

We respect and honour Aboriginal and Torres Strait Islander Elders past, present and future. We acknowledge the stories, traditions and cultures of Aboriginal and Torres Strait Islander peoples on this land and commit to building a brighter future together.

SUMMARY OF KEY INSIGHTS

Suicide and self-harm hospitalisations in the Hunter, New England and Central Coast are both expected to remain consistent over a 20-year forecast period if the current intervention approaches continue. Without modifying the current approach to suicide prevention in the region, it is expected that there will be an approximate 1% increase in suicides over the forecast period.

Within the modelling, the top three interventions which had the greatest population level impacts on reducing both suicide and self-harm hospitalisations are post-attempt care (6.5% suicide and 6.66% self-harm hospitalisations), safety planning (5.25% suicide and 5.16% self-harm hospitalisations) and social connectedness (5.92% suicide and 5.17% self-harm hospitalisation). In combination, these interventions averted 16.69% of suicides over the forecast period and 15.97% of self-harm hospitalisations.

Community-based education appears to have a notable impact by the end of the forecast period, however there is an initial increase in suicide deaths if it is implemented individually. This significantly diminishes its effect, resulting in 0.59% reduction in suicide and 0.86% for self-harm hospitalisations over the forecast period.

GP Training is expected to have the least significant impact on suicide and self-harm hospitalisation rates (0.17% for both suicide and self-harm hospitalisations), although if it is implemented alongside significant increases in service capacity it is shown to be more effective. This combination suggests that GP training may be beneficial in identifying individuals in distress, however the impact is mitigated by limited capacity in surrounding services.

Increasing service capacity as a standalone intervention has limited impact on suicide deaths and self-harm hospitalisations and requires substantial expansions across a range of different types of health services, along with significant investment to a level that is likely not feasible. The effect of increasing service capacity also lessens throughout the forecast period, and when implemented with other interventions it has little to no additional impact on the number of suicide deaths or self-harm hospitalisations by 2040. Doubling psychiatric hospital care averts 0.23% of suicides and 0.22% of self-harm hospitalisations and doubling GP services results in 0.13% reduction in suicides and self-harm hospitalisations. The most feasible option in terms of increasing capacity is a 10% increase of community mental health services, which is expected to have the most significant impact by averting 5.94% of suicides and 5.99% of self-harm hospitalisations.

For Aboriginal and Torres Strait Islander populations, Aboriginal specific programs have the most significant impact for Aboriginal people over the forecast period, averting 19.64% of suicides and 18.87% of self-harm hospitalisations. For Aboriginal and Torres Strait Islander people accessing general population interventions, safety planning has the second most significant impact, averting 8.19% of suicides and 8.13% of self-harm hospitalisations. This is followed by post-attempt care (suicide 6.15% and self-harm hospitalisations 6.17%).

Introduction

THE AIM

The aim of this project was to use system dynamics modelling to develop an interactive decision support tool capable of testing a range of strategies to reduce suicidal behaviour across the Hunter, New England and Central Coast. It was also important to explore differential impacts of investment in suicide prevention programs and services on sub-populations (Hunter New England Local Health District (LHD), Central Coast LHD, Aboriginal & Torres Strait Islander population), in order to guide evidence-based decision making in the region.

A SYSTEMS APPROACH

A partnership was established between Hunter New England and Central Coast Primary Health Network (HNECC PHN), Hunter New England Local Health District, Central Coast Local Health District and Sax Institute in order to apply dynamic simulation modelling to suicide prevention in the HNECC PHN region. The model was developed using a participatory modelling approach that involved a range of local and state-level stakeholders, including representatives from state governments, health and social policy agencies, local councils, non-government organisations, the education sector, emergency services, research institutions, community groups, primary care providers, and people with lived experience of suicide. Significant consideration was also given to ensuring there was substantial representation from particular populations that experience health-related vulnerabilities, such as Aboriginal and Torres Strait Islander peoples, LGBTI, people living in rural and remote areas, culturally and linguistically diverse populations and youth. The participatory approach provided valuable insight into the specific needs and priorities for different regions across the entire HNECC PHN, which can then be locally applied to reflect the specific needs, strengths and resources of each community within the broader area.

THE MODEL

The model is a logically consistent mathematical framework that integrates best available data and evidence sources. It has an interactive interface and can be used as a 'what if' tool to test the likely impacts over time of a range of intervention and service planning scenarios to see what combination of strategies is likely to achieve the maximum reductions in attempted suicide and suicide in HNECC PHN. The model can be used to inform decision making, advocacy, business case development and help build consensus for coordinated action. The model can be updated over time to ensure it remains current and continues to produce forecasts that are consistent with observed data.

The model captured population and demographic dynamics, pathways to mental health care and suicidal behaviour, service interactions and workforce capacity, and the potentially non-additive effects of intervention combinations. The model reproduced historic trends in the incidence of attempted suicide (self-harm hospitalisations) and suicide deaths in the region. A series of intervention scenarios were investigated to forecast their impact on suicidal behaviour over a 20-year period and compared to a 'business as usual' reference scenario (baseline), in which mental health and suicide prevention measures currently in place remain unchanged until the end of the simulation period (2040).

The model structure involves four interconnected sectors, which include population, psychological distress, service pathways and suicide behaviour. A detailed description of each component is provided in Table 1.

Table 1 – Description of the model components

Component	Description
Population	This captures changes in the size and composition of the HNECC PHN population catchment due to births, migration, and mortality. The population is stratified by LHD and indigenous status in order to allow exploration of the differential effects of interventions. Population size increases through births (which are added to the population stock) and net migration.
Psychological Distress	The psychological distress component captures changes in the prevalence of moderate to very high psychological distress in the population. Prevalence increases as people with no mental health issue become distressed and decreases as people experiencing distress recover (either spontaneously or through effective treatment). The prevalence of psychological distress determines rates of mental health service usage and self-harm.
Service Pathways	Service pathways captures the movement of distressed patients through the mental health service system, which consists of GPs, online services, psychiatrists and allied mental health services, psychiatric hospital beds, general acute hospital wards, emergency departments, and community mental health services.
Suicide Behaviour	Suicide behaviour captures hospitalisations for intentional self-harm and suicide deaths. Self-harm hospitalisation and suicide rates depend on the prevalence of psychological distress in the population and the number of people who have disengaged from mental health services (these people are at greater risk of self-harm)

Key to interpreting the data modelling described within the report is understanding the interventions applied to each scenario. A brief description of the interventions identified as part of the model is outlined in Table 2, with further details presented in Appendix 1.

Table 2: Interventions

Intervention	Description
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.
Community-Based Education	Community-based education programs aim to improve recognition of suicide risk and increase help seeking through improved understanding of the causes and risk factors for suicidal behaviour. The effectiveness of this intervention is assumed to increase with increasing community support due to greater opportunity for identification of at-risk individuals by community and organisational gatekeepers.
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.
Family Education 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 chronic mental disorders.
Post Attempt Care:	Post-attempt care is an active outreach and enhanced contact program to reduce readmission in those presenting to services after a suicide attempt. It includes individually tailored contact, solution focused counselling, and motivations to adherence to follow-up treatments and continuity of contact.
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).
Safe Space Alternative to ED	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.
Social Connectedness	Community support programs and services that increase social connectedness, reducing isolation and enhancing resilience in the face of adversity.
Aboriginal Population Programs	Aboriginal population-specific social connectedness and community-based education programs. These programs are targeted versions of the corresponding whole-population interventions

PURPOSE OF THIS DOCUMENT

This Key Insight Report provides a summary of findings from Dynamic Simulation Modelling for suicide prevention in the Hunter New England and Central Coast Primary Health Network catchment. The model was utilised to simulate a range of scenarios in order to identify the interventions that have the greatest impact on reducing suicide and self-harm hospitalisations, the combination of interventions with the largest impact and the interventions that have the most significant effect on suicide and self-harm hospitalisations for Aboriginal and Torres Strait Islander people.

This document provides an overview of the impact of the interventions and gives a visual reference for the outputs from the model. This document explores the impact of interventions on suicide rates and self-harm hospitalisations, though does not provide a cost-benefit analysis for implementation.

