THE UNIVERSITY OF SYDNEY

Brain and Mind Centre

Investing for impact: Why uncertainty is not a barrier to sound decision making to support the COVID-19 mental health recovery.

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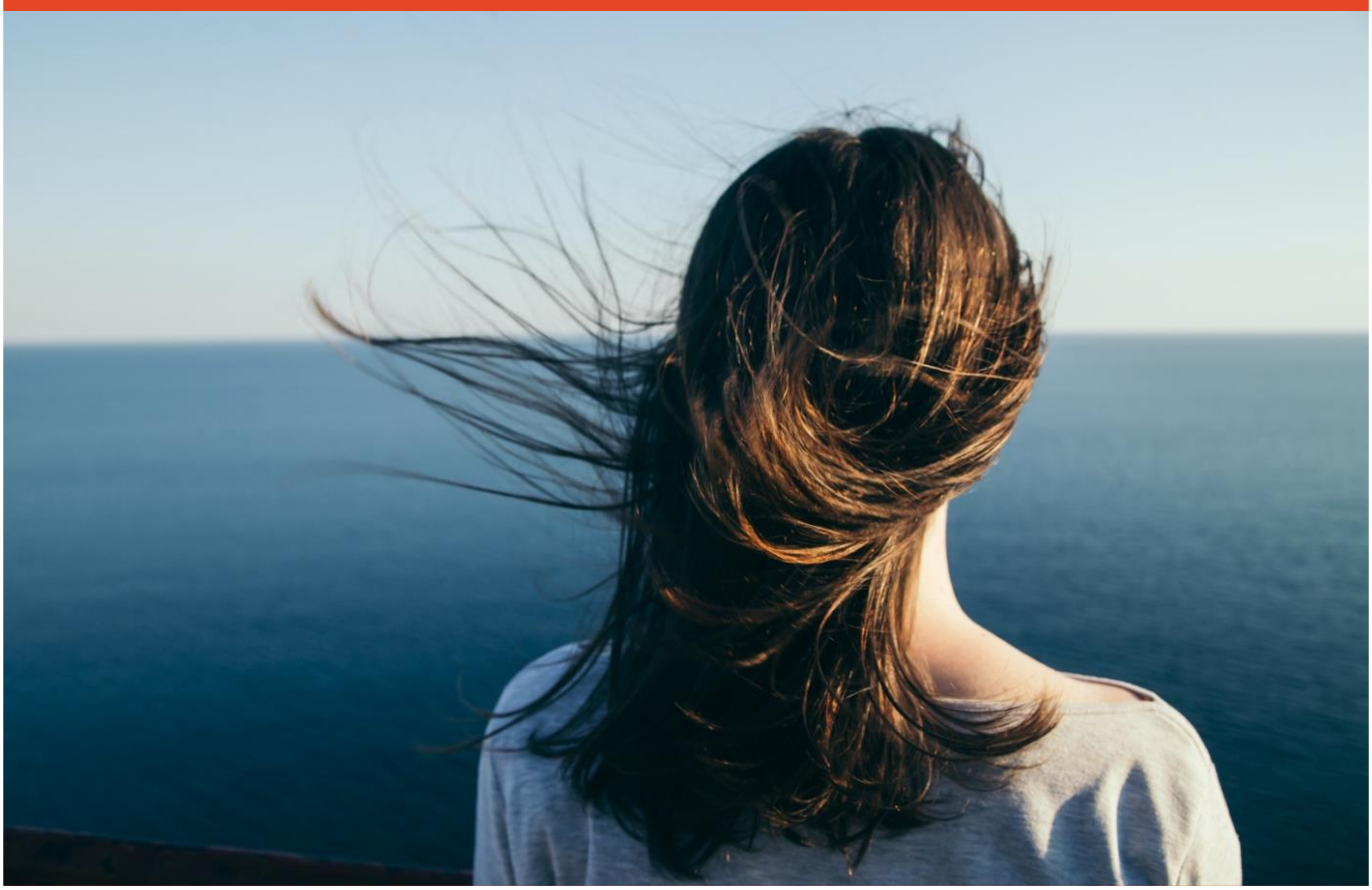

Key messages

- The COVID-19 pandemic provided an opportunity to demonstrate the significant value of systems modelling in empowering governments that engaged with such tools to act proactively and effectively despite uncertainties and imperfect knowledge that characterise an evolving crisis.
- The same approach is possible in the mental health field, and far more is known about mental health and suicide than was known about coronavirus at the outset of the pandemic, representing an opportunity to leverage systems modelling to effectively address the complex and persistent challenge of suicide prevention in the COVID-19 era.
- However, a commonly levelled (but misguided) criticism prevents systems modelling from being more routinely adopted to inform decision making; namely, that the presence of uncertainty around key model input parameters renders a model useless, or the common catchcry ‘garbage in, garbage out.’
- Using a regional model developed for Perth South Primary Health Network in 2020 to inform investments in suicide prevention, an analysis was undertaken to better understand the extent to which uncertainties around key parameter inputs to COVID-mental health systems models are important in guiding how best to respond.
- We considered four possible COVID-related population mental health trajectories ranging from very little impact on current rates to dramatic effects.
- Results demonstrate that the top three best performing intervention combinations (i.e., combinations of post-suicide attempt assertive aftercare, community support programs to increase community connectedness, technology enabled care coordination, and family education and support) were consistent across all four possible COVID-mental health scenarios, reducing suicide deaths by approx. 23-25% against the baseline.
- These findings suggest that systems models retain their value in guiding investments to achieve optimal impact in reducing suicide deaths despite uncertainty in the trajectories of population mental health outcomes over the coming years.
- Strengthening the mental health data ecosystem in Australia to support systems modelling will assist in reducing the uncertainty around projected trajectories of population mental health outcomes; however, these results suggest that the idea that model precision is necessary to inform robust decision making is misguided.

Background

At the outset of the COVID-19 pandemic, systems models were rapidly deployed in a number of countries to estimate likely trajectories of transmission, mortality, and health system burden. The extent to which decision makers engaged with the modelling to help inform proactive and timely actions to arrest virus transmission varied across nations providing an important natural experiment. Those countries that dismissed the high projected mortality estimates as being highly uncertain and unnecessarily 'alarmist', adopting a wait and watch approach, fared poorly in being able to control the virus through reactive decision making, and experienced significant adverse impacts on health system, economic and social indicators. Those countries such as Australia and New Zealand that engaged genuinely with the modelling fared far better and demonstrated the significant value of systems modelling in helping decision makers test the likely impact of possible control measures (what combination, at what time, at what scale, and for how long), weigh up the trade-offs of alternative strategies, and act proactively and effectively to arrest transmission despite the complexity, uncertainties, and imperfect knowledge that characterise an evolving crisis. One of the commonly levelled (but misguided) criticisms of systems modelling in the field of mental health is that the presence of uncertainty around key model input parameters renders a model useless, justifying a return to a more a traditional comprehensive, 'evidence based' approach to decision making that is blind to possible population mental health trajectories and the impacts investments are likely to have. There are two primary insights that would suggest that engagement with systems modelling to inform population mental health decision making remains a worthwhile endeavor despite uncertainty:

1. Without systems modelling and simulation, decision makers will continue to rely on mental forecasting, a far less systematic, robust, or objective basis for determining the optimal combination scale, targeting, timing and duration of health, social, and economic policies and initiatives that will deliver the greatest impacts;
2. Regional and national applications of systems modelling have highlighted numerous 'evidence-based' interventions that deliver little impact (some even have the potential to deliver worse outcomes) and hence represent poor investment choices in responding to population mental health threats and preventing suicide.[1-5]

A recent review and update of systems modelling undertaken by the Systems Modelling, Simulation, & Data Science group at the Brain and Mind Centre (see April 2021 report), demonstrated that estimates of the peak prevalence of psychological distress provided in the Road to Recovery Revised Report in August 2020 were closely aligned with that seen in the real-time data collected in 2020.[6] Despite a more rapid economic recovery than projected by the Reserve Bank of Australia in mid-2020, revision of model inputs with new empirical data continue to forecast negative population mental health outcomes associated with the social and economic impacts of COVID-19, though somewhat arrested by the actions that have been taken in response to being cognisant of the potential adverse trajectories highlighted by the original models. However, uncertainties remain.

