

# Supporting mental wellbeing with analytics and behaviour change

AIA Australia supported by Quantum Health



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# Glossary

**Early intervention:** interventions that are appropriate for and specifically target people displaying the early signs and symptoms of a health problem (e.g. a mental illness).

**Health:** a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity.

**Health promotion:** the process of enabling people to increase control over, and to improve, their health.

**Mental health or mental wellbeing:** a state of wellbeing in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively, and is able to contribute to his or her community.

**Mental health problem:** less severe and of shorter duration than mental disorders, but may develop into a mental disorder. Also interferes with a person's cognitive, emotional or social abilities, but to a lesser extent than a mental disorder. Mental health problems are more common mental complaints and include the mental ill-health temporarily experienced as a reaction to life stressors.

**Mental health promotion:** any action taken to maximise mental health and wellbeing among populations and individuals. It is concerned with enabling people to maximise their health potential through influencing environmental conditions.

**Mental illness or mental disorder:** a diagnosable illness that significantly interferes with an individual's cognitive, emotional or social abilities. Mental disorders are of different types and degrees of severity and some of the major mental disorders perceived to be public health issues are depression, anxiety, substance use disorders, psychosis and dementia. Mental disorders are diagnosed by standardised criteria, such as those contained in the Diagnostics and Statistical Manual of Mental Disorders (DSM-IV).

**Non-communicable disease (NCDs) or chronic disease:** diseases that tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioural factors. The main types are cardiovascular diseases (like heart attack and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes.

**Prevention interventions:** interventions that occur before the initial onset of a disorder to prevent the development of a disorder. Prevention interventions can be classified according to their target group as universal, selective and indicated.

# Foreword

## AIA Foreword

At AIA Australia our purpose is to Make a Difference in People's Lives. We pursue our dream of championing Australia and New Zealand to be the healthiest and best protected nations in the world by helping people live healthier, longer, better lives.

In recent years a steady rise in the rates of mental illness in Australia has been one of the major issues standing in the way of this dream – an increase we've seen borne out both in national statistics and in the growing number of mental health claims we receive. A lot of great work has been done to raise awareness about mental health, and it's vital that this work continues. We must keep looking for ways to help people manage and improve their mental wellbeing.

As a life and health insurer operating across 19 countries in the Asia-Pacific, AIA is committed to better understanding the factors that impact mental health and to working to improve mental wellbeing, both earlier on and more effectively. Understanding the changes in behaviour or circumstance that most influence risks of depression will enable us to identify behaviours that support mental wellbeing, and to develop programs that assist and incentivise positive action.

This is a goal that both the public and private sectors can unite on. This white paper has been based on the world's largest and richest study of the link between depression, demographics, health, lifestyle and circumstance. We're proud to have partnered on this work with Quantum, a world leader in data science and artificial intelligence. We want the white paper to be an insightful, industry-leading piece of research that can be used not only to inform our work at AIA Australia, but to assist governments and NGOs with the prioritisation of investment and development of policy aimed at improving mental health.

Our shared-value approach means that we put our efforts into projects and interventions that benefit not only our customers and our business, but society more broadly. We hope to collaborate with decision-makers, and the mental health sector, in leveraging the findings of the white paper to improve the wellbeing of Australians.

The white paper has also been produced as part of AIA Vitality's commitment to driving awareness of the importance of healthy behaviours. AIA Vitality is a proven, global, science-backed program that uses theories of behavioural economics to educate, support and incentivise members to better understand their health and make small changes that will help improve it over time. The program has had incredible success in Australia since its launch in 2014 and is continually evolving. The clear link between exercise and mental wellbeing is one of the reasons that a core pillar of the AIA Vitality program is to 'Move Well.' AIA Vitality also incentivises members to undertake mental wellbeing self-assessments.

The white paper highlights both the interplay between individual behaviours and mental wellbeing and the potential of evidence-based innovative solutions, such as AIA Vitality, to help educate, support and incentivise behaviour changes that might help people be more aware of, and improve, their mental wellbeing (for example, in sleep, exercise and diet). If we're able to do this we may be able to help people get the support they need sooner, or even to prevent them from experiencing poor mental health in the first place.

I'm excited and optimistic about seeing how we can make a difference through this paper, and similar ones for New Zealand – as well as through AIA Vitality more broadly – to help Australians and New Zealanders live healthier, longer, better lives. This work is only the beginning.

Take care and be well,



**Damien Mu**  
CEO and Managing Director,  
AIA Australia and New Zealand

## Quantium Foreword

Quantium Health is a global health analytics company. We work at the forefront of helping people and organisations to use data to drive better health decisions.

We are committed to increasing awareness and transparency – both towards the medical therapies that best treat illness, and the lifestyle and behaviour changes that individuals can make to reduce the risk of illness in the first place.

We are proud to have been involved in supporting AIA Australia with their innovative study, which has been powered by Discovery Health's very rich health and wellness data set. Importantly, while much research has looked at smartwatch data and depression incidence as standalone topics, we believe this is the first to combine the two at scale.

While this work looks specifically at how lifestyle affects risk of mental illness, we also plan to extend these analyses to cover a range of other important chronic illnesses, including obesity, diabetes, heart failure, musculoskeletal and respiratory problems.

This study is a great illustration of the power of large data sets to shed light on complex problems and identify solutions that can be implemented by professionals and affected individuals. We see data and analytics, when well deployed, as being real therapeutic tools – generating improvements in patient outcome as material as new medicines, diagnostic tests or surgical techniques.



