



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

## Evaluating the Effectiveness of Components of National Suicide Prevention Strategies

**Citation for published version:**

Schlichthorst, M, Reifels, L, Spittal, M, Clapperton, A, Scurrah, K, Kolves, K, Platt, S, Pirkis, J & Krysinaka, K 2022, 'Evaluating the Effectiveness of Components of National Suicide Prevention Strategies', *Crisis: The Journal of Crisis Intervention and Suicide Prevention*. <https://doi.org/10.1027/0227-5910/a000887>

**Digital Object Identifier (DOI):**

[10.1027/0227-5910/a000887](https://doi.org/10.1027/0227-5910/a000887)

**Link:**

[Link to publication record in Edinburgh Research Explorer](#)

**Document Version:**

Peer reviewed version

**Published In:**

Crisis: The Journal of Crisis Intervention and Suicide Prevention

**General rights**

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

**Take down policy**

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact [openaccess@ed.ac.uk](mailto:openaccess@ed.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.



EVALUATING THE EFFECTIVENESS OF COMPONENTS OF NATIONAL SUICIDE  
PREVENTION STRATEGIES: AN INTERRUPTED TIME SERIES ANALYSIS

Running title: COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGY

Marisa Schlichthorst<sup>1</sup>, Lennart Reifels<sup>1</sup>, Matthew Spittal<sup>1</sup>, Angela Clapperton<sup>1</sup>, Katrina  
Scurrah<sup>1</sup>, Kairi Kolves<sup>1</sup>, Steven Platt<sup>2</sup>, Jane Pirkis<sup>1</sup>, and Karolina Krysinska<sup>1\*</sup>

<sup>1</sup> Centre for Mental Health, School of Population and Global Health, The University of  
Melbourne, Australia

<sup>2</sup> Usher Institute, University of Edinburgh, UK

\* Corresponding author; Centre for Mental Health, School of Population and Global Health,  
The University of Melbourne, Australia, email: [karolina.krysinska@unimelb.edu.au](mailto:karolina.krysinska@unimelb.edu.au)

Address:       Level 4, 207 Bouverie Street  
                  The University of Melbourne  
                  Melbourne School of Population and Global Health  
                  Victoria, 3010, Australia

**KEYWORDS:** suicide prevention, national suicide prevention strategy, suicide mortality

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

**Introduction**

1  
2  
3  
4 Suicide remains a serious public health issue worldwide, with over 700,000 people dying by  
5  
6 suicide each year (World Health Organization [WHO], 2021). This high burden underscores  
7  
8 the need for ongoing suicide prevention efforts, in particular a national suicide prevention  
9  
10 strategy, which offers a systematic way to develop a comprehensive and integrated national  
11  
12 response and provides a framework to support suicide prevention activities and their  
13  
14 evaluation (WHO, 2018). Such a framework promotes a coordinated and multi-sectoral  
15  
16 approach to suicide prevention, which involves collaboration between governmental and non-  
17  
18 governmental agencies at both national and local levels. Adoption of a national suicide  
19  
20 prevention strategy reflects a government's recognition that suicide is a priority public health  
21  
22 issue, heralds its commitment to suicide prevention, and allows the identification of gaps in  
23  
24 legislation, provision of services, and the suicide prevention evidence base (Platt, Arensman,  
25  
26 & Rezaeian, 2019; WHO, 2014; 2018). Finland was the first country to implement a national  
27  
28 suicide prevention strategy, during the period 1986-1996 (Hakanen & Upanne, 1996). As of  
29  
30 2021, just under 40 countries have a national suicide prevention strategy, although there are  
31  
32 some notable differences between LMICs and HICs (WHO, 2021). While approximately  
33  
34 35% upper-middle and high-income countries have adopted a strategy, only 10% of low- and  
35  
36 lower-middle- income countries have a similar nationwide initiative (Platt et al., 2019).  
37  
38  
39  
40  
41  
42  
43  
44  
45

46 To address the bio-psycho-social complexity of suicide (Stack, 2021), national suicide  
47  
48 prevention strategies usually encompass a diverse range of public (mental) health approaches  
49  
50 (WHO, 2021). Platt and colleagues (2019) compiled a list of twelve typical components  
51  
52 included in national suicide prevention strategies (Table 1). These range from universal  
53  
54 interventions, such as restriction of access to lethal means of suicide and responsible media  
55  
56 reporting, to selective and indicated interventions, such as access to health and social care  
57  
58  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 services, crisis intervention, and follow-up after a suicide attempt, which are underpinned by  
2 oversight and coordination, as well as surveillance, monitoring and evaluation (WHO, 2014).  
3  
4 While there is a strong evidence base for the effectiveness of limiting access to certain  
5 suicide methods, such as jumping sites like bridges (Ishimo et al., 2021; Pirkis, San Too,  
6  
7 Spittal, Krysinska, Robinson, & Cheung, 2015), firearms (Houtsma, Butterworth, & Anestis,  
8  
9 2018), and pesticides (Knipe et al., 2017). By contrast, there is an ongoing need to strengthen  
10 the evidence base for other strategies, such as postvention (Andriessen, Krysinska Kølves. &  
11  
12 Reavley, 2019) and training and education. (Hawgood, Woodward, Quinnett, & De Leo D,  
13  
14 2021; Zalsman et al.,2016).  
15  
16  
17  
18  
19  
20  
21

22 - Table 1 -  
23  
24

25 Despite the increasing implementation of national suicide prevention strategies, there  
26 is limited and mixed evidence regarding their impact on suicide rates (De Leo & Evans,  
27  
28 2004; Lewitzka, Sauer, Bauer, & Felber, 2019; Martin & Page, 2009; Matsubayashi & Ueda,  
29  
30 2011; Taylor, Kingdom, & Jenkins; 1997). For instance, De Leo and Evans (2004) looked at  
31 rates of suicide following the implementation of national strategies in selected countries and  
32  
33 found a decline for males and females in Finland, and an increase for males and females in  
34  
35 Norway, males in Sweden, and females in Australia. More recently, a study (Lewitzka et al.,  
36  
37 2019) found a post-implementation decline in suicide rates in males in the four countries that  
38  
39 De Leo and Evans (2004) examined, with the strongest effects in middle-aged groups (25-44  
40  
41 years and 45-64 years), in comparison to control countries without national suicide  
42  
43 prevention strategies. Other study (Matsubayashi & Ueda, 2011) reported an overall decrease  
44  
45 in suicide rates in 21 Organization for Economic Co-operation and Development (OECD)  
46  
47 countries over 1980-2004 after they implemented national strategies, noting that the decrease  
48  
49 was most marked for the younger and older age groups.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

Published research studies have several methodological limitations, especially model misspecification and the absence of evidence about implementation of the strategy (e.g., timing of inception of program delivery and ‘dose’ or ‘intensity’ of delivery). Publication bias may also be an issue. Of importance, the cross-national studies conducted to-date have failed to recognise the complexity of national suicide prevention strategies and disaggregate their overall impact by examining the contribution of specific components. To address this gap, we aim to: (a) describe which components have been included in national suicide prevention strategies; and (b) analyse the potential contribution of individual components of national suicide prevention strategies to reduce suicide rates.