This report provides insight into forecasted trends for suicide and self-harm hospitalisation from the most up-to-date data available, therefore predictions may be updated as new data emerges. The model is intended to be a living resource and remains the primary 'what-if' tool to be used in policy and commissioning decision -making.

While this report discusses the impact of interventions in relative terms, it is important to note that each figure represents an expected loss of life.

KEY QUESTIONS

These key questions were developed in order to identify the interventions that individually have the most significant impact on suicide deaths and self-harm hospitalisations and the most effective combination of interventions that achieves the greatest possible reduction over the forecast period. The model also sought to provide specific insight into the combination of interventions that would have the greatest impact on suicide deaths and self-harm hospitalisations for Aboriginal and Torres Strait Islander people. What are the expected outcomes if the current approach continues 'business as usual'?

1. What is the individual impact of each intervention?
2. Which combination of interventions are likely to deliver the greatest population level impacts on suicidal behaviour in HNECC PHN?
3. Which combination of interventions are likely to have the least significant impact on suicidal behaviour in HNECC PHN?
4. What is the necessary change to service capacity in order to have a notable impact?
5. Which combination of interventions are likely to have the most significant impact on suicidal behaviour for Aboriginal and Torres Strait Islander people?

INTERPRETING DATA

It is important to note that the scale for the Y axis on each figure changes according to the numerical range being displayed. This can result in some figures appearing to show steep impacts that may actually be less significant than the data in other models. It is recommended that the percentages provided in text be relied upon for representing the impact of interventions.

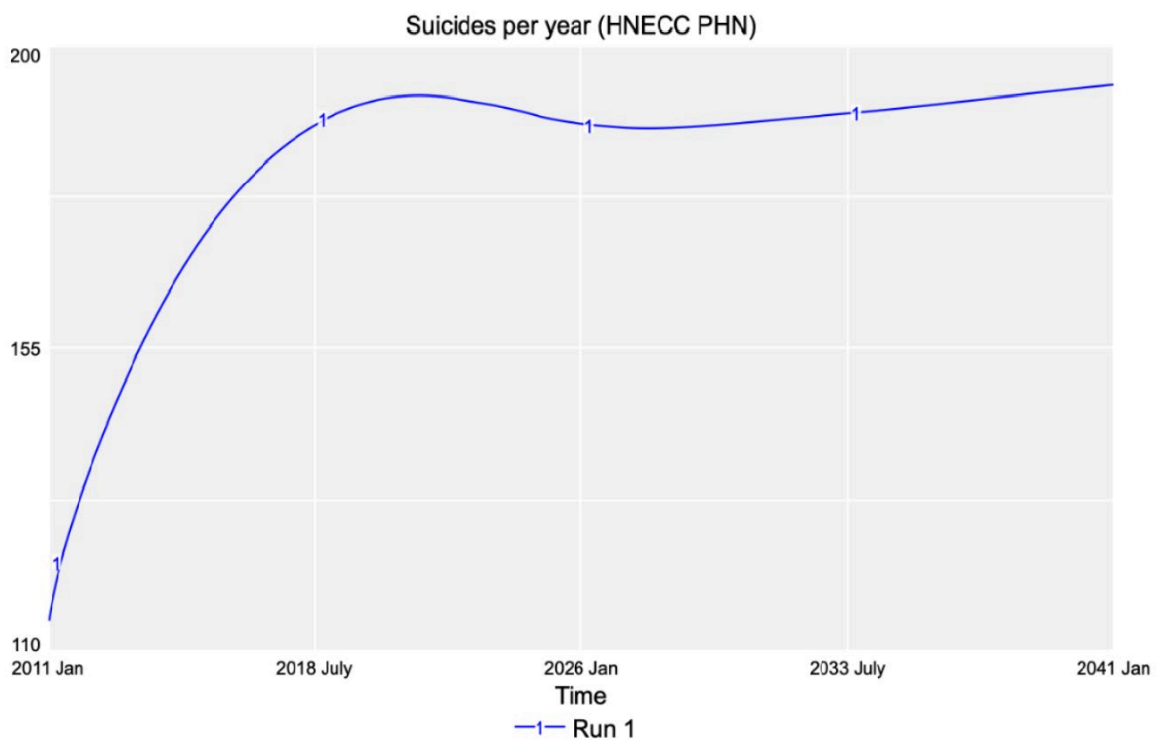
Key Questions

1. What are the expected outcomes for suicide and self-harm hospitalisations if the current approach continues?

Summary Statement

Suicide in the Hunter, New England and Central Coast is expected to remain relatively consistent over the 20-year forecast period under the baseline scenario. Despite a small decrease throughout this period (around the year 2030), by the forecast period there will be a 1% increase in suicide deaths. This may indicate that the suicide rate may be decreasing slightly, however due to population growth the number of deaths appears to remain relatively stable.

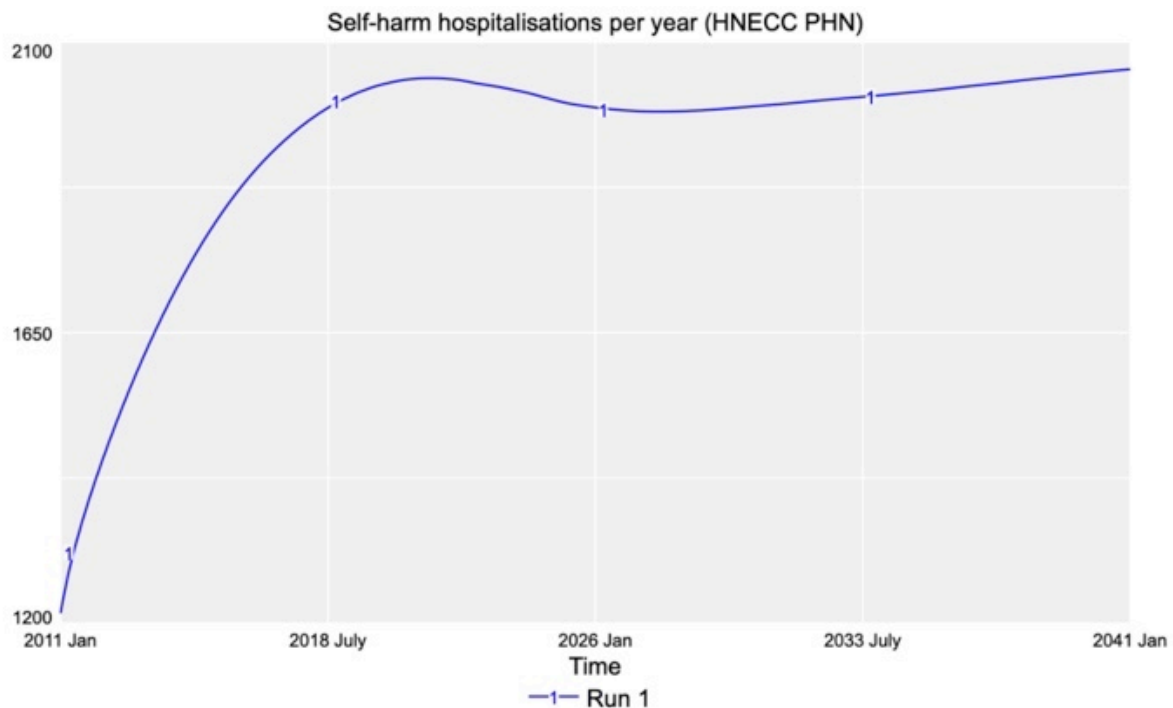
Figure 1. Expected rates for suicide for HNECC PHN over next 20 years



Run 1 – Baseline

Self-harm hospitalisations for the Hunter, New England and Central Coast are expected to follow a similar trend, with a slight decrease predicted around 2027 that gradually increases to marginally pass current rates (2036 in Feb 2020; 2058 in Nov 2040).

Figure 2. Self-harm hospitalisations for Hunter New England Central Coast PHN



Run 1 – Baseline

Description of outputs:

- The current approach reference scenario (baseline) assumes mental health and suicide prevention measures currently in place remain unchanged until the end of the simulation period (2040).
- Both suicide and attempted suicide cases are expected to increase over the 20-year forecast period from 2020 given continued population growth in HNECC PHN under the baseline ('business as usual') scenario. It is estimated that this will result in an increase in suicide deaths of 1% across the region if no interventions are changed.

