A Better Start *National Science Challenge*

E Tipu e Rea

REVISED RESEARCH AND BUSINESS PLANS



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Tā Apirana Ngata



Tā Apirana Ngata (1874 - 1950)

E tipu e rea mō ngā rā o tō ao

Ko tō ringa ki ngā rākau a te Pākehā

Hei ora mō te tinana

Ko tō ngākau ki ngā tāonga a ō tīpuna Māori

Hei tikitiki mõ tõ māhuna Ko tõ wairua ki tõ atua, Nānā nei ngā mea

katoa

– Tā Apirana Ngata

Grow and branch forth for the days destined to you Your hands to the tools of the Pākehā for the welfare of your body Your heart to the treasures of your ancestors as adornments for your brow

Your spirit to god, who made all things¹

¹ Source: http://www.canterbury.ac.nz/maoristudents/support/Ta_Apirana.shtml/

GLOSSARY AND ACRONYMS

Māori	English		
Нарū	Subtribe, clan		
Hauora	Health and well-being		
Hui	Meeting		
Iwi	Peoples, nations, tribe; Iwi form the largest social units in Māori culture		
Kāhui	Māori advisory group for the Challenge		
Kaumātua	Iwi elder		
Kaupapa Māori	Theory and praxis stemming from being and operating as Māori to bring about transformation through research.		
Māramatanga	Seeking information, enlightenment, insight, understanding, meaning, significance.		
Mātauranga	Education and learning		
Mātauranga Māori	The knowledge, comprehension, or understanding of everything visible and invisible existing in the universe		
Tamaiti	Child		
Tamariki	Children		
Tauiwi	Foreigner, European, non-Māori.		
Tikanga	Correct procedure, custom, habit, protocol.		
Whānau	Family/families		
Whānaungatanga	Building relationships		

Acronym	Meaning
BeST	Better Start – E Tipu e Rea
BLISS	Baby-Led Introduction to SolidS
CoRE	Centre of Research Excellence
EOG	Establishment Oversight Group
EOS	Establishment Oversight Subgroup (tasked with providing working governance on behalf of EOG and reporting to EOG)
GUiNZ	Growing Up in New Zealand
HABITS	Health Advances through Behavioural Intervention TechnologieS
HUMBA	Healthy Mums and BAbies
HRC	Health Research Council
MBIE	Ministry of Business, Innovation and Employment
MInT	Motivational Interviewing in Treatment
NIPPER	Nutritional Intervention Preconception and in Pregnancy to improvE offspRing outcomes
NSC	National Science Challenge
POI.nz	Prevention of Obesity in Infancy study
PredPrev	Prediction and Prevention of early childhood obesity
RfP	Request for Proposals
SAP	Science Advisory Panel
SLT	Science Leadership Team
SPARX	Smart Positive Active Realistic and X-Factor Thoughts

A Better Start – E Tipu e Rea

OVERVIEW

OVERVIEW

THE CHALLENGE

Tamariki (children) and young people are Aotearoa² New Zealand's future. Ensuring all tamariki transition to adulthood on a trajectory to a healthy and successful life will benefit all aspects of New Zealand's health, well-being and economic life. On the contrary, when tamariki have health, learning and behavioural challenges their lifecourse is likely to be altered, amplifying the risks and costs of diseases such as obesity, diabetes, heart disease, mental health disorders, as well as poor educational outcomes and reduced employment opportunities.

New Zealand has a significant proportion of tamariki and young people with health, educational and mental health vulnerabilities. These vulnerable tamariki are concentrated in low socioeconomic communities with a disproportionate burden falling on Māori and Pacific communities.

The challenge for A **Be**tter **S**tart – E **T**ipu e Rea (**BeST**) is to identify critical health, education and mental health issues that, if prevented or effectively identified and resolved, would have a major positive impact on the vulnerable tamaiti's lifecourse trajectory. Within the constraints of the challenge funding BeST. has identified that childhood obesity, early literacy and behavioural problems are critical areas to focus on, are amenable to research-based interventions and can lead to vastly improved outcomes for the individuals and society. The rationale for these choices is outlined in the Research Plan. The importance of investing in evidence-based care of our tamariki was highlighted in the Health Select Committee's 2013 report "Inquiry into Improving Child Health Outcomes and Preventing Child Abuse" (1). The report identified that improvements were required in nutrition and obesity, early education and well-being in very young tamariki and that further research was required across these domains to improve outcomes. These domains are central to our Challenge's three themes of obesity, literacy and mental health.

Our high level approach is to work from a strengths-based model and identify factors that contribute to successful outcomes for vulnerable tamariki, their whānau and communities, in addition to identifying determinants of risk. The feasibility and acceptability of potential interventions that will facilitate educational success and healthy well-being in vulnerable tamariki will be tested. Findings from pilot interventions will inform large scale community-based trials that will provide the evidence for national policy and delivery agencies to implement and to bring about positive change.

Our approach will embrace Vision Mātauranga by fostering connections between indigenous and western scientific processes and perspectives. It is proposed that the research will take place within a framework of ethical values and bicultural perspectives that encompass knowing, valuing, doing, caring, and sharing resources and responsibilities in the quest for a better start to life. Ngata's 'e Tipu e Rea' refers to how health and education advancement, would benefit by reapplying learnings from the worlds of the Treaty partners, resulting in improved outcomes for both cultures. Our Vision and Mission reflect this approach.

BeST recognises that it must do more than the proposed research to define and test potential solutions. It must also advocate for, work in partnership with communities of practice in co-constructing design and implementation of the solutions to ensure the key research findings are translated into long term outcomes. The cornerstone elements of BeST (including scope/domain/roles/impact statement and aspirational outcomes) are outlined following the Vision and Mission below. If we are successful we will set New Zealand on a pathway of preventing and reducing childhood obesity and improving literacy and mental health and well-being.

² Aotearoa, the original (indigeous Māori) name for New Zealand, literally means 'land of the long white cloud'.



For young New Zealanders to have a healthy and successful life and a positive transition to adulthood.

MISSION AND AIMS

To predict, prevent and treat vulnerability in obesity, poor literacy and mental health through research excellence that will achieve healthy, well-adjusted and well-educated tamariki and young people.

We aim to achieve our mission by taking both a life course and a "braided river" approach to integrate themes, research disciplines and both western and indigenous models of knowledge and practice as well as incorporating the use of digital technology into our proposed solutions.

Our primary aims are:

- To determine characteristics, associations and predictors of biological (manifest as obesity), social, psychological and educational vulnerability in tamariki and adolescents that will inform policy, health and education intervention strategies to improve the potential for young New Zealanders to have a healthy and successful life;
- To develop culturally responsive research-based interventions that will result in Government and sector policy changes that will be implemented within the community;
- To unlock the science and innovation potential of Māori knowledge, resources and people for the benefit of New Zealand through focusing on enhancing hauora (health and well-being) and Mātauranga (education and learning) in vulnerable tamariki.

DOMAIN AND SCOPE OF OPERATIONS

Our domain is any aspect of obesity, literacy and mental health relevant to tamariki and young people.

Our scope of operations includes:

- Establishing a national research collaboration and virtual centre of excellence that provides robust evidence and advice for policy, service delivery and practitioner change to improve outcomes for young people;
- Investing in research, science or technology or related activities to achieve our mission;
- Working with stakeholders, practitioners and communities (including Māori and Pacific people) to ensure the relevance of the research and its translation to facilitate achievement of social, educational and health impact.



Given the mission, domain and scope of operations as well as the expectations defined within the Request for Proposal (RfP) and Science Board feedback we see ourselves playing several roles:

- Investing to build internationally leading research capabilities relevant to our research themes and aims;
- Investing in novel research and innovative opportunities;
- Building research skills and expertise in multidisciplinary and collaborative research (including Māori and Pacific researchers) that has the potential to create opportunities for positive change in tamariki and young people lives;
- Coordinating and leveraging research (including co-funding) across New Zealand that is aligned to BeST to ensure it is mutually reinforcing achievement of the mission;
- Actively engaging with leading international research groups relevant to BeST to access leading thinking, research capabilities and infrastructure, build reputation and influence;
- Aggregating, integrating and communicating knowledge relevant to the themes and aims to policy, service delivery and front line practitioners as well as to the public (including Māori and Pacific communities) to create the conditions for positive change;
- Developing pathways for research translation and engagement to enable next and end-users to change policy, service delivery and practice (and, where appropriate, to commercialise intellectual property) to deliver social and health benefits for tamariki and young people in New Zealand.

These roles inform the business or operational model for BeST and the resourcing requirements that it implies.

IMPACT STATEMENTS

- By 2021 BeST will determine characteristics, associations and predictors of biological, social, psychological and educational vulnerability that are informing potential (and testing early) interventions to improve outcomes for young people in New Zealand;
- By 2026 culturally responsive research-based interventions will result in policy changes and services to prevent or ameliorate biological, social, psychological and educational vulnerability leading to more equitable outcomes and population level improvements in young people's lives.

ASPIRATIONAL LONG TERM OUTCOMES

- Early prevention and effective treatment leading to a decline in childhood obesity;
- Improvement in childhood literacy and more equitable educational outcomes
- Early identification and reduction in adolescent mental health disorders.

These outcomes will focus on the most vulnerable (Māori, Pacific and those of lower socioeconomic status) and be achieved through establishing the prevalence of these problems in New Zealand tamariki, developing predictors of risk, identifying variables that contribute to successful outcomes despite vulnerability, early prevention and treatment interventions will be evidenced by statistically and clinically meaningful improvements in a suite of indices from national and regional data sets.

DIRECTORATE AND SCIENCE LEADERSHIP TEAM

Table 1 - Directorate



Professor Wayne Cutfield, Director, Professor of Paediatric Endocrinology, Liggins Institute University of Auckland.



Professor Gail Gillon, (Ngāi Tahu iwi) co-Director, Pro-Vice-Chancellor, College of Education, Health and Human Development, University of Canterbury.



Professor Barry Taylor, co-Director, Dean, Dunedin School of Medicine, University of Otago.

Table 2 – Science Leadership Team (SLT)



Distinguished Professor Niki Davis, Professor of e-learning, College of Education, Health & Human Development University of Canterbury.



Professor David Fergusson, Christchurch Health and Development Study, University of Otago.



Professor Angus Hikairo Macfarlane, (Te Arawa iwi) Professor of Māori Research, and Professor of Education Psychology, Office of the Assistant Vice Chancellor Māori, University of Canterbury.



Professor Sally Merry, Professor, Clinical, Psychological Medicine; Head of Department, Psychological Medicine.



Doctor Cathy Wylie, Chief Researcher at New Zealand Council for Educational Research.

Brief bios of Directorate and SLT members are available online.

SCIENCE ADVISORY PANEL

Internationally renowned scientists with expertise relevant to the BeST mission have been recruited to form the Science Advisory Panel (SAP) for an initial three- years term. The SAP provides critical appraisal and constructive comments during the establishment, implementation and review of research programmes and projects. The SAP provided feedback during the research prioritisation planning process, completed in 2014. The SAP will be invited to site visits and the annual science forum to commence in 2016 and will support the Board and Directorate in assessing and guiding the science quality and performance towards our mission.

Table 3 - SAP members



Professor Pim Cuijpers, Professor of Clinical Psychology, Vrije University Amsterdam, Netherlands.



Professor John Hattie, Director of the Melbourne Education Research Institute at the University of Melbourne, Australia.



Professor Brendan Hokowhitu, Dean, Native Studies Faculty, University of Alberta, Canada.



Professor John Lochman, Professor and Doddridge Saxon Chair in Clinical Psychology, University of Alabama, USA.



Professor Ken Ong (Chair), MRC Group Leader & Paediatric Endocrinologist, University of Cambridge, UK.



Professor Martin Wabitsch, Professor of Pediatrics, Head of Division of Pediatric Endocrinology and Diabetes and Endocrine Research Lab, Department of Pediatrics and Adolescent Medicine, Ulm University, Germany.

Brief bios of SAP members are available online.

INTERIM KĀHUI

During the development of the initial research plans, a group of the Māori researchers involved formed a Kāhui to consider options to support the three health related Challenges, give effect to Vision Mātauranga and to capture synergies between research areas and communities of interest involving Māori. Following the Ministry of Business, Innovation and Employment (MBIE) decisions to fund commencement phase for BeST, the Establishment Oversight Group (EOG - which is the group of senior Party managers providing interim governance oversight to the Challenge) have agreed to the formation of an *Interim* Kāhui to facilitate the next stages of each Challenge by providing advice to BeST, in the spirit of good-will and to

ensure that the Challenge is optimally positioned in relation to Vision Mātauranga and engagement with Māori communities and agencies during the Commencement Phase.

A Terms of Reference for the Interim Kāhui has been approved by the EOG and is included in <u>Appendix 1</u>. This will be replaced by a permanent Kāhui to serve the three related Challenges once they are fully approved for funding. The interim Kāhui has been closely involved in the development of this proposal and will give advice and feedback on the research proposals within the research plan as well as all aspects of the plans relevant to their Terms of Reference.

Table 4 - Interim Kāhui members



Garrick Cooper, (Ngāti Karaua (Hauraki), Te Pirirākau (Tauranga Moana)), College of Arts, University of Canterbury.



Distinguished Professor Richard Faull, (Ngāti Rahiri, Te Atiawa), Director of the Centre for Brain Research, University of Auckland.



Moe Milne, (Ngāti Hine, Ngapuhi), Chair of the Bicultural Therapy Model committee for the Northland Corrections Facility and a member of the Mental Health Advocacy coalition. She is also the owner of Te Moemoea.



Professor Helen Moewaka Barnes (Chair), (Ngāti Wai/Ngāti Hine/Ngāti Manu), Director of Whāriki and Co-director of the SHORE and Whāriki Research Centre, Massey University.

STAKEHOLDER ENGAGEMENT

BeST has identified key stakeholders relevant to it at three broad strategic levels which are listed in the table below; (i) national policy makers (Government agencies via Science and tamaiti health Advisors), (ii) national organisations, (iii) health care and education providers (next users) and (iv) community groups (end users), notably Māori and Pacific. The nature and frequency of engagement vary across the levels and is likely to be most intensive for levels (iii) and (iv) throughout BeST and (i) and (ii) in the 2019-2024 period. The early and extensive stakeholder engagement and consultation is to enable stakeholder commitment to BeST vision and mission and co-creation of the science proposals leading to knowledge exchange and successful implementation to realise our long term outcomes.

Through the development of this proposal, stakeholders engagement involved:

- A hui (supported by the Ngāi Tahu Research Centre and Office of the Assistant Vice Chancellor Māori) was held at the University of Canterbury. The hui followed MBIE workshops in 2014 detailing the Challenge framework. It brought together both Māori and non-Māori lead researchers and stakeholder community leaders to discuss potential research areas under the three Challenge themes. This workshop helped shape the research topics and identified interested research groups from around the country. Following this workshop an online stakeholder reference group was formed.
- Each proposal research group contacted the local stakeholders and key community groups relevant to their proposal and consulted with them in the development of their proposals.
- Submission: Once a first draft of the different proposals were developed, BeST engaged with government agencies and national organisations. The process and outcome of this engagement is described below.

BeST identified the following 12 organisations/institutions as stakeholders playing a strategic national role relevant to BeST:

Table 5 – Key stakeholders			
Ministry of Social Development (L1)	Richie Poulton, Science Advisor		
Ministry of Health (L1)	Pat Tuohy, Chief Advisor		
Ministry of Education (L1)	Stuart McNaughton, Science Advisor		
Office of the Children's Commission (L1)	Russell Wills, MB		
Families Commission (L1)	Jeremy Robertson, Principal Advisor, Social Science		
New Zealand Mental Health Foundation (L2)	Judi Clements, Chief Executive		
Whānau Ora (L2)	Sarah Howard, Te Puni Kokiri's Statistics Team Manager		
	Sarah Widmer, Principal		
	Advisor, Monitoring and Evaluation Team		
Māori Women's Welfare League (L2)	Mateoroa Dodd, Acting General Manager		
Pegasus (L3)	Lynley Cook, Population Health Specialist		
Procare (L3)	Lorraine Heteraka-Stevens, Nursing Director		
	John Cameron – Associate Clinical Director, Medical		
Principals Federation (L3)	Denise Torrey, President		
TAHA (L3)	the Well Pacific Mother and Infant Service		

L1-3 are the levels described above for stakeholders

All stakeholders listed have committed to engage with the Challenge with most able to attend a face-toface interactive forum to discuss the early draft science proposals. Those not able to attend were invited to two teleconferences to discuss the proposals and subsequently provided feedback. As later described under prioritisation it was the assessment feedback primarily form the SAP and Stakeholders that determined the selection of the final four proposals and shaped these proposals to their final forms.

Feedback collected during this stakeholders forum is available online.

In order to ensure that feedback from stakeholders who were not able to attend the forum was captured and included, we also organised two teleconferences in early March. The 4 proposals selected after the prioritisation session were sent in advance of the teleconferences so that useful feedback could be provided.

In addition, early in the Challenge development a BeST email list server was set up to interact and communicate with more than 100 researchers across the country with an interest in the Challenge research domains. Research ideas and feedback from list server participants has shaped the Challenge and proposals.

Engagement with Māori has occurred at several levels: through Māori researchers within the Planning Group, through the Māori Association of Social Scientists, the Kāhui and Māori hui. Refinement and consultation of methods and delivery of all research proposals with Māori and Pacific communities is an important early action as outlined in the Research Plan <u>Next Steps</u> section. Both of these communities are critical partners in the delivery of research and the subsequent community implementation of research findings.

CONTEXT FOR BEST

Significant health, educational, and social disparities persist in New Zealand, and, as in other societies, indigenous and minority populations are the most affected. In addressing these disparities and ensuring equitable outcomes for all New Zealanders, an important first step is to provide "a better start" to life, hence the Challenge name. "E Tipu e Rea" is the Challenge's Māori name, which translates as 'grow ye o seed and fulfil your potential' and was penned by Sir Apirana Ngata, a revered Māori leader (Member of Parliament 1905-1943). The importance of early childhood in particular is re-enforced by the recent analysis of early intervention on adult health outcomes (2).

The challenge given to us has been to use science to improve the potential of young New Zealanders to have a healthy and successful life. Focusing especially on altering trajectories early in life and at adolescence, to bring together already developed expertise in New Zealand, and to explore, understand, and use the new digital world we live in to create better outcomes. The framework set for the Challenge requires developing a science plan around three broad themes: 1) maternal health, pregnancy, and early childhood; 2) successful transition into adulthood; and 3) education: living in a digital world.

In response to the initial MBIE RfPs and Science Board feedback on our initial submission, in 2014, as well as several workshops, smaller working groups, and input from a reference group of 114 interested researchers, we propose to focus on three childhood areas within the broader framework: obesity, literacy, and mental health. Digital technologies will be threaded through these areas as appropriate. Moreover, we propose a platform of multidisciplinary childhood research embedded within a new "braided rivers approach" which integrates knowledge from indigenous and western science perspectives (see Figure 1). Durie (3) and Macfarlane (4) discussed the issues of Māori knowledge and scientific enquiry in the context of the resurgence of indigenous approaches to understanding tamariki's health, education, and well-being. They advocate for two knowledge bases, each with their own standing and integrity. They argue for a "braided rivers approach" which combines the input from two systems of understanding in order to create new knowledge that can be used to advance understanding in two worlds.