### **Materials and Methods**

We identified national suicide prevention strategies through a comprehensive search process and then conducted a narrative review and statistical analyses.

#### *Search and eligibility criteria*

Countries with national suicide prevention strategies and the national strategy documents were identified via the WHO MiNDbank (2020) and the WHO (2018) *National suicide prevention strategies* report (Figure 1). Searches were conducted in November 2020. The search identified 39 countries and documents for 30 countries were available via the WHO MiNDbank (2020). After screening these documents, the *National Mental Health and Suicide Prevention Policy* in Fiji (Ministry of Health and Medical Services, 2015) was excluded as it did not include sufficient information on suicide prevention priorities.

For inclusion in the narrative review, a country had to have a national suicide prevention strategy published before 2020 and the associated documentation had to be available via the WHO MiNDbank (2020). For countries with several iterations of a national

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 strategy, the most recent strategy document was included. In case of Finland, Sri Lanka, and  
2 Sweden, where the identified national strategy documents were published over 20 years ago,  
3  
4 two authors (MS, JP) followed up with the International Association for Suicide Prevention  
5 national representatives and other suicide prevention experts to enquire whether a more  
6 recent version of the national strategy was available. We consequently found that there had  
7 been no more recent strategy implemented in Sri Lanka. In Sweden, a more recent version of  
8 the strategy was launched in 2008 and was included in the study. More recent strategy  
9 documents were available for Finland and Norway; however, both were published in 2020  
10 and focused on implementation over 2020-2030 (Finland) and 2021-2025 (Norway) and were  
11 thus excluded. Google Translate was used to translate strategy documents that were  
12 published in languages other than English.  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26

27 For inclusion in the quantitative analyses, the national strategy had to be published no  
28 earlier than 2002 and no later than 2017 to allow for the availability of at least two years of  
29 suicide data pre- and post-publication of the strategy. In addition, suicide incidence estimates  
30 had to be of at least medium quality according to the WHO Mortality Database (2020)  
31 categorisation. Based on these criteria, five countries (Bhutan, The Dominican Republic,  
32 Namibia, Nicaragua, and Sri Lanka) were excluded.  
33  
34  
35  
36  
37  
38  
39  
40  
41

42 Twenty-nine countries (14 lower middle-income countries (LMICs) and 15 high  
43 income countries (HICs)) with national strategies were included in the narrative review and  
44 24 countries (9 LMICs and 15 HICs) in the quantitative analyses (Table 2).  
45  
46  
47  
48  
49

50 - Table 2-

51 - Figure 1 -  
52  
53  
54  
55

56 *Coding of national suicide prevention strategies*  
57  
58  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 The national suicide prevention strategy documents were coded using a framework, which  
2 consisted of the 12 components typically included in national suicide prevention strategies  
3 (Platt et al., 2019) (Table 1). Two researchers (KK, MS) independently reviewed the strategy  
4 documents and identified which of the 12 components were included in a strategy. Following  
5 the independent review, the two researchers met to compare their coding results. In cases  
6 where the coding results differed, they referred back to the original source document. If  
7 consensus still was not reached, a third researcher (KKō) was consulted for a final decision.  
8 This final coding was captured in the coding framework either as a “yes” (the component is  
9 included in the national suicide prevention strategy) or a “no” (the component is not included  
10 in the national suicide prevention strategy).

### *Selection of population level suicide data*

11 Age-standardised suicide incidence estimates for each country for the relevant years between  
12 2000 to 2019 were downloaded from the WHO Global Health Observatory (GHO) (2021)  
13 data repository. This source provides a comprehensive and comparable set of cause of death  
14 estimates and represents the best estimates of the WHO, based on the available evidence,  
15 until November 2020. As all countries included in our study had at least medium data quality,  
16 the WHO GHO estimates analysed in this paper were based on data originally sourced from  
17 the WHO Mortality Database. Incidence estimates were available from 2000 to 2019 (Table  
18 2).

### *Statistical analyses*

19 The year of introduction of the national suicide prevention strategy was recorded and each  
20 year of data available for each country was coded as either “before” or “after” the

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 introduction of the strategy. The year the strategy was introduced was included in the before  
2 period. Interrupted time series models were fitted separately to the suicide data for each  
3 country and each sex (males, females, and males and females combined). This allowed direct  
4 comparison of the effect of period (before/after) within countries even though the timing of  
5 introduction varied between countries. These models are unweighted linear regression models  
6 that are fitted to the log-transformed suicide rates, with period included as a covariate. This  
7 effect, which is the main effect of interest, is referred to as the “period effect”. To account for  
8 the underlying trend in suicide incidence within a country, an effect for time was also  
9 included in each model. Time was modelled using fractional polynomials fitted using the fp  
10 and fp\_select commands to identify and fit the best fractional polynomial with maximum  
11 degree of 2 from the standard set of powers (-2, -1, -0.5, 0, 1, 2, 3).

12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27 Having estimated the coefficients for the period effect for each country and sex strata  
28 within each country, we pooled these data to estimate the mean change in suicide rates  
29 overall and for males and females separately. This was done by inputting the period  
30 coefficients and their standard errors into a random effects meta-analysis, conducted  
31 separately for each of the three groups (total, male, female). Separate meta-analyses were  
32 also performed for each of the 12 strategy components, with each meta-analysis including  
33 only the countries where that strategy component was present. Results from these 13 meta-  
34 analyses are presented as forest plots with exponentiated estimates (i.e., on the relative risk  
35 (RR) scale), sorted by strategy iteration (first/second or subsequent) and first year after  
36 strategy introduction. The total number of strategy components present for each country was  
37 also counted and meta-regression models were fitted to test for association with number of  
38 components. Sensitivity analyses allowed lags of one and two years, and weighted  
39 interrupted time series models (weighted by inverse of SE of log(ASR)). All analyses were  
40 performed using Stata v16.1 (Stata Corp., 2019).