2. What is the individual impact of each intervention?

Summary statement:

As individual interventions, GP Training, Community based acute care services and Safe Space alternatives to ED showed limited impacts on forecast suicide and attempted suicide cases when compared to the baseline. It is noted that Community Education appears to have a reasonable effect by the end of the forecast period, however the initial increase significantly reduces the accumulative impact and if community-based education is combined with an increase in community mental health and GP mental health services, this is even more effective. Social Connectedness showed the greatest impact as a standalone intervention. Further detail of each intervention applied to the model is provided in the Appendix.

Figure 3. Impact of individual interventions on suicide for HNECC PHN over next 20 years

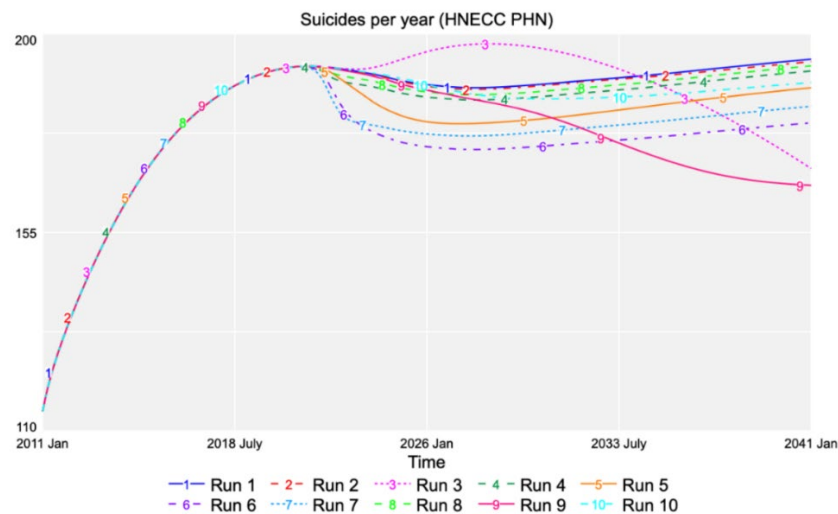
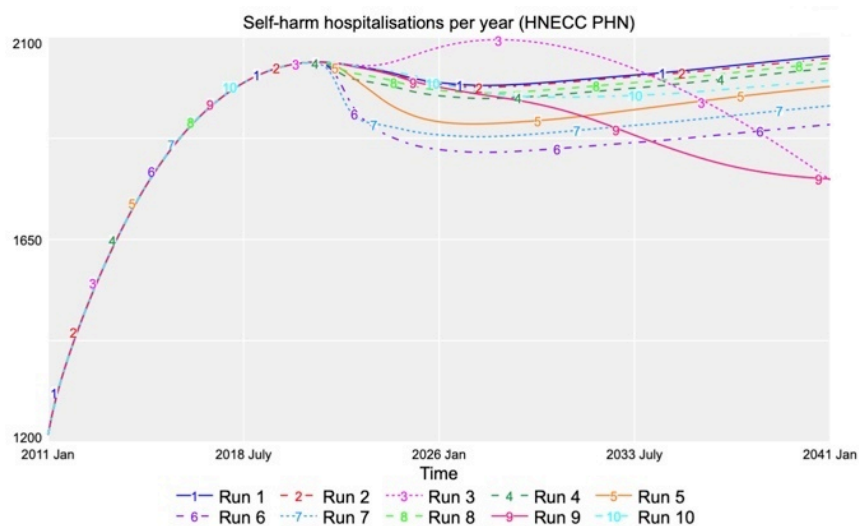


Figure 4. Impact of individual interventions on self-harm hospitalisations for HNECC PHN over next 20 years



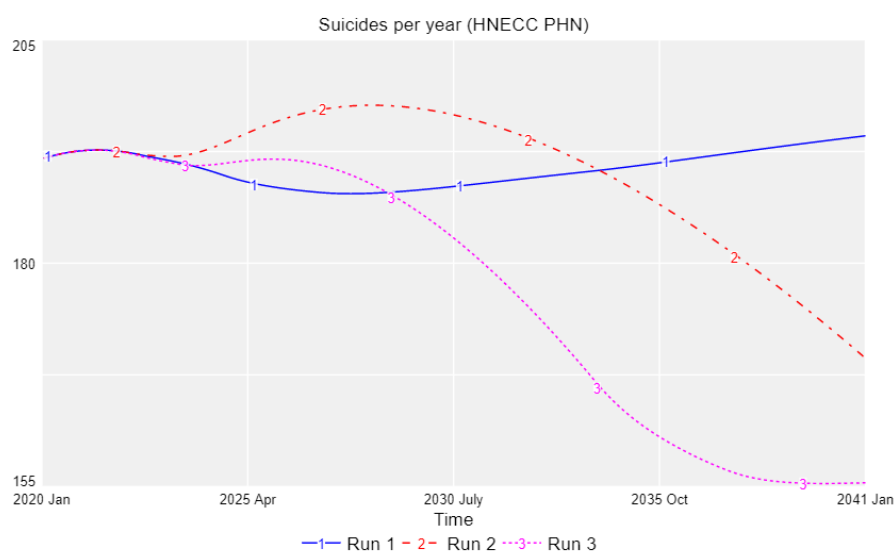
- | | |
|---|---|
| Run 1 – Baseline | Run 6 – Post-attempt care |
| Run 2 – GP Training | Run 7 – Safety planning |
| Run 3 – Community-based education | Run 8 – Safe space alternative to ED |
| Run 4 – Community-based acute care services | Run 9 – Social connectedness |
| Run 5 – Family education and support | Run 10 – Aboriginal population programs |

Description of outputs

- Individually, post-attempt care is expected to have the greatest impact over the forecast period, averting 6.65% of suicides and 6.66% of self-harm hospitalisations.
- While social connectedness has the most significant impact by the end of the forecast period, the scale-up time for effect is significantly more protracted compared to the majority of other interventions. Overall, this intervention results in a 5.92% reduction in suicides and 5.17% of self-harm hospitalisations over the forecast period.
- Safety planning has the third most significant impact, averting 5.25% of suicides and 5.16% of self-harm hospitalisations over the forecast period.
- GP training averted just 0.17% of both suicides and self-harm hospitalisations, community-based acute care services led to a reduction of 1.3% for suicide and 1.65% for self-harm hospitalisations and safe space alternatives to ED prevented 0.77% of suicides and 0.92% of self-harm hospitalisations.

Community-based education appears to have a reasonable effect by the end of the forecast period, however the initial increase significantly reduces the accumulative impact. As an individually implemented intervention, community-based education averts 0.59% of suicide deaths and 0.86% of self-harm hospitalisations over the forecast period. However, this can be amplified by increasing service capacity simultaneously. Figure 5 demonstrates that if community-based education is combined with a 5% increase in community mental health and 50% increase in GP mental health services, it is possible to avert 12.20% of suicides and 12.32% of self-harm hospitalisations.

Figure 5. Community-based education



Run 1 – Baseline

Run 2 – Community-based education

Run 3 – Community-based education, 5% increase in community mental health and 50% increase in GP mental health services

Description of outputs

- As an individually implemented intervention, community-based education averts 0.59% of suicide deaths and 0.86% of self-harm hospitalisations over the forecast period. However, this can be amplified by increasing service capacity simultaneously.
- If community-based education is combined with a 5% increase in community mental health and 50% increase in GP mental health services, it is possible to avert 12.20% of suicides and 12.32% of self-harm hospitalisations.

3. Which combination of interventions are likely to deliver the greatest population level impacts on suicidal behaviour in HNECC PHN?

Summary statement:

A key benefit of dynamic simulation modelling is the capacity to provide strategic information about the way in which individual interventions will interact with each other, to either amplify or diminish impact. The model indicates that the combination of post-attempt care, safety planning and social connectedness provide the greatest population level impact for both suicides and self-harm hospitalisations over the forecast period.