Figure 1 - A symbolic depiction of the braided rivers framework for the BeST. The E Tipu e Rea Challenge expresses itself symbolically as "Waiora mo te Mātauranga" - theories of knowledge intersecting as mutually inclusive domains flowing forward to progress tamariki's well-being.

A braided rivers framework within the context of this challenge symbolises the integration of knowledge from differing sources. The braiding of Māori and non-Māori perspectives is central to the framework, but also the braiding of knowledge from differing academic disciplines, differing agencies that support our tamariki and whānau, and differing approaches to new research as the National Science Challenges (NSCs) advance. To provide a better start to life for tamariki and their whānau who are in particular need, we must harness our efforts in innovative ways. There is no simple answer or single line of research that

will ensure a better start for our young tamariki. Rather, it is through the braiding of knowledge from multiple domains, meaningful collaborations between research and professional communities, and successful engagement of whānau in their tamariki's health, education, and well-being that will help realise our Challenge aspirations. These are key elements that thread through the platform of research proposed in this Challenge.

BeST is developing an integrative approach across three themes obesity, literacy, and mental health integrating the disciplines of biology and health, social science, psychology, education, and digital technologies. There are key overarching activities across all three themes: (i) a Big Data platform project will inform and assist in establishing the prevalence and predictors of obesity, educational performance, psychological and social resilience, assist in validating prediction models of obesity and poor literacy, provide a mechanism in which to model the economic, social and health impact of planned interventions; (ii) Digital technologies which are incorporated as key elements in all themes.

A strength of BeST is engagement and inclusion of national data sets (both within and outside the Integrated Data Infrastructure provided by Statistics New Zealand) and large prospective cohorts within New Zealand (Growing Up in New Zealand - GUINZ, the Pacific Island Families Study, and the Auckland component of the Nutritional Intervention Preconception and in Pregnancy to improvE offspRing outcomes - NIPPER). Furthermore, there is the opportunity to share data and work collaboratively with other large datasets within New Zealand (Early years, Prevention of Obesity in Infancy study - POI.nz, Motivational Interviewing in Treatment - MINT, the Playground Study, Healthy Mums and Babies - HUMBA) and internationally (GUSTO-Singapore, NIPPER-Southampton, Singapore, Auckland and the Northern Finland Birth Cohort studies-Finland and Imperial College London). These datasets and cohorts enable new research to extend existing platforms in a cost-effective and collaborative manner and important knowledge sharing. These are detailed in the <u>Research landscape</u> section and in the <u>Fit with existing research</u>.

Within each of the three themes, a logical flow of projects is proposed that aim to contribute to BeST utilising the special opportunities present in New Zealand. These projects will answer critical research questions that will lead to greater community engagement and successful interventions.

The portfolio of research proposed in this Challenge is organised into three themes with topic areas that meet MBIE's RfP objectives. Within these three themes there are four main proposals that contain a total of 10 projects over the first five-7year period. The three themes will be advanced simultaneously, but across themes there will be feedback on processes and outcomes from individual projects, through a series of regular meetings (as proposed by the Kāhui).



Figure 2 – Illustration of the research programme across the three Challenge themes

As illustrated in Figure 2, BeST contains three major themes (obesity, literacy, and mental health) that include four proposals (PredPrev, Early literacy, Health Advances through Behavioural Intervention TechnologieS - HABITS and Big Data). There are common tools and platforms across all three themes, but the magnitude of these roles will vary across themes. For example, the Big Data proposal plays a larger role in obesity and literacy than in mental health. Conversely, digital technologies are fundamental to the mental health theme. There are a number of key ongoing New Zealand studies that on completion will provide important information for the design and refinement of intervention studies planned in the four proposals. The proposals in this Challenge will involve engagement with stakeholders and communities from the outset, to ensure that research findings can be implemented successfully.

At the BeST stakeholders forum, the stakeholder representatives were asked "what are the three largest problems facing childhood health and education?". The stakeholders unanimously endorsed the selection of these three themes and held a strong collective view that these three themes were indeed the most important areas facing our country's tamariki.

Theme 1: Obesity

Why was obesity chosen?

Obesity reflects excessive body fatness and has been defined in tamariki as a body mass index (BMI) \geq 95th percentile for age (while overweight as a BMI \geq 85th percentile). In 2013, obesity was recognised by the American Medical Association as a disease, escalated from a risk for disease.

Obesity is the largest tamaiti health issue New Zealand faces, which contributes to the country's most common non-communicable diseases such as type 2 diabetes, heart disease, stroke, arthritis and cancer with risks factors for these diseases that begin in childhood and are amplified through adult life. One in three New Zealand tamariki are overweight or obese, exceeding rates seen in the USA (5,6). Furthermore, obesity has an amplified impact on minority ethnic groups and the disadvantaged. The prevalence of obesity in Māori is two-fold and in Pacific Islanders three-fold higher than that seen in Caucasians, while obesity prevalence is three-fold higher in those of lower socioeconomic status independent of ethnicity. The impact of childhood obesity extends into the other two research theme areas: education and childhood behaviour. Obesity is associated with low self-esteem, conduct disorders, depression, and learning disability (7-11). While other health areas such as infectious disease, allergy and respiratory disease are important, prevention is well in train for infectious disease for example (e.g. New Zealand now has a 90% immunisation rate) and none of these topics has such wide-ranging long-term implications as childhood obesity.

Identifying those at risk of obesity in early childhood and preventing its development is considered to be more important and more effective than attempting to reduce established obesity in later childhood. Interventions to prevent or treat childhood obesity incorporate the use of Big Data (proposal 1), as well as assessments of educational achievement (proposal 3) and behavioural issues (proposal 4). These are critical associations and later secondary outcomes to obesity interventions, thus braiding together the four proposals across the three themes through obesity research.

Theme 2: Literacy

Why was literacy chosen?

Literacy is the ability to identify, understand, interpret, create, communicate and use printed and written materials (including via digital technologies) associated with varying contexts. Literacy involves a continuum of learning to enable an individual to achieve his or her aspirations and to develop his or her knowledge and potential (12).

The right to be literate is a human right (13) and is considered fundamental to ensuring individuals can fully participate within modern societies.

The research plan focuses on facilitating early literacy success in the tamaiti's first year of school. Early reading achievement is the strongest predictor of later reading achievement (14) which in turn is closely related to educational success and increased employment opportunities (15).

Approximately one in four New Zealand tamariki are failing in their early literacy development (16-18). Māori, Pacific and those tamariki of lower socioeconomic classes are over-represented in those with poor literacy. Indeed, 2013 national data show between 30–35 % of Māori and pacific tamariki are not meeting expected national standards for reading in their primary school years (16-18). Furthermore, the disparity between high and low reading performance in New Zealand tamariki is one of the largest in the developed world (17). Worryingly, these results have not improved since 2001 (17).

Poor literacy tracks from childhood to adulthood and adversely affects later economic prosperity. The cost of illiteracy is high, the Economic and Social Cost of Illiteracy Report estimated that the social and economic impact of illiteracy to New Zealand is \$3 billion a year. The report concluded that the end result of low literacy levels is trapping people in a cycle of poverty, poor health, limited employment

opportunities, reduced income potential and low productivity in businesses. An estimated 43% of New Zealanders have difficulty with the literacy demands of their job (19,20). According to a recent survey of New Zealand employers, literacy and numeracy are ranked in the top three skills that employers look for in an employee.

Theme 3: Mental health

Why was mental health chosen?

New Zealand has one of the highest rates of adolescent and young adult suicide in the western world, with the majority related to underlying mental health disorders, but with only 40% being in contact with our mental health services (21). Suicide is the second most common cause of death for this age group, second to injury. The problem is especially seen in Māori males with rates up to 2.5 times higher than their non-Māori peers. Underlying this are now a well-known high prevalence of mental health disorders – in particular depression and anxiety in adolescence. Prevalence rates of mental health disorders of 25.9% for girls and 18.2% for boys were found in almost 1,000 New Zealand adolescents aged 15 years (22). Māori and Pacific adolescents are at greater risk for mental health problems (23,24).

New Zealand's school adolescent health surveys (25) suggest that while three quarters of adolescents report overall good well-being, self-harming behaviour is reported by 24%, depressive symptoms by 13%, two weeks of continuous low mood by 31%, suicidal ideation by 16% and suicide attempts by 4.5%. These rates are higher in 2012 compared with 2007.

Thus, adolescent mental health is clearly an issue of significant prevalence and high morbidity and mortality. Long-term outcome of adolescent mental health disorders show significant ongoing morbidity and effects on adult mental health (recurrence rates of 60–70%), educational attainment and work life (26). We believe this justifies the BeST NSC identifying adolescent mental health as an area of research priority.

RESEARCH LANDSCAPE

STEP UP FROM EXISTING RESEARCH ACTIVITY

The research plan proposed for this challenge represents a significant change from current research activity with two overarching step changes; linking health and education research and blending Māori and western science perspectives. The issues this Challenge addresses are complex and the more traditional research silos and funding streams present in education and in health have not achieved the translational research that is necessary to bring about system wide change to ensure better health and education outcomes for all tamariki. Such joint focus develops a more holistic approach to tamariki well-being and recognises the bi-directional relationships between a person's health and education and the strong influence of whānau and community on tamariki's successful outcomes.

The research blends together both Māori and western science perspectives on a scale yet to be attempted in New Zealand. Improving outcomes for Māori is one of the Government's highest priorities and reflects the global call for significant improvements in health and education for indigenous populations. Respecting, integrating, and valuing indigenous knowledge is key to this improvement and this Challenge proposal demonstrates this step change.

Distinguished Professor Sir Peter Gluckman (Chief Science Advisor to the Prime Minister) in his 2013 report stated: "It is also concerning that in New Zealand, there has been insufficient attention paid to proactive investment in research needed to support policy formation. For at least the last 20 years, our public research funding bodies have not prioritised policy-relevant research, resulting in a disconnect between central agency needs and funded research priorities. In turn, this has led to a growing gap between the research community and the policy community in identifying the needs of the policy community that research could address" (27). The BeST proposal recognises this disconnect and will undertake translational research with an emphasis on providing the evidence to translate research into policy.

Across all three themes current research funding models do not allow for sequential research projects that lead to large-scale community intervention and ultimately a change in community behaviour. NSCs have a

9-year timeline to achieve meaningful community impact. BeST will exploit this benefit to achieve community impact. A step up from usual research will include investment into implementation research, strategies and policies that will transform research findings into benefit to our tamariki and communities. The step up in research for each theme area is addressed below in the Research Landscape section.

CURRENT RESEARCH LANDSCAPE

A diverse range of research and programme development is already underway to support better health (obesity and mental health) and education outcomes for young New Zealanders, particularly for Māori, Pacific and those of lower socioeconomic status. Differing methodologies are evident within the current research landscape. Examples include:

- Investment in practitioner led research such as the \$10M of new education funding for school community focused research within the Ministry of Education's initiative on teaching effectiveness. This fund is focused on teacher-led initiatives to support teachers inquiring into innovative practices that lead to success for Māori, Pacific, and tamariki with special education needs, testing ideas with experts and community leaders, and sharing successful teaching outcomes within their
- 2. Kaupapa Māori Research is a methodology advanced by Graham Hingangaroa Smith (1990) and extended by other Kaupapa Māori theorists such as Linda Smith (1997), Leonie Pihama (2001) and Taina Pohatu (2005). Other theorists who have also contributed to the development and growth of Kaupapa Māori methodology include Russell Bishop (2005), Kuni Jenkins (2001), Cheryl Smith (2003) see http://www.rangahau.co.nz/research-idea/27/ for details. Recent projects that include kaupapa Māori research principles are "E Hine" using a longitudinal case study approach to explore the experiences of young Māori women (under 20 years of age) as they become mothers, and their engagement with the health system as their babies grow (Led by Dr Bev Lawton); Ka Awatea focused on Māori student success at school and highlighting the importance of constructive and supportive relationships at school and between school and whānau as strong determinants of Māori tamariki's success (led by Angus Macfarlane (<u>26</u>)) and "Mapping the themes of Māori talk about health" led by Cram (28).
- 3. Analyses of research findings to inform practices such as "The Iterative BeST Practice Syntheses (BES) Hei Kete Raukura" series of documents commissioned by the Ministry of Education to draw together reliable evidence, including analyses of research evidence, regarding effective teaching practices. The BES related to Teacher Professional Learning and Development research base (29) has been particularly influential in helping to link research to practice in regards to professional learning that supports improvements in students' achievement.
- 4. Project and programmes of research involving western science experimental designs. For example, in the field of obesity the Health Research Council (HRC) have funded 37 obesity related grants of which 24 included a focus on tamariki or pregnant mothers over the last 9-years. Of these 13 were project grants and one programme grant with the other 11 grants being seeding grants or individual fellowships. The Auckland studies have focused on basic science or observational studies apart from the OPIC study, a four country pacific community intervention that showed no effect on anthropometric variables. The Otago studies including one programme grant (adult and tamaiti focus), one community intervention (the Apple study) and two randomised controlled trials focused on obesity prevention - POI.nz and the MInT study. The POI.nz study with 802 Dunedin infants and families focused on education and support with regards to sleep, feeding and physical activity in infancy (30,31). The MInT study involved 271 overweight tamariki and their parents (30,32,33). The Playground study is a school-based obesity prevention initiative involving 900 Otago and Auckland tamariki aimed to increase physical activity and decrease bullying. Not HRC funded are the FLAME study - a longitudinal study of 241 tamariki looking at family habits that might predict obesity development (34-37) and the BLISS trial, a RCT comparing modified of Baby-Led with standard weaning practice. In the other theme areas and also using a western research paradigm is a Royal Society Marsden funded project identifying risk factors for early speech and language difficulties that may influence later literacy development (38), and randomised controlled trials of mhealth interventions (described in more detail below).
- 5. Longitudinal cohort studies- there are two important recently begun longitudinal cohorts; GUINZ and the Pacific Island Study that will be essential in assessment of early childhood obesity. These are informed by the well-known New Zealand longitudinal studies based in Dunedin and Christchurch where participants are now in their mid-adult lives. With regard to tamaiti and adolescent mental health, there has been considerable work on early prevention in high-risk groups (39), understanding suicide and suicidality in New Zealand (40,41) with perhaps the bulk

of the publications related to mental health outcomes in the Dunedin and Christchurch longitudinal studies.

- 6. Large-scale prospective intervention studies about to start are nutritional intervention studies to reduce the risk of gestational diabetes and obesity in the offspring; NIPPER and HUMBA.
- 7. Community interventions that were not established as primarily research projects such as Project Energise and Healthy Families New Zealand. Project Energise is a mid-childhood school and community-based lifestyle and activity-based intervention-based in the Waikato region. Project Energise started as a cluster RCT with initially disappointing results (42) but now reporting more encouraging long-term outcome data using historical controls (43,44). Healthy Families New Zealand is a large Ministry of Health community-based lifestyle approach to reducing the prevalence of obesity and related diseases/consequences in 10 socially disadvantaged pilot centres across New Zealand.

Each of these methodologies has provided important insights from which BeST will draw upon. However, differing methodologies have more typically been isolated to the research and participant community groups within their discipline with little cross over from education and health or Māori kaupapa research and western science models. The step change for BeST is the integration of methodologies and the multidisciplinary nature of the research groups, bringing together leading health and education researchers. The Challenge creates the research environment for researchers to work in innovative ways and to ensure research evidence will inform policy and practice through collaborative partnerships between researchers and practitioners and strong community and stakeholder engagement.

FIT WITH EXISTING RESEARCH

This Challenge builds on and extends from the knowledge and expertise gained in many of the studies described in the Research Landscape above. The New Zealand research underpinning much of the work is mentioned in the proposal science plans for the four proposals. Furthermore, indigenous knowledge and current practices within the three theme areas will be further sought and included within the final design of projects in each theme.

We have described international collaboration within many of the projects outlined in the Research Plan section. In addition we are well linked with The Australasian Child and Adolescent Obesity Research Network (ACAORN) which has been established to foster and coordinate research collaboration among Australian and New Zealand tamaiti and adolescent obesity research groups with two of our members leading the prevention and treatment streams within this research network. Challenge members are also well linked to global research agendas in tamaiti language, culture and identity, in global literacy initiatives: Literacy Success for ALL, UNESCO's educational and digital technology initiatives as well as indigenous research communities focused on tamariki's education and healthy well-being.

Obesity

The obesity studies referred to above are almost all are connected to BeST by having investigators in common, thus leading to ongoing collaboration and sharing of both data and common understanding of the important next questions to be asked. The step up from existing research will be (i) a novel approach to predict infants at risk of obesity and develop intervention strategies particularly focusing on Māori and Pacific tamariki, (ii) In the 2019-24 period engagement with obese adolescents will focus on novel digital interactive phone apps that then lead to personalised obesity interventions.

GUINZ tamariki are nearing five years of age and have longitudinal data that will inform the early prevention and intervention studies planned in the obesity and literacy proposals. Data from these tamariki will be included in the incidence, obesity and literacy prediction models. There are two large prospective nutritional intervention studies in New Zealand to reduce the risk of GDM and new-born macrosomia; NIPPER and HUMBA.

The Pacific Island Families study has longitudinal data from early childhood trough to adolescence in a large group of Auckland Pacific Island tamariki. They will provide valuable data to better understand the timing and development of early childhood obesity. Little is known about the early weight patterns of Pacific tamariki outside of American Samoa.

NIPPER is detailed in the <u>Research Plan obesity theme</u>. NIPPER and the offspring of the NIPPER study will provide information for the revised obesity prediction model (obesity theme project three). In addition the offspring of HUMBA could serve as a validation cohort of the obesity prediction model if it is funded. Professor Wayne Cutfield who is PI on the obesity theme proposal will coordinate follow up of the offspring of the NIPPER study and is an associate investigator on the HUMBA proposal thus enabling the effective future linking of these projects.

The Otago early childhood intervention studies nearing completion (described above), POI.nz, MiNT FLAME and BLISS, will provide crucial information to aid in the design of the obesity intervention project planned.

BeST researchers from the Big Data platform group led by Professors Boyd Swinburn, Barry Taylor and Barry Milne have submitted a proposal to provide the evaluation framework and ongoing assessment of the 10 Healthy Families New Zealand pilot regions. If successful, this will give the opportunity to provide quantitative and qualitative rigorous assessment of these major community interventions before they progress to national roll out. BeST have begun discussion with Healthier Lives to include researchers and added resourcing to this critical project.

Whānau Pakiri is a New Plymouth, largely Māori childhood and adolescent obesity intervention study based upon "readiness to change" (to being more healthy). Investigators on this proposal are also BeST investigators (Professors Paul Hofman and Wayne Cutfield) and will have access to data and insights from Whānau Pakiri that will provide useful input into the design of the adolescent obesity engagement and obesity intervention study planned for 2019-2024.

Literacy

The proposed Literacy study described in the Research Plan builds from a range of research studies and programmes focused on enhancing educational achievement for priority learners and links to other funded research initiatives. Data from the Longitudinal study "GUINZ Study" (45) will provide valuable insight into key issues that support early literacy success despite vulnerability and lead researchers from GUINZ have informed development and design of the proposed research plan.