## Results

### *Narrative review*

Eighteen of the 29 countries implemented their national suicide prevention strategies for the first time, including 12 LMICs (86%) and 6 HICs (33.3%). The remaining 11 countries had either a second (n=6) or subsequent (n=5) iteration of their strategy. The number of components adopted by countries ranged from four to 11. Training and education, such as gatekeeper training and training of primary care physicians, were included in all but one strategy (96.5%). Other components included in more than half of the national strategies were awareness raising (82.7%), access to services (75.8%), means restriction (72.4%), follow-up after a suicide attempt (68.9%), postvention (68.9%), media reporting (65.6%), and stigma reduction (48.2%). Only six countries (20.6%) included psychotherapy in their national strategies, while crisis intervention was included in one third of the strategies (37.9%). The majority of countries adopted surveillance (93.1%) and oversight and coordination (79.3%). Full details of the components included in the national strategies are presented in Table 3.

- Table 3 -

### *Statistical analyses*

After adjustment for underlying time trends, estimated period effects for total suicide rates in individual countries ranged from a significant decrease in yearly suicide rate with RR=0.80 (95% CI 0.69-0.93, for South Korea) to a significant increase with RR=1.12 (95% CI 1.05-1.19, for Uzbekistan). (Figure 2a). However, there was no evidence of a consistent change for the 28 countries. The pooled estimate of the period effect was  $RR_P=1.00$  (95% CI 0.97 – 1.04,  $p=0.81$ ,  $k=24$ ,  $I^2=79.6\%$ ) for both sexes (Figure 2a),  $RR_P=1.00$  (95% CI 0.96 – 1.03,

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

$p=0.84$ ,  $I^2=71.0\%$ , Figure 2b) for males (figure 2b), and  $RR_P=1.02$  (95% CI 0.97 – 1.07,  $p=0.5$ ,  $I^2=82.4\%$ ) for females (Figure 2c).

Similar results were obtained when each component was considered separately. For example, when a pooled effect was estimated for the 17 countries with strategies including restriction of access to commonly used methods of suicide,  $RR_P=1.00$  (95% CI 0.97-1.04,  $p=0.32$ ) for males and females combined, and there was no difference between the RR estimates for countries whose strategies did and did not include this component ( $p=0.74$ ). The only subgroup differences observed were for countries that did and did not include crisis intervention. Countries whose strategies included this crisis interventions had a reduced RR after its introduction ( $RR_P=0.94$ , 95% CI 0.87-1.01,  $p < 0.01$ ) in contrast to countries whose strategies did not include this component ( $RR_P=1.04$ , 95% CI 1.01-1.07,  $p=0.01$ ,  $p$ -value for difference between subgroups=0.02). Results for this component were similar for males ( $p$ -value for subgroup differences 0.02) but not females ( $p = 0.10$ ). However, given the large number of tests conducted, these results would not be considered significant after any adjustments for multiple testing, and are unlikely to be clinically relevant. See Supplementary Figure 1 for full details.

Based on subgroup and meta-regression analyses for total suicide rates, there was also no evidence of differing effects by strategy iteration (first vs second/subsequent,  $p=0.80$ , Supplementary Figure 2a), economic status (HICs vs LMICs,  $p=0.81$ , Supplementary Figure 3a), number of components included (4-11, grouped as 4-7, 8-9, and 10-11,  $p=0.46$ , Supplementary Figure 4a), year of first introduction of the strategy (2006-2017, grouped as 2006-2011, 2012-2014 and 2015-2017,  $p=0.77$ , Supplementary Figure 5a), or suicide rate in the year prior to publication of the strategy (low, medium or high,  $p=0.98$ ). Very similar results were obtained when males and females were considered separately (Supplementary Figures 2b-5b and 2c-5c).

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 Sensitivity analyses included models fitted using lags of one and two years, linear  
2 yearly trends, full (rather than best fitting) fractional polynomials and weighted by the  
3 estimated SE of the suicide rate. None of these modifications materially changed the results  
4 or conclusions. For example, with a lag of two years and for males and females combined,  
5  $RR_p=1.00$  (95% CI 0.97 – 1.03,  $p=0.88$ ) (full results not shown).  
6  
7  
8  
9  
10

### Discussion

11  
12  
13  
14  
15  
16  
17  
18 Our study is the first to consider the potential impact of components included in national  
19 suicide prevention strategies on suicide incidence. The narrative review revealed considerable  
20 diversity between countries in the inclusion of these components. While training and  
21 education and surveillance were included in over 90% of the existing strategies,  
22 psychotherapy and crisis intervention were included in less than half of the strategies. These  
23 differences may reflect the range of priorities recommended for countries at earlier and later  
24 stages of suicide prevention strategy development (WHO, 2014). Other possible sources of  
25 diversity include the relative influence of civil society interest groups, the extent of  
26 recognition and integration of voices of lived experience, and the willingness of non-health  
27 sector agencies and government departments to take responsibility for specific actions.  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42

43 In our statistical analyses we found no consistent estimated pooled changes ( $RR_p$   
44 consistently approximately equal to 1). This result is different from results of previous studies  
45 which reported changes in suicide rates in countries with national suicide prevention  
46 strategies (De Leo & Evans, 2004; Lewitzka et al., 2019; Martin & Page, 2009; Matsubayashi  
47 & Ueda, 2011; Taylor et al., 1997). This difference may be related to the fact that the earlier  
48 studies were looking at the implementation of whole strategies, whereas our study aimed at  
49 assessing the effectiveness of particular components. It is possible that whole strategies,  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 which are intrinsically complex and multi-level, make a difference, unlike individual specific  
2 components, which are a mix of universal, selective and indicated interventions targeting  
3 different groups, in different settings, by different mechanisms (Van Der Feltz-Cornelis et al.,  
4 2011). Further, previous studies have used a variety of different samples, methodologies, and  
5 control variables. For instance, Matsubayashi and Ueda (2011) analysed suicide mortality  
6 data using a fixed-effect estimator over 1980-2004 in 21 OECD nations controlling for a  
7 range of political, economic, and socio-demographic variables. Lewitzka and colleagues  
8 (2019) analysed suicide rates in four countries with national strategies using six years as the  
9 study period with four control countries (no strategy). Further, our analyses showed decreases  
10 in national suicide rates in some countries (e.g., South Korea), while there were increases in  
11 suicide mortality in other countries (e.g., Uzbekistan).  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26

27 Although the study did not find changes in suicide incidence that were associated with  
28 particular components of national suicide prevention strategies, we cannot conclude that the  
29 components (or the whole strategies) are ineffective. It may be that they take longer to show  
30 an effect (Collings, Jenkin, Stanley, McKenzie, & Hatcher, 2011) or only have an effect in  
31 certain sub-group (DE Leo & Evans, 2004). In our study, we identified the existence of  
32 national suicide prevention strategies, but we were not able to ascertain whether a specific  
33 strategy had been implemented or, if implemented, the quality, scale, intensity, completeness  
34 and timing of the implementation process (Burgess, Pirkis, Jolley, Whiteford, & Saxena,  
35 2004). There are numerous barriers to successful implementation on many levels, from  
36 unsupportive socio-economic, political, social and legal environments to ineffective planning  
37 and coordination, and limited knowledge and resources (Arensman, Scott, De Leo, & Pirkis,  
38 2020).  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56