**Neil Soderlund**  
CEO – Quantum Health

# Executive summary

Mental wellbeing is essential for communities to thrive. With mental illness representing the leading cause of disability worldwide, this is clearly a universal concern, and one that appears to be growing. So far, efforts to combat mental illness through intervention have primarily focused on treatment rather than prevention. Preventing the onset of depression and other mental illnesses thus represents an important public health priority.

In Australia the mental health landscape is complex. There are multiple determinants that influence mental wellbeing, and the personal, social and economic impacts of mental health issues are well known. Significant and increasing evidence supports interventions that promote mental wellbeing and prevent the root causes of mental illness throughout life. Approaches to promote mental wellbeing and reduce mental health conditions are both essential and should be complementary.

Risk of developing a mental illness is impacted by a combination of diverse factors – biological, psychological, social and environmental, among others. Effectively promoting mental wellbeing and preventing mental health conditions requires increased exposure to protective factors while decreasing exposure to risk factors. There is a definite need to quantify risk and identify individuals at high risk of developing mental health conditions. Once at-risk individuals have been identified, timely and effective preventive interventions must be delivered.

Primary prevention aims to address the causes of mental health conditions to prevent them from occurring at all. The advantage of primary prevention is that it is an upstream approach that reduces both morbidity and mortality rates, making them cost-effective and efficient. Targeting upstream causes of mental health conditions can influence policies that reduce a population's exposure to mental health condition risk factors. To improve health at the population level, preventive interventions must be scalable and cost-effective, transportable to a variety of settings, and deliverable without the need for highly-trained professionals.

Most mental illness develops in adolescence, which means that interventions focused on children and young people should be a key focus. Technology-based approaches have several benefits for increasing the public health impact of prevention programs.

The ability to calculate the risk of developing depression can improve understanding of the changes in behaviour or circumstances most likely to affect depression risk,

and therefore help to prioritise investment and policy into improving mental health. It could also enable incentivisation of behaviours that support mental wellbeing, with individuals at a higher risk of depression able to be identified using risk-profiling and risk prediction through data analytics. This can help to target and design effective prevention and early intervention programs to reduce the incidence, prevalence and recurrence of depression.

The growing availability of rich, longitudinal data sources and new techniques that enable very large datasets to be combined and analysed rapidly and accurately provides a new opportunity to deepen understanding of the major public health challenges facing society, such as mental health. In a study conducted by AIA Australia and Quantum, Discovery Health and AIA Vitality provided combined, rich, longitudinal data with advanced analytics to find more effective ways to help improve mental wellbeing and prevent avoidable episodes of depression.

The study combined health claims and biometric-tracked physical activity data including steps, heart rate and exercise type from Discovery Health and Vitality in the South African market. The data offered a unique source of insights into health and behavioural characteristics that can be used to understand depression risk. In total, the initial dataset investigated covers a population of over five million lives, including healthcare claims incurred over 10 years, equating to 1.5 billion lines of claims and activity data.

The objective of the study was to create an algorithm that calculates a mental wellbeing score for individuals, based on their circumstances and choices, to incentivise behaviour that supports improved mental wellbeing.

The most important factors found to drive higher depression risk include high levels of stress and insomnia, higher levels of health problems and days off work for illness, and unhealthy lifestyle choices including smoking, lack of exercise, and high levels of sugar consumption.

Key insights from the study are highly instructive to people at risk of depression and health funders and providers. They could assist in the:

- defining of risk factors for depression, including early-stage factors
- identifying of people with the highest risk, and
- providing of additional evidence for supporting interventions that are more likely to be effective among these populations.

The relative contribution of groups of factors (and their relative contribution to addressable change in risk) is:



**Exercise levels (64%)** – People who do more exercise, or who do it at a higher intensity, have lower risks of depression. Those who take 10,000+ steps have been found to have half the depression rate of those who take 2,000 or less.



**Sleep patterns (16%)** – People who sleep less than four hours a night have 32 per cent higher depression rates than those who sleep seven to eight hours.



**Diet (14%)** – People who consume three or more sugary drinks per day increase their risk of depression by 11 per cent.



**Smoking and alcohol use (6%)** – Current and ex-smokers have a 23 per cent higher risk of depression than non-smokers.

The depression-risk algorithm developed through this study can be used to power programs that engage individuals to improve their mental wellness by targeting the controllable factors (i.e. lifestyle choices). Lifestyle factors represent around a quarter of the depression impact and can therefore be incentivised for improvement. The potential opportunity to improve health outcomes is significant.

By undertaking a voluntary mental wellbeing assessment, people can increase their awareness of mental wellness and what they can do to protect and improve it. We can then tailor support and incentives to each person to achieve optimal impact.

Our research suggests that if the Australian population could practise at least average health habits, the national depression incidence rate could reduce from six per cent to 4.7 per cent. Such a reduction would result in 300,000 fewer depression incidences, leading to 4.7 million recovered working days and saving the Australian economy around \$3 billion per annum.

# Introduction

Mental health or mental wellbeing is essential for communities to thrive, yet one third of the world's adult population is believed to suffer from a mental health condition such as depression and anxiety. Depression represents the leading cause of disability worldwide. This is clearly a universal concern, and it appears to be growing.

In Australia, one in five people are impacted by mental health conditions<sup>1</sup>. Almost four million Australians suffer from a chronic or episodic mental health condition every year<sup>2</sup>. The Australian Institute of Health and Welfare (AIHW) measures the impact of disease on financial costs, mortality, morbidity and other indicators. Their research indicates that mental and substance abuse disorders ranked fourth (12%) in terms of causes of burden of disease, trailing only cancer (18%), cardiovascular diseases (14%) and musculoskeletal conditions (13%)<sup>3</sup>. In 2019, the draft report of the [Productivity Commission](#) estimated the daily cost of mental illness to the country to be \$500 million.