Figure 6. Impact of combined interventions on suicide for HNECC PHN

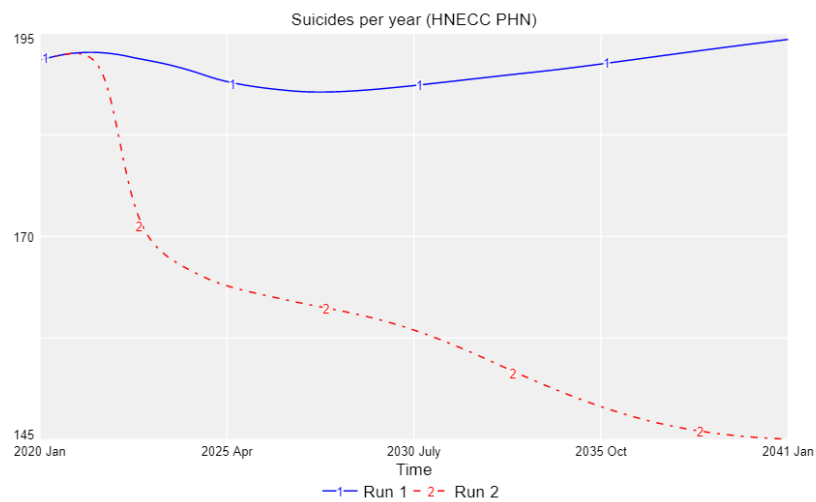
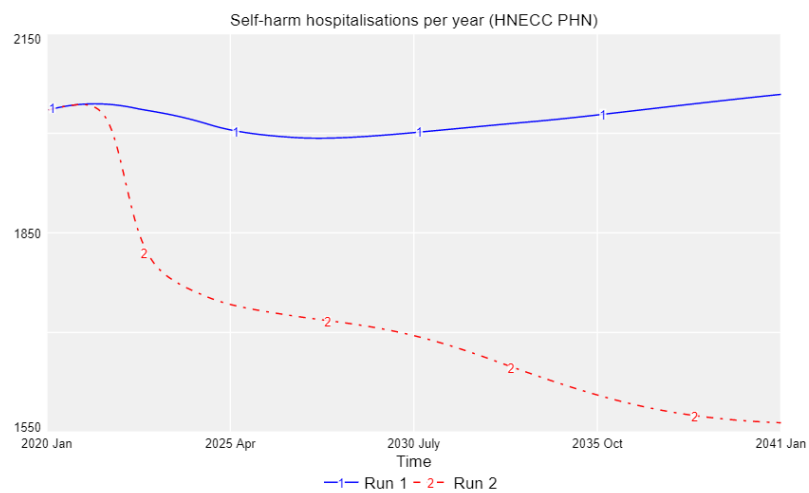


Figure 7. Impact of combined interventions on self-harm hospitalisations for HNECC PHN



Run 1 - Baseline

Run 2 - Post-attempt care, social connectedness and safety planning

Description of outputs:

- In combination, these Post-attempt care, social connectedness and safety planning are the most effective and are expected to avert 16.69% of suicides and 15.97% of self-harm hospitalisations.

4. Which combination of interventions are likely to have the least significant impact on suicidal behaviour in HNECC PHN?

Summary statement:

GP training had the least significant impact as an individual intervention; however it is important to note that this could be somewhat mitigated by doubling service capacity. This indicates that the GP training itself is not inherently ineffective, though it has limited impact if the broader system does not have the capacity to respond.

This broad scale-up of services relies on significant expansion of human resources, infrastructure and financial costs, indicating this does not represent the most feasible approach to preventing suicide deaths and self-harm hospitalisations in the Hunter New England and Central Coast Primary Health Network catchment.

Figure 8. Interventions with least significant impact for suicide in HNECC PHN

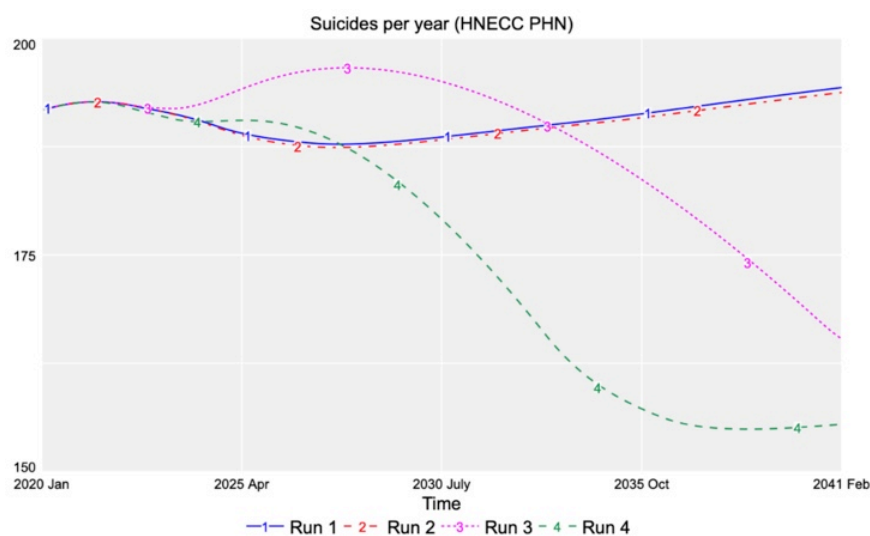
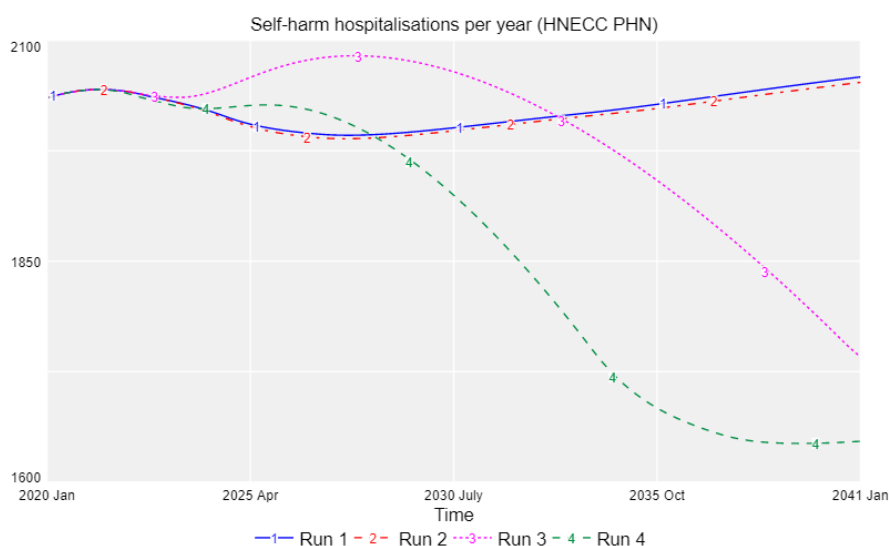


Figure 9. Interventions with the least significant impact on self-harm hospitalisations in HNECC PHN



Run 1 – Baseline

Run 2 – GP Training

Run 3 – GP training and community-based education

Run 4 – GP training, community-based education and 1.5 x capacity for GP mental health services, psychiatrist and allied health services and psychiatric hospital care

Description of outputs:

- GP training had the least significant impact as an individual intervention (0.17% for suicide and self-harm hospitalisations) unless combined with other interventions.
- When GP training is combined with community-based education the rate of suicides per year initially increases, signalling the need for appropriate service capacity to support increased presentations. If capacity across multiple different primary and tertiary health services is increased by one and a half times, there is still a small increase to suicide deaths before the rates begins to decline.

5. What is the necessary change to service capacity in order to have a notable impact?

Summary statement:

As a stand-alone intervention, increasing service capacity beyond expected annual growth appears to have little impact on the expected baseline suicide or self-harm hospitalisation rates for the Hunter, New England and Central Coast Primary Health Network catchment.