The planned research will complement research supported by the Manaiakalani Education Trust focused on raising educational achievement and growing success in citizenship by a group of schools in Tamaki, Auckland. One of the projects is focused on raising literacy achievement in more advanced areas such information literacy and critical literacy skills in the upper primary and secondary school years (Grades 4–13). Recent findings from this project (46) show that achievements from specific interventions are not necessarily maintained over the summer holiday period (6-8 week break). Poor foundational reading skills will lead to inefficient reading processes that require constant work and focus. The proposed study seeks to develop stronger foundational reading and writing skills to support more independent learning. Stronger literacy foundation skills will enable tamariki to take greater advantage of subsequent instruction and interventions aimed at more advanced literacy skills. Ongoing evaluations from Manaiakalani programme related to effective teaching practices and professional learning will help inform implementation of the intervention project.

We will collaborate with the research team recently funded to investigate digital technology use to enhance learning through whānau engagement teaching and game-based learning (Developing in Digital Worlds MBIE 2015 funded project). Our planned focus on the use of digital technologies to enhance language learning in emergent bilingual tamariki in preschool and year 1 will complement their focus on promoting achievement and participation in the digital world in and out of school through cognitive and social development in a wide age group spanning from four - 18 years. Learnings will be shared across projects to enrich outcomes and to enhance benefits accrued from the research to inform policies and practices.

The Challenge proposal will also learn from and interact with a three-year, Ministry of Education-funded project " focused on professional development for year 1 teachers to enhance early literacy learning (led by Professor William Tunmer and Professor James Chapman, Massey University, and being implemented with teachers in the lower North Island region). The proposed intervention in our Literacy theme is consistent with their conceptual framework for the teachers' professional development ("The Cognitive Foundations of Learning to Read- based on the Simple View of Reading) and both projects will complement each other well to advance knowledge in ensuring literacy success for young vulnerable tamariki.

The research is also well positioned within the context of a national project Mau ki te Ako, a culturally responsive professional learning and development programme to support teachers and school leaders achieve Māori educational success (47). A team of seventy facilitators work alongside educators to provide culturally responsive professional development and learning to support a better understanding and delivery of a culturally responsive school culture and curriculum.

Te Tapuae o Rehua (a consortium between Ngā Tahu iwi, University of Canterbury and the University of Otago) (47) lead the programme and involve rūnanga in delivering professional development to the facilitators through the sharing of their histories, knowledge and tikanga. The cluster of schools and teachers involved in the intervention study will have participated in Mau ki te ako and thereby have stronger cultural competency and understanding which will be particularly beneficial in relation to supporting emergent bilingual tamariki in English and Te Reo Māori who will be participants in the study.

Current tamariki and adolescent mental health research in New Zealand

Smart Positive Active Realistic and X-Factor Thoughts (SPARX) is an evidence-based e-therapy which was launched in 2014 under the Prime Minister's Youth Mental Health Project as a nationally available self-help tool to help young people deal with depression. It is an innovative fantasy 'serious game' that helps young people learn cognitive behavioural therapy (CBT) skills to address clinical depression in a virtual world and apply these skills in the real world. Two randomised controlled trials have established the efficacy of the programme (48,49).

The Youth2000 survey series is led by the Adolescent Health Research Group) from The University of Auckland (Associate Professor Simon Denny is the Chair and Dr Theresa Fleming is the nominated Principal Investigator for the planned 2017 survey). Over the past eleven years the Adolescent Health Research Group has collected data on these topics from a total of 28,000 students who completed the Youth '12, Youth '07 and Youth'01 surveys. Each wave involves a large, representative sample of secondary school students from over approximately a third of all high schools in New Zealand. The survey includes questions about ethnicity, culture, physical health, food & activities, substance use, sexual health, injuries and violence, home and whānau health, school achievement and participation, neighbourhood environment, spirituality and access to healthcare. The planned Youth2017 survey will continue the Youth2000 series strong mental health focus.

Treatment Approaches for Children and Young people (TrACY study) is a Health Research Council funded trial of MATCH-ADTC (Modular Approach to Therapy for Children with Anxiety, Depression, Trauma or Conduct problems) which is a new flexible modular system that combines evidence-based therapies for common mental health problems to take into account the frequent co-morbidity seen in practice. The multi-site trial (MATCH vs. usual care) involves five District Health Boards and participants are recruited from tamariki and adolescent mental health services.

BRAVE-ONLINE is a successful computerised Cognitive Behavioural Therapy programme for tamariki and adolescents with anxiety developed in Australia. It is a ten-module intervention with child/youth friendly animations, sound clips, interactive quizzes and games. Drs Karolina Stasiak and Stephanie Moor (University of Otago) have conducted an open feasibility trial to evaluate BRAVE-ONLINE with whānau following the Canterbury earthquakes. Currently, the programme is available to whānau in Christchurch through a General Practitioner referral. Evaluation data is collected through an on-going clinical audit to assess the impact of the programme in clinical practice.

Waka Hourua is a relatively new initiative to support Māori whānau, hapū, iwi, Pasifika whānau and communities to develop and enhance their own capacity and capability to prevent suicide and to respond safely and effectively when and if suicide occurs. It includes research to help build knowledge and understanding about safe, effective, evidence-based suicide prevention programmes in Māori and Pacific people communities.



Figure 3 – Fit of proposals in the 3 themes with existing research

INTERNATIONAL LINKAGES

There are 14 international experts who will be advisors and/or investigators within the themes of the Challenge.

Theme 1 - Obesity:

Professor **Keith Godfrey** is Director of the Centre for Developmental Origins of Health and Disease at the University of Southampton. His research is defining measures to improve the early growth and development of tamariki, thereby improving their lifelong health. Assoc Professor **Yap Seng Chong** is the Principal Investigator of the National Research Foundation Metabolic Translational and Clinical Research Flagship Programme in Singapore, a \$25 million study on the developmental origins of metabolic disease. **Marjo Riita Jarvelin** is Professor of Lifecourse Epidemiology at Imperial College, London. She is Director of the highly published (>500 publications) Northern Finland Birth Cohorts and developed the original obesity calculator. Professor **Melissa Wake** of the Murdoch Institute, Melbourne, is leading Growing Up in Australia's Child Health CheckPoint, a cutting-edge physical and biomarkers module for the Longitudinal Study of Australian Children. Her interests are in community tamaiti health research including obesity. Professor **Mark Hanson**, University of Southampton and Professor **Louise Baur**, University of Sydney are chair and member respectively of the WHO Commission to Ending Childhood Obesity Science and Evidence Subgroup. Both have agreed to be advisors to the theme.

Theme 2 - Literacy:

Distinguished Professor **Laura Justice** (Department of Teaching and Learning, Ohio State University) principal investigator or co-investigator on numerous large-scale US Department of Education funded literacy projects. Professor **Hugh Catts** (Director School of Communication Sciences, Florida State University) a leader in the field of early identification and prevention of language-based reading disabilities. Professor **Kate Nation**, Director of the Language and Cognitive Development Research Group Department of Experimental Psychology, University of Oxford. She has expertise in language and literacy development, Professor **Tom Cavanagh**, Colorado State University, College of Education expertise in restorative justice and restorative practices in schools and culturally appropriate pedagogy of classroom relationships, **Monika Axelsson** is Professor of Bilingualism in Stockholm University, Sweden. Her recent research includes the conditions of recently arrived learners in Swedish schools and on the language of primary school science. **Therese Laferrière** is Professor of Education in Laval University, Canada, and a CRIRES centre director. Her recently commissioned report to the Canadian Social Science Research Agency (SSHRC) is informing research policy and practice in Canada and abroad.

Theme 3 - Mental health:

Professor **Peter Silverstone**, Department of Psychiatry, University of Alberta and the Scientific Director of the Strategic and Clinical Network for Addiction and Mental Health (SCN) including online interventions one of which is SPARX, Professor **Helen Christensen** executive director of the Black Dog Institute, Professor of Mental Health, University of New South Wales, and Emeritus Professor at the Australian National University. Professor **Paul Stallard** Professor of tamaiti and whānau health at the University of Bath where he leads the Child and Adolescent Mental Health Group.

Big Data proposal:

Connections and support will be developed with The Farr Institute of Health Informatics Research in the UK (Professor **Andrew Morris**, Dean, Dundee School of Medicine), Institute for Clinical Evaluative Sciences (ICES) in Ontario, Canada (Dr **Michael Schull**) and the Population Health Research Network - Australia's first national data linkage network.

SKILLS DEVELOPMENT

PhD students are integral to virtually all projects in the Challenge. Within New Zealand there is limited Māori and Pacific research expertise across the Challenge domains. BeST is committed to assist in the training of young Māori and Pacific researchers largely through PhD positions, research nurse and assistant positions and also in the mentoring of Māori and Pacific researchers participating in projects by principal investigators. A preference for Māori and Pacific PhD students will be given so that it is expected that there will be at least one per proposal (approximately half of the PhD student positions on the Challenge).

It is important for the Challenge to upskill all of its researchers at all levels in the "braided rivers approach", including learning more of Māori methodologies, views and beliefs and future solutions across the three themes. Professor Angus MacFarlane together with the kāhui will provide guidance into how we acquire and share such fundamental information.

Each of the three Universities (Auckland, Canterbury and Otago) in which many of the studies are based provide regular seminar series and courses to young researchers to increase skills such as statistics for research and grant and manuscript writing. Science symposia will be held at one to two yearly intervals and will provide an opportunity for young researchers to increase their knowledge across disciplines and have the opportunity to present their research findings.

International research collaborators will create opportunities for younger researchers to broaden their research skills and could include assistance with post-doctoral placements at overseas universities.

CO-FUNDING

BeST has several different strategies to enhance funding beyond the initial MBIE funding envelope of \$34.2M over 9-years. Notably over the first four years the research funding envelope is \$10.87M (including \$470K contingency budget). Through co-funding models this will be expanded by at least an additional \$2.8M. This will be achieved by external research contract and agreements in principal to explore co-funding opportunities with several research funding bodies and philanthropic organisations.

BeST has submitted a proposal to the Ministry of Health for the Healthy Families New Zealand project assessment framework and monitoring contract over four years. We have not yet heard back from the Ministry of Health as to whether we were awarded this contract. Healthy Families New Zealand contribute \$1.6M to BeST research funding with BeST contributing \$400K to this project.

BeST has a total contestable funding pool of \$1.4M. We believe that the contestable funding can be at least doubled to >\$2.8M through matched co-funding and sponsored research. The principal co-funder is likely to be the HRC in which there is agreement in principal to explore co-funding through the HRC Partnership Agreement in which an early round of matched co-funding (likely 2016) with the majority of the BeST contestable funding (likely approximatively up to \$1.2M matched to \$1.2M of HRC funding). The contestable round would be a RfPs in the three theme domains and would be managed by the HRC through its rigorous assessment process in partnership with BeST with funding proposals jointly approved by the Challenge Board and HRC.

Other co-funding organisations in which an informal agreement to explore co-funding has been conducted include (i) Cure Kids and (ii) National Heart Foundation, both philanthropic national research funding organisations; (iii) Starship Foundation, a philanthropic organisation affiliated with Starship Hospital which is New Zealand's only tamariki hospital providing tertiary support and care across a range of medical disciplines nationwide; (iv) Canterbury Community Trust, focused on supporting tamariki post-earthquake disruptions.

In addition, access to established cohorts and large prospective studies that will provide demographic, clinical and laboratory information and subjects such as NIPPER, GUINZ and HUMBA are invaluable resources that would cost 10's of millions of dollars if we were to invest to recreate them.

There is also the opportunity to creatively examine co-founding of students and post-docs in partnership with closely aligned Centres of Research Excellence (CoREs) and Challenges such as Gravida, Ngā Pae o te Māramatanga focused on research of relevance to Māori communities and other NSCs including High Value Nutrition and Healthier Lives.

CONTESTABLE FUNDING

Over the 9-year period and for the first four years 10.2% of the total research budget will be allocated contestable funding. Contestable funding will focus on research priority areas identified during Challenge development with RfPs from researchers across New Zealand. In the initial four-year period the majority of contestable funding will go towards a co-funding partnership with HRC as discussed above under co-funding. In addition contestable funding will be used to build Māori and Pacific research capacity.

FIT WITH SECTOR AND RESEARCH STRATEGIES

The November 2013 Report of the Parliamentary Health Committee, "Inquiry into improving child health outcomes and preventing child abuse, with a focus on preconception until three years of age" recommended refocusing health investment from pre-conception through the first three years of life. Key recommendations specifically addressed childhood obesity, resilience, mental health and early education which directly align with BeST.

Hapū Ora, an HRC and Ministry of Health project to support Māori life course research priorities, strongly concluded that "a 'determinants of health' approach to understanding maternal and infant health, with implications across the life course was required".

The Māori Education Strategy, Ka Hikitia – Accelerating Success- supports an integrated approach (such as proposed in this plan of research) to ensure success for every Māori student. The strategy prioritises action and resources towards developing evidence that will support Māori achieving strong language and educational outcomes (50).

LINKAGES TO OTHER CHALLENGES AND CORES

One of the three Challenge's themes is obesity which is also the primary focus of Gravida a national CoRE, which is undergoing resubmission to the Tertiary Education Commission. There are common senior researchers across both entities. Both Gravida and BeST have childhood obesity as major research priorities. Gravida and BeST will work together to synergise research and platform skills in obesity research. Gravida's strengths are in understanding mechanisms of obesity, disease and health biomarkers and developing novel obesity prevention and treatment. BeST is focused on community-based obesity interventions in childhood to achieve impact. A number of combined projects are planned including the combination of Gravida biomarkers and BeST clinical predictors of obesity used synergistically to identify later childhood obesity at birth, crucial to informing education strategies to prevent obesity.

BeST has clear linkages with High Value Nutrition (maternal and infant nutrition) and Healthier Lives (early childhood nutrition and obesity and adult obesity/prediabetes). A multipronged collaborative approach is planned to link childhood obesity with adult obesity and prediabetes. If BeST's submission to Healthy families New Zealand to conduct its monitoring framework and assessment, Healthier Lives will partner with BeST, contribute science input and co-fund the scientific evaluation of this important major Ministry of Health community-based obesity initiative. To link childhood and adult obesity, BeST and Healthier Lives will include a co-funded RfP in conjunction with the HRC from contestable funding for a project that focuses on this topic. The Big Data proposal establishes a pathway to access the Statistics New Zealand Integrated Data Infrastructure. Such a large data platform will be of value to Healthier Lives and Ageing Well in exploring national health and sociodemographic incidence and outcome data. In addition, the economic and health modelling of the Big Data group can also be shared with Healthier Lives as they consider measuring the value of interventions developed. Because of the longer lives of tamariki the modelling projecting the benefits of childhood interventions is inherently more complex.

A directors' group will include regular meeting of the three health challenges and High Value Nutrition directors to explore collaborative research opportunities together with strategic and management opportunities and issues.

Māori tamariki and their whānau are important participants in all of our proposals. BeST is keen to look at ways in which it can work with Ngā Pae o te Māramatanga (the prospective Māori CoRE), by sharing expertise, ideas, engagement and the research training of Māori research students.

INFRASTRUCTURE

Much of the research of the Challenge is field based. Within the three principal Universities (Auckland, Otago, and Canterbury) are facilities and support to engage with and conduct community-based research. In addition the Paykel Clinical Research Unit (Liggins Institute, University of Auckland) is one of Australasia's largest and busiest mother and tamariki's research units. A range of clinical evaluations are possible from formal psychological evaluation through to sophisticated intricate clinical studies on mothers and tamariki.

The Universities of Otago and Auckland provide a broad resource of expertise to the Challenge, that spans all the basic health sciences through to expertise in population health. They also provide access to expertise in the social sciences, health economics and marketing, all relevant to delivering on the BeST challenges. Both contain the country's medical schools, as well as schools of pharmacy and physiotherapy. The University of Otago also houses the country's only Dental school. Collectively these two universities operate across physical facilities that span the country but that are focused in Auckland, Dunedin, Christchurch and Wellington.

Our Challenge will have the support of The New Zealand Institute of Language, Brain and Behaviour based at the University of Canterbury. This is a multi-disciplinary research Institute dedicated to the study of human language. The Institute will be particularly helpful in supporting analysis work for the Literacy Theme of the Challenge. The Institute provides researchers to an excellent range of research equipment and language analysis labs, including some equipment which is not available anywhere else in New Zealand.

Although a more minor component of the first phase of the Challenge, the Liggins Institute, University of Auckland and University of Otago have state-of-the-art laboratory facilites available to Challenge researchers as required as well as DEXA, peripheral quantitative CT, ultrasonography and Doppler flow measurements and access to MRI scanning.

PATHWAY TO OUTCOMES

To achieve the aspirational outcomes of reductions in childhood obesity and mental health problems and improvement in literacy, BeST has developed a logic model for its research intervention leading to change through close engagement with both policy agencies and practitioners and with the communities where our most vulnerable tamariki and young people are to be found.

This is based on a logical, sequential research approach of:

- Quantifying and defining these problems in New Zealand tamariki;
- Defining indices of risk to identify those at risk;
- Leading to identification of interventions and
- Testing them in before after trials to establish that there is an effect, then moving to
- Large-scale community intervention trials using a variety of designs including individual RCTs, cluster RCT's and sequential implementation trials with randomisation of the sequencing.

Equally importantly will be the parallel approach to working with policy makers, next and end-users to ensure the approaches are practical and able to be implemented as well as acceptable in the community context.

The overall intervention model is outlined in the following Outcome Measurement Framework (see Figure 4 below). This will be the basis for monitoring the progress of the Challenge by management and governance. The approach to performance monitoring and management is detailed further in the <u>Business</u> <u>Plan section</u>.



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Short term	Medium term	Long term	
2014 - 2019	2019 - 2024	2025-	
Stakeholder and community engagement and understanding of childhood vulnerability (obesity, poor literacy and behavioural issues)	Community based RCTs to test pilot study hypotheses Validating community based interventions	Early prevention and effective treatment leading to a decline in childhood obesity	
Quantify the national incidence of early childhood obesity, poor literacy and	to reduce vulnerability to obesity, poor literacy and mental health problems in young people	Improved literacy throughout childhood	
Identify determinants and predictions of poor health, education and mental wellbeing outcomes in children relevant to	Active engagement between communities with at risk or vulnerable children, key delivery agencies, co-funders and researchers to bring about positive change	reduced mental health problems throughout childhood	
Confirm interventions likely to lead to improved outcomes for vulnerable children	Public and agency dissemination and implementation of research findings		
Pilot interventions established/completed		Decline in levels of childhood obesity in intervention cohorts and wider test	
Amount of co-funding achieved		communities	
Enhanced 2 way understanding of cultural, community and next user perspectives on issues affecting vulnerability and options	Number of clear assessment and intervention strategies validated with potential for positive outcomes	Improvement childhood literacy (notably yr 1) in intervention cohorts and test communities	
for positive change	>1 in each theme area	Reduction in targeted mental health	
Number of clear intervention strategies defined from pilot studies with potential for positive outcomes	Number of community, regional or national roll outs of validated intervention strategies committed to by next users	problems in children and adolescents in intervention cohorts and wider test communities	
>1 in each theme area	>1 in each theme area	Improvements in a suite of outcome	
Number of end-user communities or groups directly engaged and participating in research	Increased awareness of positive options for preventing or reducing vulnerability in young people by end users	indices for each theme compared to national data bases and other control groups	
>2 in each theme area Degree of leveraging of funds from third parties	2 yearly survey of end users engaged in Challenge research		
>10% of funds invested			

By 2026 effective research based interventions will result in policy changes, services and community understanding and behaviour to prevent or ameliorate vulnerability to obesity, poor literacy and mental health problems leading to population level improvements in young people's lives.