Uncertainty regarding model input parameters can arise from lack of data availability or quality of data, a lack of contextually relevant, generalisable research evidence, and/or a highly dynamic, evolving situation such as that seen during the COVID-19 pandemic and preceding natural disasters in Australia (i.e., drought, bushfires, floods). However, not all data and evidence gaps are equal. Sensitivity analyses reveal which model parameters make little difference, and which make a substantial difference to projected trajectories of key population mental health outcomes. Such knowledge can prioritise new data collection and research efforts. Calls for more timely tracking of outcomes including the prevalence of psychological distress, mental health-related emergency department (ED) presentations, self-harm hospitalisations, and suicide deaths are indeed important. Equally as valuable is understanding which key model input parameters are most important to forecasting future trajectories of those outcomes, and additionally tracking those. In the early days of the pandemic when there was sparse data on key input parameters of coronavirus transmission models, these models remained valuable to decision making. In the mental health field far more is known, though there remain uncertainties. The purpose of this study was to better understand the extent to which remaining uncertainties around key parameter inputs to COVID-mental health systems models are important in guiding how best to respond.

What did we do?

Building on the program of systems modelling undertaken by the Brain and Mind Centre, University of Sydney (https://www.sydney.edu.au/brain-mind/our-research/youth-mental-health-and-technology.html) a regional model developed for Perth South Primary Health Network in 2020 to prospectively evaluate a range of mental health system strengthening and suicide prevention interventions was extended and updated to capture the impacts of COVID-19 on population mental health outcomes. Appendix A provides a brief, high-level summary of the causal structure and pathways of the model, model validation graphs, and descriptions of each intervention, including assumptions and the evidence sources used to inform the integration of each intervention in the model (further information is available on request). The substantial adverse mental health impacts of social dislocation and job loss resulting from the continuing COVID-19 pandemic (e.g., Moreno et al., 2020; Atkinson et al., 2020)[7,8] were modelled primarily as an increase in psychological distress incidence from 1 March 2020 that declines gradually until the end of the simulation period. The scale (denoted by CES) and duration (denoted by CED) of the COVID-19 effect on psychological distress are the key uncertain parameters that influence the trajectory of mental health outcomes such as suicidal behaviour. The effectiveness of different combinations of interventions were explored across a range of possible estimates of the scale and duration of the adverse COVID-19 effect on psychological distress to see whether the best performing suite of interventions for reducing suicide deaths were consistent or inconsistent across the alternative COVID-19 mental health trajectories.

Specifically, we considered four scenarios of the COVID-19 effect on psychological distress that resulted in a range of projected impacts on rates of suicide, from very little to dramatic:

A: short duration (CED = 0.5 years) and low impact (CES = 0.11) – lowest projected increase in suicides

B: short duration (CED = 0.5 years) and high impact (CES = 0.33),

C: long duration (CED = 1.5 years) and low impact (CES = 0.11),

D: long duration (CED = 1.5 years) and high impact (CES = 0.33) – highest projected increase in suicides

Optimal combination of interventions: In addition to the ability to scale up or down mental health services capacity captured in the core structure of the model, a range of possible mental health and suicide prevention programs and initiatives were integrated into the model (detailed in the Appendix A). Potential discordance in the best-performing intervention scenarios across the four COVID-mental health scenarios (A, B, C, D) was assessed by examining reductions in total (cumulative) numbers of suicides under all possible combinations of three interventions selected from the 13 programs, services and initiatives modelled. Differences in projected numbers of suicides between the baseline scenario and each optimal intervention scenario were calculated for the period 2021−2041.

What did we find?

The five best performing intervention combinations in minimising suicide deaths compared to the business-as-usual scenario (continuing current programs and services) are listed below, and Table 1 summarises the number and percentage reduction in cumulative suicides against the baseline (business as usual) these combinations projected across the four COVID-19 mental health scenarios. These results demonstrate that the top three best performing intervention combinations (i.e., combinations of post-suicide attempt assertive aftercare, community support programs to increase community connectedness, technology enabled care coordination, and family education and support) were consistent across all four possible COVID-19 mental health scenarios, reducing suicide deaths by between 23-25%. While a broader range of programs, services, and initiatives not examined in the current model for the Perth South PHN population catchment may offer value, and while different combinations may perform best in different regions, these findings suggest that systems models retain their value in guiding investments of optimal impact despite uncertainty around the trajectory of population mental health outcomes. Strengthening the mental health data ecosystem in Australia to support systems modelling will certainly assist in reducing the uncertainty around projected trajectories of population mental health outcomes and estimates of impact of alternative strategies to change those trajectories; however, these results suggest that the idea that model precision is necessary to inform robust decision making is misguided.

Top 3 best performing intervention combinations for minimising suicide deaths in the region:

1. AA, CS, TCC – best performing
2. AA, CS, FE
3. CS, FE, TCC

Abbreviation	**Intervention name**
BAU	Business as usual
AA	Post-suicide attempt assertive aftercare
CS	Community support programs to increase community connectedness
SP	Safety planning
FE	Family education and support
TCC	Technology-enabled care coordination

Table 1. Cumulative suicides (2021-2041) for each COVID-mental health scenario and combination of interventions.

Intervention combination	**Scenario A** (***n*, % reduction**)		**Scenario B** (***n*, % reduction**)		**Scenario C** (***n*, % reduction**)		**Scenario D** (***n*, % reduction**)	
BAU	2,953	-	3,346	-	3,063	-	3,827	-
AA, CS, TCC	2,224	24.7	2,525	24.5	2,302	24.8	2,907	24.0
AA, CS, FE	2,240	24.1	2,530	24.4	2,315	24.4	2,907	24.0
CS, FE, TCC	2,268	23.2	2,548	23.8	2,338	23.7	2,920	23.7
AA, CS, SP	2,308	21.8	2,623	21.6	2,393	21.9	3,020	21.1
AA, FE, TCC	2,355	20.3	2,620	21.7	2,421	21.0	2,977	22.2

In addition, Figure 1 shows time series graphs of the best performing combinations across the four COVID-19 mental health scenarios (A, B, C, D) and Figure 2 illustrates the same curves with 95% intervals (as a result of varying effect sizes +/- 20% of default values, and drawing values from the uniform distribution on each interval across 100 runs). The 95% intervals provide a measure of the impact of uncertainty in the assumed intervention effects and should not be interpreted as confidence intervals. Figure 3 (with a 2041 time horizon) and Figure 4 (with a 2026 time horizon) demonstrate that within each COVID-19 mental health scenario, the order of the best performing intervention combinations changes depending on the time horizon under consideration; however, the rankings are largely consistent between COVID-19 scenarios at each horizon. The difference in rankings due to time horizon is a result of some intervention combinations acting quickly to reduce suicide deaths while others are slower to demonstrate an impact but have amplifying effects over time as illustrated in Figures 1 and 2. Effective combinations of interventions tend to combine fast-acting with slow-acting interventions.