Figure 10. Impact of capacity on suicide in HNECC PHN

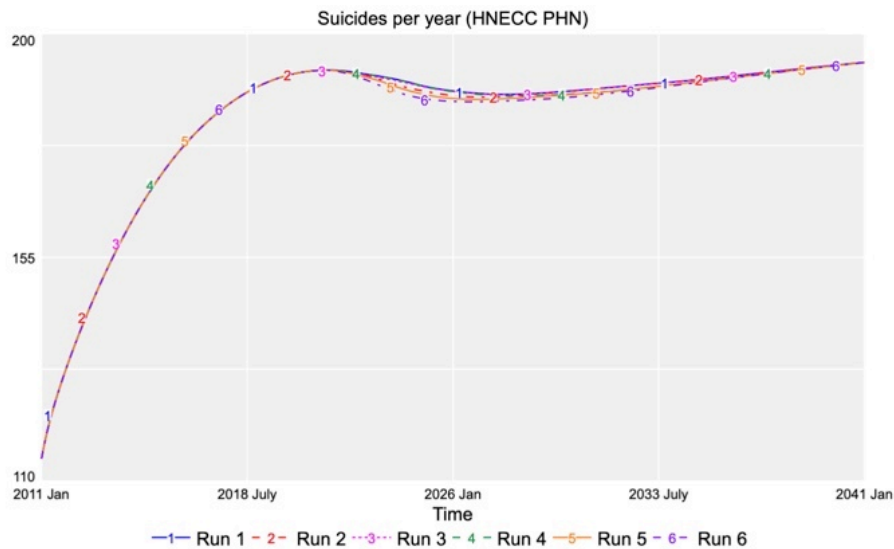
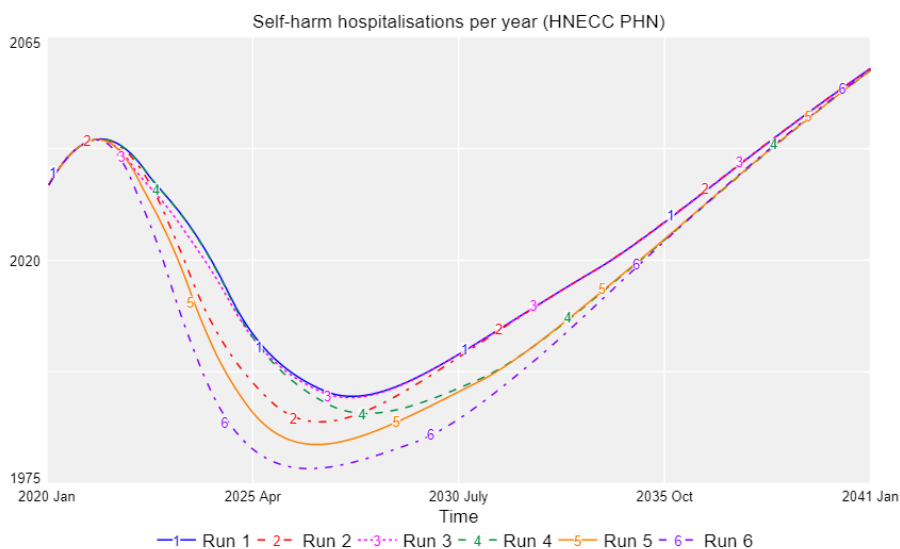


Figure 11. Impact of capacity on self-harm hospitalisations in HNECC PHN



Run 1 – Baseline

Run 2 – GP mental health services x 1.5

Run 3 – Psychiatrists and allied health services x 1.5

Run 4 – Psychiatric hospital care x 1.5

Run 5 – GP mental health services, psychiatrists and allied health services, psychiatric hospital care x 1.5

Run 6 – GP mental health services, psychiatrists and allied health services, psychiatric hospital care x 2

Description of outputs:

- Doubling the capacity for all services had no greater impact than increasing capacity by one and a half times.

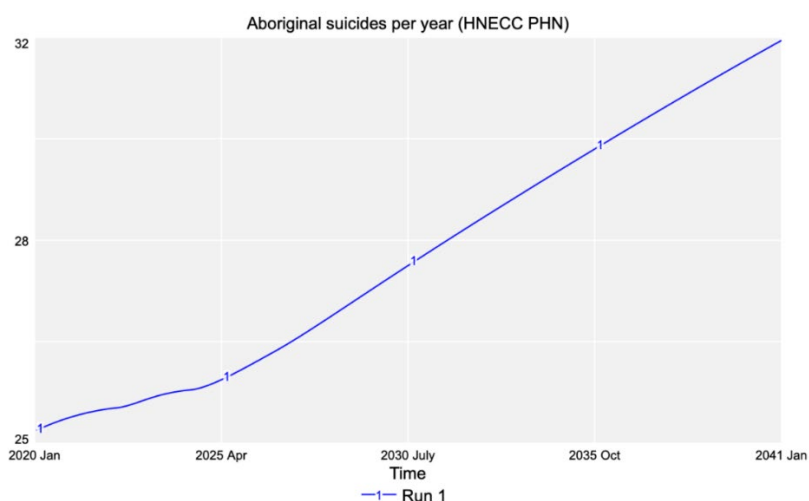
6. Which combination of interventions are likely to have the most significant impact on suicidal behaviour for Aboriginal and Torres Strait Islander people?

Summary statement:

The suicide rate for Aboriginal and Torres Strait Islander people is expected to increase from 25 deaths per year in 2020 to 31 deaths per year by 2041.

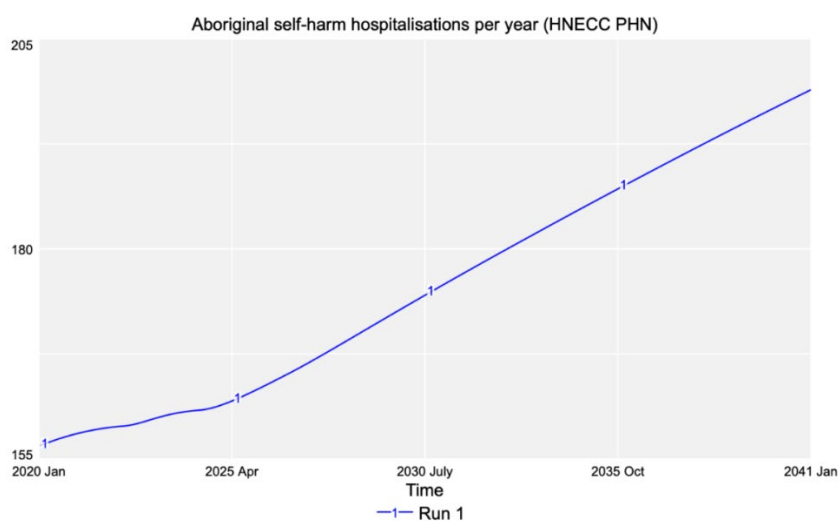
Aboriginal Programs are the most effective intervention for the Aboriginal cohort. This intervention includes social connectedness and community-based education being delivered specifically for Aboriginal and Torres Strait Islander populations. Although community-based education leads to an increase in suicide deaths in the non-indigenous population, this can be attributed to an overwhelming demand for support that would outweigh service capacity, which would not be an issue when targeting a specific group within the broader population. Due to this targeted approach it is also expected the scale-up time for Aboriginal specific programs would be faster compared to broad population level interventions, enabling the positive impacts to be experienced in a shorter time frame.

Figure 12. Expected rates for Aboriginal suicide for HNECC PHN over next 20 years



Self-harm hospitalisations for Aboriginal and Torres Strait Islander people is expected to steadily increase over the forecast period.