Figure 4 (cntd) – BeST: Outcome measurement framework

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A Better Start – E Tipu e Rea

RESEARCH PLAN

RESEARCH PLAN

INVESTING IN RESEARCH FOR LONG TERM CHANGE

9-YEAR STRATEGY (MID 2015 TO MID-2024)

1. High level investment and budget structure

BeST has used the \$0.473M commencement phase funding provided by MBIE to refine the Research and Business Plans, addressing feedback from Science Board and Assessment Panel on the initial proposal in 2014.

If successful, the funding available for investment in BeST would be available in two tranches - \$13.7 M from commencement (expected on 1 July 2015) to 30 June 2019 and \$20.5M for the following five years to 30 June 2024. There are other non-research activities (e.g. public outreach and communications) that directly contribute to the mission of BeST and ensure robust processes are in place with strong oversight.

There will be no option for carry-over of funds from the first period to the second period. The cash flow profile need not be linear but we do need to avoid having unspent funds at 30 June 2019.

In this context there is a need for BeST to include provision for:

- Outstanding science leadership: The mechanism used during the commencement phase involves a mixed model with both central national leadership/management supported by a distributed science leadership model. This involves a Director (up to 0.4 FTE), two co-Directors (up to 0.1 FTE each) and up to 4 members of a SLT (up to 0.03 FTE each) for a fixed period during the re-write of the BeST submission to MBIE. The ongoing leadership model was confirmed by the EOS during the commencement phase and is proposed be extended into the next funding period. We envisage the Directorate and SLT having an ongoing role during this next phase as part of the distributed leadership of the Challenge and being involved in critical business processes including monitoring and reviewing research performance, stakeholder engagement, supporting annual reporting and planning, assessing contestable proposals and promoting the Challenge in relevant fora. This provision of funding for the Directorate and SLT is in addition to the FTE allowances they may have as investigators within the strategic research programmes outlined in the Science Plan.
- Strong **Governance and Advisory**: This includes the direct costs of the independent members of the Board plus estimated travel and accommodation costs for an annual meeting of the international SAP. No fees are included for the SAP members.
- Administrative and Operational functions: The functions and activities required here include office administration and management, accounts and purchasing, arranging travel and accommodation (across all functions), secretarial services to the Board, administrative services to the Director, operations management including all business process relating to funding (priority, contestable and contingency funding processes, subcontracting, monitoring and managing performance and reporting), Board and Advisory processes and contract management with MBIE. We have kept the resourcing here to a minimum including not making budget allowance for basic administrative support that will be provided by the host.

- Communications, Marketing, Translation and Outreach: In addition to facilitating the translation of research into outcomes, there is a significant expectation for the NSCs in general to play a prominent national role in promoting science to the public (i.e. outreach – the approach to this has yet to be determined but may well include working across the NSCs and other major science initiatives such as CoREs to ensure coordination and efficiency). In addition we intend to communicate with the diverse sets of stakeholders (next and end-users) engaged with the mission of BeST using web, social media and events. It is also likely we will hold major events annually.

The budget framework for BeST is balanced across these central functional needs and research investments. This involved difficult tradeoffs (e.g. reducing research investment to invest in communications and public outreach) within a small NSC which is carrying the same functional requirements which are largely fixed costs within a modest total budget.

Similarly, within the funds available to support research, a difficult balance has been struck between funds to support an open call for projects (i.e. contestable), a small contingency for unexpected opportunities, and the major proportion of funds for the strategic programmes developed during the Commencement phase and presented in this plan.

This has resulted in the following broad funding or investment categories over the two funding periods (note the first period is four years and the second period is five years):

Table 6 – High level breakdown of funding	2015/2019	2019/2024
Central administration/Management	\$ 609k	\$ 775k
Governance/Advisory	\$ 200k	\$ 275k
Communications/stakeholders liaison	\$ 628k	\$ 850k
Science leadership	\$ 1,435k	\$ 2,000k
Research costs	\$10.87 M	\$16.6 M
Strategic research programmes and projects	\$9 M	\$ 13.75 M
Contestable Research Investment	\$ 1.4 M	\$ 2.5 M
Contingency	\$ 0.47 M	\$ 0.35 M
TOTAL	\$13.7	\$20.5M

Note: If contingency funds are not used in any year they can be reprioritised to either of the other research investment categories in the next year.

A more detailed budget is presented in Appendix 2.

These funding parameters provided the constraints on which our science planning and prioritisation is based

2. The science plan

A. Overview

Three themes across childhood have been identified that will be developed up to and beyond the remaining 9 years: obesity, literacy, and mental health. As outlined in the <u>Context for BeST</u> section, the theme areas were selected based upon: the prevalence of the problem in New Zealand tamariki; the severity of impact on health and its sequel; the effects on functioning in society, economic prosperity and knowledge; relevance to Māori tamariki and whānau; the skills and potential of NZ researchers in these themes; and the capacity to address the Challenge's vision and mission. The rationale for the selection of these themes is detailed in the Overview section under Context and also in the Science plan background and rationale for each of the proposals.

In the first four-year period of research funding (to mid-2019) in each of these three themes there is a more focused proposal addressing aspects of the theme. In two of these themes an early prevention and intervention approach is proposed. For the obesity theme, the proposal focuses on early childhood prediction and prevention of obesity. Targeted early prevention of obesity will almost certainly be more effective than attempting major weight loss in a tamaiti with established obesity, which is usually ineffective long-term. In a review of 15 long-term childhood obesity treatment studies, only three had any benefits and they were small at best (51). For the second theme, early recognition and intervention aims to prevent poor literacy and educational failure. This would have greater impact on educational achievement than correcting later illiteracy when educational failure is already entrenched. The proposal in the mental health theme focuses on recognition, engagement, and management of mental health

disorders in adolescents. Adolescence was selected as it is a developmental phase in which interventions using innovative internet and phone-based platforms can be exploited. These platforms involve recognition and assessment of mental health disorders that are not possible at younger ages.

The Big Data proposal is an overarching platform across the three themes that provides data, analyses, and future economic modelling on impact for the other three proposals. This proposal also includes the provision for the establishment, assessment and scientific evaluation of Healthy Families New Zealand. This is a Ministry of Health New Zealand large-scale, nationwide, pilot intervention to address obesity and related diseases. Whilst this is an initial four-year evaluation period, ongoing evaluation to assess long term impact and changes to the community intervention are planned. Theme research groups in conjunction with the Big Data platform group, will model and measure the economic, health and educational lifecourse impact of theme interventions. One of the major attractions of interventions early in the lifecourse are the accrued benefits over time such that the economic and health benefits over the lifecourse are enormous.

Whilst these proposals focus on more discrete areas of the three themes, there will be other themerelevant research performed by others outside the Challenge in which the Challenge will form collaboration. This will enable the Challenge to contribute to the success of this research and overall impact in the three theme areas and is detailed below.

B. Development of research proposals

A common logical and sequential approach to the development of research proposals has been adopted in the obesity, literacy, and mental health proposals. A major strength of our Challenge is the availability of many detailed longitudinal and cross-sectional local, national, and international studies and datasets. These are a rich source of data and contain well-characterised subjects. Thus, the Big Data proposal will contribute to and inform proposals in the three themes, particularly the obesity and literacy proposals. Local (e.g. GUiNZ) and national datasets will be used to first understand the prevalence and associations with obesity, poor literacy, and behavioural problems in New Zealand tamariki. Prediction models from these large local and national datasets will be developed for early childhood prevention studies (notably obesity and poor literacy). Internet-based models with computer- and phone-based interfaces will be created for adolescent mental health disorders and obesity. This will facilitate community engagement with, and acceptance of potential interventions, which in turn will inform pilot studies and then lead to development of large-scale interventions. The final critical step for the Challenge is to develop implementation strategies to ensure that the results of this world-class research will ultimately yield real benefits for our communities. This will involve: (i) adapting interventions that can be easily scaled across the country, and (ii) working with key communities, stakeholders, and policy makers to ensure that new policies and guidelines can be implemented. This latter phase is often missing from shorter-term research proposals, which usually have very focused outcomes but little community impact. Throughout the 9-year period, there will be ongoing engagement with communities, stakeholders, and Ministries, so that the implementation strategy can be prepared during the second five years of the Challenge.

C. "Braiding of science rivers"

A "braided rivers approach that integrates knowledge from indigenous and western science perspectives is presented in the Overview <u>context for BeST</u> section. A similar "braiding of science rivers" has occurred across proposals and the three themes. Data from the national Integrated Data Infrastructure national and GUINZ studies have been secured through the Big Data proposal, and will be used in studies to evaluate incidence of obesity, poor literacy, and behavioural problems in new school entrants. These datasets will also underpin the development of obesity prediction models and identify risk factors for poor literacy. The Big Data platform group will model and measure the economic, health and educational lifecourse impact of interventions for each of the three themes. The monitoring and assessment of the Healthy Families New Zealand pilot interventions is planned in the Big Data platform, and will address successful community-based changes in obesity and related diseases that is a valuable component of the obesity theme.

A novel internet and phone-based platform will be used in adolescents across the mental health and obesity themes, in order to screen, engage, and manage adolescents with these disorders. There are associations and outcomes in the obesity, literacy and mental health themes that straddle across the other themes, linking the proposals across themes. For example in the obesity prediction and prevention proposal secondary outcomes include improvements in literacy and mental health in new entrant school tamariki.

D. Lifecourse

BeST will address the lifecourse impact of early interventions to create good health (healthy weight), literacy and prosperity, and well-adjusted adults. The Challenge will do all it can to understand the lifelong benefits of early childhood and adolescent interventions through a mixture of long term modelling of outcomes, participation in longitudinal studies, participation with the Healthier Lives NSC in a collaborative

project that addresses both childhood and adult obesity and cross sectional analyses of community wide obesity interventions across all ages. A lifecourse approach in science planning is illustrated in figures 5 and 6 and explained in the sections "E. Theme 1. Obesity" and "F. Theme 2.Literacy" below.

Much of the focus of the Challenge is on early childhood interventions to maximise the health (through obesity prevention) and education (literacy) opportunities throughout the lifespan. The effect of these early interventions on lifelong health, well-being and prosperity will be modelled by the Big Data group to evaluate the lifecourse impact of all interventions. The interventions in adolescence also focus on a critical period in the lifecourse, when the setting a different trajectory is likely to directly affect the intergenerational transmission of risk – for instance by decreasing pregnancy and post-natal distress of young mothers that in turn directly affects the parenting experiences of young tamariki who are highly influenced by parental mood and behaviour (52).

Over the 9-year funding period, there will be balanced focus across each of the themes to examine risks and interventions in infancy/early childhood and also in late childhood and adolescence. This approach is part of the strategy to capture risk identification, early prevention/intervention and later childhood treatment. Each of the Challenge's intervention study subjects will be followed and reassessed in later childhood to gauge the longitudinal impact of early intervention throughout childhood. In addition, BeST has the opportunity to collaborate with, and participate in, the long term assessment of tamariki involved in the very earliest intervention (immediately prior to conception and during pregnancy, e.g. NIPPER and HUMBA) and longitudinal lifecourse studies (e.g. GUINZ).

Participation in Healthy Families in New Zealand would allow the Challenge to be involved in building a research evaluation framework around this major Ministry of Health initiative that includes community members of all ages enabling assessment across the lifespan albeit in a cross-sectional intervention.

E. Theme 1: Obesity

The obesity prediction and prevention proposal contains a logical sequence of projects that extends for 9 years. It will adopt a novel approach of targeted prevention in an age group in whom obesity prevention has not been well tested. The sequence begins with understanding beliefs, attitudes, and practices towards childhood weight and obesity. The prevalence of the overweight and obesity problem and associated risk factors will be determined in new school entrants (five year olds). A model that predicts obesity in new school entrants will be developed and validated from birth and early infancy, using sociodemographic, hormonal, metabolomic, and genetic variables. Parental and whānau acceptability of the model will be assessed. We will then undertake a pilot intervention RCT in infants at risk of obesity to prevent obesity at school entry. The intervention studies (POI.nz, MiNT and Play) conducted in mainly European tamariki. A large-scale study will then be planned, which will incorporate an intervention that can be easily implemented across communities throughout New Zealand.

Whilst the proposal in this theme is the early prediction and prevention of childhood obesity, there will be other obesity research projects and activities that will be conducted as part of the Challenge and others that can be captured through collaboration as summarised in the Figure 3. The opportunity to collaborate with these other important studies expands the BeST investment in this area almost 10-fold. These other studies extend both the developmental stages and strategies to tackle obesity that will be addressed and particularly include pregnancy (NIPPER, HUMBA), early childhood (POI.nz study), childhood (Whānau Pakiri), and the entire lifecourse (Healthy Families New Zealand). NIPPER, HUMBA and POI.nzx are large expensive studies that BeST could not fund alone. The NIPPER budget alone exceeds \$30M. The long-term follow-up of the well-characterised tamariki of NIPPER, HUMBA and POI.nz will also assist in a more comprehensive understanding of the early development of obesity, through comprehensive hormonal, genetic, epigenetic, and biomarker analyses. The NIPPER and HUMBA studies will be conducted in obese women at risk of gestational diabetes, and address the impact of nutritional interventions throughout pregnancy on mother and baby. The POI.nz study is an HRC funded for arm RCT of a sleep or food/activity intervention in 802 families in Dunedin with follow-up now to five years. Whanau Pakiri is a regional lifestyle intervention study of obese tamariki (predominantly Māori) who are assessed as "ready to change" (from being obese to slimmer and healthier), led by Dr Y Anderson with Professors Cutfield and Hofman (BeST) as associate investigators. In addition, studies will be conducted that extend the early research into recognition and engagement with obese adolescents (see the Mental health proposal), leading to engaging lifestyle interventions in this group. Healthy Families New Zealand shifts the focus from more targeted prevention and intervention to a systems-based whole-community approach to changing lifestyle to reduce obesity and related diseases. The cost of this large nationwide pilot intervention (funded by the Ministry of Health) exceeds the entire 9-year BeST budget.

Additional BeST proposals for the second five-year funding period (mid 2019 to mid-2024) that will be considered include; (i) an adolescent obesity treatment proposal, (ii) economic and health modelling to quantify the impact of intervention over the lifecourse and (iii) research into effective policies and community implementation of successful obesity prevention and treatment interventions (see the <u>Translation</u> section below).

Strategically those tamariki in whom obesity could not be prevented in early childhood will be treated in adolescence. The adolescent obesity proposal will include sequential projects that firstly addresses engagement and then intervention. Engagement of adolescents in any intervention is challenging and usually the Achilles heel to success. Engagement will involve novel use of digital technology (through smart phone applications) to engage with overweight and obese adolescents. Effective engagement is the major limitation to achieving weight loss in obesity treatment studies in this group. Once an effective engagement strategy has been developed and tested obesity treatment will be examined. Obesity treatment will include subject selection of a range of interventions leading to a degree of individualised intervention.



Figure 5 - The BeST lifecourse approach to breaking the "obesity cycle" with obesity proposals and projects together with contributions with other themes and other key collaborative projects outside BeST.

F. Theme 2: Literacy

Through a logical series of studies, the 9-year plan for the Literacy theme is focused on ensuring young vulnerable tamariki experience early literacy success to build a strong foundation for educational success. The negative spiral from poor literacy, to poor academic achievement, to frequent behaviour problems, youth offending, adolescent health issues, poor employment opportunities, low socioeconomic status, and poor health outcomes is well documented in the international literature. This plan seeks to change such outcomes by creating a positive cycle from evidenced-based interventions and successful school engagement in the tamaiti's first year at school. Figure 6 below depicts this life course cycle which may be a catalyst for change within a whānau cycle. If vulnerable tamariki have the chance for literacy and educational success they may have more opportunity as they mature to adulthood to ensure their tamariki enjoy a better start to life.

The first five-year plan begins with research to better inform our understanding of what contributes to early literacy success, despite vulnerability, through links with the data integration project (including learnings from kaupapa Māori research designed studies) and through understanding experiences of tamariki, whānau, health and educational professionals as tamariki transition from preschool education settings into formal schooling at five years of age. There will be a particular focus on tamariki living in our digital world who are emergent bilingual in English and Te reo Māori or Samoan) to increase our understanding of how digital technologies may support bilingual language use in mainstream education settings.

In the first four-year plan a cohort of 200 vulnerable tamariki will be followed from preschool through school and their responsiveness to effective classroom school instruction that incorporates a specific pilot language intervention will be determined. Effective strategies to manage any identified health issues in the

tamariki that may interfere with their early literacy learning will also be determined. The outcome measures will focus on early reading and writing success at the end of their first year at school with a follow up in their second school year. Findings from the pilot intervention will support a larger-scale national intervention in the second five-year period of the research plan. The large-scale intervention will aim to ensure consistency of practices across schools to ensure more equitable early literacy outcomes for vulnerable tamariki that will support later literacy and educational achievement.



Figure 6 - A life course approach depicting a positive cycle stemming from interventions to build strong foundational language skills for early literacy success in a tamaiti's first year at school

The plan will link into other research within the Challenge (as depicted in Figure 3) and will also link to other current projects (e.g. MBIE Living in a digital world, Ka Awatea, Māori learning success; Ministry of Education-funded project focused on professional development for year 1 teachers to improve tamariki's literacy learning – see the <u>Research landscape</u> section). Opportunities via contestable funding will also allow new research groups to contribute to the research plan, particularly in the second five-year period of funding. For example, projects focused on adolescent literacy success; projects that follow cohorts from other studies through their early school years (e.g. E Hine Project tamariki, from a cohort of 40 Māori teenage mothers, as they begin their journey through school; projects that continue the planned links with GUiNZ study as the tamariki develop through their school years).

G. Theme 3: Mental Health

There is broad recognition that prevention of mental health disorders would begin with care in planning and supporting healthy pregnancies and then supporting secure maternal-infant attachment. Internationally and in New Zealand there is now considerable evidence on what works in this area and the current challenge is at governmental level on how to support and implement what we already know (53). There remains a need for refinements and improvements and in this regard a project proposed by a promising young Māori researcher, Tania Cargo and David Fergusson ("Whakahōnoretia ō tātou mātua, hei māpihi maurea ki ō tātou tāmariki" - a Māori responsive version of Parent-Child Interaction Therapy (PCIT-Māori), is being supported by BeST for co-funding. The next cutting edge of research would look at interventions that directly target improvements in early childhood learning of self-regulation. There are several trials currently funded in this area (54), and the results and possible extension of this work will be watched carefully and potentially supported in the second five years. New treatments (drug or otherwise) for established severe mental health disorders affecting a smaller number of people, was not considered a
priority for this Challenge as they are the focus of considerable international research and it is unlikely that treatment of this end of the spectrum would need to be different in New Zealand.

Our focus in the first four years will be in the identification of the large number of adolescents who suffer from mild-moderate mental health issues and the development and testing of an internet- and mobile device-based screening and intervention that could be used across the whole community actually supporting our currently over-stretched adolescent mental health workforce. We will in the second five years extend the understanding and learning from these interventions to life-style behaviours such as adolescent sleep, eating and activity (theme 1).