57 Reductions in suicide incidence are only one possible, although highly desired,  
58 outcome indicator of the effectiveness of a national suicide prevention strategy (WHO,  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 2014). Other intermediate outcome indicators include the establishment of suicide attempt  
2 and self-harm surveillance systems, increased awareness of suicide risk factors, improved  
3 identification of suicide risk, improved access to quality health care, reduced access to lethal  
4 means of suicide, and lower numbers of people hospitalized after a suicide attempt (Rezaeian  
5 & Khan, 2020).  
6  
7  
8  
9  
10

11  
12 Outcome evaluations of national suicide prevention strategies focused on suicide  
13 mortality data, including our study, have many methodological challenges. These include the  
14 relative statistical rarity of suicide, naturally occurring fluctuations in suicide rates over time,  
15 regression to the mean, and delays between registration of a suicide death and publication of  
16 mortality data (De Leo, 2015; WHO, 2021). We carefully selected two time periods – the  
17 baseline (i.e., pre-publication of a national suicide prevention strategy) and post-publication –  
18 and controlled for the iteration of the strategy. Nonetheless, this approach might not have  
19 been able to account for the complex process of implementation over time (Platt et al., 2019).  
20 Our analyses considered a number of confounders and covariates (gender, LMIC/HIC status,  
21 and strategy iteration). Nonetheless, we did not account for other variables, such as economic  
22 recession, political disruption, and broader national and local level mental health and social  
23 policies (Collings et al, 2018; Rezaeian & Khan, 2020; Vijayakumar, Daly, Arafat, &  
24 Arensman, 2020).  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44

45 The downloaded WHO Global Health Observatory data, while representing the best  
46 available estimates from WHO, include 95% confidence intervals, indicating that there is  
47 some uncertainty about these estimates. Despite this uncertainty, our main analyses treated  
48 the rates as observed data. However, the meta-analytic results were consistent when the  
49 interrupted time series analyses were weighted by the inverse of the standard error of the  
50 mortality rates (obtained by transformation of the confidence intervals), providing some  
51 reassurance that this limitation did not have a great effect. Mortality rates were available for  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1 at most 20 years for each country, with a minimum post-publication time of three years and a  
2 maximum of fourteen years. The variation in pre- and post-publication times between  
3 countries may have affected the power to detect significant changes within individual  
4 countries, especially for countries with extreme splits, such as 17 (pre-)/3 (post-).  
5  
6 Nonetheless, the interrupted time series models used all available data, which provides more  
7 power than merely examining a few years pre- and post-publication. Furthermore, bias from  
8 potential classification of suicide deaths as “undetermined” is minimized by the WHO  
9 methodology (WHO, 2020).  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21

### Conclusion

22  
23  
24  
25 Our study was unable to identify any specific suicide prevention strategy component that was  
26 associated with a reduction in suicide rates. Further detailed evaluations, probably using  
27 different methodologies, will be required to confirm this finding. It is likely that the effects of  
28 different components are nuanced, for instance more effective in reducing suicide rates in  
29 particular age or gender groups across countries. Until then, it is reasonable to recommend  
30 development, implementation and evaluation of national suicide prevention strategies, which  
31 include multiple components, emphasizing the importance of accurate and timely  
32 surveillance (especially during the COVID-19 era and its aftermath).  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47

### References

48  
49  
50  
51  
52 Andriessen, K., Krysinska, K., Kölves, K., & Reavley, N. (2019). Suicide prevention service  
53 models and guidelines 2014–2019: A systematic review. *Frontiers in Psychology*,  
54 2677. <https://doi.org/10.3389/fpsyg.2019.02677>  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

Arensman, E. (2017). Suicide prevention in an international context. *Crisis*, 38(1), 1-6.

<https://doi.org/10.1027/0227-5910/a000461>

Arensman, E., Scott, V., De Leo, D., & Pirkis, J. (2020). Suicide and suicide prevention from a global perspective. *Crisis*, 41(Suppl 1), S3-S7. <https://doi.org/10.1027/0227-5910/a000664>

Burgess, P., Pirkis, J., Jolley, D., Whiteford, H., & Saxena, S. (2004). Do nations' mental health policies, programs and legislation influence their suicide rates? An ecological study of 100 countries. *Australian & New Zealand Journal of Psychiatry*, 38(11-12), 933-939. <https://doi.org/10.1080/j.1440-1614.2004.01484.x>.

Collings, S., Jenkin, G., Stanley, J., McKenzie, S., & Hatcher, S. (2018). Preventing suicidal behaviours with a multilevel intervention: a cluster randomised controlled trial. *BMC Public Health*, 18(1), 1-13. <https://doi.org/10.1186/s12889-018-5032-6>

De Leo, D. (2015). Can we rely on suicide mortality data? *Crisis*, 36(1), 1-3. <https://doi.org/10.1027/0227-5910/a000315>

De Leo, D., & Evans, R. (2004). *International suicide rates and prevention strategies*. Göttingen: Hogrefe & Huber.

Hakanen, J., & Upanne, M. (1996). Evaluation strategy for Finland's suicide prevention project. *Crisis*, 17(4), 167-174. <https://doi.org/10.1027/0227-5910.17.4.167>

Hawgood, J., Woodward, A., Quinnett, P., & De Leo, D. (2021). Gatekeeper training and minimum standards of competency: Essentials for the suicide prevention workforce. *Crisis*. <http://dx.doi.org/10.1027/0227-5910/a000794>

Houtsma, C., Butterworth, S. E., & Anestis, M. D. (2018). Firearm suicide: pathways to risk and methods of prevention. *Current Opinion in Psychology*, 22, 7-11.

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

Ishimo, M. C., Sampasa-Kanyinga, H., Olibris, B., Chawla, M., Berfeld, N., Prince, S. A., ...