Figure 13. Expected rates for self-harm hospitalisations for Aboriginal and Torres Strait Islander population HNECC PHN over next 20 years



Run 1 – Baseline

For Aboriginal and Torres Strait Islander people accessing general population interventions, safety planning has the second most significant impact, averting 8.19% of suicides and 8.13% of self-harm hospitalisations. This is followed by post-attempt care (suicide 6.15% and self-harm hospitalisations 6.17%) and social connectedness (suicide 6.10% and self-harm hospitalisations 5.32%)

Figure 14. Impact of individual interventions on Aboriginal suicide for HNECC PHN over next 20 years

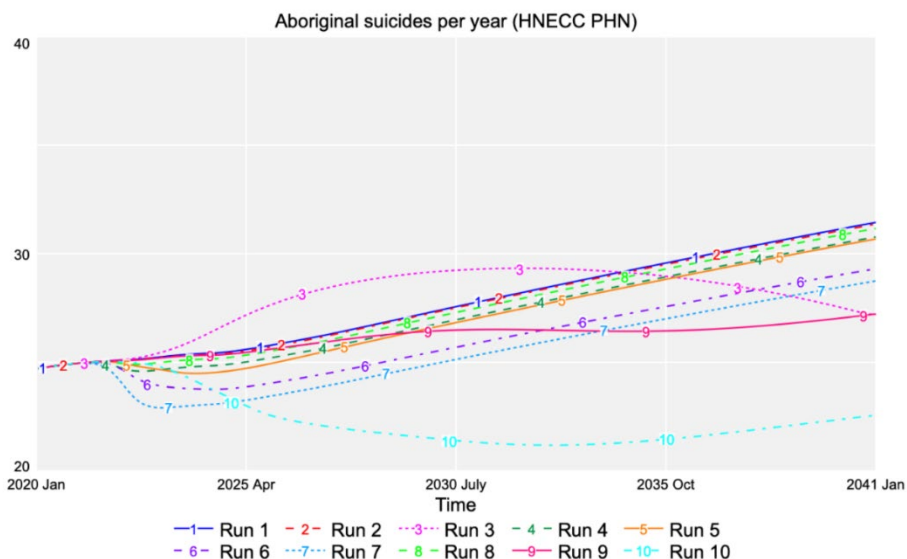
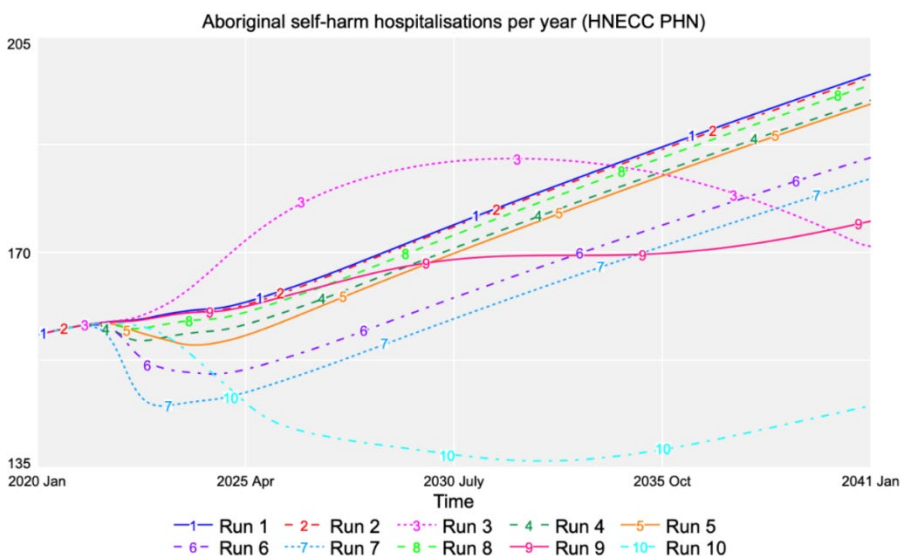


Figure 15. Impact of individual interventions on Aboriginal self-harm hospitalisations for HNECC PHN over next 20 years



- | | |
|---|---|
| Run 1 – Baseline | Run 6 – Post-attempt care |
| Run 2 – GP Training | Run 7 – Safety planning |
| Run 3 – Community-based education | Run 8 – Safe space alternative to ED |
| Run 4 – Community-based acute care services | Run 9 – Social connectedness |
| Run 5 – Family education and support | Run 10 – Aboriginal population programs |

The impact of Aboriginal specific programs is similar to the combined effect of post-attempt care, safety planning and social connectedness, which together prevent 19% of suicides and 18.28% of self-harm hospitalisations.

It is important to note, that the addition of Aboriginal specific programs to the combination of post-attempt care, social connectedness and safety planning does not have a significantly greater impact on suicide or self-harm hospitalisations (20.27% for suicide and 19.42% for self-harm hospitalisation).

Figure 16. Impact of combined interventions with the greatest impact on suicide for Aboriginal and Torres Strait Islander population

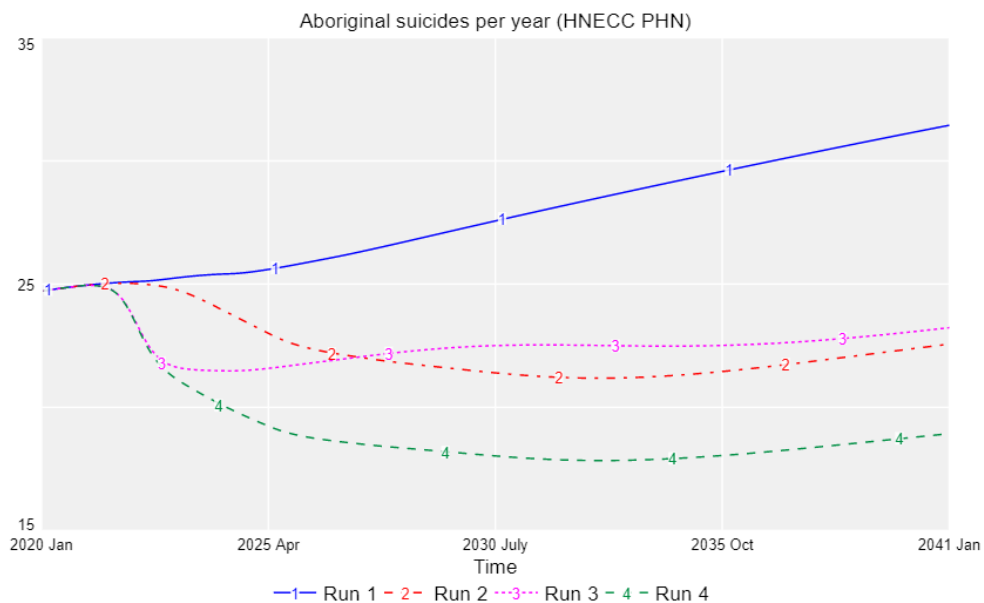
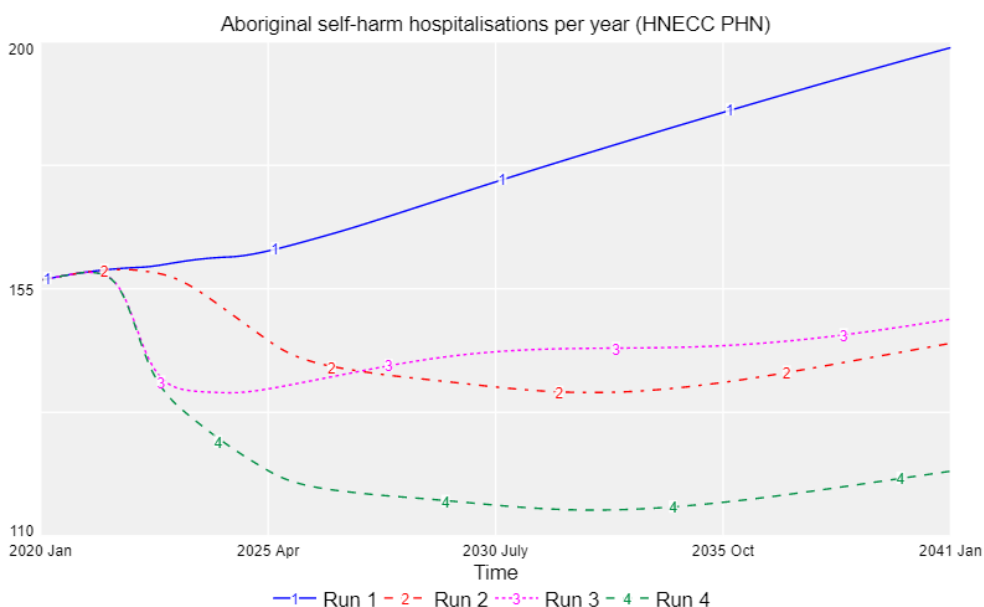


Figure 17. Impact of combined interventions with the greatest impact on self-harm hospitalisation for Aboriginal and Torres Strait Islander population



- Run 1 – Baseline
- Run 2 – Aboriginal specific programs
- Run 3 – Safety planning, social connectedness and post-attempt care
- Run 4 – Aboriginal specific programs, safety planning, social connectedness and post-attempt care

Doubling the current growth rate for GP mental health services had minimal impact for Aboriginal and Torres Strait Islander people, averting just 0.13% of both suicides and self-harm hospitalisations.