TRANSLATION

NSCs are mission-led Challenges and are thus expected to make a meaningful positive improvement to the health and prosperity of New Zealanders. BeST is committed to turning research into reality and have designed research projects that logically progress to prevention or treatment. The next step in actually helping to make meaningful community change will be based upon implementing strategic principles over the 9-year Challenge period;

- 1. All research proposals will have a clear pathway to implementation which is formally examined in the proposal science assessment process and in ongoing performance reviews.
- 2. Early engagement with stakeholders. We have engaged stakeholders from research planning and will maintain that relationship throughout the life of the Challenge. Through the submission drafting stage we have developed interactions with (i) national policy makers; i.e. Government agencies relevant to the Challenge through the Science Advisors (Chief Science Advisor, Ministry of Social Development, Education, MBIE) and the Child Health Advisor to the Ministry of Health and the Children's Commissioner; (ii) National organisations including Whānau Ora and the Māori Women's Welfare League; (iii) Health care and education providers that includes two of the largest Primary Health Organisations (General Practice organisations); ProCare (Auckland) and Pegasus Health (South Island), TAHA (the Well Pacific Mother and Infant Service), and the Principal's Federation; (iv) Selected community groups relevant to specific projects.
- 3. Early engagement with target communities will be better developed in the first six months of the Challenge (see the <u>Next Steps</u> section below).
- 4. In the 2015-2024 Challenge period investment in implementation of the Challenges findings and recommendations through implementation research and delivery.

RETURN ON INVESTMENT

Modelling the economic, health and well-being and prosperity impact of childhood interventions across the lifespan is critical to the Challenge. One of the major benefits of early life (i.e. childhood) interventions is that the cumulative lifetime years that follow amplify the benefits of early intervention. The Big Data platform group will include economic modelling in the 2019-2024 years to model and measure benefit on interventions developed or considered across the three themes. Such modelling will also help to fine tune interventions when modelling indicates that interventions at different ages or with different effect size leads to different late adult outcomes.

Theme One Obesity: The focus of this theme is understanding, prevention and treatment. More than a million New Zealand adults are now obese, according to the 2013 Ministry of Health annual report. In 2011-2012 the tamaiti obesity rate had also increased, reaching 23% in Pacific and 17% in Māori tamariki. In New Zealand health care costs attributable to overweight and obesity were estimated to be \$686m or 4.5% of New Zealand's total health care expenditure in 2006 (55). The combined costs of health care and lost productivity in New Zealand using the friction cost approach were \$784m and \$911m using the human capital approach (55). Obesity tracks from early childhood into adulthood. Overweight/obese three year old tamariki in the USA had an approximately 50% likelihood of being overweight/obese at 35 years (56). Therefore obesity prevention is more cost effective than obesity treatment and must begin in childhood to be effective. When extrapolated nationwide, a 10% reduction would lead to a conservative saving in health care and lost productivity costs of \$91M pa for New Zealand. Outcomes from this theme will significantly contribute to the prevention of obesity through:

1. Better understanding national prevalence of disease related parameters (e.g. BMI and obesity) and associations with social, ethnic, educational, economic and environmental variables;

- 2. Evaluation of the performance of the Ministry of Health's Healthy Families New Zealand focused on reducing obesity rates;
- 3. Predicting infants at risk of obesity in early childhood and introducing preventative interventions from infancy in those at high risk. A very modest 1% reduction in later obesity is estimated to reduce health care and lost productivity costs by \$9.1M pa;
- 4. Effective interventions to manage obesity in adolescence which address engagement and treatment (including digital technologies) have the potential to reduce lifelong obesity-related diseases, improve esteem and psychological well-being and improve social and employment success.

Theme 2 Literacy: This theme addresses improvement in literacy from the early school years throughout childhood and adolescence. Many policy analysts consider literacy rates as a crucial measure of the value of a region's human capital. For example, literate people can be more easily trained than illiterate people - and generally have a higher socioeconomic status and thus enjoy better health and employment (57). Literacy increases job opportunities and access to higher education. Literacy a cornerstone of education is a proxy for socioeconomic status, occupation and lifestyle which in turn influence income, housing and other material resources (58).

An improvement in early school literacy from 67% to 90% will greatly enhance the academic performance of these tamariki through their school years and improve later income and employment. Each additional year of schooling increases a women's income by 10-20% (59).

A tamaiti's literacy level is related to socioeconomic status, maternal literacy and literacy tools available at home (60). Only 45% of the poorest tamariki are read to every day at age three, this is compared to 65% in middle income whānau and 78% in the richest whānau.

Literacy and in turn socioeconomic status impacts health outcomes across the lifespan. Low education in girls who become poorly educated mothers of low socioeconomic status in turn have tamariki with an increased risk of Alzheimer's disease and other dementias (61). Furthermore, mothers educational attainment is predictive of their sons' cognitive function at 58 and 64 years of age with lower maternal education being associated with poorer scores on neuropsychological tests (61).

Theme 3 Mental health: This theme addresses childhood and adolescent mental health prevalence in New Zealand, risk factors and novel interventions to prevent and treat mental health disorders. Research both retrospective and prospective has shown that most adulthood mental health disorders begin in childhood and adolescence (62). Predictably, across the lifespan, mental health disorders that begin in older tamariki, adolescents and young adults lead to greater disability adjusted life years than in older adults. This finding underpins the importance of prevention and early treatment in this age group (63).

There has been limited research to examine the cost of mental health disorders in childhood and adolescence. One study determined that a tamaiti with ADHD has annual medical costs of \$4,306 and a tamaiti with a conduct disorder \$14,000 per annum compared to tamariki with neither disorders at \$1,944 per annum (64,65).

Depression was associated with high levels of expenditures (\$6,688 per annum) compared to tamariki with no psychiatric diagnosis (\$160 per annum) (66).

The National Children with Special Health Care Needs study found that family costs were higher for whānau of tamariki with behavioural health issues than for other whānau with tamariki with special healthcare needs and that whānau had considerable care-giving time related to the tamaiti's condition (67).

Limited economic modelling suggests that computerised cognitive behavioural therapy has been shown to be far more cost-effective (approx. \$4,000 pa per patient) than therapy as usual for depression and anxiety (68).

Improvement of parenting and whānau management skills in those whānau facing difficulty can reduce the risks of abuse of young tamariki, bring about more effective whānau fiscal management and improve maternal mental health.

INVESTING IN RESEARCH FOR OUR COMMUNITIES

MĀORI **COMMUNITIES**

1. Vision Mātauranga

Thirty years ago, the hui taumata was launched to prescribe a vision of cultural, educational and economic achievement for Māori. Not unlike the principles adopted at that 1984 event, the MBIE's (2013) Vision Mātauranga Framework advocates for sound Treaty relationships by way of a policy that determines to unlock the innovation potential of Māori knowledge, resources and people. Like all communities, Māori communities have their particular issues, needs and concerns. While many of the issues and needs are shared with fellow citizens of New Zealand, some are distinctively Māori. It is on this premise that a "braided rivers" approach (4) discussed in the Challenge introduction, will be advanced. Effective practice by professionals working with Māori tamariki and their whānau, it is argued, occurs BeST where differing knowledge bases are cherished and where there is a crossing of cultural borders and "a braiding of rivers". Within this approach, the mana (dignity) of the individual, the inclusion of the whānau, and the integrity of the professional are all valued (69). A good example of this working is the randomised controlled trial of Wahakura versus standard bedside bassinet for infant sleep currently funded by a grant from the HRC to Dr David Tipeen-Leach and Professor Taylor (70).

For many years the scientific study of New Zealand tamariki has been dominated by one world view at the expense of others. Western science constructs have constantly been used to explain, for example, the psychological facts of childhood (tamarikitanga) and whānau with little account taken of cultural (Te Ao Māori) imperatives (71). This Challenge will provide the first large platform of multidisciplinary childhood research to be embedded within a new "braided rivers" approach, which integrates knowledge from indigenous and western science perspectives.

A better start to life is at the heart of contemporary concerns in health, education, and economic growth and is part of the regular vernacular of countless Māori parents, whānau, iwi organisations, professionals and policy-makers. "E tipu e rea" takes us back to the wisdom of Ngata and his desire for the young to be successful in their learning, to be healthy, and to be inclusive of others' world views while never relinquishing the qualities inherent in their own world. With that in mind, this Challenge will demonstrate an authentic alliance to the Vision Mātauranga Framework. E tipu e rea: Wai ora mo te mātauranga: Just as water brings life to the braided riverbeds that cross the plains of New Zealand, so will the braiding of research, ideas, cultural perspectives, and collaborations within this Challenge be the source of new knowledge to support a better start to life for our generations to come.

Māori stakeholder representation in supporting governance of BeST will be provided by the kāhui that will serve as an advisory group to the Challenge and Governance Board. At the outset of planning the BeST Challenge, planning group members each committed to working in a partnership model with Māori. They developed and agreed to the principles outlined below.

2. Agreed principles for Vision Mātauranga and Māori Engagement

Te Tiriti o Waitangi is about mutual relationships, responsibilities and accountabilities. The BeST Challenge is committed to respectful, collaborative relationships and approaches based on Te Tiriti o Waitangi. The Challenge will incorporate the MBIE Vision Mātauranga objectives to perform high quality research that will improve the quality of life for Māori and all young New Zealanders. We acknowledge the world views, skills and experiences of the team and the accountabilities each brings to the Challenge. The principles below are a set of guiding statements intended to support Vision Mātauranga Policy objectives whilst meeting the needs of all New Zealanders.

Principles

The BeST National Science Challenge will commit to:

- Māori and non-Māori inclusion at the governance level, consistent with Te Tiriti o Waitangi;
- Recognising Māori world views, tikanga, knowledge and language;
- Meaningful involvement of Māori in decision making in the planning, implementation evaluation and dissemination of the Challenge research;
- Building long-term positive relationships and consulting as appropriate with Māori stakeholders;
- Considering the inclusion of Māori research methodologies and the need to protect and enhance Māori knowledge of health and well-being;
- Undertaking future-focused interdisciplinary research that will inform equitable transformation of health, education, and well-being for Māori and all New Zealanders;
- Helping to build Māori research capacity, capability and research leadership.

The team is open to increasing the capability of all Challenge members to engage as appropriate with Māori interests. The specific details of how each programme of research within the Challenge addresses Vision Mātauranga is included in the Research Plan Part 2.

The research plan is focused on areas of high priority for Māori and is consistent with the Māori Education Strategy, Ka Hikitia: Accelerating Success 2013- 2017 as well as the Māori Health Strategy, He Korowai Oranga, with an emphasis on supporting Māori whānau to achieve their maximum hauora.

A Māori Kāhui has been established to support the Challenge in developing its approach to engaging with Māori and in implementing Vision Mātauranga. The Kāhui membership and roles are outlined in the Terms of Reference in <u>Appendix 1</u>.

PACIFIC PEOPLE

The high prevalence of overweight and obesity as well as the persistent educational underachievement among Pacific people suggests that prevention programmes have not been successful across all population groups. In Pacific researchers' experience, in order for intervention studies to be successful they need to be responsive and relevant for Pacific communities and be designed and implemented in ways that meet their cultural realities.

BeST contracted TAHA (Well Pacific Mother and Infant Service) to facilitate robust engagement with Pacific stakeholders.

After consulting with expert Pacific Advisory Group and Key Pacific stakeholders (through online survey, meetings and telephone conversations), TAHA provided the following recommendations to be considered by BeST:

- Ensure thorough scoping of existing knowledge, understanding and interventions about Pacific peoples before progressing with the research;
- Ensure ongoing dialogue and partnership with Pacific stakeholders, communities and whānau throughout the entire research, and recruit Pacific researchers onto the project;
- Acknowledge research fatigue and some cynicism among stakeholders towards the effectiveness
 of further research to changing health outcomes for Pacific peoples curb these wherever
 possible by achieving ongoing dialogue and partnership;
- Fully understand cultural and social sensitivities regarding research methodologies and approaches, whether biomedical, quantitative or qualitative;
- Health literacy not just for youth, but for all members of the whānau was strongly proposed by stakeholders as a priority area, whatever the issue;
- Aim for coordination of the project objectives and acknowledge the close connection between the objectives and broader social and economic influences and influencers;
- Keep focused on the outcomes that will make a difference at the level of whānau and individuals therefore consider scalability and sustainability;
- Acknowledge successful interventions and progress these; identify ineffective approaches and seek to avoid these.

Post submission (April and May 2015), TAHA will conduct further consultation about BeST, with Pacific communities, whānau and other stakeholders. The Directorate and incoming Board will be guided by this consultation in the development of the research programmes and their delivery.

PRIORITISATION

FUNDING RECOMMENDATIONS

In the original submission to MBIE in 2014, there were a total of 24 projects within three themes:

- 10 projects in maternal health, pregnancy and early childhood theme
- 10 projects in the successful transition to adulthood theme
- Four projects in the education: living in a digital world theme

Following feedback from MBIE, the BeST SLT reduced the number of proposals to 7 involving 20 discrete projects. These were then developed further, including addressing the Science Board and Assessment Panel feedback and an evolved integrated strategic framework for the Challenge to a level they could be assessed against criteria established to meet the expectations of a mission-led science approach.

The Directorate group, comprising Professors Wayne Cutfield, Gail Gillon and Barry Taylor met on 20 February 2015 to consider the 7 research proposals for the initial tranche of research funding. The meeting was chaired by Dr Robin Olds, the MBIE-funded independent strategic advisor, and supported by Dr Elsa Kassardjian, the Challenge's operations manager.

The 7 proposals (with lead investigators) and requested estimated budgets until mid-2019 were:

- Eke pānui, ake tamaiti Early Literacy, Professor Gail Gillon, University of Canterbury \$2.800 M;
- Growing Up in Digital Worlds, Professor Niki Davis, University of Canterbury \$2.700 M;
- HABITS, Associate Professor Sally Merry, University of Auckland \$5.726 M;
- AWHI RITO -A randomised controlled trial of a culturally responsive version of PCIT, Mrs Tania Cargo, University of Auckland \$1.670 M;
- PREDPREV Obesity, Professor Wayne Cutfield, University of Auckland \$1.506 M;
- Novel adolescent obesity strategies to manage a growing problem, Professor Paul Hofman, University of Auckland - \$0.713 M;
- Big Data project (incorporating community assessment and intervention), Professor Barry Taylor, University of Otago \$2.975 M.

REVIEW PROCESS

As stated above, the proposals were developed through an iterative series of reviews. The 7 proposals considered in the meeting had undergone internal review with feedback from the Challenge SLT, been presented to and received feedback from a group of key national stakeholders, and had been reviewed by the external SAP. Not all members of the SAP reviewed all proposals, with some members considering only the proposals they felt were within their area of expertise. The SAP members were asked to score the proposals they reviewed against four assessment criteria set by the Challenge (approved by the EOG), that is:

- Criterion 1. Alignment with BeST mission and impacts;
- Criterion 2. Potential scale of impact on health and/or education and/or social benefits;
- Criterion 3. Science stretch and innovation;
- Criterion 4. Stakeholders engagement.

In addition, the Directorate members attending the meeting on 20 February (Professors Wayne Cutfield, Gail Gillon and Barry Taylor) and the independent strategic advisor (Dr Olds) also reviewed and scored the proposals with which they were not involved.

All comments and scores were compiled by Dr Kassardjian, and were tabled during the meeting for the group to consider.

More information on the prioritisation process and criteria is available <u>online</u>.

CONFLICTS OF INTEREST

Conflicts of interest were declared by each of the Directorate members for particular proposals, being those on which they were the lead investigator. It was agreed by the meeting that the conflicted members should not comment on the proposals with which they were conflicted. However, the meeting also agreed that the intent was not to discuss individual proposals, but rather consider the total portfolio of proposals and ensure that there was an appropriate mix to deliver to the Challenge mission.

The full conflict of interest policy is available online in the Collaboration Agreement.

OUTCOME

The combined scores for each of the three themes as well as for the Big Data proposal are presented in Table 7 below (Prioritisation criteria and diagrams comparing the ratings are presented in <u>Appendix 3</u>):

	Number				
Table 7 – Ratings received	of ratings received	Mission	Engagement with stakeholders	Science	Impact
#1 - Education 1 (Eke pānui, ake tamaiti)	5	3.8	3	3.4	3.8
#2 - Education 2 (digital worlds)	6	3	3.2	2.5	2.8
#3 - Mental Health 1 (HABITS)	8	4.5	4.4	3.6	4.1
#4 - Mental Health 2 (PCIT)	7	3.4	4	3	3.6
#5 - Obesity 1 (PREDPREV)	6	5	4.3	4.2	4
#6 - Obesity 2 (Adolescent)	7	4	3.6	3.5	3.7
#7 - Big Data	6	4.7	3.8	3.7	4.4

Decisions were reached by consensus. The following recommendations were made by the Directorate and endorsed by the EOG:

- 1. Eke pānui, ake tamaiti Early Literacy (Professor Gail Gillon, University of Canterbury): Recommended for inclusion subject to addressing feedback, adjusting budget and incorporating use of digital technologies to develop bilingualism, primarily in relation to Te Reo Māori.
- Growing Up in Digital Worlds (Professor Niki Davis, University of Canterbury): Not recommended apart from the component relating to use of digital technologies to develop bilingualism, primarily in relation to Te Reo Māori, which is to be incorporated within the context of eke pānui, ake tamaiti Early Literacy.
- 3. HABITS (Associate Professor Sally Merry, University of Auckland). Recommended for inclusion subject to addressing feedback, adjusting the budget and including if possible the component of the proposal on adolescent obesity relating to research on awareness of obesity and adherence to interventions in adolescents.
- 4. AWHI RITO A randomised controlled trial of a culturally responsive version of PCIT (Mrs Tania Cargo, University of Auckland). While the proposal was viewed as worthy research, funding from the Challenge was not recommended. This recommendation was based on the scoring (see <u>Appendix 3</u>) and recognition that it is a discrete project that does not link with the other proposals or themes of the Challenge. BeST would like to assist in providing alternative sources of funding for this discrete project.
- 5. PREDPREV Obesity (Professor Wayne Cutfield, University of Auckland). Recommended for inclusion subject to addressing feedback and adjusting the budget.
- 6. Novel adolescent obesity strategies to manage a growing problem (Professor Paul Hofman, University of Auckland). Not recommended apart from the component relating to the use of mobile device and applications to assess obesity recognition and awareness which is recommended for incorporation into the HABITS proposal (within a constrained budget).

<u>Note:</u> After some time, it became evident that it was not possible to fit the adolescent obesity component within the HABITS budget. Therefore the decision was made to consider this project in the second five years of funding.

7. Big Data project (Professor Barry Taylor, University of Otago). Recommended subject to addressing feedback, adjusting the budget and exploring the opportunity to work with other Challenges, particularly the hauora-related Challenges, to identify potential synergies.

Figure 7 below provides a summary of the prioritisation steps undertaken since the development of the original submission back in April 2014.



Figure 7 – Overview of the prioritisation steps with projects clustered inside proposals.

Following feedback, all four proposals have undergone extensive revision and further feedback to strengthen against the four assessment criteria.

BUDGET PRINCIPLES

To ensure comparable and appropriate budgeting across proposals budget resourcing principles were established by the directorate and the MBIE advisor Dr Robin Olds. In a mission-led submission such as BeST, the costs of research are very heavily weighted around people and associated overheads. Thus careful considerations of FTEs at all levels has been discussed at length and agreed. These principles approximate staff resourcing of a typical HRC project and thus benefited from Dr Old's experience.