Depression, anxiety and substance use disorders are the most common mental health conditions in Australia. Most people who have had a major depressive episode will experience multiple episodes. The risk of recurrence increases with each subsequent depressive episode<sup>4</sup> while the time to recurrence decreases<sup>5</sup>. An average depressive episode is twenty weeks<sup>6</sup>, while people who have had at least one episode will have an average of four depressive episodes<sup>7</sup>.

Depression significantly impairs functioning, increases mortality from suicide, has significant social and economic consequences and is associated with elevated morbidity and mortality.

Efforts to combat depression through intervention have primarily focused on treatment rather than prevention. Despite the development of effective preventive interventions that target high-risk groups, poor reach and sustainability in the community have been issues. Sustainable preventive interventions that can impact population health are critical. Preventing the onset of depression thus represents an important public health priority, particularly given the lack of access to effective treatments for many people<sup>8</sup>.

In this paper we present new research that identifies unique insights into predicting depression risk using data analytics and technology. These learnings can be applied to assist with early identification and to inform behavioural interventions. Our research supports two areas highlighted by the recent [Lancet Psychiatry review](#):

- dual prevention of physical and mental comorbidities (large-scale interventions to reduce dual risk of physical and mental factors in high risk groups), and
- investigation of the use of digital technologies (for monitoring of risk and delivering lifestyle interventions).

# The issue

## The mental health landscape

In Australia the mental health care landscape is complex. Health and mental health sectors are poorly connected, while mental health services are delivered via public, private, non-profit organisations, the community, and family members.

Funding happens through the government, private health insurers, employers, charities, other agencies and individuals. This fragmentation leads to disparities, gaps and barriers to significant improvement in national health outcomes.

## Determinants

Determinants of health are the factors that influence how likely an individual will be to remain well or become unwell or injured. Three determinants of health are key: social (e.g. income, education, employment and social support); biomedical (e.g. weight and blood pressure), and behavioural (e.g. smoking and inadequate physical activity)<sup>9</sup>.

The World Health Organization (WHO) defines [social determinants of health](#) as “the circumstances in which people grow, live, work, and age, and the systems put in place to deal with illness. The conditions in which people live and die are, in turn, shaped by political, social, and economic forces”<sup>10</sup>. The social determinants of health influence mental and physical health: poor physical health can cause mental disorders, and vice versa.

Social determinants of mental health include factors such as housing, education, employment, income and social justice. These factors illustrate the complex interactions that shape mental health and wellbeing, as well as how good mental health can be promoted and protected<sup>11</sup>.

## Impact

The personal, social and economic impacts of mental health issues are well known, with mental health conditions able to significantly affect a person’s daily abilities to function due to changes in their thoughts, feelings, behaviours and physical health. These changes may be mild or moderate and vary in duration, and how people manage them can impact their personal and/or working life. The Productivity Commission estimates that the cost of mental health conditions and suicide to Australia is up to \$180 billion annually (or nearly \$500 million per day).

Mental health is a major driver of economic participation and productivity in this country, with links to income levels, living standards, social engagement and connectedness. In 2018, KPMG and Mental Health Australia’s [Investing to Save](#) report estimated that absenteeism and presenteeism cost Australian employers \$2.6 billion and \$9.9 billion respectively.

Improving mental health at the population level could have significant economic benefits over time.

**Poor mental health is a growing issue that reduces quality of life and life expectancy.**

## Critical success factors

Because most risk and protective factors are beyond the capacity of mental health and health services to control, strategies must address everyday issues such as income, social status, physical environments, social environments, education and educational settings, working conditions, family dynamics, genetics, personal health practices, coping skills, opportunities, and access to health services.

Historically, interventions have been reactive and focused on treatment. This has neglected the important role of mental health promotion and prevention of mental health conditions across the life-span. Solutions need to involve multiple sectors, including health, education, workplaces, housing and justice.

An increasing amount of evidence is supporting preventive interventions that promote mental wellbeing and prevent mental health conditions throughout life. The Lancet Psychiatry’s 2018 review, [Preventive strategies for mental health](#)<sup>12</sup>, presents a meta-analysis of the link between mental health conditions (including depression) and physical activity, alcohol, tobacco use, sleep and diet. The findings from this research are consistent with those presented in this white paper. The Lancet review calls for governments to help prevent mental illness by addressing behavioural factors (including physical activity), and by using new technologies. It sets out a blueprint for policy action by health services and ‘promising areas for future research.’

**The value of mental wellbeing promotion and prevention is significant.**

# Mental health promotion and early identification of risk

There needs to be a focus on supporting and improving mental wellbeing and preventing the root causes that lead to mental health conditions. Approaches to promoting mental wellbeing and reducing mental health conditions are both essential and should be complementary.

## Mental health promotion

Mental health promotion includes any action that aims to optimise mental wellbeing among populations and individuals. It motivates behaviour change in the pursuit of healthier lifestyles that decrease the risk of mental health conditions.

## Early identification of risk

Early identification can be achieved through screening, which needs to identify risk factors<sup>13</sup> and calculate a risk profile. The earlier this can be done, the better the chance of intervening with the right type of help at the right time.

## Mental health risk

Risk for developing a mental health condition is impacted by a combination of diverse factors – biological, psychological, social and environmental, among others. Effectively promoting mental health and preventing mental health conditions requires increased exposure to protective factors while decreasing exposure to risk factors<sup>14, 15</sup>.