Doubling psychiatric in hospital care also had a very limited effect, resulting in 0.05% of suicides and 0.04% of self-harm hospitalisations being averted.

Figure 18. Impact of doubling service capacity on suicide for Aboriginal and Torres Strait Islander population in HNECC PHN over next 20 years

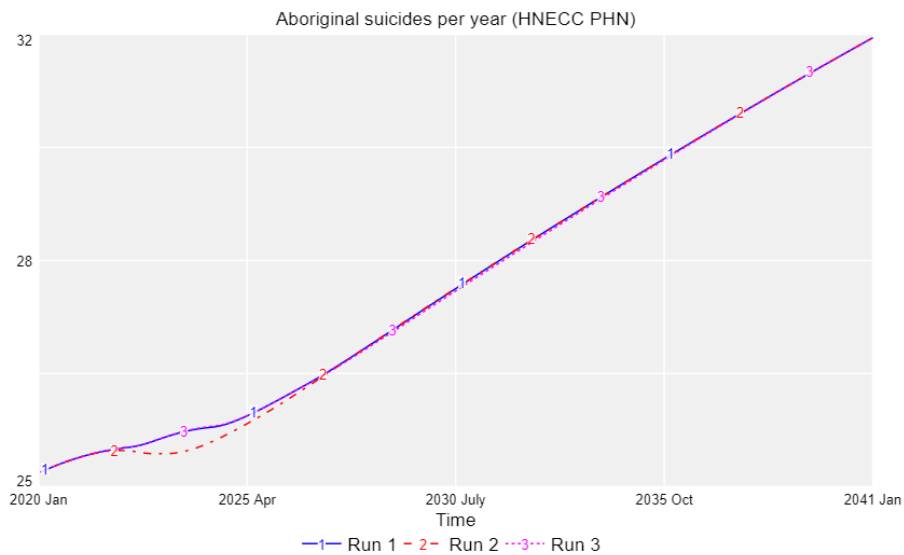
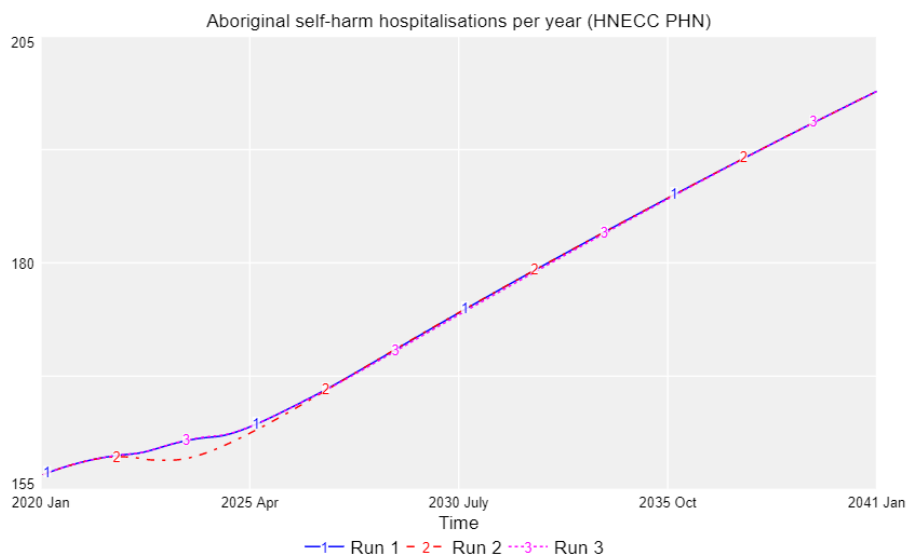


Figure 19. Impact of doubling service capacity on self-harm hospitalisations for Aboriginal and Torres Strait Islander population in HNECC PHN over next 20 years



Run 1 – Baseline

Run 2 – GP Mental Health services capacity doubled

Run 3 – Psychiatric in hospital care capacity doubled

GP training and Safe Space alternatives to ED have minimal impact on the expected suicide rate for Aboriginal and Torres Strait Islander people over the forecast period.

GP Training averts 0.19% of both suicides and of self-harm hospitalisations, while Safe space alternatives to ED account for the prevention of 0.89% of suicides and 0.88% of self-harm hospitalisations.

If implemented individually in a mainstream model, community-based education leads to small increase for both suicides and self-harm hospitalisations (-0.01%; -0.22%), however if this is delivered in an Aboriginal specific program the effect becomes notably greater (12.47% suicides and 12.50% self-harm hospitalisations).

Figure 20. Least impactful intervention for Aboriginal and Torres Strait Islander suicide in HNECC PHN over next 20 years

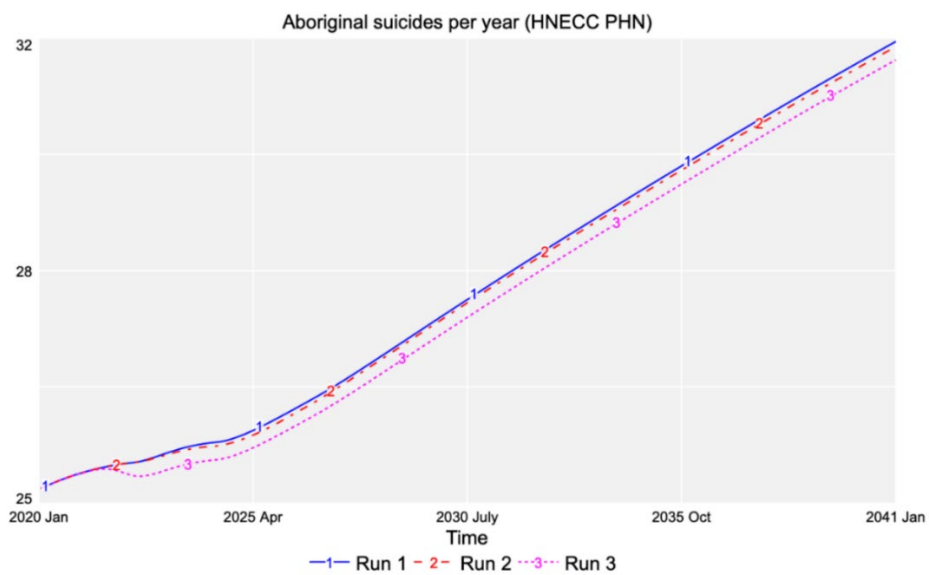
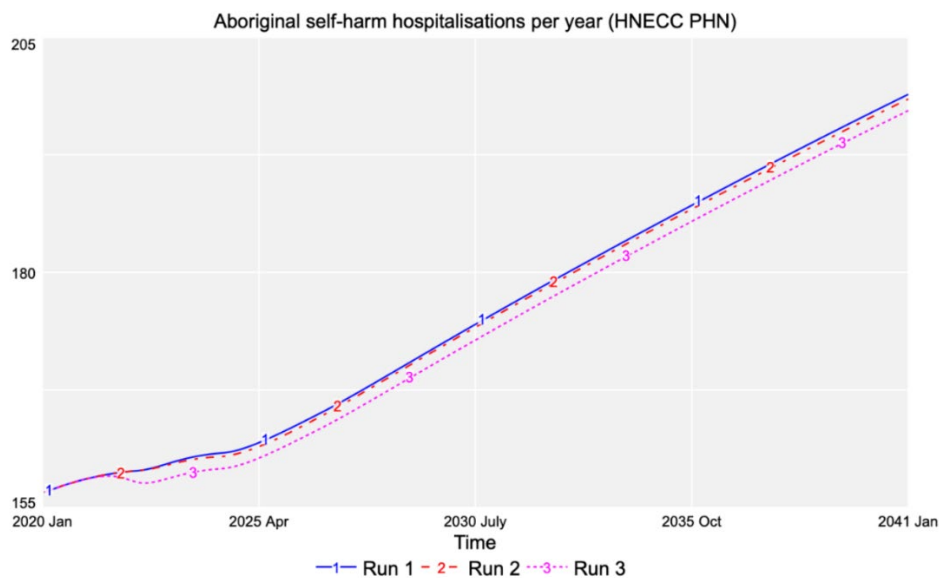