& Lang, J. J. (2021). Universal interventions for suicide prevention in high-income Organisation for Economic Co-operation and Development (OECD) member countries: A systematic review. *Injury Prevention*, 27(2), 184-193.  
<https://doi.org/10.1136/injuryprev-2020-043975>

Knipe, D. W., Chang, S. S., Dawson, A., Eddleston, M., Konradsen, F., Metcalfe, C., & Gunnell, D. (2017). Suicide prevention through means restriction: impact of the 2008-2011 pesticide restrictions on suicide in Sri Lanka. *PloS One*, 12(3), e0172893.  
<https://doi.org/10.1371/journal.pone.0172893>

Lewitzka, U., Sauer, C., Bauer, M., & Felber, W. (2019). Are national suicide prevention programs effective? A comparison of 4 verum and 4 control countries over 30 years. *BMC Psychiatry*, 19(1), 1-10. <https://doi.org/10.1186/s12888-019-2147-y>

Martin, G., & Page, A. (2009). *National suicide prevention strategies: A comparison*. Brisbane: The University of Queensland.

Matsubayashi, T., & Ueda, M. (2011). The effect of national suicide prevention programs on suicide rates in 21 OECD nations. *Social Science & Medicine*, 73(9), 1395-1400.  
<https://doi.org/10.1016/j.socscimed.2011.08.022>

Ministry of Health and Medical Services (2015) [Internet]. (2020, April 15). *National Mental Health and Suicide Prevention Policy in Fiji*.

Pirkis, J., San Too, L., Spittal, M. J., Krysiniska, K., Robinson, J., & Cheung, Y. T. D. (2015). Interventions to reduce suicides at suicide hotspots: a systematic review and meta-analysis. *Lancet Psychiatry*, 2, 994-1001. [https://doi.org/10.1016/S2215-0366\(15\)00266-7](https://doi.org/10.1016/S2215-0366(15)00266-7).



## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

Platt, S., Arensman, E., & Rezaeian, M. (2019). National suicide prevention strategies—  
progress and challenges. *Crisis*, *40*(2), 75-82. <https://doi.org/10.1027/0227-5910/a000587>

Rezaeian, M., & Khan, M. M. (2020). Suicide prevention in the Eastern Mediterranean  
region. *Crisis*, *41*(Suppl 1), S72-S79. <https://doi.org/10.1027/0227-5910/a000669>

Stack, S. (2021). Contributing factors to suicide: Political, social, cultural, and economic.  
*Preventive Medicine*, *152*(Pt. 1), 106498. <https://doi.org/10.1016/j.ypmed.2021.106498>.

StataCorp. (2019). *Stata Statistical Software: Release 16*. College Station, TX: StataCorp  
LLC.

Taylor, S. J., Kingdom, D., & Jenkins, R. (1997). How are nations trying to prevent suicide?  
An analysis of national suicide prevention strategies. *Acta Psychiatrica Scandinavica*,  
*95*(6), 457-463. <https://doi.org/10.1111/j.1600-0447.1997.tb10132.x>

Van Der Feltz-Cornelis, C. M., Sarchiapone, M., Postuvan, V., Volker, D., Roskar, S., Grum,  
A. T., ... & Hegerl, U. (2011). Best practice elements of multilevel suicide prevention  
strategies. *Crisis*, *32*(6), 319–333. <https://doi.org/10.1027/0227-5910/a000109>

Vijayakumar, L., Daly, C., Arafat, Y., & Arensman, E. (2020). Suicide prevention in the  
Southeast Asia region. *Crisis*, *41*(Suppl 1), S21-S29. <https://doi.org/10.1027/0227-5910/a000666>

World Health Organization (2014). *Preventing suicide: A global imperative*. Geneva: World  
Health Organization.

World Health Organization (2018). *National suicide prevention strategies: Progress,  
examples and indicators*. Geneva: World Health Organization.

## COMPONENTS OF NATIONAL SUICIDE PREVENTION STRATEGIES

World Health Organization (2019). *Suicide worldwide in 2019: Global health estimates*.

Geneva: World Health Organization.

World Health Organization (2020). *WHO methods and data sources for country-level causes of death 2000-2019*. Geneva: World Health Organization.

World Health Organization. (2021). *Live life: An implementation guide for suicide prevention in countries*. Geneva: World Health Organization.

WHO MiNDbank [Internet]. (2020, April 15).

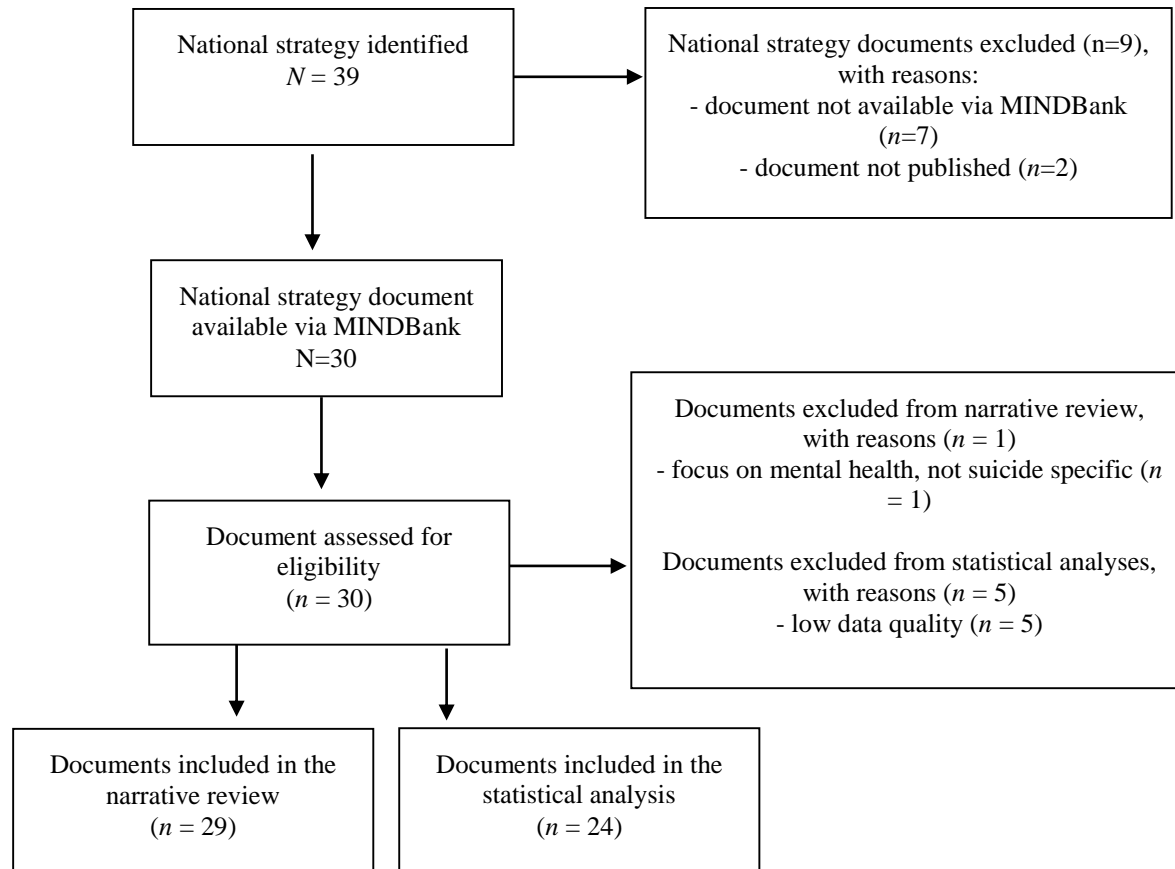
[https://www.mindbank.info/collection/topic/suicide\\_prevention\\_](https://www.mindbank.info/collection/topic/suicide_prevention_)