- **Protective factors** influence whether a person who is exposed to a risk factor will develop a mental health condition. Increasing a person's exposure to protective factors, such as resilience, can help to prevent mental health conditions.
- **Risk factors** are characteristics and exposures that put an individual's mental health at risk. Preventing mental health conditions requires identifying and modifying risk factors. Some risk factors are non-modifiable, such as age and gender. Other risk factors are modifiable – either by the individual, such as lifestyle behaviours, or by other mediators, such as the government via policy<sup>14</sup>.

Exposure to a risk factor does not necessarily result in a mental health condition as protective factors may help to reduce the risk. Effective prevention therefore demands an understanding of the risk and protective factors for mental wellbeing and mental health conditions, identifying groups and individuals who can potentially benefit from interventions and developing, disseminating and implementing helpful interventions. Identifying and understanding risk factors can inform the parameters for interventions that, ideally, simultaneously improve protective factors, reduce modifiable risk factors and support people's managing of non-modifiable risk factors<sup>14</sup>.

## Quantification of risks

There is a definite need to identify and quantify risk factors that are relevant to mental health conditions<sup>16</sup>. Large-scale, population-based studies that have the power to calculate the population-attributable risk of specific mental health conditions from modifiable risk factors are important for informing population-based prevention strategies – particularly for primary prevention. These developments could help health practitioners identify individuals at high risk of developing mental health conditions. This research can also inform risk factor equations, assessment tools and treatment algorithms that direct allocation of investment and resources. They could also be used to update widely-used risk assessment tools such as the AUSDRISK (for five-year diabetes risk) to include mental health parameters<sup>16</sup>.

**There are lead indicators (lifestyle, behavioural, demographic) that correlate to risk of developing mental illness. The impact of these can be quantified.**

# The AIA Australia–Quantum study

## Background

Many risk factors for depression have been identified in the past, but there has been no way of measuring how they result in risk for any individual person. Therefore, interventions have been aimed at moving everyone to the lower-risk end of the spectrum for risk factors.

The ability to calculate the risk of developing depression can increase understanding of those changes in behaviour or circumstances that make the most difference to depression risk, thus helping the prioritisation of investment and policy into improving mental health. It could also enable incentivisation of behaviour that supports mental wellbeing.

Individuals who have a higher risk of depression can be identified using risk-profiling and risk prediction through data analytics. This can help with the targeting and designing of effective prevention and early intervention programs to reduce the incidence, prevalence and recurrence of depression.

The study detailed below identifies specific risk factors that predict the incidence of the first two depressive episodes. The findings have informed a predictive algorithm based on data analytics. The insights can be used to support targeted health promotion, primary prevention and early intervention.

## Objective

The objective of the study was to create an algorithm that calculates a mental wellbeing score for individuals, based on their circumstances and choices, to incentivise behaviour that supports better mental wellbeing.

We selected depression as the specific condition to investigate for this study. Our findings indicated the following:

- Prevalence – one in seven Australians (between the ages of 16 and 85) will experience depression in their lifetime, and one in sixteen in any given year.
- Severity – a depressive episode impairs functioning, is associated with elevated morbidity and mortality, increases mortality from suicide, and has significant social and economic consequences. Beyond this, it has a broader impact on families, employers and society.

## Literature review

A review of existing studies was undertaken to increase and inform our understanding of factors that have a potential link to depression risk. The focus of the review was on published studies investigating the connection between depression and behaviour. A total of 121 published papers from peer-reviewed

sources were reviewed, 74 of which were deemed relevant and selected for further investigation. From these, 26 feature groups were prioritised for consideration of inclusion in the model.

In general, the literature suggests that a set of health, lifestyle, and exercise factors, as well as previous depression, are connected most strongly with depression risk:

- *Health* – chronic and serious illness, diabetes, heart disease, pain, current or recent pregnancy
- *Diet* – Body Mass Index (BMI) and dietary choices
- *Lifestyle* – smoking, alcohol, diet, sleep
- *Circumstance* – bereavement, unemployment, and
- *Exercise* – activity (intensity, duration and frequency).

This review also highlighted the limitations of existing research that could be addressed through this study, specifically:

- A focus on severe depression to the exclusion of less severe diagnoses.
- Limited risk-adjustment with some studies only allowing for differences in a few factors (typically, age<sup>17</sup>, age and gender<sup>18</sup>, or race and gender<sup>19</sup>).
- Few factors or only a single factor investigated – for example, body weight<sup>20</sup>, alcohol use<sup>17</sup>, cholesterol<sup>21</sup> or exercise levels<sup>22</sup>.
- Small and/or specialised study cohorts investigated – for example, medical students at a single university, or sub-populations, such as those in extreme poverty or the elderly<sup>23, 24</sup>. Some studies derived conclusions based on fewer than 100 participants<sup>25, 26</sup>.
- Limited verified data collection in larger studies – for example, self-reported information such as body weight, depression, and comorbidities (e.g. diabetes) for inclusion<sup>27</sup>.

Our literature study did not uncover any publications that have investigated interactions between multiple choices, circumstances and health factors, as has the AIA Australia–Quantum study, nor one that covered as large a cohort of individuals, over as many years, as linked to their verified health status.

*The HUNT Cohort study<sup>28</sup> is the most recent and relevant study to investigate the link between activity levels and depression. This study tracked a large population (33,908 adults) with no previous symptoms of mental disorders or limiting physical health conditions over an 11-year period. The data considered included validated measures of exercise, depression, anxiety and a range of potential confounding and mediating factors. This study found that regular leisure-time exercise was associated with reduced incidence of future depression; specifically, 12 per cent of future cases of depression could have been avoided if all participants had engaged in at least one hour of physical activity each week.*

# Data

## Overview

The growing availability of rich, longitudinal data sources and new techniques that enable very large datasets to be combined and analysed rapidly and accurately provides a new opportunity to deepen understanding of the major public health challenges facing society, such as mental health. This study was made possible by bringing together rich, longitudinal data assets and the combined expertise of AIA Australia, Discovery Health and Quantum Health to use advanced analytics to help improve mental wellbeing and prevent avoidable episodes of depression.