Figure 21. Least impactful intervention for Aboriginal self-harm hospitalisations in HNECC PHN over next 20 years



- Run 1 - Baseline
- Run 2 - GP training
- Run 3 - Safe Space alternatives to ED

Description of outputs:

- Aboriginal specific programs have the most significant impact for Aboriginal people over the forecast period, averting 19.64% of suicides and 18.87% of self-harm hospitalisations.
- For Aboriginal and Torres Strait Islander people accessing general population interventions, safety planning has the second most significant impact, averting 8.19% of suicides and 8.13% of self-harm hospitalisations. This is followed by post-attempt care (suicide 6.15% and self-harm hospitalisations 6.17%) and social connectedness (suicide 6.10% and self-harm hospitalisations 5.32%)
- The impact of Aboriginal specific programs is similar to the combined effect of post-attempt care, safety planning and social connectedness, which together prevent 19% of suicides and 18.28% of self-harm hospitalisations.
- The addition of Aboriginal specific programs to the combination of post-attempt care, social connectedness and safety planning does not have a significantly greater impact on suicide or self-harm hospitalisations (20.27% for suicide and 19.42% for self-harm hospitalisation).
- Doubling the current growth rate for GP mental health services had minimal impact for Aboriginal and Torres Strait Islander people, averting just 0.13% of both suicides and self-harm hospitalisations.
- Doubling psychiatric in hospital care also had a very limited effect, resulting in 0.05% of suicides and 0.04% of self-harm hospitalisations being averted.
- GP training and Safe Space alternatives to ED have minimal impact on the expected suicide rate for Aboriginal and Torres Strait Islander people over the forecast period.
- GP Training averts 0.19% of both suicides and of self-harm hospitalisations, while Safe space alternatives to ED account for the prevention of 0.89% of suicides and 0.88% of self-harm hospitalisations.
- If implemented individually in a mainstream model, community-based education leads to small increase for both suicides and self-harm hospitalisations (-0.01%; -0.22%), however if this is delivered in an Aboriginal specific program the effect becomes notably greater (12.47% suicides and 12.50% self-harm hospitalisations).

Recommendation

As a standalone intervention, post-attempt care has indicated the strongest impact in reducing suicides over time. In the first instance, the development and procurement of after care services across the HNECC PHN region is recommended.

Secondary interventions that would enhance the effect of post-attempt care include social connectedness and safety planning. It is recommended that these activities either be implemented as individual interventions or be included in the post-attempt care activities to further augment the impact.

For Aboriginal and Torres Strait Islander populations, it is recommended that culturally specific programs be implemented, with a focus on incorporating post-attempt care, social connectedness and safety planning into the design.

Conclusion

The key insights from Dynamic Simulation Modelling for Suicide Prevention in the Hunter, New England and Central Coast demonstrate the need to assess the effectiveness of interventions from a holistic perspective, considering how they interact to have a collective impact on suicidal behaviour across the region. By modelling the combined effect of a range of different options, it has been possible to identify how particular interventions may appear to have minimal impact on their own but have an amplifying impact when implemented with another intervention. This can have significant real-world implications for the commissioning of services and for the broader policy decisions that are made to reduce suicide in the Hunter, New England and Central Coast.

It is important to thank all the participants who provided their expertise and time to this process. It is through their input that these insights have been identified and it is hoped that the model will contribute to ongoing efforts in the region to reduce the impact of suicide and suicidal behaviour.

Appendix 1

Summary of interventions and scenarios that are tested in the Dynamic Simulation Model

The default start time for all interventions is January 2020, which may be varied by the user to reflect different implementation scenarios. The default values of the interventions are listed below and appear on the intervention interface, which may also be varied by the user.

Intervention	Description
GP training	<p>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.</p> <p>Parameters that can be modified are:</p> <p>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.</p> <p>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, <i>Med. J. Aust.</i> 174, 222-226).</p>
Community-based education	<p>Community-based education programs aim to improve recognition of suicide risk and increase help seeking through improved understanding of the causes and risk factors for suicidal behaviour. The effectiveness of this intervention is assumed to increase with increasing community support due to greater opportunity for identification of at-risk individuals by community and organisational gatekeepers.</p> <p>Parameters that can be modified are:</p> <p>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. The default value (1.585) is derived from Jorm et al. (2003, <i>Psychol. Med.</i> 33, 1071-1079), and assumes that education programs will increase the rate of help seeking for mental health problems by 58.5%.</p> <p>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).</p>

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 that can be modified 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).

Family education 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 chronic mental disorders.

Parameters that can be modified 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.

Post-attempt care

Post-attempt care is an active outreach and enhanced contact program to reduce readmission in those presenting to services after a suicide attempt. It includes individually tailored contact, solution focused counselling, and motivations to adherence to follow-up treatments and continuity of contact.

Parameters that can be modified 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).

**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 that can be modified 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 52.1 weeks, or 1 year).

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).

**Safe space
alternative to
ED**

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 that can be modified 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).

**Social
connectedness**

Community support programs and services that increase social connectedness, reducing isolation and enhancing resilience in the face of adversity.

Parameters that can be modified 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%.

Social connectedness decay rate – the rate at which the SCI decreases to its baseline value (9.15) after investment in social connectedness programs ends. The default value (0.5) implies that the increase in the SCI due to social connectedness programs (i.e., the difference between the current SCI and baseline value) decreases at a rate of 50% per year.

Aboriginal population programs

Aboriginal population-specific social connectedness and community-based education programs. These programs are targeted versions of the corresponding whole-population interventions. Note that social connectedness and community-based education programs are implemented in combination by default; the separate effects of each type of program can be examined by setting the start year for the program that is not of interest to 2041 (e.g., the impact of social connectedness programs alone can be examined by setting the start year for community-based education programs to 2041).

Social connectedness parameters that can be modified 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%.

Social connectedness decay rate – the rate at which the SCI decreases to its baseline value (9.15) after investment in social connectedness programs ends. The default value (0.5) implies that the increase in the SCI due to social connectedness programs (i.e., the difference between the current SCI and baseline value) decreases at a rate of 50% per year.

Community-based education parameters that can be modified 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. The default value (1.585) is derived from Jorm et al. (2003, *Psychol. Med.* 33, 1071–1079), and assumes that education programs 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).
GP mental health services	Multiplies the annual rate of increase in the total number of mental health-related GP consultations that can be completed per week (i.e., across the whole Primary Health Network). The default value (1) corresponds to the business as usual case, in which services capacity continues to increase at the current rate, estimated using Medicare Benefits Schedule (MBS) data for 2012–2017 assuming services were operating at (near-) maximum capacity over this period.
Psychiatrist and allied services	Psychiatrist and allied services – multiplies the annual rate of increase in the total number of psychiatrist and allied services that can be provided per week. The default value (1) corresponds to the business as usual case, in which services capacity continues to increase at the current rate, estimated using Medicare Benefits Schedule (MBS) data for 2012–2017 assuming services were operating at (near-) maximum capacity over this period.
Psychiatric hospital care	Psychiatric hospital care – multiplies the annual rate of increase in the maximum number of psychiatric hospital admissions per week. The default value (1) corresponds to the business as usual case, in which services capacity continues to increase at the current rate, estimated using hospital separations data for 2011–2018 available from HealthStats NSW (http://www.healthstats.nsw.gov.au) and data on the provision of specialised psychiatric care in public hospitals published by the Australian Institute of Health and Welfare (available at: https://www.aihw.gov.au/reports-data/health-welfare-services/mental-health-services/data).
Community mental health services	Community mental health services – the annual increase in the total number of community mental health service contacts per 10,000 population that can be provided per week. The default value (0, corresponding to no capacity growth) was derived from service usage data for 2008–2017 published by the Australian Institute of Health and Welfare (available at: https://www.aihw.gov.au/reports-data/health-welfare-services/mental-health-services/data).