The following staffing budget principles were developed by the Director with input from the Strategic Advisor for each proposal:

- 1. A more substantive allocation for the lead PI is required to show that this researcher will have a committed leadership role to the project. This has been set at 0.2 FTE;
- The total amount available for support to other academics is restricted to approximately 0.2 FTE to ensure adequate other research staffing (e.g. research assistants, nurses and PhD and Masters students) and operational resourcing;
- 3. A half time project manager to each proposal to provide operational coordination of all projects within each proposal;
- 4. A full-time research assistant or two part-time research assistants with preference for Māori and Pacific staff as these are the two major ethnicities that will be recruited across proposals;
- 5. Inclusion of one-two PhD students to each proposal with preference for Māori and Pacific students to optimise training opportunities of future researchers in these ethnic groups;

6. Further staffing and operational costs will require detailed justification for each project within each proposal.

The projected costs illustrating these budget principles are available <u>online</u>.

Based upon these budget principles indicative budgets have been calculated for each proposal and justified by the lead PIs to the Directorate and the MBIE Science Advisor. It is recognised that further budget refinement is required to precisely justify all costs with these costings and quotes currently being sought. These will be included once there is feedback from the MBIE Science Assessment Panel and Science Board on proposals and the proposals adjusted/modified accordingly. Only when MBIE agree to fund BeST will the Directorate in conjunction with the MBIE Science Advisor and all lead PIs of the four proposals review and agree final budgets, key performance indicators and timelines for each project with the proposals. Final investment decisions will then be made by the incoming Board on the advice of the Director.

Based on current estimates the indicative budgets for each of the four strategic research programmes is outlined in the table below.

Indicative budgets

Budget until mid-2019 (first tranche funding)
\$1.800M
\$2.100M
\$2.900M
\$2.200M

RESEARCH PROPOSALS

OBESITY: PREDPREV

1. Overall goal

The overall goal is to understand and predict obesity in infancy. This will enable early interventions to prevent the development of obesity and ameliorate associated learning and behavioural problems to be appropriately implemented. This programme of research will determine the extent of the obesity problem across ethnicities in New Zealand, while understanding the cultural attitudes and beliefs towards obesity among different ethnic groups and particularly amongst Māori and Pacific communities. Complex, but practical prediction models will be developed to predict obesity at school entry from birth/early infancy parameters. Factors associated with resilience to obesity among at-risk tamariki will be identified. Parental and community acceptance of the risks and consequences of obesity will be evaluated, and specifically designed interventions will be co-constructed with Māori and Pacific communities, stakeholders and researchers to prevent obesity and reduce associated poor literacy and behavioural disorders at school entry.

2. Background and science rationale

Obesity was identified as a Challenge focus because of the impacts of the current obesity epidemic on a wide range of health outcomes, including diabetes, cardiovascular disease, stroke, cancer, and arthritis. Furthermore, there are psychosocial impacts of obesity, leading to social isolation, poor self-esteem, and lower employment rates. There are associations that may be causative between obesity, literacy and mental health, linking these three theme through obesity. Obesity is linked to inflammation and sleep disruption which in turn can cause disruption in cognitive function (72). In addition childhood maltreatment is associated with an increased risk (odds ratio 1.36) of lifetime obesity (73).

While broad topics such as infectious disease, allergy and respiratory disease are important, at the population and impact level, prevention has improved in New Zealand with now a 90% immunisation rate and none of these topics having such wide ranging health implications as childhood obesity.

Overall, 31% of adults in New Zealand are obese, and obesity is predicted to overtake smoking as the factor responsible for the greatest burden of disease by 2016 (5). International comparisons suggest that New Zealand is in the top three OECD countries for obesity prevalence (74).

Importantly, childhood obesity has a very wide range of health implications, not only in the short term but also in the long term. Obesity tracks from early childhood into adult life (56,75). Longitudinal data from early childhood to adulthood showed that overweight/obese three-year-old tamariki had a 50% likelihood of being overweight/obese at 35 years (56). Childhood obesity is also linked to school performance and mental well-being, including low self-esteem, behavioural disorders, depression, and learning disability (7-11). Several recent large childhood studies in the USA and UK have found that obese tamariki were more likely to suffer from internalizing and externalising problems, ADHD, conduct disorders, depression, learning disability, and grade repetition (7,8). Increasing severity of obesity increased the risk of all of these problems (8). Interestingly, many of these problems were evident in obese tamariki at the age of five years (9-11), primarily learning disability and low self-esteem in girls and conduct disorders in boys (7,9-11).

In the USA, there has been dramatic doubling in the prevalence of childhood obesity over the past 20 years (76,77). In New Zealand, childhood obesity is also extremely common, with one in three tamariki overweight or obese compared to one in four Australian tamariki. In 2009, among all New Zealand tamariki aged two-four-years, 11.0% were obese and 23.7% overweight (5), exceeding the obesity prevalence in the USA for the same age group (8.9%) (5,6).

Notably, ethnicity and affluence are major influences on obesity. Early childhood obesity shares a number of common risk factors with early poor performance at school, including minority ethnicity, lower socioeconomic status, and poorer maternal education (7-11). In New Zealand, the incidence of obesity varies markedly across ethnicities, and is two-three-fold higher amongst tamariki from Māori and Pacific origins compared to New Zealand Europeans (78). In fact, obesity rates among Pacific (27%) and Māori (19%) tamariki aged two-14-years exceed even those reported in the USA (16%) (5,6). Interestingly, the pattern of weight gain is likely to be different in Pacific tamariki in particular. In a study of American Samoan tamariki, rapid weight gain began in early infancy with high rates of obesity by 15 months of age, when 39% of males and 31% of females were already overweight or obese. This establishment of obesity occurs far earlier than that described in European tamariki (79). In addition, compared to tamariki of more affluent whānau, obesity rates are three times higher in those of lower socioeconomic status (5). Thus in high risk populations (such as Māori and Pacific) obesity and associated educational and psychological problems are evident early in childhood justifying an obesity preventive approach from this early stage.

As a result, this proposal is focused upon: (i) early childhood prediction of obesity and associated poor future school performance and diminished psychological well-being; and (ii) early interventions to prevent the development of obesity and associated educational or behavioural problems. The plan of research is set within the context of the Māori Health Strategy, He Korowai Oranga, emphasising whānau hauora and supporting Māori families to maximise their health (80).

This proposal directly aligns with BeST's mission "to predict, prevent and treat vulnerability in obesity" from the earliest stage in post-natal life (early infancy). The proposal focuses on the prediction of obesity at school entry (≤five years of age) and associated interventions to prevent it (put into practice between early infancy and school entry). The evaluation of the impacts of obesity prevention will include assessments of literacy and behavioural problems (the other two themes in the Challenge mission).

It is not science 'as usual' because this research project encompasses a logical sequence of studies to achieve the greatest impact on obesity, literacy, and behaviour over 9 years. Thus, this proposal:

- is beyond the boundaries of conventional research funding in New Zealand that rarely exceeds three years;
- differs from a single discipline focus by capturing biomedical, educational and psychological outcomes;
- includes a diverse range of research skills from physiology, clinical research, social and life course epidemiology, and public health to community interventions in high-risk groups;
- involves partnerships with Maori and Pacific peoples in research design and study implementation.

A targeted approach to obesity prediction and prevention will be used because there is poor parental awareness and recognition of their child's weight status, with more than 50% of parents unaware of their child's obesity (81). Birth and early infancy prediction models of mid-childhood obesity have been developed in relatively homogenous European populations with data from 20-80 years ago (82,83). These models may not be relevant to New Zealand, which has a rapidly changing and more ethnically diverse population. In Auckland for example, New Zealand Europeans represent just ~50% of the population, with Asians representing 23%, Pacific Islanders 15%, and Māori 11% (84,85). Furthermore, over the past 20 years there have been marked increases in the numbers of Pacific Islanders (43%) and Asians (>500%) (84,85).

To date, prediction models have not been used to develop preventative interventions for those at high risk for childhood obesity as proposed in our study. In addition, obesity prevention interventions have not examined the associated benefits to behaviour and school performance given the common sociodemographic risk factors.

3. Research proposal

A. Research team

Principal investigators

Professor Wayne Cutfield (Lead) is a Professor of Paediatric Endocrinology and Director of the Liggins Institute (University of Auckland). Professor Cutfield has expertise in understanding the consequences of obesity (including insulin resistance and diabetes mellitus) as well as the assessment of obesity in tamariki. His Google Scholar H-index is 37, with 202 published journal articles, 145 of which listed on PubMed.

Associate Professor Rachael Taylor is the Karitane Senior Research Fellow in Early Childhood Obesity and Deputy Director of the Edgar National Centre for Diabetes and Obesity Research (University of Otago). She also leads (or co-leads) several large randomised controlled trials (Play, MInT, POI and BLISS) investigating different approaches to the effective prevention and treatment of obesity in chi tamariki, in home, school, and community settings and has an H-index of 26.

Associate Professor Susan Morton is the Director of New Zealand's contemporary longitudinal study of tamariki and whānau (GUiNZ), and the Director of the Centre for Longitudinal Research at the University of Auckland. She is an epidemiologist and specialist in public health medicine with expertise in life course epidemiological methodology and translation of research evidence to inform policy across sectors.

Other investigators

Dr Teuila Percival (CNZOM) is a Samoan paediatrician and director of the Pacific Health Unit and TAHA (Well Pacific Mother and Infant Unit), University of Auckland. She has expertise in Pacific Island community studies, including obesity and diet.

Marewa Glover is a Māori epidemiologist with expertise in social inequity and community clinical trials (Massey University).

Assoc Professor Sally Merry is a psychiatrist (University of Auckland) with expertise in understanding, assessing, and preventing behavioural problems in childhood.

Dr Triecia Wouldes is a clinical psychologist (University of Auckland) with expertise in assessment of cognitive function and learning during early childhood.

Yannan Jiang a senior biostatistician specialised in clinical trials (Dept of Mathematics, University of Auckland), who will assist in refining study design and data analyses.

Professor Philip Baker is the Director of Gravida (a Centre of Research Excellence) who is a co-investigator of NIPPER.

Professor Melissa Wake of the Murdoch Institute (Melbourne) is leading Growing Up in Australia's Child Health CheckPoint, a cutting-edge physical/biomarkers longitudinal study of Australian tamariki.

Professor Marjo Riita Jarvelin is Professor of Lifecourse Epidemiology at Imperial College (London). Professor Jarvelin is the Director of the Northern Finland Birth Cohorts (with >500 publications) and has developed an obesity calculator.

Professor Keith Godfrey is the Director of the Centre for Developmental Origins of Health and Disease at the University of Southampton (UK), who is also a principal investigator in the NIPPER study.

Professor Yap Seng Chong is the principal investigator of the National Research Foundation Metabolic Translational and Clinical Research Flagship Programme in Singapore, which is a \$25 million study on the developmental origins of metabolic disease. Professor Chong is also a co-investigator in the NIPPER study.

B. Hypothesis and aims

Hypothesis

Childhood obesity can be understood and predicted in infancy and early intervention focused on high risk groups can prevent the development of obesity and ameliorate associated learning and behavioural problems.

Aim 1: Understanding the problem:

- To determine across ethnicities (using data from GUINZ and B4School Check): (a) the incidence of obesity, poor literacy, and behavioural problems at school entry in New Zealand; and (b) BMI velocity patterns in infancy and early childhood.
- To understand cultural (especially Māori and Pacific whānau) attitudes and beliefs towards obesity.

Aim 2: Predicting the problem: To develop prediction models from birth/early infancy incorporating sociodemographic, anthropometric and biological (such as blood and hair samples) variables that can accurately predict the risks of obesity at school entry (five years of age).

Aim 3: Predicting resilience: To identify characteristics of tamariki and their whānau who demonstrate resilience to obesity, poor literacy and behavioural problems in the face of identified risk factors.

Aim 4. Acceptability of the problem: To determine parental, whānau, iwi and community acceptance of the risks and consequences of obesity; to also determine their willingness to engage in processes to change tamariki's environments, which may alter the risk of obesity and associated learning and behavioural problems. To seek Māori and Pacific whānau and community leaders ideas into possible preventative strategies and interventions

Aim 5. Preventing the problem: To design and test intervention packages (based on the knowledge gained from earlier projects) to prevent obesity and reduce associated poor literacy and behavioural disorders at school entry.

C. Research plan (mid 2015 - mid 2019)

Objective 1: Engagement and relationship building with Māori and Pacific communities

a. Milestone 1: Successful community engagement and support for the projects planned.

Objective 2: Obesity incidence in four-five year-old New Zealand tamariki

- a. Milestone 1: Access and analyse data from GUINZ and B4School Check (year 1);
- b. Milestone 2: Incidence analysis (year 1).

Objective 3: Cultural understanding and attitudes towards obesity

- a. Milestone 1: Completion of the focus group meetings (year 1);
- b. Milestone 2: Analysis of the focus group data (year 1).

Objective 4: Obesity prediction model for four-five year-old tamariki

- a. Milestone 1: Analysis of initial prediction model from GUiNZ (year 1);
- b. Milestone 2: Validation of prediction model (year 2);
- c. Milestone 3: Analysis of obesity-resilient tamariki (year 3);
- d. Milestone 4: Refinement of prediction model from NIPPER (years 7-8).

Objective 5: Parental acceptability of obesity prediction model

- a. Milestone 1: Completion of recruitment and data collection (year 2);
- b. Milestone 2: Analyses of collected data (year 2).

Objective 6: Design of intervention to prevent obesity

a. Milestone 1: Literature review, local analyses of interventions, and planning of intervention for pilot study (year 4).

D. Vision Mātauranga and Pacific engagement

Braiding of Vision Mātauranga and Pacific engagement will occur throughout the planned projects. The optimal strategy will be identified following extensive literature review led by Marewa Glover (Māori researcher and co-investigator) and subsequently adopted. Facilitators will maximise Māori and Pacific peoples' participation in studies, building relationship and partnership, employing Māori and Pacific staff, drawing on their knowledge models, targeting recruitment techniques, and adapting study materials. As a result, we have engaged: (a) Rawiri Wharemate, a kaumātua (iwi elder) with the Werry Centre who will assist in coordinating local iwi (tribe) involvement; and (b) TAHA (the Well Pacific Mother and Infant

Service), a national organisation that will facilitate Pacific stakeholder and community engagement and involvement.

E. Research methodologies

Any incorporation of analytes from biological samples will initially come from GUINZ who have applied the principles of kaitiakitanga (guardianship) regarding the inclusion of Māori in the consent process, storage and analysis of samples. The use of Māori knowledge is governed by the GUINZ data access structure which includes Māori representation and authority.

Project 1: Prevalence of vulnerable tamariki (obesity, poor literacy and behavioural problems) (year 1)

A two-pronged approach using two different datasets will be used to assess the ongoing prevalence of obesity (primary outcome), poor literacy and behavioural problems (secondary outcomes) in four-five year-old tamariki given the likely common demographic factors across the three areas. This project will be performed in conjunction with eke pānui, ake tamaiti that plans to understand the prevalence of poor literacy prior to developing targeted literary prevention research projects. Similarly, the early prevalence of behavioural problems will be provided to the HABITS proposal team that is examining adolescent interventions to address mental health disorders. Datasets used will include (i) GUINZ (detailed in project two), and (ii) the Statistics New Zealand Integrated Data Infrastructure (IDI) which includes the B4School Check. The IDI contains 39 national databases that include; health and safety, education, benefits, tax and income, whānau and households, justice, and migration. The B4School Check includes auxological, health and demographic information on all New Zealand tamariki at school entry (approx. 300,000 tamariki since 2008). The IDI provides a less comprehensive, more extensive national cross-sectional assessment than GUINZ.

In addition, longitudinal data from GUINZ (birth, 9 months, two years and 4.5 years) will be used to determine BMI velocity across ethnicities, given the uncharacterised but likely different patterns in Māori and Pacific tamariki compared to New Zealand Europeans.

Project 2: Cultural understanding and attitudes towards childhood obesity (year 1)

Critical to this proposal is to understand the beliefs and attitudes towards obesity and its prevention in Māori and Pacific extended whānau. In these ethnicities, the roles of extended whānau members (notably grandparents) in the care of tamariki tend to be more important than in New Zealand European whānau. Little is known about Māori beliefs, and adiposity has been positively viewed across some Pacific nations in the past.

Qualitative assessment will be conducted using focus groups with a structured interview format, which will be co-chaired by a research team member and a senior member of the respective ethnic communities. Each focus group will consist of 12 participants, with 6 parents and 6 grandparents and an equal sex distribution. There will be five focus groups representing five key ethnicities that include Māori and the main Pacific groups (Samoan, Fijian, Cook Islanders and Tongan). Focus group questions will explore the views, beliefs, understanding and concerns regarding childhood obesity. Questions will include information about those whānau members with an influential role in the care of tamariki, views and beliefs of a healthy body size and obesity, health problems related to obesity and what could make a difference in the prevention of obesity.

Project 3: Early prediction of obese tamariki (years 1-2 and 7-8)

A three pronged approach will be used:

Stage 1. GUINZ data (years 1-2) An obesity prediction model will be developed from GUINZ data obtained during pregnancy, at birth and 9-12 months of age. The timing of the prediction model data will depend upon the predictive value of additional factors beyond birth demography and auxology that have not been included in other early models, which could help to inform the subsequent intervention pilot study. These factors will include infant feeding behaviour, parental attitudes and beliefs regarding weight gain and adiposity and parenting styles. In addition, the added value of incorporating in the model the pattern of early dietary behaviour and rate of early weight gain in infancy will be assessed.

GUINZ is a multidisciplinary longitudinal study of childhood development in New Zealand that includes information on 6,853 tamariki born in 2009 and 2010, as well as their whānau and their environment. Data have been collected from before birth and includes health, growth, behavioural, and cognitive domains. Retention rates are very high compared to contemporary longitudinal studies, at over 93% of baseline up to the pre-school period. The whānau come from across the socioeconomic spectrum. Significant numbers of Māori (~1,600), Pacific (~1,400), and Asian (~1,100) tamariki are included in the cohort which ensures adequate representation of at-risk ethnic groups (Māori and Pacific) (45). These numbers provide sufficient explanatory power to enable ethnic-specific analyses to be conducted. Sociodemographic, anthropometric, behavioural, and educational data have been collected during pregnancy, at birth, 9 months, two years, and at 4-5 years; biological samples have also been collected at birth and at four-five years of age in almost 100% of the cohort. These data will be used to develop a model from birth and infancy variables that will predict overweight and obesity at 4-5 years of age. Longitudinal data up to four-five years of age will be available in late 2015. The model will then be validated against approximately 1,000 controls from prospective obesity intervention studies in Dunedin. Assoc Professor Rachael Taylor who is a lead investigator on this proposal is either principal or associate investigator on all of these projects that include the Prevention of Obesity in Infancy (POI.nz), the Motivational Interviewing in Treatment (MINT) and the Playground (PLAY) studies. She will be able to add valuable insight into the development of the intervention pilot project planned.