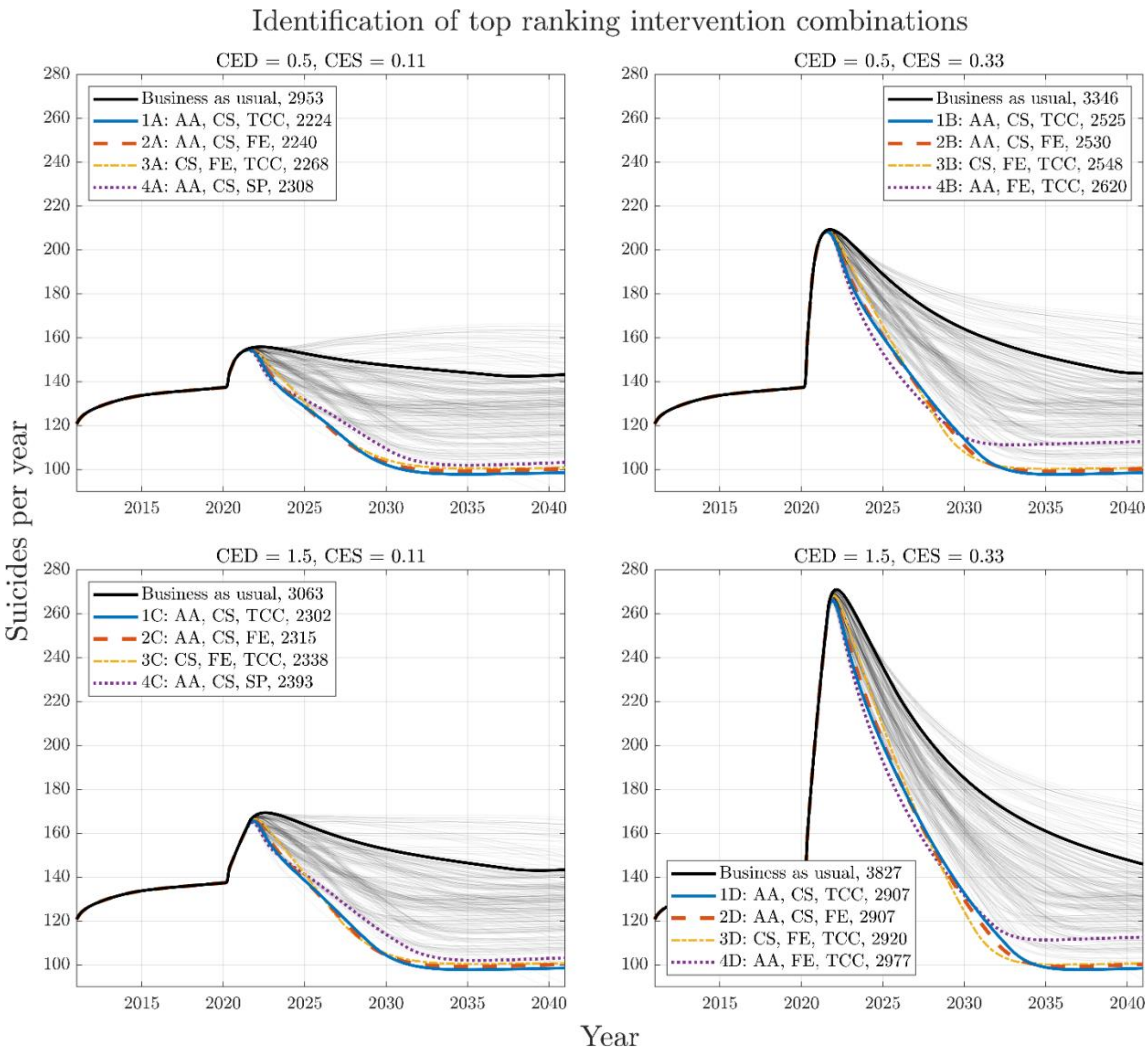

Figure 1. Trajectories for the best performing intervention combinations in reducing suicides deaths over the period 2021-2041 for the four different COVID scenarios: top left, short duration and low impact; top right, short duration and high impact; bottom left, long duration and low impact; bottom right; long duration and high impact. Default parameters are chosen for each intervention. The top three ranking sets of interventions are consistent across COVID scenarios; however, the fourth top intervention combination differs depending on CES. The thick black curve indicates the business-as-usual case, the coloured curves indicate the six intervention scenarios that most reduced cumulative suicides from 2021-2041, and the thin black curves all other intervention combination scenarios.

