</b>
<b>International</b>	
18. Story Bridge, Brisbane, Australia, 2015	Barrier
19. Clifton Suspension Bridge, Bristol, UK 1998	Barrier (partial fencing)
20. Van Stadens Bridge, Port Elizabeth, Eastern Cape South Africa, 2013	Barrier
21. Grafton Bridge, Auckland New Zealand, 1996 removed after 60 years; Barrier reinstalled in 2003	Barrier (perspex canopies)
22. Westgate Bridge, Melbourne, Australia, 2011	Barrier
23. Grand Duchess Charlotte Bridge, Luxembourg City, Luxembourg, 1993	Barrier (plexiglas)
24. Segovia Viaduct, Madrid, Spain, 1998	Barrier (acrylic glass)
25. Sydney Harbour Bridge, Sydney, Australia	Barrier
26. Erskine Bridge, Scotland, 2011	Barrier
27. Nusle Bridge, Prague, Czech Republic, 1997, 2007	Barrier
28. Tromso Bridge, Norway, 2005	Barrier
29. Long Gully Bridge, Sydney, Australia, 2010	Barrier
30. Gateway Bridge, Brisbane, Australia, 1993	Barrier
31. Mooney Bridge, New South Wales, Australia, 2003	Barrier

**Table 3. Examples of Telephones/Crisis Phones and Signage Measures at Bridges**

<b>Location and Date Installed (where available)</b>
1. Aurora Bridge, Seattle, Washington, United States, 2006
2. Story Bridge, Brisbane, Australia
3. Mid-Hudson Bridge, Poughkeepsie, New York, United States, 1984
4. Mapo Bridge, Seoul, South Korea, 2012
5. Bloor Viaduct, Toronto, Canada, late 1990s
6. Golden Ears Bridge, Vancouver, Canada
7. Bourne Bridge, Massachusetts, United States, 1980
8. Sagamore Bridge, Massachusetts, United States, 1980

<b>Location and Date Installed (where available)</b>
9. Arroyo Seco Bridge, Pasadena, California, United States, 2013
10. Coronado Bay Bridge, San Diego, United States, 1990
11. Sunshine Skyway Bridge, Saint Petersburg, Florida, United States, 1999
12. 5 Bridges, Catskills, New York, United States, 2007
13. Vista Bridge, Portland, Oregon, United States, 2012
14. Lethbridge Viaduct, Lethbridge, Alberta, Canada, 2012
15. Penobscot Narrows Bridge, Maine, United States, 2015
16. Leo Frigo Bridge, Green Bay, Wisconsin, United States, 2005
17. Lions Gate Bridge, Vancouver, Canada, 2009
18. Second Narrows Bridge, Vancouver, Canada, 2010
19. Burrard Street Bridge, Vancouver, Canada, 2016
20. Rio Grande Gorge Bridge, Santa Fe, United States, 2014
21. Golden Gate Bridge, San Francisco, United States, 1993
22. George Washington Bridge, New York/New Jersey, United States
23. Tasman Bridge, Hobart, Tasmania, 2016
<b>Summary:</b>
<ul style="list-style-type: none"> <li>• Total sites identified through search: 23</li> <li>• Countries: United Kingdom; United States; Canada; Australia; Tasmania; South Korea</li> <li>• Dates range of interventions: 1980s-2016</li> </ul>

**Table 4. Examples of Surveillance Measures (Cameras, unless otherwise specified) at Bridges**

<b>Location and Date Installed (where available)</b>
1. Clifton Suspension Bridge, Bristol, UK, 1998
2. Story Bridge, Brisbane, Australia
3. Mid-Hudson Bridge, Poughkeepsie, New York, United States
4. Mapo Bridge, Seoul, South Korea, 2013
5. Van Stadens Bridge, Port Elizabeth, Eastern Cape South Africa, 2005

<b>Location and Date Installed (where available)</b>
6. Golden Gate Bridge, San Francisco, United States, Cameras and Patrols, 1996
7. Sunshine Skyway Bridge, Saint Petersburg, Florida, United States, Camera and Patrols, 1999
8. George Washington Bridge, New York/New Jersey, United States, Cameras and Patrols, 2014
9. Foyle Bridge, Derry, Northern Ireland, 2016
<b>Summary</b> <ul style="list-style-type: none"> <li>• Total sites identified through search: 9</li> <li>• Countries: United Kingdom; Australia; United States; South Korea; South Africa; Northern Ireland</li> <li>• Date range of interventions: 1996-2016</li> </ul>

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