Stage 2. NIPPER data (years 6-9) NIPPER (Nutritional Intervention Preconception and in Pregnancy to improve offspring outcomes) is a prospective and more comprehensive study than GUINZ that is about to commence. It will provide additional information beyond GUiNZ that includes a more extensive collection of biological (hair, serum, urine, stools, DNA and extensive analysis - metabolic hormones and analytes, metabolomics, global DNA methylation and common gene variants), sociodemographic, and educational data. We will assess the value of this information to determine added benefit of these extra parameters to refine the prediction model and enhance understanding of the evolving biological processes that lead to childhood obesity. This will be one of the most comprehensively evaluated early life cohorts ever established. NIPPER will recruit 1,800 women planning pregnancy in Auckland (600), Southampton (600), and Singapore (600), and it is anticipated that 50% will become pregnant within 6 months. It will be bolstered by two additional control cohorts collected in parallel (NIPPER Plus in Auckland and S-PRESTO in Singapore) that will add a further 2,000 pregnancies and tamariki to the 900 controls from NIPPER. These studies will begin in mid-2015. Our prediction study will be conducted in collaboration with both NIPPER and Gravida (a Centre of Research Excellence). The biological samples collected at birth will attempt to identify specific easy-to-measure biological parameters; these include hair cortisol, small molecules (metabolomics) and Guthrie card whole blood to measure common gene variants and epigenetic change (genome-wide DNA methylation). Hair cortisol is associated with both chronic stress and childhood obesity (86,87), and is yet to be evaluated as a novel predictor of obesity. All lab costs (except hair cortisol) will be met by NIPPER (and possibly Gravida). In addition, easily gathered biological samples (such as hair samples) will be collected longitudinally through early childhood. Data at four-five years of age will be available in 2021-3.

Stage 3. Predicting resilient tamariki (years 1-2)

The cohorts (approximately 1,000 tamariki) used to validate the prediction models of obesity (see stage 1) will make it possible to identify tamariki with obesity resilience, i.e. those who were predicted in infancy to be at high risk at four-five years of age but who did not become overweight or obese. Factors that will be examined will include maternal and birth demography, parental attitudes and beliefs regarding feeding and obesity, infant auxology, pattern of weight gain from birth through infancy, and infant feeding and weaning practices. Subsequent characterisation of these tamariki will provide insights into obesity resilience, ultimately underpinning strategies for the subsequent intervention study to prevent obesity. We will also determine whether these tamariki have fewer behavioural and learning problems than those who develop obesity.

Project 4: Parental acceptability of prediction information (years 2-3)

Before any intervention based on prediction models can be considered to prevent obesity, it is necessary to evaluate parental acceptance of the information about their child's risk in a culturally sensitive manner. If parents and whānau are unwilling to receive or acknowledge this information, then intervention will be ineffective. Following delivery and prior to leaving hospital, 50 Māori, 50 Pacific, and 50 New Zealand European new parents and their immediate whānau will be asked to complete a questionnaire. This will assess the acceptability of the obesity prediction model concept and the information it provides. Acceptance of the information in >75% of parents for each of the three group will be set to determine whether an obesity intervention study is planned that is informed from parental recognition of a tamaiti's risk of future obesity. Parental feedback regarding future intervention(s) will be also be discussed during this study to help inform project five.

Project 5: Pilot targeted prevention of overweight and obese tamariki (years 4-9)

A prospective randomised controlled intervention trial will be planned and initiated, aiming at preventing overweight (BMI >85th percentile) and obesity (BMI >95th percentile for age) at five years of age among high-risk tamariki. The intervention will be informed by the results of projects 1 to 3, and the following principles will be incorporated into its development:

1. A thorough literature review of interventions in early childhood to prevent obesity in targeted groups. This will include analysis of studies principally in New Zealand Europeans (with few Māori and Pacific) such as POI, MiNT and BLISS. These are obesity intervention studies in early infancy nearing completion, which include sleep hygiene, baby led feeding, and lifestyle education for parents. Each of these studies has a

single intervention approach in a mainly European population, in contrast to the multi-component proposed project that has a large focus on Māori and Pacific tamariki.

2. Informing parents at birth and again at one year of age about the child's risk of obesity, while providing education on awareness and recognition of obesity. A major impediment to intervention studies in New Zealand is that parents of high-risk tamariki do not believe their tamariki are at risk of obesity, and therefore ignore lifestyle education and information.

3. Understanding the risk factors for obesity at school entry, which will help refine the intervention and identify the optimal way to approach parents.

4. Multifactorial intervention to maximise its benefits, including awareness and recognition of obesity, parental lifestyle education facilitated through internet and smart phone communication, reducing community and environmental barriers and enhancing enablers to change.

5. Delegation of recruitment and follow-up of study whānau to ethnically- and culturally-appropriate research assistants and PhD students.

6. Early input from Maori and Pacific stakeholders and communities into study design and delivery.

Study structure of Project 5:

- Primary outcome rates of overweight and obesity.
- Secondary outcomes rates of literacy and behavioural problems.
- Power calculation to show a reduction in overweight or obesity rates in a high-risk group (prediction of 60% overweight (BMI ≥85th percentile) or obese (BMI ≥95th percentile) by age five years) from 60% to 42% between the intervention and control groups will require 120 sets of parents/infants in each group, with 80% power and statistical significance at p<0.05 using a twosided Z-test with pooled variance and independent samples. Accounting for a possible loss to follow-up of approximately 10%, we will recruit a total of 270 sets of parents/infants (135 per group).
- Subjects 270 sets of European, Māori and Pacific first-time parents (stratified for these three ethnicities to ensure equal representation) will be recruited shortly after birth across greater Auckland (with a relatively large resident population of Māori and Pacific people). Newborn infants at high risk (>50%) of overweight or obesity at five years of age will be randomised to intervention and control groups. Infants with known syndromes or medical illnesses, twins, or those born premature, post-term or small-for-gestational-age will be excluded.

F. Research outcomes

- To understand the prevalence of obesity and associated factors in tamariki at school entry across ethnicities and cities in New Zealand.
- To successfully predict school entrant obesity from early infancy for tamariki of key ethnicities; Pacific, Māori and European.
- Demonstration that culturally appropriate information about future obesity risk given to parents of infants will lead to an understanding of the information and preparation to initiate positive changes that will reduce the development of obesity.
- To learn from the characterisitcs of tamariki resilient to obesity to further inform intervention strategies.
- To contribute to research training of Māori and Pacific researchers leading to a greater and more experienced research workforce in the obesity field.
- Prevention of overweight and obese school entrant tamariki. This will be achieved through successful interventions that are introduced in infants predicted to be at high risk of later obesity.

G. 2019-2024 research plan

The obesity prediction model will be further refined from the NIPPER, NIPPER Plus, and S-PRESTO in years 6-9 with the addition of detailed biochemical and genetic data. Easily-measured and inexpensive biomarkers and additional sociodemographic factors will create a rigorous high-quality obesity prediction model. Furthermore, these data will provide insights into mechanisms and processes involved in the development of obesity.

The pilot obesity intervention study will be completed by year 10. The next important step will be to implement a community-based large-scale intervention underpinned by data from the pilot study, which will lead to the prevention of obesity and associated learning and behavioural problems in tamariki who are new entrants to schools across New Zealand.

H.9-year plan diagram

Project Years	1	2	3	4	5	6	7	8	9
Project 1: Incidence									
Project 2: Cultural obesity beliefs									
Project 3: Prediction (GUINZ)									
Project 3: Predicting resilience									
Project 3: Prediction (NIPPER)									
Project 4: Parental acceptability									
Project 5: Pilot prevention									

I. Contingency plan

The only risk is that Project 4 "parental acceptability of obesity" determines that parents would not accept or wish to know whether their infant was at risk of childhood obesity. This would change the focus of the pilot intervention project from infancy to early childhood, but would not cancel it. The NIPPER project has had now funding approved and will commence in May 2015.

LITERACY: EARLY LITERACY (EKE PĀNUI, AKE TAMAITI)

1. Overall goal

The ultimate goal is to ensure vulnerable tamariki experience literacy success in their first year of schooling, in order to establish a strong foundation for subsequent educational achievement and healthy well-being. A programme outcome will be that vulnerable tamariki will achieve at or above their expected reading and writing level by the end of year 1 or that they have developed critical foundation skills (phonological awareness, letter knowledge and vocabulary) to ensure literacy success in year 2. Vulnerable tamariki who are emergent bilinguals (e.g. in English and either Māori or Samoan) will increase their oral vocabulary and phonological awareness skills in both languages, developing their potential for continued bilingualism in both spoken and written forms. Ecological, psychological, cognitive, and physical health variables that may influence early literacy success in New Zealand tamariki will be identified. Potential barriers to early reading success and healthy well-being for vulnerable tamariki will be appropriately managed in the tamaiti's first year at school through the use of emerging digital technology strategies, and through health and education professionals working collaboratively together with the tamariki's whānau.

2. Background and science rationale

A. Background

Literacy was identified as a Challenge focus because achieving more equitable educational outcomes, particularly for Māori and Pacific tamariki, is a critical issue for New Zealand to address. An estimated 20–25% of tamariki in New Zealand schools are 'failing' in their literacy development (16-18). Māori and Pacific tamariki and those from low socioeconomic communities are over-represented amongst underachievers. Large-scale reading assessments indicate that the difference in reading performance between high- and low-performing readers in 9-year-old tamariki in New Zealand are among the largest in the OECD (88,89). Such inequity in reading outcomes leads to long term educational, health and social inequities. The percentage of young people in New Zealand who are not in any form of education, employment or training, is higher than other countries in the OECD, with Māori and Pacific youth rates approximately double that of New Zealand European or Asian youth (90). Critics are calling for urgent

changes to educational practices, particularly in the early school years, to ensure more equitable reading and subsequent outcomes (17,91).

This proposal aims to achieve more equitable literacy outcomes through focusing on successful literacy achievement in the first year of school for vulnerable tamariki. It will address the Challenge objective of improving the potential of young New Zealanders to have a successful life through developing "interventions to manage risk, improve educational and health outcomes and promote resilience in our population". The research will build upon detailed analysis of current knowledge within the New Zealand cultural context and develop an intervention that adopts a holistic approach consistent with Māori concepts of "Hauora" and "Mātauranga." The intervention will involve whānau, teachers, student teachers, peers, health professionals, speech-language therapists, and communities to ensure vulnerable tamariki can take full advantage of evidenced-based literacy instruction and effective teaching from school entry within 21st century learning environments. This will be the first study of its type to specifically focus on an integrated and multidisciplinary approach across education and health to improve literacy outcomes in year 1 vulnerable tamariki.

The proposed research will also incorporate digital technologies. It will determine the usefulness of digital technologies in the management of health issues that may interfere with tamariki's literacy development. The focus will be on the management of health issues that may impact on the participant's literacy learning in their first school year (e.g. hearing, vision, speech, oral language, sleep, and behavioural issues) and determine how more integrated health and education services best support vulnerable tamariki's learning.

In addition, the research plan will evaluate how the digital world can facilitate oral language and foundational literacy skills in bilingual tamariki as they transition from their preschool education setting to a main stream school in English medium. Currently, over 40% of young New Zealand tamariki are growing up in whānau speaking multiple languages (92). Many adults mistakenly believe that focusing on the dominant English language improves life chances, even though simultaneous bilingualism has been linked to lifelong benefits by neurological research (93). Bilingualism accompanied by knowledge of whānau culture, supports the development of self-identity for Māori and other ethnic groups (94). The proposed project will provide important new insights into bilingualism, focusing during the first five-year period on tamariki who are emergent bilinguals and, whose whānau members include speakers of Māori and English, or Samoan and English. (Bilingualism in other languages will be considered in the second five-year plan).

Simply focusing interventions on closing "the gap" between Māori/Pacific and non-Māori/Pacific literacy achievement within a dominant culture framework is not necessarily helpful (Hemara, 2000). Rather, focusing on meeting Māori and Pacific educational aspirations within frameworks supported by Māori and Pacific communities is more culturally meaningful (95). Thus, the proposed research is set within the context of the Māori Education Strategy, Ka Hikitia: Accelerating Success 2013- 2017, the Pacific Education Plan 2013- 2017 (with a focus on Pacific tamariki well prepared for education success) and the Māori Health Strategy, He Korowai Oranga, with an emphasis on supporting Māori families to achieve their maximum health and well-being.

B. Science rationale

Early reading success is a strong predictor of later reading and subsequent educational achievement (96-98). Strong educational achievement leads to higher rates of employment, tertiary qualifications, and improved social, emotional, and healthy well-being (99,100). Thus, early reading success may be seen as a strong protective factor for tamariki entering school that are at risk of poor social and economic outcomes. Yet, in 2013, 35% of year 1 tamariki in New Zealand did not meet the national standards for reading achievement (16). Although this rate drops to 20% overall by the end of year 2, there is a consistent rate of reading under-performance (30–35%) among Māori and Pacific tamariki, which is evident across the primary school years. These data suggest that these tamariki have not developed strong foundational literacy skills to support more complex literacy learning. This research plan will address this need through focusing on tamariki's early literacy success in their first year of school.

A well-researched model of skilled reading (Simple View of Reading)(101) purports that the variance in tamariki's reading comprehension can be explained by two factors: word recognition and linguistic comprehension. Tamariki's phonological awareness (i.e. awareness that words are made up of individual sounds or phonemes) is critical to word recognition development, while vocabulary knowledge is important for linguistic comprehension. This research study will focus on strengthening skills in both of these areas during the child's first year of schooling. Measures of phonological awareness are amongst the most powerful predictors of early reading success in English and are also strong predictors of reading across alphabet-based languages (102). A computer-based phonological awareness assessment task developed in New Zealand predicted reading success at the end of year 1 from school entry with 92% accuracy, and when administered mid-year 1 predicted end-of-year reading success with 94% accuracy (103).

Recent evidence from a series of quasi-experimental studies conducted in New Zealand showed that explicit phonological awareness instruction can significantly increase both reading and spelling

achievement in young tamariki at risk (104-108). Although encouraging, these studies show that a small group of tamariki fail to respond to the intervention in the expected manner. Referred to by some researchers as "treatment resisters", the reason for these tamariki's underperformance is not well understood, as no single variable can easily explain their lack of progress (109). Intensifying intervention in their first school year may be needed to decrease the numbers of lower performing readers in subsequent years (110).

The approach in this proposal differs from previous science-based reading interventions because, it acknowledges that there are multiple interacting variables that need to be addressed to ensure early reading success for particularly vulnerable tamariki, including those that may present as treatment resisters. It adopts a multidisciplinary focus and examines the benefits of evidenced-based literacy instruction (including phonological awareness and vocabulary instruction) in the first year of school within a wider context. This wider context includes health and specialist educational services for tamariki, the engagement of whānau and other caregivers in tamariki's learning, and culturally-responsive teaching practices. In addition, the language-learning environment of tamariki who demonstrate emerging bilingualism in Māori or Samoan will be studied in more depth during the first five-year period of the research programme with the opportunity to focus on other languages (e.g. Asian languages in the second five-year period).

This wider perspective is consistent with a Māori world view that a tamaiti's potential may be realised when their mind, body, and spirit are being developed in unison (111). Vulnerability - or loss of wholeness - may result if one or more of these dimensions fail to develop. Durie (112) extended this concept to include a fourth dimension, whānau, and suggested that all four dimensions are necessary to achieve overall well-being. This project will adapt this framework to examine vulnerability and protective factors for early reading success. Study participants will include Māori and Pacific tamariki and tamariki from low socioeconomic backgrounds identified by the Ministry of Education as 'priority learners' (113). An additional dimension of the research with emergent bilingual tamariki relates to language revitalisation of the indigenous language of Māori and Pacific tamariki's literacy development (e.g.(110)) and will stimulate the engagement of those communities in line with our Vision Mātauranga.

The benefits of digital technologies (e.g. computers) to assist second language acquisition have largely been investigated with adults learning a foreign language (111). Surprising, little is known about the effects of digital technologies on bilingual tamariki's language development in both languages. This proposal will address this research gap, determining benefits of mobile devices to facilitate a tamaiti's emerging bilingualism at home and at school. The study will build on recent findings indicating that the use of digital technology is more effective when purposefully regulated to support tamariki's learning (114-116).

Study participants are likely to be at increased risk of significant health issues (117), as it has long been recognised that tamariki's educational and health statuses are inextricably linked. Health and educational issues are typically addressed independently. In 2012 however, the Government's action plan recognised the need for integration of public services (e.g. social, education, and health) to improve outcomes for the most vulnerable tamariki in New Zealand (118). This proposal addresses this need for better integration of data from various sources. Harnessing research data and routinely collected health information as proposed here in collaboration with the Big Data proposal will enable researchers, communities, and stakeholders to have detailed insight into inequity in literacy and health outcomes in New Zealand tamariki.

Rapidly increasing use of digital technologies in health management, such as mHealth services (use of mobile electronic devices in a patient's health care) also provide new opportunities for the integration of information for a better start in today's digital world (119). Online Health Pathway information for health practitioners (e.g. digital pathways to track referral pathway of patients being developed within the Canterbury Health region³) can provide valuable information that may increase whānau's take-up of referred services for their tamariki. For example, research shows a low rate of follow-up to pre-school health checks (e.g. hearing) for some priority groups (120). Considering protocols for the safe and ethical use of Online Health Pathway information and other potential mHealth services for differing groups (e.g. teachers as well as health professionals) to support tamariki's access to health services is a new area for research. The need to consider mHealth services within differing cultural contexts is also an important new area for research (121). The proposed study will determine whether digital technologies are useful in: (i) facilitating the uptake of referred health services for vulnerable tamariki; and (ii) ensuring whānau,

³ HealthPathways is web-based information portal supporting primary care clinicians to plan patient care through primary, community and secondary health care systems within Canterbury . It is like a 'care map', so that all members of a health care team – whether they work in a hospital or the community - can be on the same page when it comes to looking after a particular person. HealthPathways are designed to be used at the point of care, primarily for General Practitioners but is also available to Hospital Specialists, Nurses, Allied Health and other Health Professionals within Canterbury .

tamariki, and teachers are receiving appropriate support to address health issues that potentially interfere with tamariki's literacy learning in a classroom context (e.g. hearing and vision problems, speech difficulties, sleep disturbance, and behavioural issues (104,105,122,123)).

Reducing literacy inequalities and improving health outcomes of tamariki most in need is a global goal that has eluded some of the world's wealthiest countries (122,124). Comprehensive multidisciplinary research plans are necessary to further advance our knowledge to inform policies and practices to bring about system wide change. The proposed science plan is unique in drawing upon expertise from both health and education disciplines in culturally appropriate ways for our New Zealand context. The overall goal of this project is to ensure vulnerable tamariki experience success in their first year of schooling, in order to establish a strong foundation for subsequent educational achievement and healthy well-being.

3. Research proposal

A. Research team

The research team has proven capability to deliver this project through the quality of investigators' previous work. In addition, advisors and international experts will contribute to the science excellence. The principal investigators and members of the team have engaged with health and education stakeholders and practitioners in the development of this plan through several hui, focus groups, individual meetings, and online discussion groups. We link to policy stakeholders through the GUINZ study as well as the researchers' established relationships with multiple agencies and participation in Ministry Advisory Groups.