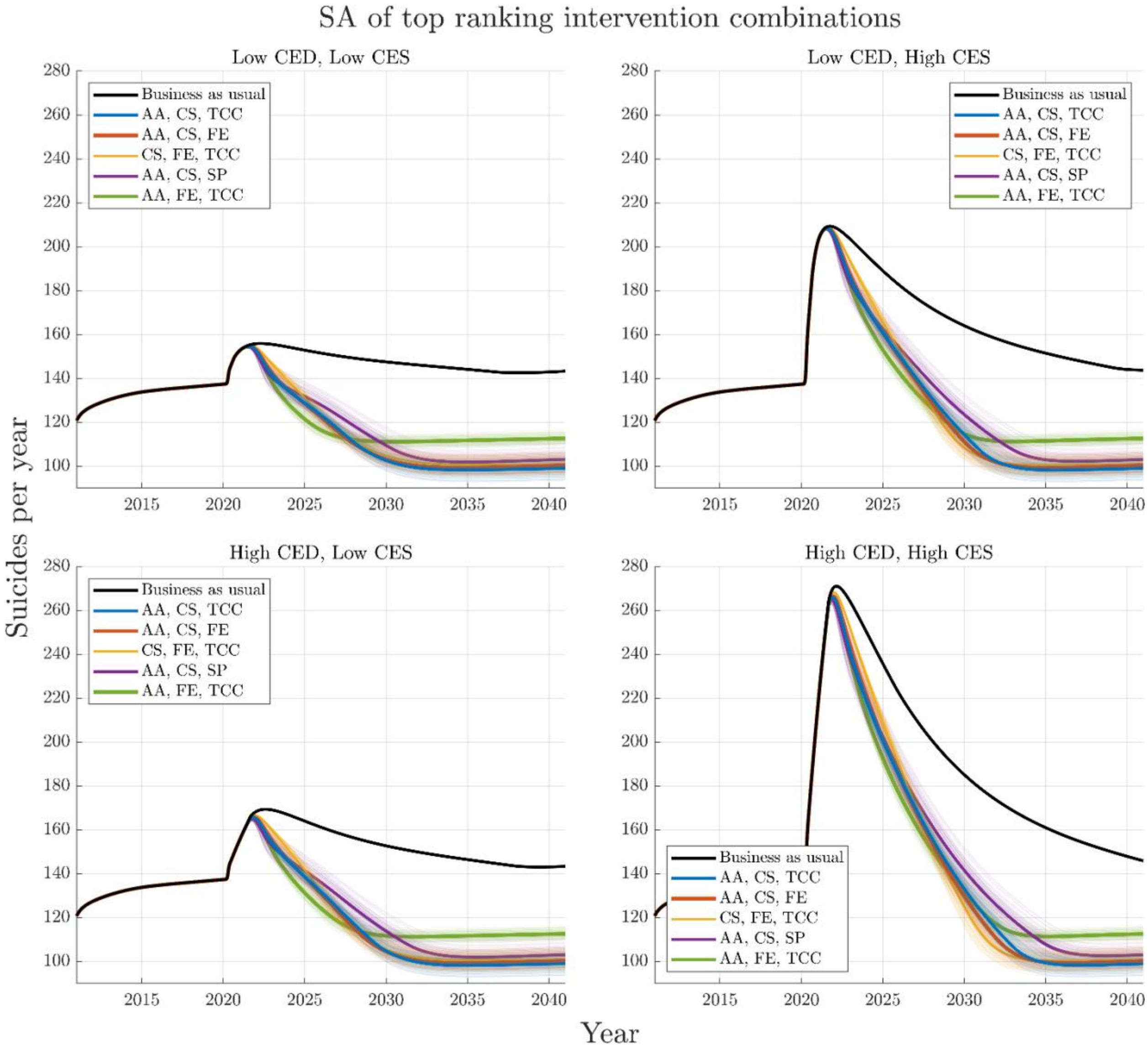

Figure 2. Sensitivity analyses of top performing combinations of interventions identified in Figure 1. Effect size parameters were chosen from a uniform distribution on +/- 20% of default parameter values across 100 model runs. Distribution means are indicated with a heavy line, and 95% intervals by shaded areas. Panels represent COVID scenarios (A, B, C, D) as in Figure 1.

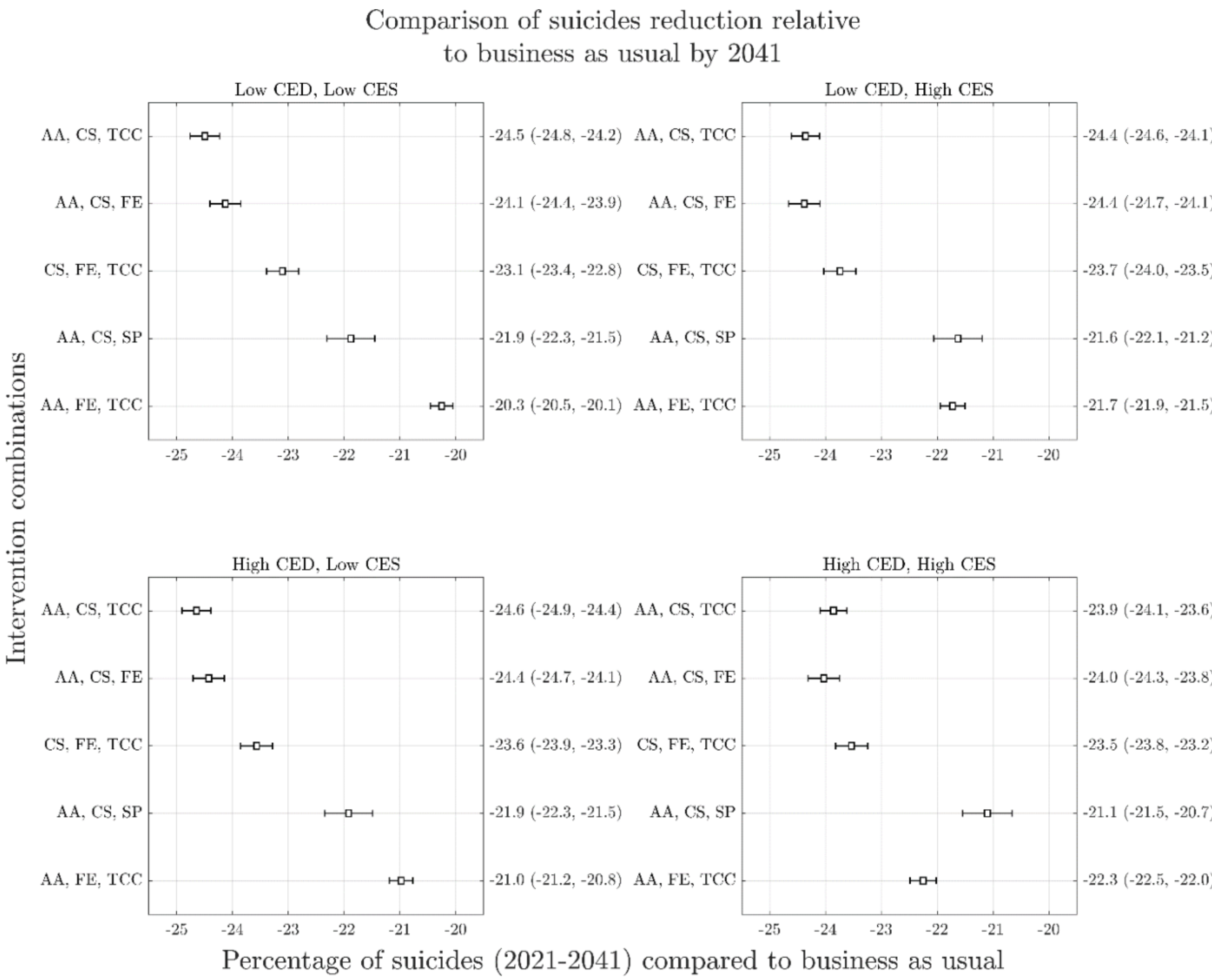

Figure 3. Forest plots arising from sensitivity analyses of cumulative suicide numbers (2021-2041) of top ranking intervention combinations across the four COVID scenarios, varying intervention effect size parameters. Effect size parameters were chosen from a uniform distribution on +/- 20% of default parameter values across 100 model runs. Panels represent different COVID scenarios (A, B, C, D) as per previous figures. Differences of means from initial rankings (as in Figure 1) arising in high impact (CES = 0.33) scenarios are due to non-linear effects of interventions. Overlapping 95% intervals indicate possible ambiguity of rankings within each COVID-mental health scenario, relating to effect size uncertainty. Similarity of possible rankings between scenarios is indicative that uncertainty about the effects of COVID on mental health do not change recommendations about optimal intervention investments.