Discovery Health is an innovative health insurer. Based in South Africa, it has business operations and partnerships around the world. Vitality is a global wellness program provided to members of Discovery and partners, such as AIA Australia, that offers incentives for achieving health and lifestyle goals.

Discovery Health and Vitality data offers a uniquely rich source of insight into health and behavioural characteristics that can be used to understand depression risk. The study combined health claims and biometric-tracked physical activity data including steps, heart rate and exercise type from Discovery Health and Vitality in the South African market.

In total, the initial dataset investigated covers a population of over five million lives, including healthcare claims incurred over 10 years and equating to 1.5 billion lines of claims and activity data.

Throughout this process, strict protections were put in place to protect the privacy of individuals and the security of their data. For instance:

- All personal information (names, dates of birth, membership numbers, addresses) were removed from the dataset to ensure there was no way to identify individuals.
- All free text fields (i.e. in the biometric recordings) were removed to prevent sharing of potential personal information that could be captured in those fields.
- All data was stored on secure servers and in accordance with the agreed governance protocols.

The study considered a wide range of data to determine both the health and behavioural links to depression risk. These include:

- Health claims – doctor and specialist visits, diagnoses, medication, hospitalisation, psychologist visits.
- Vitality biometric – data collected from a physical activity recording device, including daily steps, heart rate, speed, activity types.
- Vitality questionnaire – questions about lifestyle choices and circumstance, including eating habits, sleep patterns, smoking, alcohol use and stress levels.
- Vitality demographics and health metrics – demographic indicators and measures of physical health, including age and gender, health metrics recorded and verified by health professionals, BMI, cholesterol levels, blood sugar and blood pressure.

Appropriate exclusions and adjustments were made to the data to reduce potential biases in the model<sup>a</sup> and to boost its power to predict new diagnoses of depression occurring in the context of the Australian population<sup>b</sup>.

## Relevance of the study in the Australian context

Despite the differences between South Africa and Australia (for example, in demographics, culture and socioeconomics), this data provides a reasonable proxy and starting point for Australia in terms of depression prevalence. This is seen through a comparison of prevalence in the national and working populations. For instance, the national depression rate in 2017 is slightly lower in South Africa (4.6%) than Australia (5.9%)<sup>29</sup>. Similarly, depression prevalence in the working population is similar between Australia (6.2% in 2007)<sup>30</sup> and South Africa (4.9% in 2009)<sup>31</sup>.

a For instance, people in active treatment for depression were excluded, and a separate algorithm was developed for anyone with a history of depression.

b Specific comorbidities were excluded (including cancer, HIV, severe mental illness), and data considered was limited to individuals of Australian working age (16-65 years old).

# Methodology and approach

## Model design

Predictive models were designed to optimise their predictive power and optimise their applicability to real-world deployments. Key decisions taken were:

- to predict the likelihood of a depression diagnosis in a one-month period
- to treat the prediction of individuals with past depression diagnoses differently to those without past diagnoses, and
- to consider participants' data over relevant periods:
  - Medical (claims) history – three years
  - Circumstance and lifestyle (activity) – six months
  - Questionnaire data (health indicators/characteristics and self-reported lifestyle data) – most recent response.

Features were grouped into five categories considered to be potentially connected to depression risk: Demographics, Seasonality, Lifestyle, Exercise, and Health.

## Modelling approach

An iterative modelling process tested each feature for significance in predicting depression. The machine learning approach used a gradient boosting machine (GBM) model to improve predictive power and manage the large dataset. In total, around 1,400 features were created using the various datasets available (demographic, health, biometrics and questionnaire).

## Model performance

The algorithm makes it possible to target individuals at the highest risk of depression. By focusing on the top tenth percentile of those at the highest risk of the condition, the algorithm will capture 40 per cent of the group most likely to suffer from it. This allows for more efficient intervention targeting.

# Results and implications for mental health policy and programs

## Findings on risk factors for depression

In general, the study substantiates commonly accepted truths that there's a correlation between lower depression rates and healthier choices (e.g. more exercise, less unhealthy food, not smoking) and happier circumstances (e.g. less stress, fewer sleeping problems, less personal or family illness). The final model identified 41 features (out of a total 1,400) as being highly significant in reducing mental wellbeing and predicting risk of depression. These include:

- Depression rates in women being almost double that of men.
- People who have previously been diagnosed with depression being re-diagnosed at rates 20 times higher than those who have never been diagnosed.
- The rate of depression increasing 1.5 times among those who have a very ill family member.

The most important factors found to drive higher depression risk include high levels of stress and insomnia, higher than average levels of health problems and days off work for illness, and unhealthy lifestyle choices including smoking, lack of exercise, and high levels of sugar consumption.

## Implications for policy and programs

Key insights from the study are highly instructive to people at risk of depression, and to health providers and funders. They could assist with the:

- defining of risk factors for depression, including early-stage factors
- identifying of people with the highest risk, and
- provision of additional evidence for supporting interventions that are more likely to be effective among these populations.

The depression-risk algorithm developed through this study can be used to power programs that engage individuals and improve mental wellbeing by targeting the controllable factors (lifestyle choices) that represent around a quarter of the depression impact and can be incentivised for improvement. The potential opportunity is significant.