WHO Global Health Observatory (GHO). (2021, March 8)

<https://apps.who.int/gho/data/view.main.MHSUICIDEASDRv?lang=en>

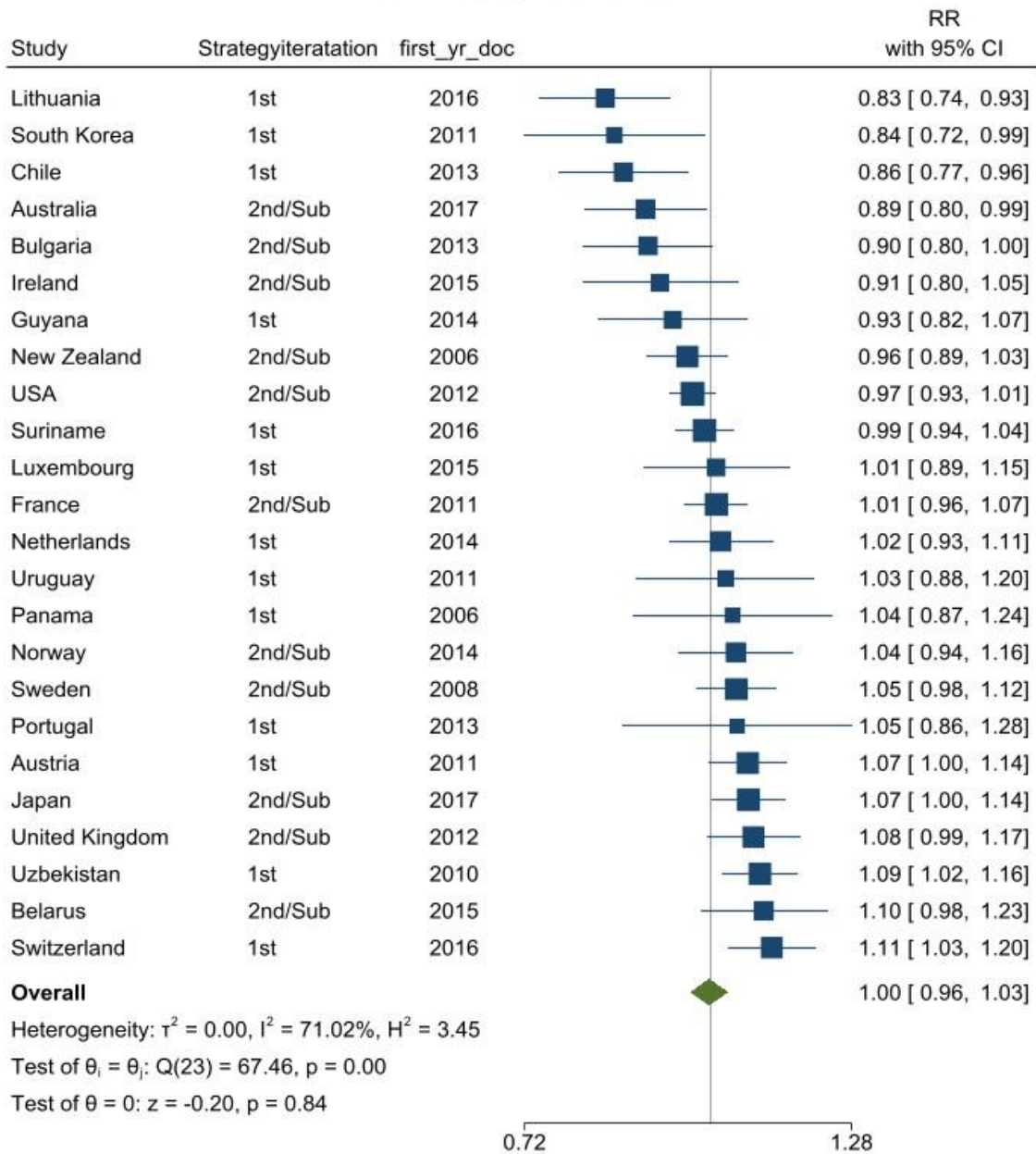
Zalsman, G., Hawton, K., Wasserman, D., van Heeringen, K., Arensman, E., Sarchiapone, M., ... & Zohar, J. (2016). Suicide prevention strategies revisited: 10-year systematic review. *The Lancet Psychiatry*, 3(7), 646-659. [https://doi.org/10.1016/S2215-0366\(16\)30030-X](https://doi.org/10.1016/S2215-0366(16)30030-X)

Figure 1: Flow Chart.