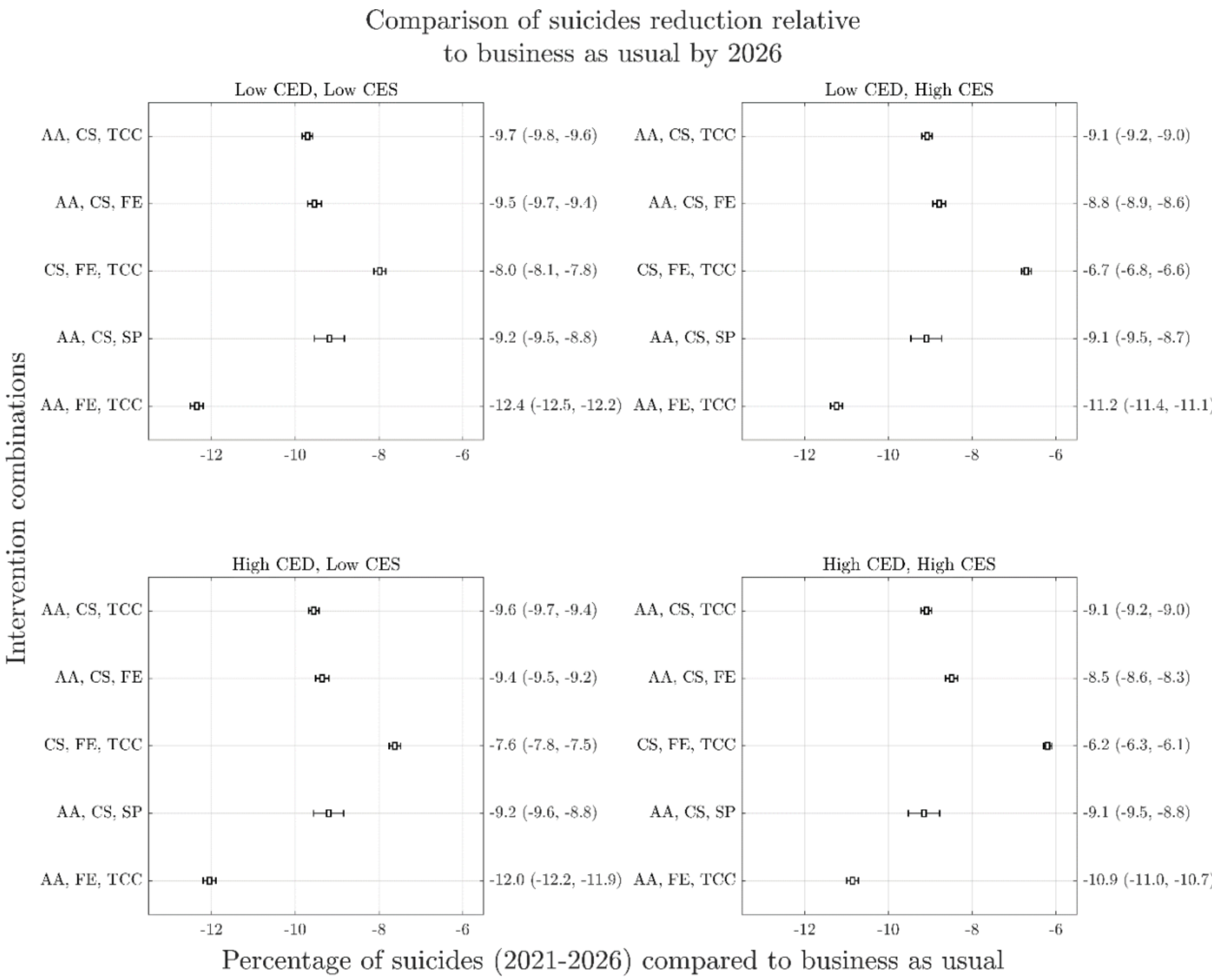

Figure 4. Forest plots similar to Figure 3 for cumulative suicides from 2021-2026. Note substantially different performance rankings from Figure 3, but similarity of rankings across COVID scenarios.

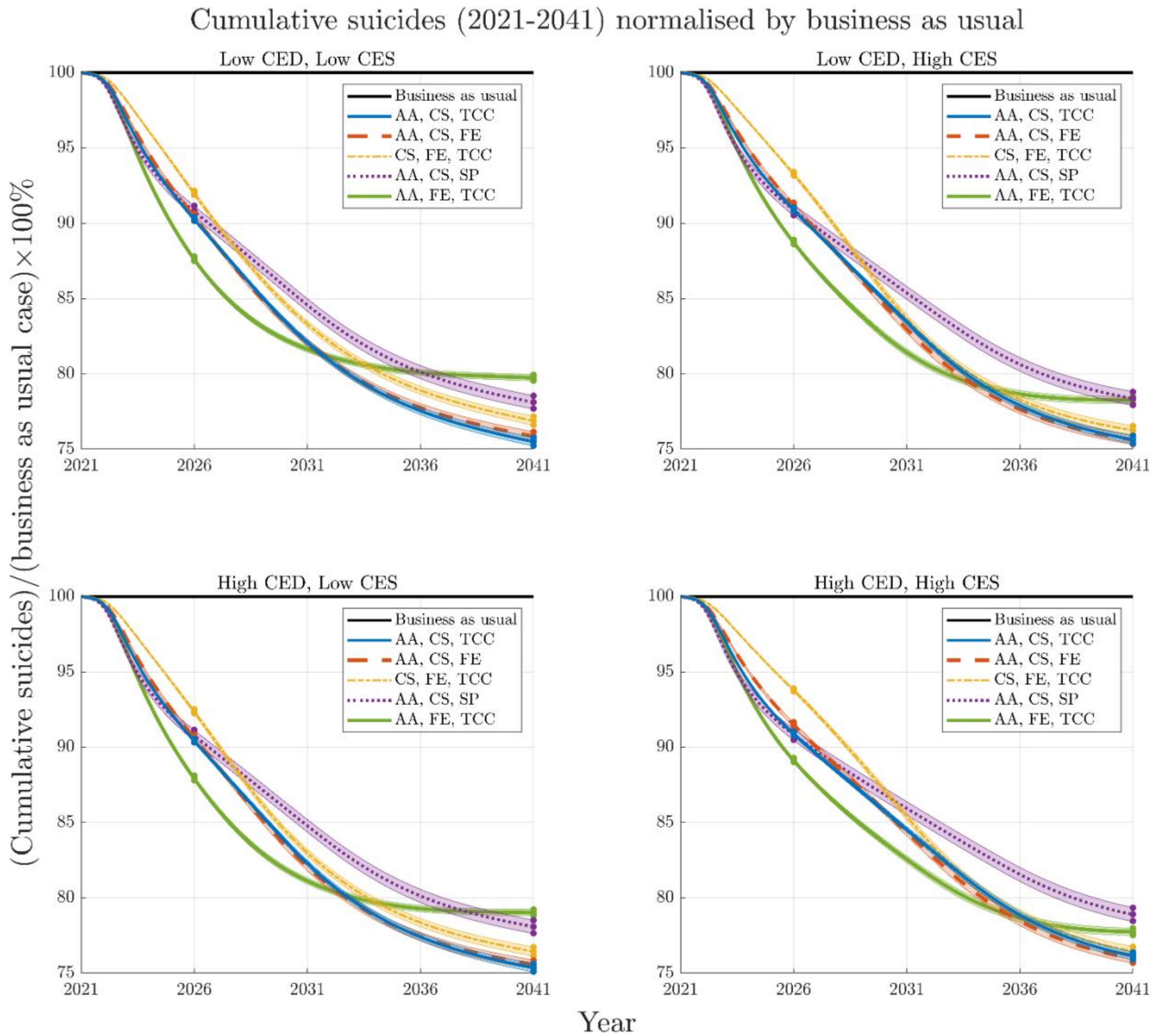

Figure 5. Mean and 95% intervals of cumulative suicides for each top performing combination of interventions (normalised by respective business as usual cases) for four COVID scenarios from 2021-2041. Time slices illustrated in Figures 3 and 4 are noted at 2026 and 2041.Note that while different combinations of interventions change rankings over time, the rankings (including 95% intervals) remain similar regardless of the severity or duration of the COVID scenario.