## Selected insights

Our research suggests that if the Australian population could practise at least average health habits, the national depression incidence rate could reduce from **six per cent to 4.7 per cent**. Such a reduction would result in **300,000 fewer depression incidences**, leading to **4.7 million working days recovered** and saving the Australian economy around **\$3 billion** per annum. This is based on our findings regarding non-controllable and potentially controllable risk factors.

## Non-controllable risk factors

70% of depression risk is linked to factors outside the individual's control. These factors include:



Gender – females have a higher depression risk than males.



Age – while older individuals in the dataset were more likely to be depressed, this is explained by non-age features such as stress and comorbidities.



Illness – individuals facing health concerns have an increased risk of suffering from depression, including when it's a family member who has a serious illness.

## Controllable risk factors

We determined the relative impact of behaviour changes associated with a reduced risk of depression by simulating the change in population risk from below average levels to the average level. The impact of these changes is to reduce the predicted depression level by 30% for the population.

The relative contribution of groups of factors (and their relative contribution to addressable change in risk) is:



**Exercise levels (64%)** – People who do more exercise, or who do it at a higher intensity, have lower risks of depression. Those who take 10,000+ steps have been found to have half the depression rate of those who take 2,000 or less.



**Sleep patterns (16%)** – People who sleep less than four hours a night have depression rates 32 per cent higher than those who sleep seven to eight hours.



**Diet (14%)** – People who consume three or more sugary drinks per day increase their risk of depression by 11 per cent.



**Smoking and alcohol use (6%)** – Current and ex-smokers have a 23 per cent higher risk of depression than non-smokers.

## Limitations and suggestions for future studies

Several enhancements could be made to the depression-risk algorithm that would enhance its predictive power and applicability to a wider range of real-world settings.

These include:

- Addressing limitations in data quality and coverage from health claims, self-reported data, and other data not available – for instance, replacing self-reported sleep with biometric data from wearable devices.
- Accounting for potential biases from geographic differences between countries, and self-selection in the Vitality program.

- Creating a defined control population.

## Looking upstream

While all types of prevention have value, the advantage of primary prevention is that it is an upstream approach. Upstream approaches focus on an outcome across an entire population in a community and emphasise a range of influences across different sectors in the environment that impact behaviour. This approach does not focus on targeting mental health conditions as such, but instead targets the reduction of risk factors that impact mental health conditions. Such upstream approaches have benefits beyond mental health, reducing both morbidity and mortality rates and making them cost-effective and efficient.<sup>32</sup>

Targeting upstream causes of mental health conditions can influence policies that reduce a population's exposure to mental health condition risk factors. Upstream approaches are likely to be the most effective approaches because they aim to change social, economic and structural factors that lead to mental health conditions. This results in a modified distribution of risk factors at a population level. Public health efforts to reduce exposure to these risk factors depend significantly on community and individual-level interventions<sup>8</sup>. Influencing policy may be the most effectual way to do this.

To improve health at the population level, preventive interventions must be cost-effective, transportable to a variety of settings, and deliverable without the need for highly-trained professionals<sup>8</sup>.

Certain settings have better potential for delivering effective preventive interventions, especially for screening and administration. Settings with significant potential for early identification and prevention include schools, workplaces, primary care clinics, and specialty clinics where mental health conditions are common (e.g. cardiology and endocrinology)<sup>8</sup>.

Most mental ill-health develops in adolescence, which means that the implementation of interventions focused on children and young people should be prioritised – for instance, parental education around modelling behaviour and family participation programs to reduce risk factors early in life. Schools, particularly middle and senior schools, have large numbers of adolescents at a higher risk of developing mental health conditions, particularly depression<sup>8</sup>.

Technology-based approaches, such as those delivered online, have several benefits for increasing the public health impact of prevention programs. These include standardisation of delivery, which allows control over how the intervention is delivered. In addition, remote clinicians could be used to provide individualised feedback, which allows the extension of reach without compromising clinical monitoring<sup>33</sup>.

## Existing products and solutions

Several products and solutions available on the market claim to use Artificial Intelligence (AI) to predict depression risk. These include:

- Chatbot apps with self-help tools – e.g. Ginger.io, Tess, Wysa, Woebot (the first two also include referrals for assistance).
- Mindstrong Health to track risk of relapse in previously diagnosed individuals.
- VMHC2 to help mental health professionals who treat veterans to measure depression and stress through screening tools.
- Marigold Health, which facilitates support groups through text-based support and triage for escalation.

However, most are limited in that they use only self-reported information, are unable to pinpoint the earliest symptoms of depression, or do not adjust for other key factors such as comorbidities, demographics, sleep, activity and lifestyle.

# Shifting the focus towards preventive strategies

The **Lancet Psychiatry's** 2018 review, [Preventive strategies for mental health](#), summarises the aims of prevention in mental health as reducing the incidence, prevalence, and recurrence of mental health disorders and their associated disability.

Aligned with this, we propose three core recommendations.

## Core recommendations

### 1 **Improve access to mental health promotion activities for everyone**

We recommend expanding the reach of mental health promotion from the individual level to the community level. Strategies for advancing upstream, community-level, primary prevention strategies to promote community wellbeing could include influencing policy and legislation, changing organisational practices, fostering coalitions and networks, educating providers, promoting community education and strengthening individual knowledge and skills<sup>14</sup>.

### 2 **Increase awareness and engagement with mental wellbeing**

We recommend increasing engagement on the topic of mental health. By increasing awareness of risk factors and behaviours, and by providing relevant feedback, nudges and support where appropriate, we can help those at risk get the help they need at the right time.

### 3 **Intervene with behaviour change strategies**

As stated in the [2019 Lancet Psychiatry's Commission: a blueprint for protecting physical health in people with mental illness](#), modifiable behaviours, such as physical activity, diet and smoking, are increasingly being recognised as fundamental to both physical and mental health.