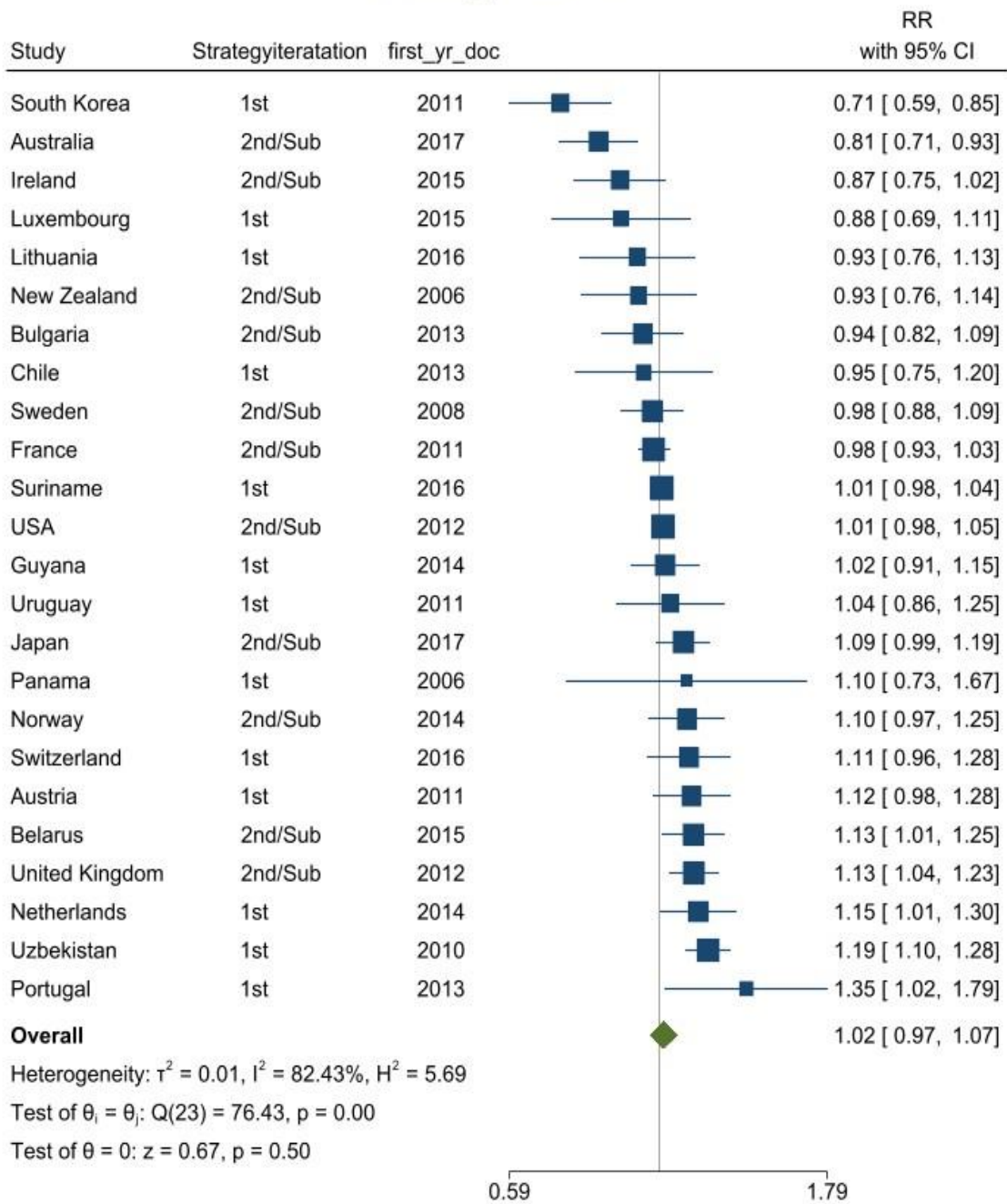


### Results (M) - FPselect1



Random-effects REML model  
 Sorted by: `_b_period first_yr_doc`

### Results (F) - FPselect1



Random-effects REML model  
 Sorted by: \_b\_period first\_yr\_doc

Table 1. Typical components of a national suicide prevention strategy (Platt et al., 2019)

- Restriction of access to commonly used methods of suicide
- Promotion of responsible media reporting
- Access to health and social care services
- Training and education
- Psychotherapeutic interventions intended to reduce repeated suicidal behavior
- Enhanced care/follow-up targeted at people with a history of attempted suicide
- Crisis intervention
- Postvention
- Awareness raising
- Addressing stigmatized attitudes toward mental ill-health and suicidal behavior
- Surveillance, monitoring, and evaluation
- Oversight and coordination





New Zealand	2 <sup>nd</sup>	+	+	+	+		+		+		+	+	+
Norway	2 <sup>nd</sup> or more				+	+	+		+			+	+
Panama	1 <sup>st</sup>			+	+		+	+	+	+		+	+
Portugal	1 <sup>st</sup>	+	+	+	+		+		+	+	+	+	
Republic of Korea	1 <sup>st</sup>	+	+		+	+	+	+	+	+	+	+	+
Sri Lanka	1 <sup>st</sup>	+	+	+	+		+						
Suriname	1 <sup>st</sup>	+	+	+			+		+	+	+	+	+
Sweden	2 <sup>nd</sup> or more	+		+	+					+	+	+	+
Switzerland	1 <sup>st</sup>	+	+	+	+		+		+	+		+	
Uruguay	1 <sup>st</sup>				+		+			+	+	+	+
USA	2 <sup>nd</sup>	+	+	+	+		+	+	+	+	+	+	+
Uzbekistan	1 <sup>st</sup>	+	+	+	+		+		+	+	+	+	

1. Restriction of access to commonly used methods of suicide; 2. Promotion of responsible media reporting; 3. Access to health and social care services; 4. Training and education; 5. Psychotherapeutic interventions intended to reduce repeated suicidal behavior; 6. Enhanced care/follow-up targeted at people with a history of attempted suicide; 7. Crisis intervention; 8. Postvention; 9. Awareness raising; 10. Addressing stigmatized attitudes toward mental ill-health and suicidal behavior; 11. Surveillance, monitoring, and evaluation; 12. Oversight and coordination.

Table 2: List of countries with national suicide prevention strategies included in the study.

Countries	Country classification	Year(s) of national strategy	Pre period for statistical analysis	Post period for statistical analysis	Inclusion: narrative review	Inclusion: statistical analysis	Data quality*
Australia	HIC	2017	2000-2017	2018-2019	Yes	Yes	High
Austria	HIC	2011	2000-2011	2012-2019	Yes	Yes	High
Belarus	LMIC	2015	2000-2015	2016-2019	Yes	Yes	High
Bhutan	LMIC	2015-2018	NA	NA	Yes	No	Low
Bulgaria	LMIC	2013-2018	2000-2013	2014-2019	Yes	Yes	Medium
Chile	LMIC	2013	2000-2013	2014-2019	Yes	Yes	High
Dominican Republic	LMIC	2014	NA	NA	Yes	No	Low
England	HIC	2012	2000-2012	2013-2019	Yes	Yes	High
France	HIC	2011-2014	2000-2011	2012-2019	Yes	Yes	High
Guyana	LMIC	2014	2000-2014	2015-2019	Yes	Yes	Medium
Ireland	HIC	2015-2020	2000-2015	2016-2019	Yes	Yes	High
Japan	HIC	2017	2000-2017	2018-2019	Yes	Yes	High
Lithuania	LMIC	2016-2020	2000-2016	2017-2019	Yes	Yes	High
Luxembourg	HIC	2015-2019	2000-2015	2016-2019	Yes	Yes	High
Namibia	LMIC	2011	NA	NA	Yes	No	Low
Netherlands	HIC	2014-2017	2000-2014	2015-2019	Yes	Yes	High
New Zealand	HIC	2006-2016	2000-2006	2007-2019	Yes	Yes	High
Nicaragua	LMIC	2000	NA	NA	Yes	No	High
Norway	HIC	2014-2017	2000-2014	2015-2019	Yes	Yes	High
Panama	LMIC	2006	2000-2006	2007-2019	Yes	Yes	High
Portugal	HIC	2013-2017	2000-2013	2014-2019	Yes	Yes	High
Republic of Korea	HIC	2011	2000-2011	2012-2019	Yes	Yes	High
Sri Lanka	LMIC	1997	NA	NA	Yes	No	Medium
Suriname	LMIC	2016	2000-2016	2017-2019	Yes	Yes	Medium
Sweden	HIC	2008	2000-2008	2009-2019	Yes	Yes	High
Switzerland	HIC	2016	2000-2016	2017-2019	Yes	Yes	High
Uruguay	LMIC	2011-2015	2000-2011	2012-2019	Yes	Yes	Medium
USA	HIC	2012	2000-2012	2013-2019	Yes	Yes	High
Uzbekistan	LMIC	2010-2020	2000-2010	2011-2019	Yes	Yes	Medium