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References:

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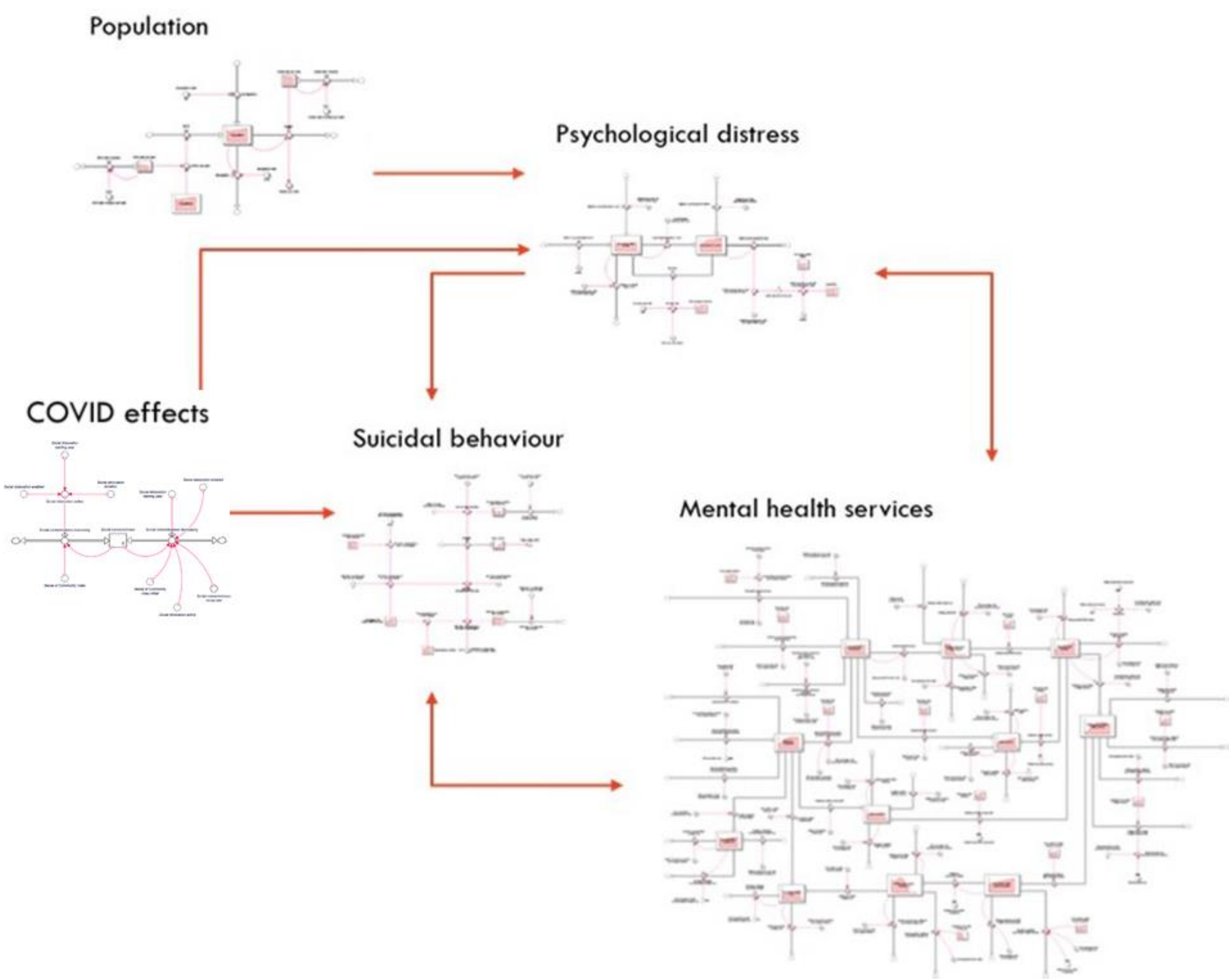
Appendix A

Model summary:

The core model structure included: 1) a population component, capturing changes over time in the size of the population resulting from births, migration, and mortality; 2) a psychological distress component that models flows of people to and from states of low or no psychological distress (Kessler 10 [K10] scores below 15), and moderate to very high psychological distress (K10 score 16−50); 3) a mental health services component that models the movement of psychologically distressed people through one of several possible service pathways across the primary to tertiary service continuum involving (potentially) general practitioners, psychiatrists and allied mental health professionals (including psychologists, mental health nurses, social workers etc.), psychiatric inpatient care, community mental health centres, and online services; and 4) a suicidal behaviour component that captures self-harm hospitalisations (used as a proxy for suicide attempts – see limitations) and suicide deaths. Figure S1 provides a high-level overview of the causal structure and pathways of the model. Figure *S1* presents a high-level map of the core model showing the (causal) connections among sectors.

***Figure S1**: A high-level overview of the causal structure and pathways of the system dynamics model*



Model validation

The model broadly reproduces historic trends across a range of indicators including the prevalence of psychological distress, mental health-related ED presentations, self-harm hospitalisations, and services referrals from 2011. Light blue curve labelled 1 represents historical data, red curve labelled 2 represents model output.

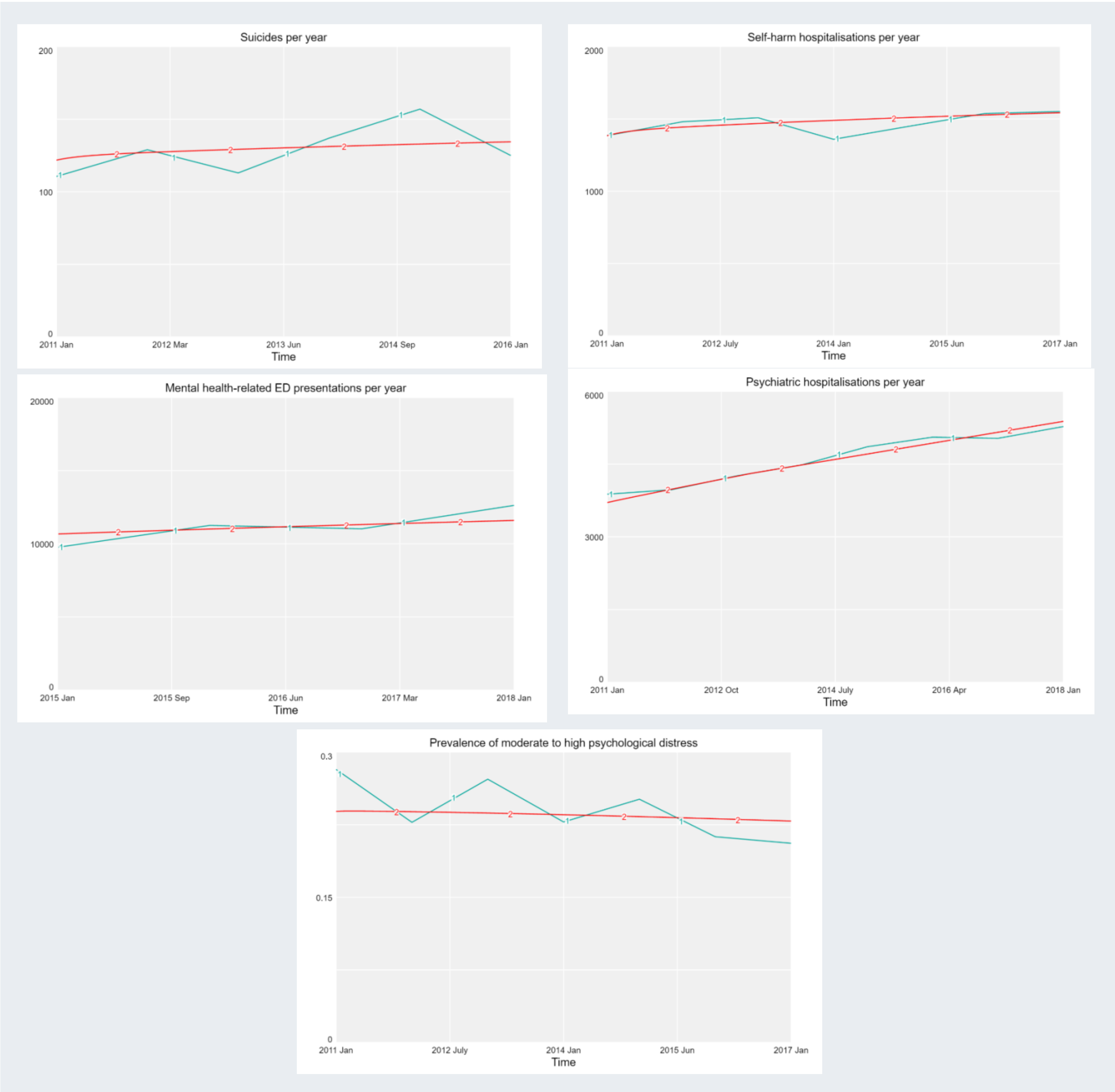


Table S1. Intervention definitions, parameter assumptions, and evidence sources. Parameters determining the direct effects of each intervention can be modified (on request) via an interactive model interface, enabling users to assess the impact of parameter assumptions on model outputs.