Delivering programs to large groups of individuals without the need for trained professionals will help to minimise costs and maximise sustainability<sup>8</sup>.

We recommend targeting modifiable risk factors with behaviour change strategies based on behavioural economics and clinical evidence in community settings, such as schools and workplaces using technology-based approaches.

**Interventions that focus on behaviour change are critical.**

# A note from Professor Ian Hickie

If we are to reduce the very substantial social and economic impact of common mental disorders such as anxiety and depression – there exists an urgent need to move from the increased provision of treatments for those who are already ill to the widespread uptake of effective prevention and early intervention strategies. Targeting the most common and disabling mental disorders, notably depression, is also essential if we are to see real gains across the population. Depression accounts for premature death through its direct associations with suicide and accidental death, but also through its links to cardiovascular disease, tobacco smoking, diabetes and other metabolic disorders. Even more importantly, depression accounts for the largest adverse impact of any mental disorder on social and economic participation, directly affecting mood, motivation, cognition, social engagement, sleep and energy levels. It is also indirectly associated with alcohol and other substance misuse and other physical health problems.

To date, few communities, governments and public or private organisations have been willing to make best use of 21st-century digital technologies, data analytics and personal engagement strategies to enable people to take effective actions. For individuals, families or communities to take effective personal action, they need detailed information that helps them focus their efforts on strategies that work: personal information that really spells out actual risk and guides one to take specific actions. This is a critical first step. Consequently, the development of smart risk calculators based on large, substantive and informative data sets is essential. Those calculators need to be available to individuals so they can determine their own level of risk and which strategies may be most relevant to their personal situation.

Increasingly, there is worldwide evidence that a range of very specific strategies that focus on increased levels of physical activity (preferably every day!), improved sleep patterns, reduced use of alcohol and other drugs, increased social engagement and regular eating patterns tied to healthy diets have the potential to reduce an individual's chance of developing a first or recurrent episode(s) of depression. The earlier in life these strategies are employed, the more likely they are to be effective – it's particularly important that they are emphasised during a person's adolescence and early adult life.

Additionally, these strategies are most pertinent to those who may be at high risk due to other factors – for example, family history, past episodes of anxiety or depression, or the presence of another chronic physical illness (e.g. arthritis, chronic pain, diabetes). Individuals may also be at increased risk when facing very specific challenges such as childbirth, job loss, financial stress, caring for a sick or disabled relative, onset of a new physical illness (e.g. cancer therapy, post-infective illness) or break-up of intimate relationships. Being able to employ strategies specific to one's needs can significantly reduce the risk of depression in these circumstances.

The strategies outlined in this white paper are a clear example of 21st-century approaches that have a real chance of making a difference. They are the types of approaches that now need substantial support from agencies with the capacity to support their application at community levels.

**Professor Ian Hickie,**

Professor of Psychiatry, Central Clinical School, Sydney Medical School, Co-Director, Health and Policy, Brain and Mind Centre, NHMRC Senior Principal Research Fellow.

# Opportunities

*It always seems impossible until it is done.*

Nelson Mandela

Despite its substantial health impact, strategies to prevent depression remain fragmented and sub-scale, with limited public awareness of how best to prevent harm. Given the increasing awareness and incidence of mental illness, this is a ripe opportunity: now is the time to pursue actionable ways of preventing depression and other mental health conditions.

Increasing data availability and emerging analytical techniques are providing new ways to understand the mental health challenges facing society. By combining promising community-level preventive strategies with emerging research and an increasing commitment, we can transform mental health. Collaboration across communities and other sectors can alleviate individual, familial, and community distress and increase population health and wellbeing.

This study has developed a framework to quantify depression risk in terms of modifiable behaviours. This allows participants to understand the impact of their choices, and for appropriate support and incentives to be provided through a program such as AIA Vitality.

A shared-value model, where incentives drive better behaviour and the cost savings that result from this improved behaviour in turn fund these incentives, can dramatically impact people's choices. With the right incentives in place, people can be encouraged to be healthier. We now need to make this a reality.

The scale of depression highlights the need for effective strategies that can impact as many people as possible. Policymakers can apply these insights to focus on cost-effective prevention rather than more expensive cure approaches.

Promoting mental wellbeing and preventing mental health conditions is relevant to all. The range of potential risk factors involved means that multiple sectors can play important roles and benefit from effective initiatives.

Transparent communication and proactive engagement with all stakeholders are essential to effectively identify synergies, create collaborations and share insights.

## AIA Australia's commitment

AIA Australia's commitment to making a difference in mental health spans the continuum, from prevention to treatment. This innovative strategy is focused on finding evidence-based approaches to shift efforts upstream to mental health promotion, prevention and early intervention.

We understand that instant gratification, short-term costs and misplaced optimism result in many people making decisions that ultimately lead to negative health outcomes. We are also convinced of the need to translate the latest science into actionable steps that will have the greatest impact for the most people.

At AIA Australia we believe we have a social responsibility, as underpinned by our shared-value approach, to help people improve their health. This white paper is one step along the path to better outcomes for our customers and our broader community. And it's one that will require ongoing advocacy and collaboration.

Along with our partners, we want to change the way people experience insurance – a commitment embodied by the AIA Vitality program.

# AIA Vitality

Vitality is the world's largest behaviour change platform linked to financial services. Built on behavioural economics and actuarial science, and with a stated purpose of helping people become healthier and enhancing and protecting their lives, the program supports, guides and incentivises members through three steps: *Know your health*; *Improve your health*, and *Enjoy the rewards*. Members earn Vitality Points by engaging in the program. As they accumulate points, members advance through status levels, which in turn unlock greater financial and lifestyle benefits.