HIC: high-income country; LMIC: low- and middle- income country

\* High quality data: country has reported at least five years' data from 2008 or later, the latest year data are reported by ICD code, and has average usability from 2008-latest  $\geq 80\%$ .  
Medium quality data: country reports at least five years of data from 2008 or later to, the latest year data are reported by ICD code, and has average usability during the period 2008-latest  $\geq 60\%$  and  $< 80\%$  or at least five years' data are reported using a shortlist, and the average usability during the period 2008-latest  $\geq 80\%$  (WHO, 2020).



1 Marisa Schlichthorst, PhD, was a research fellow at the Melbourne School of Population and Global  
2 Health at the University of Melbourne, VIC, Australia. She is part of the National Leadership in  
3 Suicide Prevention Research initiative. Her research is on male suicide prevention and media  
4 interventions with an interest in social change and social media engagement.

5 Lennart Reifels, PhD, is a senior research fellow at the Centre for Mental Health, The University of  
6 Melbourne, Australia, who coordinates the LIFEWAYS Project: Leading Research Into Suicide  
7 Prevention (previously known as the National Leadership in Suicide Prevention Research Project). His  
8 key research areas include suicide prevention, population mental health, and disaster risk reduction.  
9

10 Angela Clapperton is a Senior Research Fellow in the Melbourne School of Population and Global  
11 Health at the University of Melbourne. Angela has extensive experience using mortality and  
12 morbidity datasets for suicide and related research, and she has a particular interest in surveillance  
13 and analysing linked datasets to inform public health policy and health service practice.  
14

15 A/Prof Katrina Scurrah is an experienced biostatistician, with expertise in the development and  
16 application of models for complex data, especially that obtained from twins, families and linked  
17 administrative databases, and considerable experience in statistical programming (Stata and R). She  
18 is a Principal Research Fellow in the Centre for Mental Health.  
19

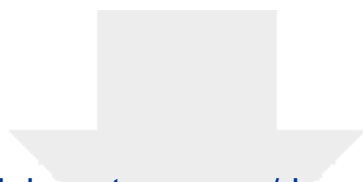
20 Kairi Kõlves, PhD, is professor at the Australian Institute for Suicide Research and Prevention and  
21 director of the WHO Collaborating Centre for Research and Training in Suicide Prevention at Griffith  
22 University, Australia. She is well known for her work in epidemiology of suicidal behaviors and  
23 suicide bereavement.  
24

25 Matthew Spittal is Professor of Epidemiology and Biostatistics in the Centre for Mental Health at the  
26 University of Melbourne. He leads the Mental Health Epidemiology Unit which specialises in the  
27 design and analysis of mental health studies, including randomised controlled trials, cohort studies,  
28 data linkage studies, case-control studies, sample surveys and meta-analyses.  
29

30 Stephen Platt is Emeritus Professor of Health Policy Research at the University of Edinburgh. He has  
31 published widely on social, epidemiological and cultural aspects of suicide and self-harm. He is a  
32 consultant on suicide prevention research and policy to the Irish and Scottish governments.  
33

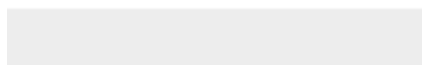
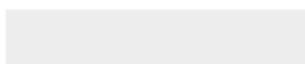
34 Jane Pirkis is director of the Centre for Mental Health at the University of Melbourne, VIC, Australia.  
35 She is also editor-in-chief of Crisis and Vice President of the International Association for Suicide  
36 Prevention (IASP). She is well known for her work on suicide prevention policy, and has received  
37 various awards, including IASP's 2019 Erwin Stengel Research Award.  
38

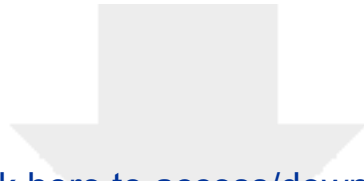
39 Karolina Kryszynska, PhD, is a senior research fellow at the Centre for Mental Health, The University of  
40 Melbourne, Australia. She is an experienced suicidologist with over 25 years of experience in the field.  
41 Her main research interest is suicide, suicide prevention, lived experience, and postvention. She has  
42 published and presented extensively on these topics.  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65



[Click here to access/download](#)

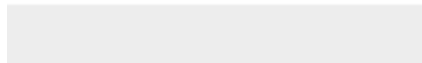
**Electronic Supplementary Material (ESM)**  
SupplementaryFigure1.pdf

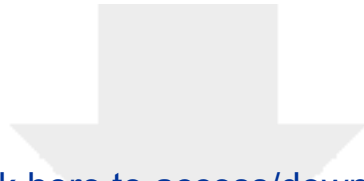




[Click here to access/download](#)

**Electronic Supplementary Material (ESM)**  
SupplementaryFigure2.pdf





[Click here to access/download](#)

**Electronic Supplementary Material (ESM)**  
**SupplementaryFigure3.pdf**

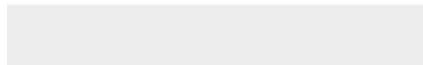
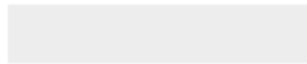


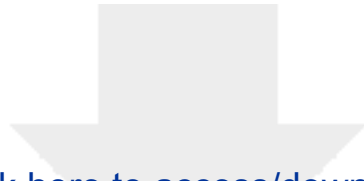




[Click here to access/download](#)

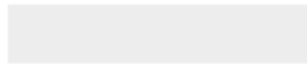
**Electronic Supplementary Material (ESM)**  
SupplementaryFigure4.pdf





[Click here to access/download](#)

**Electronic Supplementary Material (ESM)**  
SupplementaryFigure5.pdf





[Click here to access/download](#)

**Electronic Supplementary Material (ESM)**  
SupplementaryFigure6.pdf