Intervention	Description
1. Post-suicide attempt care	Post-attempt care is an active outreach and enhanced contact program that aims to reduce readmission in those presenting to services after a suicide attempt. It includes individually tailored contact, solution focused counselling, and motivations to ensure adherence to follow-up treatments and continuity of contact. Parameters determining the direct effects of this intervention are: *Maximum post-attempt care rate* – the maximum proportion of patients hospitalised for a suicide attempt receiving post-attempt care. The default value (1) assumes that post-attempt care will be provided to all patients hospitalised for a suicide attempt (after an initial scale up period). *Post-attempt care effect* – the proportion of potential repeat suicide attempts expected among patients receiving post-attempt care. The default value (0.398) implies that 39.8% of repeat attempts that would have occurred without post-attempt care actually occur when post-attempt care is provided; i.e., post-attempt care is assumed to prevent 60.2% of potential repeat suicide attempts. The default estimate is derived from Hvid et al. (2011, Nord. J. Psychiatry 65, 292-298). *Effect duration (weeks)* – the average time in weeks after a suicide attempt that post-attempt care has an effect on the probability of a repeat attempt. The default value of 52.1 weeks implies that, on average, post-attempt care reduces the repeat self-harm rate for 1 year after an attempt. After this time, post-attempt care is assumed to have no impact on the suicide attempt rate. *Repeat self-harm rate per year* – the probability that a person will self-harm in the year after a suicide attempt without post-attempt care. The default value (0.179) implies that 17.9% of people hospitalised for self-harm will re-attempt within 1 year (i.e., assuming they don't receive post-attempt care); this estimate is derived from Carroll et al. (2014, PLoS ONE 9, e89944).
2. General practitioner (GP) training	Short (1-2 days) training programs aimed at reducing suicidal ideation through referral to specialised psychiatric services. This includes people who may be thinking about suicide for the first time or have survived a previous attempt. Parameters determining the direct effects of this intervention are: *Maximum training rate* – the maximum proportion of mental health-related GP services provided by GPs who have attended a training program (this value increases as the number of GPs attending training programs increases). The default value (0.7) implies that at most 70% of mental health-related GP services will be provided by a GP who has attended a training program. *GP training effect* – the multiplicative effect of GP training on the rate of referral to psychiatrist and allied mental health services. The default value (1.4375) implies that GPs who have received training are 1.44 times more likely to refer patients with high or very high levels of psychological distress (Kessler 10 scores 22 and above) than a GP who has not received training. The default estimate is derived from Pfaff et al. (2001, Med. J. Aust. 174, 222-226).
3. Community-based education programs	

	Population-wide mental health education programs aimed at reducing stigma, improving recognition of suicide risk, and encouraging help-seeking. This intervention increases the per capita rates at which people perceive a need for mental health services and seek help from a general practitioner or online services. Parameters determining the direct effects of this intervention are: *Effect on help seeking* – the multiplicative effect of community-based education programs on the rate (per year) that a psychologically-distressed person not engaged with mental health services will perceive a need for treatment and the rate that a person perceiving a need for care will seek help from a GP or online services. The default value (1.585) is derived from Jorm et al. (2003, Psychol. Med. 33, 1071-1079), and assumes that awareness campaigns will increase the rate of help seeking for mental health problems by 58.5%. Effect of community support programs – the multiplicative effect of a 1-unit increase in the Sense of Community Index (SCI) on the impact of mental health education programs. The default value (1.034) assumes that an increase in the SCI from its baseline value (9.15) to the highest possible value (12) would increase the effect of a mental health education program on the rate of help seeking by 10%. Note that this parameter only has an effect if mental health education programs and community support programs (which increase the SCI) are implemented together (potentially with different starting times).
4. Family psychoeducation and support	Provision of education and support to families and carers of patients presenting to or engaged with mental health services, with the aim of supporting family or carer involvement in the management of diagnosed mental disorders. Parameters determining the direct effects of this intervention are: *Maximum rate per patient* – the maximum proportion of patients with a chronic mental disorder who would consent to having their family involved in the management of their care. The default value (0.553) implies that family education and support would be provided to a maximum of 55.3% of patients with a chronic mental disorder, and is derived from Shimazu et al. (2011, Br. J Psychiatry 198, 385-390). *Effect on recovery rate* – the multiplicative effect of family education and support on the recovery rate among patients with a chronic mental disorder treated by a GP, psychiatrist, or allied mental health professional. The default value (2.52) is derived from Shimazu et al. (2011, Br. J Psychiatry 198, 385-390), and implies that family education and support increase the per-service probability of recovery by a factor of 2.5.
5. Safety planning	Safety planning aims to reduce suicidal behaviour through the provision of a specific plan for staying safe during crisis to suicidal patients presenting to an emergency department. The modelled intervention also includes up to 2 follow-up phone calls to monitor suicide risk and support treatment engagement (see Stanley et al., 2018, JAMA Psychiatry 75, 894-900). Parameters determining the direct effects of this intervention are: *Maximum rate per ED visit* – the maximum proportion of suicide-related emergency department presentations in which a safety plan is provided. The default value (0.7) assumes that a safety plan is provided to 70% of patients presenting to an emergency department for suicidal ideation or behaviour. *Effect on self-harm rate* – the proportion of potential re-presentations for suicidal ideation or behaviour expected among patients provided with a safety plan. The default value (0.847) implies that 84.7% of suicide-related re-presentations that would have occurred without safety planning actually occur when a safety plan is provided; i.e., safety planning is assumed to prevent 15.3% of potential re-presentations for suicidal ideation or behaviour. The default value is derived from Miller et al. (2017, JAMA Psychiatry 74, 563-570). *Effect duration (weeks)* – the average time in weeks after a suicide-related emergency department presentation that safety planning has an effect on