The clinical integrity of the program is maintained through ongoing reviews of the latest research, and the program's results have been academically validated across various publications.

By focusing on four core pillars: physical activity (Move well), nutrition (Eat well), mental wellbeing (Think well) and preventive screening (Prevent well), the program addresses and integrates the key modifiable behaviours that impact physical and mental wellbeing.

From a mental health perspective, the program incorporates the clear evidence linking physical activity and mental wellbeing by incentivising members to be more active. The incentives are founded on reducing common financial barriers that make it harder to engage in physical activity – for example, by discounting both wearable devices that help members monitor their activity and also the membership fees of partner gyms. AIA Vitality members are also eligible to earn AIA Vitality Points for assessing their physical activity levels and reaching physical activity goals – for example, by hitting daily step counts, participating in sporting events and tracking

their sleep with a wearable device – and for undertaking mental wellbeing self-assessments, several of which focus on depression and anxiety. The mobile delivery of the program underscores AIA Australia's recognition that all Australians should have access to mental wellbeing support, regardless of where they live and work. AIA Vitality engages and educates people to act in ways that otherwise wouldn't be possible.

AIA Australia intends to leverage the insights from the research conducted with Quantum to further enhance our mental wellbeing offering. Early identification through risk profiling and personalised recommendations will help to support improved mental health outcomes by informing relevant and timely behaviour interventions – for example, through physical activity, diet and sleep.

Someone with circumstances shown to increase mental health risk (e.g. with family members experiencing poor health) could benefit from further clinical interventions. Other potential benefits include identifying people who need support from mental health professionals and incentivising and providing that support.

By incentivising members with frequent rewards, AIA Vitality encourages people to shift their behaviour towards healthier outcomes – a benefit for individuals, insurers and society.

**AIA Vitality helps individuals thrive by driving promotion, early intervention and prevention through behaviour change.**

# Conclusion

We are all responsible for reducing the stigma of mental health issues and promoting mental health and wellbeing. To achieve this, we must move towards best practice in physical and mental health, pursuing policies and initiatives at the population level that encourage early intervention at instances of ill-health and help prevent them occurring in the first place.

Understanding the determinants of healthy behaviour is important because of the role it plays in influencing overall health status. By addressing the grassroots of mental health issues and looking at it at a behavioural level, we will be able to improve the wellbeing of the wider community. We need to shift the focus towards a preventive mindset, increasing awareness among the public through health promotion and supporting initiatives for improved health through innovations across all sectors. Without this transformation, quality of life will continue to be impacted and costs related to mental health issues will continue to increase.

A mentally healthy society is achievable; we currently have a unique opportunity to leverage our understanding of the power of behavioural science and technology to help people thrive. We simply cannot wait any longer – intentional, effective, population-wide mental health prevention must happen now.

To make this happen we need more proactive and multi-sector collaborations to balance upstream and downstream efforts. Adopting a shared-value approach will help encourage the exchange of knowledge and the development of innovative interventions across these sectors, both of which are implementable at a broad community level.

We hope this paper helps to catalyse cohesive commitment to act on the increasingly evident potential of preventive measures to transform Australia's mental health landscape.

# Appendices

## Appendix 1: The history of proposed reforms in Australia

Intervention has been on the Government's radar for more than a decade, though little has come to fruition in terms of broad and impactful programs.

Over ten years ago, Australia's [2008 National Mental Health Policy](#) envisioned a mental health system that would prevent and detect mental illness at an early stage. One of the system's aims was to promote the mental health and wellbeing of the Australian community and, where possible, to prevent the development of mental health problems and mental illness.

The [National Mental Health Commission's](#) review of Australia's mental health system in 2014 showed a strong focus on treatment and disability management as opposed to prevention. Investment is heavily weighted towards acute care and crisis responses, both of which are costly and limited in their scope and reach. Only \$90.6 million – less than one per cent of the AUD\$9.5 billion invested by the government on mental health – was used for programs in the 'prevention, health promotion, self-help and education services and programs' category.

The 2017 [Fifth National Mental Health and Suicide Prevention Plan](#) set out to achieve outcomes in eight priority areas. It listed effective promotion, prevention and early intervention as key elements underpinning the [National Consensus Statement](#) for improving the physical health of people with a mental illness.

[Australia's Long-term National Health Plan](#) 2019 acknowledges the need to focus more on prevention within

the health system, with a key aspect being early detection. The plan aims to achieve this through the development and implementation of a National Preventive Health Strategy, stating that mental health should rate alongside physical health in the health system. The third of four pillars in the reform plan prioritises mental health and preventive health, with an emphasis on prevention, early intervention and recovery. The private sector has also acknowledged the need for more to be done to prevent and intervene in the early stages of mental health conditions.

KPMG's [Investing to Save](#) report 2019 outlined three recommendations for reform, the third of which is "Invest in promotion, prevention and early intervention." A sub-recommendation emphasises the need to build the evidence base for promotion by identifying quality and effective interventions. Data, research and evaluation should be improved by considering predictive analytics to identify populations who are at-risk and better target interventions to high-risk populations, as well as researching universal interventions that promote mental wellbeing by building resilience. E-health solutions are recommended for delivery of interventions as part of the mainstream service delivery. The report noted that investment in early intervention would begin to shift mental health spending, with spending on acute care reducing over time.

Aligned with this vision, the Shared Value Initiative's 2019 report [Creating shared value: the business imperative to improve mental health in Australia](#), recommends a "greater focus on integrated and proactive approaches to promoting mental health, rather than solely addressing mental ill-health."

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## **University of Sydney**

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