	the probability of re-presentations for suicidal ideation or behaviour (the default is 8 weeks). *Re-presentation rate per year* – the expected number of re-presentations for suicidal ideation or behaviour in the year after an initial suicide-related emergency department attendance. The default value (3.84) is derived from Perera et al. (2018, Med. J. Aust. 208, 348-353), and implies that in the year after presenting to an emergency department for suicidal ideation or behaviour, patients will re-present 3.8 times (on average).
6. Safe space services	Based on the United Kingdom's Safe Haven café model, this intervention provides an alternative point of contact with mental health services for people experiencing acute psychological distress who may otherwise present to an emergency department. Parameters determining the direct effects of this intervention are: *Maximum self-referral rate* – the maximum proportion of people presenting to emergency departments for suicidal ideation or behaviour who would self-refer to a safe space alternative (i.e., if it were made available). The default value (0.7) assumes that 70% of people in suicidal crisis who would normally present to an emergency department would present to a safe space alternative instead. *Effect on self-harm rate* – the proportion of potential re-presentations for suicidal ideation or behaviour expected among patients referred to a safe space service. The default value (0.398) implies that 39.8% of re-presentations that would have occurred if a person in crisis was treated in an emergency department actually occur when care is provided in a safe space alternative; i.e., care in a safe space alternative is assumed to prevent 60.2% of potential re-presentations for suicidal ideation or behaviour. The default value is derived from Hvid et al. (2011, Nord. J. Psychiatry 65, 292-298). (Note that the default value is the estimated effect of post-attempt care on the repeat self-harm rate, but that the duration of effect of safe space care is assumed to be much shorter than that of post-attempt care.) *Effect duration (weeks)* – the average time in weeks that care provided in a safe space service has an effect on the probability of repeat episodes of suicidal ideation or behaviour (the default value is 2 weeks). *Re-presentation rate per year* – the expected number of re-presentations for suicidal ideation or behaviour in the year after an initial suicide-related emergency department attendance. The default value (3.84) is derived from Perera et al. (2018, Med. J. Aust. 208, 348-353), and implies that in the year after presenting to an emergency department for suicidal ideation or behaviour, patients will re-present 3.8 times (on average).
7. Social connectedness programs	Community support programs and services that increase social connectedness, reducing isolation and enhancing resilience in the face of adversity. Parameters determining the direct effects of this intervention are: *Sense of Community Index target* – the maximum Sense of Community Index (SCI) that could be achieved with the planned social connectedness program(s), where the SCI ranges from 0 to 12, with 12 corresponding to the highest possible sense of community (see Chipuer and Pretty, 1999, J. Community Psychol. 27, 643-658). The default value (9.61) corresponds to an increase in the SCI (relative to the baseline value, 9.15) of 5% (Handley et al., 2012, Soc. Psychiatry Psychiatr. Epidemiol. 47, 1281-1290). *Effect on distress* – the multiplicative effect of a 1-unit increase in the SCI on distress onset rates. The default value (0.640) is derived from Handley et al. (2012, Soc. Psychiatry Psychiatr. Epidemiol. 47, 1281-1290), and implies that a 1-unit increase in the SCI reduces the rate at which people become psychologically distressed by 36.0%. *Effect on attempt lethality* – the multiplicative effect of a 1-unit increase in the SCI on suicide attempt lethality. The default value (0.964) assumes that an increase in the SCI from its baseline value (9.15) to 12 would reduce suicide attempt lethality by 10%.
8. Community-based acute care services	

	Responsive clinical mental health services delivered by community mental health teams. People in suicidal crisis may call and request either a home-based visit or a centre-based visit, depending on their level of functioning and risk. Parameters determining the direct effects of this intervention are: *Maximum self-referral rate* – the maximum proportion of people presenting to emergency departments for suicidal ideation or behaviour who would self-refer to community-based acute care services (i.e., if these were made available). The default value (0.7) assumes that 70% of people in suicidal crisis who would normally present to an emergency department would contact community-based services instead. *Effect on self-harm rate* – the proportion of potential re-presentations for suicidal ideation or behaviour expected among patients referred to community-based acute care services. The default value (0.398) implies that 39.8% of re-presentations that would have occurred if a person in crisis was treated in an emergency department actually occur when community-based care is provided; i.e., community-based acute care is assumed to prevent 60.2% of potential re-presentations for suicidal ideation or behaviour. The default value is derived from Hvid et al. (2011, Nord. J. Psychiatry 65, 292-298). (Note that the default value is the estimated effect of post-attempt care on the repeat self-harm rate, but that the duration of effect of community-based acute care is assumed to be much shorter than that of post-attempt care.) *Effect duration (weeks)* – the average time in weeks after referral to services that community-based acute care has an effect on the probability of repeat episodes of suicidal ideation or behaviour (the default value is 2 weeks). *Re-presentation rate per year* – the expected number of re-presentations for suicidal ideation or behaviour in the year after an initial suicide-related emergency department attendance. The default value (3.84) is derived from Perera et al. (2018, Med. J. Aust. 208, 348-353), and implies that in the year after presenting to an emergency department for suicidal ideation or behaviour, patients will re-present 3.8 times (on average).
9. Technology enabled care coordination	Technology-enabled coordinated care involves the use of online technology to facilitate delivery of multidisciplinary team-based care, in which medical and allied health professionals consider all relevant treatment options and collaboratively develop an individual treatment and care plan for each patient. Online technology enables enhanced coordination of care and facilitates communication between medical and allied health professionals, since each health professional involved in the care of a patient has access to the same information about that patient's treatment history. Parameters that can be modified in this intervention are: *Maximum rate per service* – the maximum proportion of mental health services provided that involve technology-enabled coordinated care. This proportion will depend on the number of medical and allied mental health professionals adopting online care coordination technologies, as well as the number of patients consenting to the use of these technologies in the management of their care (i.e., take-up among service providers and patients). The default value (0.7) assumes that when fully implemented, technology-enabled coordinated care will be provided in 70% of mental health services completed. *Effect on recovery rate* – the multiplicative effect of technology-enabled coordinated care on the per-service recovery rate (i.e., the probability that a patient's level of psychological distress will decrease after receiving treatment). The default estimate (1.177) is derived from Woltmann et al. (2012, Am. J. Psychiatry 169, 790-804), and implies that technology-enabled coordinated care increases the per-service probability of a reduction in psychological distress by 17.7%. *Effect on referrals to specialised care* – the multiplicative effect of technology-enabled coordinated care on general practitioners' rates of referral to specialised psychiatric care (i.e., psychiatrists and allied mental health services). The default value (1.266) implies that technology-enabled coordinated care increases the per-consultation probability that a general practitioner will refer a patient with high or very high psychological distress to specialised psychiatric care by 26.6%, and is derived from Badamgarav et al. (2003, Am. J. Psychiatry 160, 2080-2090). Note that technology-enabled coordinated care is assumed to have no effect on the referral rate for patients with moderate psychological distress.

	Effect on disengagement – the multiplicative effect of technology-enabled coordinated care on rates of disengagement from mental health services (including disengagement while waiting for services and disengagement resulting from dissatisfaction with services received). The default estimate (0.520) is derived from Badamgarav et al. (2003, Am. J. Psychiatry 160, 2080-2090), and implies that technology-enabled coordinated care reduces rates of disengagement by 48.0%. *Effect on psychiatric services capacity* – the multiplicative effect of technology-enabled coordinated care on the total capacity of specialised psychiatric services (i.e., the maximum number of services that can be provided by psychiatrists and allied mental health providers per year). The default value (1.1) assumes an increase in services capacity of 10%. *Effect on referrals to online services* – the multiplicative effect of technology-enabled coordinated care on general practitioners' rates of referral to online (self-help) services. The default value (1) assumes that technology-enabled coordinated care has no effect on the probability that a general practitioner will refer a patient to online services.
10. GP services capacity increase	A 50% increase in the annual rate of growth in general practitioner services capacity (i.e., the maximum number of services that can be provided per week).
11. Psychiatrist and allied health services capacity increase	A 50% increase in the annual rate of growth in psychiatrist and allied health services capacity (i.e., the maximum number of services that can be provided per week).
13. Psychiatric hospital capacity increase	A 50% increase in the annual rate of growth in public psychiatric hospital capacity (i.e., the maximum number of admissions per week).
13. Community mental health care services capacity increase	An increase in the annual rate of growth in community mental health care services capacity (per 10^4 population) equal to 2.5% of capacity at the start of 2011.

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