Principal Investigators

Professor Gail Gillon, (Ngāi Tahu iwi) Pro-Vice Chancellor College of Education, Health and Human Development, (Professor of Speech and Language Therapy) University of Canterbury

Professor Angus Macfarlane (Te Arawa iwi) Professor of Māori Research, Office of the Assistant Vice-Chancellor Māori (Professor of Education and kaupapa Māori research) University of Canterbury

Key scientists Co-Investigators

Distinguished Professor Niki Davis (e-learning), University of Canterbury

Professor Thomas Klee (Child Language) University of Canterbury

Professor Susan Morton (Public Health Physician) University of Auckland

Professor Elaine Reese (Developmental Psychology) University of Otago

Professor Phillip Schluter (Epidemiology) University of Canterbury and Auckland University of Technology

Professor Barry Taylor (Paediatrician) Dean, School of Medicine, University of Otago

Distinguished Professor William Tunmer (Education Psychology) Massey University

Associate Investigators

Associate Professor Una Cunningham (Linguistics, Language Learning) University of Canterbury

Dr Sonja Macfarlane (Education, Māori Kaupapa Research) University of Canterbury

Dr Elizabeth Schaughency (Child Clinical Psychology) University of Otago

Dr Cathy Wylie (Cohort studies, e-learning) New Zealand Council for Educational Research.

Other associate researchers will include researchers within GUINZ study (University of Auckland), Pacific Island Families Studies (AUT), Māori and Pacific emerging researchers and PhD students in the New Zealand Institute of Language Brain and Behaviour (TBC), health and education practitioners.

New Zealand Advisory Group

BeST Challenge SLT; kāhui advisory group; Professor James Chapman (Massey University); Associate Professor Margie Hohepa (University of Waikato); Leali'ie'e Tufulasi Taleni, Education Facilitator (Education Plus); Lynne Harata Te-Aika; and Elizabeth Brown (Ngāi Tahu iwi); Prof Te Maire Tau Ngāi Tahu Research Centre; Stakeholder engagement facilitator: Chris Mene (Leadership Lab).

International Advisors: see the <u>International linkages</u> section.

B. Hypothesis and aims

Hypothesis:

Culturally-responsive interventions that blend evidenced-based and contextually-relevant education and health practices will lead to more successful early literacy and health outcomes for tamariki entering school as priority learners.

Aims:

<u>Aim 1</u>: To better understand vulnerability and protective factors for early reading success within the New Zealand cultural context.

<u>Aim 2</u>: To determine through a pilot study the feasibility, acceptability, and cultural appropriateness of an integrated and multidisciplinary intervention designed to accelerate year 1 reading and writing development for vulnerable tamariki. This intervention will be called Eke Pānui, Ake Tamaiti (a Māori concept: "Embark reading success; grow the child's success")

<u>Aim 3:</u> To identify key factors that contribute to the growth of simultaneous bilingualism (English/Te reo Māori or English/Samoan) during the first year of school for vulnerable tamariki growing up with digital technologies.

Aim 4: To determine facilitators (including use of digital technologies such as emerging mHealth platforms and Online Health Pathways, see footnote) of the successful management of health issues that may interfere with literacy learning in vulnerable tamariki during their first year at school

<u>Aim 5</u>: To determine the efficacy of large-scale implementation of an expanded Eke Pānui, Ake Tamaiti (including the use of digital technologies to advance bilingualism in tamariki who are emergent bilingual, and use of digital technologies in managing health issues that interfere with literacy learning) across multiple sites throughout New Zealand. This phase is planned for the second five-year period of this proposal.

C. Research plan (mid 2015 - mid 2019)

Objective 1: Determinants of early literacy success

- a. Milestone 1: To establish the prevalence of school entrant foundational literacy success and associated factors through the B4 School Check and GUINZ (linked to Big Data and PredPrev Proposals) and Pacific Island Families Study teams (year 1);
- Milestone 2: Establishment of culturally-appropriate and ethically-cleared processes between researchers and database managers for data use to answer proposed questions; agreement on protocols for data reporting (years 1-2);
- c. Milestone 3: Further community and stakeholder engagement to contribute to aims and outcomes and face-validity verification of empirical findings (years 1-2).

Objective 2: Pilot intervention

- a. Milestone 1: Development of ethically-cleared pilot intervention protocols in consultation with the specific education, health Māori and Pacific communities participating in Eke Pānui, Ake Tamaiti (year 1);
- b. Milestone 2: Evaluation of pilot intervention protocols and materials in terms of feasibility, acceptability, and cultural appropriateness in consultation with communities, iwi advisors, Māori and Samoan language experts (year 1);
- c. Milestone 3: Recruitment of first cohort of participants (Christchurch) and establishment of relationships with whānau, health and education professionals supporting whānau. Semi-structured interviews and survey data collection (years 1-2);
- d. Milestone 4: Implementation of pilot intervention in Christchurch including pre-test mid- and postintervention and follow up assessments, as well as data analysis and interpretation in consultation with communities of practice (years 2-3);
- e. Milestone 6: Recruitment of second cohort of participants (South Auckland) and establishment of relationships with whānau, health and education professionals supporting whānau. Semi-structured interviews and survey data collection (years 2-3)
- f. Milestone 7: Implementation of pilot intervention in South Auckland including pre-test mid- and post-intervention and follow up assessments, as well as data analysis and interpretation in consultation with communities of practice (years 3-4);
- g. Milestone 8: Cost-benefit analysis of intervention effects (year 4);

- h. Milestone 9: Evaluation of feasibility, acceptability, and cultural appropriateness of up-scaling the intervention to other communities across New Zealand in consultation with stakeholders (year 4);
- i. Milestone 10: Development of manualised intervention procedures suitable for wider scale implementation, including recommendations for organisational and professional development (year 4).

Objective 3: Emergent bilingualism

- a. Milestone 1: Engagement with whānau and preschool tamariki recruited for first intervention cohort (Christchurch) who are emergent bilingual. Establish and build relationships with whānau and education communities. Implement early reading and language activities and semi-structured interviews (years 1-2);
- b. Milestone 2: Collection of digital stories across languages for emergent bilingual tamariki and interview, survey implementation and data analyses (years 2-3);
- c. Milestone 3: Implement milestones 1-2 with second intervention cohort (South Auckland) (years 2-4);
- d. Milestone 4: Development of guidelines for digital technology use and strategies to support tamariki's bilingual development. Consideration of programme extension in the second five-year period to support bilingualism in other languages(e.g. Chinese, and Korean) (year 4).

Objective 4: Collaborative management of child's health needs

- a. Milestone 1: Consultation with health and education practitioners involved in supporting whānau of tamariki in first cohort intervention (Christchurch) (year 1);
- b. Milestone 2: Determine current digital technology use in managing preschool and year 1 tamariki's health issues (years 1-2);
- c. Milestone 3: Determine feasibility and acceptability of collaborative enhanced digital technology use across education and health professionals including ethical issues (years 1-2);
- d. Milestone 4: Identify case studies to monitor collaborative digital health management strategies through intervention phase in first school year (years 1-3);
- e. Milestone 6: Data analysis and determination of extension to second intervention cohort (South Auckland) (years 3- 4).

D. Vision Mātauranga and Pacific engagement

The programme of research addresses Vision Mātauranga in several ways: (i) The projects are focused on areas of significant need for Māori including improved tamaiti well-being, enhanced literacy success, successful participation of Māori whānau in their tamariki's education and health management; (ii) Māori participation is evident at both project leadership and project participation levels; (iii) There is inclusion of Māori research methodologies, and Māori perspective through the research approaches; (iv) There is inclusion of specific Māori content and Māori resources in the interventions; (v) There will be development of new resources in Te Reo Māori; and (vi) There is opportunity to build Māori research capacity.

The research plan has been built following extensive consultation and hui with relevant stakeholders and community groups including school principals and junior school teachers, representatives from School Boards of Trustee, Aranui Community Campus, Kids First Kindergarten, Ministry of Education, Pegasus Health, Canterbury District Health Board, Canterbury Development Corporation, Canterbury Health Precinct Advisory Council, Community Trusts, Public Health Nursing, Te Tapuae o Rehua, Ngāi Tahu Research Centre, New Zealand Institute of Language Brain and Behaviour, Canterbury Clinical Network Child & Youth Work stream, Computers in Home Programme representative. (See <u>online</u> for an independent stakeholder report from one of the stakeholder engagement hui). Local community engagement has focused in Christchurch where the first cohort of participants will be recruited for the pilot intervention. It is recognised more comprehensive community engagement with the South Auckland community will be necessary prior to recruiting for the second cohort of participants from this region.

TAHA (the Well Pacific Mother and Infant Service) is an Auckland based national organisation that will facilitate Pacific stakeholder and community engagement and involvement. Given that Pacific tamariki are a group at high risk of poor literacy, TAHA will offer advice on recruitment strategies. We will also give preference to the appointment of Māori and Pacific students and research staff to optimise culturally appropriate engagement and to enhance training opportunities.

E. Research methodologies

The project team will integrate Māori research principles of building relationships (whānaungatanga) and visibility (kanohi kitea) in constructing the research process and interpreting the outcomes. The team will

also ensure that the locus of power within the research paradigm is devolved and shared among the community being researched (125-127). A range of quantitative and qualitative methodologies will be employed including quasi-experimental, semi structured interviews, observational techniques, and survey design. The methodologies and engagement with communities will be guided by Vision Mātauranga principles established for this Challenge under the guidance of Professor Angus Macfarlane. Online resources and workshops to support the researchers' own cultural competence, as appropriate to need, will be developed. In addition, local Māori and Pacific advisors will support the team in the development of specific research elements (language activities and assessments) and support the researchers in working in culturally appropriate ways within their local communities.

Key methods (First five-year period)

Objective 1: Determinants of early literacy success

A quantitative analysis of national cross-sectional and large local longitudinal analysis of integrated datasets will be undertaken. The researchers will work with the Big Data and PredPrev proposal teams and the GuiNZ team on data analysis to address study questions related to prevalence, vulnerability and protective factors for tamariki's early literacy success. The Big Data group is working with Statistics New Zealand on the Integrated Data Infrastructure (*see PredPrev and Big Data proposals for details*) and will assist in providing integrated national educational, health and social government datasets to better characterise determinants of early literacy success.

The GUINZ study will provide more detail regarding associations of early literacy achievement as it is a more comprehensive longitudinal cohort. GUINZ enrolled 6853 tamariki born during 2009 and 2010 stratified by Māori, Pacific, Asian and other ethnicities (128); it involves 11% of the national birth cohort, and its data are broadly generalizable (129). Tamariki and parents have been measured over multiple waves, and data linkage to health records (e.g. National minimum data set, National immunisation register) have already been undertaken on four of these waves⁴. Each data collection wave gathers information across inter-connected domains: whānau; societal context and neighborhood; education, hauora; psychological and cognitive development; and culture and identity. In addition, further literacy data will be collected and analysed from the GUINZ study (e.g. 6-year reading assessment data, national standards literacy achievement data, writing samples). The GUINZ data will be supplemented with other available contemporaneous datasets including the Pacific Islands Families Study resource (130).

Objective 2: Key methods Pilot Intervention

The first cohort of participants (100 tamariki) will be recruited for the pilot intervention in eastern Christchurch (a lower socioeconomic area with a high proportion of Māori and Pacific tamariki. This area is also adversely affected by the earthquakes, with identified stress factors related to housing, schooling, and managing community changes). The second cohort of participants (100 tamariki) will be recruited from South Auckland (a region with high Māori and Pacific population and where we have established community links via the GUINZ study). The 200 tamariki recruited in total will be followed from preschool (approximately 3-5 months prior to school entry) through to the end of their first year of school. Follow-up assessment 6 months into their second year will also be undertaken. (NB: in New Zealand tamariki typically begin school on the day of their fifth birthday or as close to their fifth birthday as practical).

<u>Participants</u>

Tamariki (aged between four years 7 months and 4 years 10 months) who are enrolled in early childhood education, including Te Kōhanga Reo (Māori immersion setting) and Pacific language education settings and who will start school at five years of age in a mainstream (English medium) primary school in eastern Christchurch (first cohort) or South Auckland (second cohort) will be recruited for the intervention. In New Zealand approximately 96% of tamariki attend some form of early childhood education. Participants will include:

- Tamariki referred through the Gateway Health and Education Assessment programme (a programme to assess and support the health and educational needs of vulnerable tamariki in foster care) through Child Youth and Family services;
- Tamariki identified by the early childhood teachers (with the support of health and specialist education professionals) as having health, behavioural, or spoken language difficulties that are likely to adversely affect their early literacy development at school. Recruitment will target in particular, tamariki with emergent bilingualism in English and either Māori or Samoan.

Sample size

Formal power calculations for the large scale intervention will be undertaken following the implementation of the pilot intervention implemented in Christchurch and South Auckland. Pragmatic detectable difference calculations are presented for the pilot intervention sample size. In the pilot, 200 vulnerable will be invited to participate (100 in Christchurch and 100 in South Akld). After accounting for attrition and class cluster

⁴ http://www.growingup.co.nz/en/about-the-study/data-collection-waves.html

effects, the effective sample size will be 140 tamariki. Assuming an alpha level of 0.05, and statistical power of 80%, this size has a standardised detectable difference (d) of 0.24. This difference is considered much smaller than is expected to be found between the intervention groups on phonological awareness, phonological decoding and vocabulary measures (based on previous findings) and thus the sample size will be sufficient to detect clinically meaningful differences in group performance.

Pilot Intervention plan

The aims of the intervention plan are:

- To determine the effectiveness of phonological awareness intervention to accelerate the participants' phonological awareness, phonological decoding, word-level reading and spelling skills;
- 2. To determine the effectiveness of vocabulary intervention to accelerate the participants' word learning abilities and vocabulary knowledge in targeted English, Māori, and Samoan vocabulary;
- 3. To determine the effectiveness of both interventions combined (over and above usual classroom instruction) in improving early reading accuracy, reading comprehension, and writing skills at the end of year 1;
- 4. To determine whether reading and writing skill gains made in Year 1 are maintained and continue to improve in year 2.

Intervention phases

Whānaungatanga "building relationships" - During the preschool phase of the study a member of the research team will establish a relationship with the tamaiti, their whānau, early childhood teacher and other health and education professionals or teams that may be involved in the child's care. Support services the tamariki may be receiving will be documented during the lead up to school, and participation in any school readiness programmes detailed. As part of the relationship building phase, whānau/carers will be invited to attend sessions held at the tamaiti's preschool to learn tamaiti-focused ways of reading books and telling stories of everyday events together as well as focusing on early literacy skills such as letter- sound knowledge.

Intervention phase (First year of school) - A quasi-experimental crossover treatment design (AB/BA) will be used to evaluate the participants' responses to phonological awareness and vocabulary interventions. This design has the advantage of lessening effects of participant variability and is more acceptable to an educational community in that the participants will receive both interventions that are hypothesised to improve early literacy development. Pre-, mid-, and post-test assessment measures, as well as curriculum data and parental engagement data will be used to evaluate participants' responses to each intervention, and to compare participants' performances after each intervention period to their class peers. 50% of the classes the tamariki attend will be randomly assigned to either Group A (phonological awareness followed by vocabulary intervention) or Group B (vocabulary intervention followed by phonological awareness).

<u>Non-treatment comparison</u>: There will be opportunity to compare performance pre- and post- intervention with aged and SES matched peers at schools not participating in the intervention project through routinely collected school entry and end of year 1 literacy related assessments. In addition comparisons with other groups of vulnerable tamariki who have not received intervention can be made via National Standards reporting data and data collected within GUINZ study.

Maramatanga "seeking information" - Pre- intervention, mid-intervention (after Group A has received phonological awareness intervention and Group B has received vocabulary intervention) and post-intervention data will be collected using formal assessment and experimental assessment probes as well as structured interviews with tamariki, parents, and teachers. Experimental measures will include: computer-based phonological awareness and letter-knowledge assessment probes, phonological decoding skill, word- reading and writing assessment probes, and oral narratives. The measures selected have all been previously used in studies involving young tamariki. Phonological awareness and word learning measures in both Samoan and Māori will also be used for emergent bilingual tamariki (Māori tests are currently under development and the Samoan test has been previously piloted (131). Measures of whānau/carers' engagement in tamaiti's reading (e.g. frequency of reading to tamaiti, parent-tamaiti interaction measures during story reading), pre- and post-intervention measures of participants' health status in areas of relevance to early learning (hearing, vision, speech, sleep) will also be collected. Days absent from school and any hospital admissions will be recorded throughout the school year.

Eke Pānui, Ake Tamaiti Intervention Content - Both the phonological awareness intervention and the vocabulary intervention will follow the same format but target different skills. Each intervention will be for 8 weeks with a four-week break between interventions. Teacher led activities: class-based phonological awareness or vocabulary instruction (18) incorporating common Māori and Samoan vocabulary (two hours per week for 8 weeks). Parent/caregiver-led activities extending concepts introduced in the preschool

phases: Shared book activities using culturally relevant stories to develop print concepts and either phonological awareness or vocabulary (132,133) (minimum one hour per week for 8 weeks). The techniques used will reinforce at home the skills introduced at the group level in school. Student-teacher or peer led activities: Small group (four-five tamariki) game activities to facilitate phonological awareness, and letter knowledge or vocabulary and letter knowledge (106) (two hours per week for 8 weeks). The intervention will draw upon online resources and strategies developed within the Ka Hikitia achieving Māori success strategy and Pacific literacy strategy (50). See table 8 below for illustration of intervention and assessment stages.

Treatment fidelity

Class and small group intervention: The research team will coach teachers of the classes involved in the study and student teachers involved with the small group activities in intervention techniques using a coaching and mentoring model. Treatment fidelity for each intervention will be established using the following techniques: Detailed treatment protocol, intervention diaries, observation and video recording of at least 20% of intervention session. Materials and lesson plans will be provided to the teachers. Home reading treatment fidelity will be established through home diaries, parental report and audio recordings of at least 20% of reading sessions. Digital technologies such as email, text messages, skype, youtube clips for modelling examples will be used to support home and school intervention activities. Independent analysis of video or audio recordings will be undertaken and evaluated against treatment protocol.

Case Studies - Observational and interview evidence will be used to produce illustrative case studies of intervention effectiveness for emergent bilingual tamariki (link to objective 3).

Digital use strategies - A parental and teacher survey (co-constructed with the communities involved in the study) will be developed to ascertain the tamaiti's engagement with digital technologies, both in and out of school at the beginning and end of their first school year (link to objective 3 and link to Developing in digital world project associated with the Challenge).

Outcomes

It is expected that:

- 1. The phonological awareness intervention will significantly accelerate the tamariki's phonological awareness, phonological decoding, and word level reading skills;
- 2. The vocabulary intervention will significantly accelerate the tamariki's word learning skills and targeted vocabulary knowledge in Māori or Samoan;
- 3. At the end of year 1 the participants' reading accuracy, reading comprehension and early writing skills will be at age appropriate levels (or better) and will be significantly better than aged and SES- matched peers with similar pre-test language profiles who have not participated in the intervention. For participants who do not reach age appropriate levels it is expected that they will have developed the necessary foundation literacy skills to ensure age appropriate literacy performance in year 2.

Term 1	Randomly Assigned	Term 2 Interv.		Term 3 Interv.		Term 4	End of year 1
Initial Assessment	Group 1	PA	Assess.	Vocab	Assess.	Usual class program	Re-Assess. Comparison
to class peers and peers from other schools not participatin g in the intervention	Group 2	Vocab	•	ΡΑ		Integrate both PA and Vocab	treatment peers
Survey							Survey -re administered

Table 8 - Pilot Intervention Implementation and Assessment phases in Year 1 of School

Interv= Intervention period; PA=Phonological Awareness intervention; Vocab=vocabulary intervention; Assess.= Monitoring assessments administered

Note: Each school term is approximately 10 weeks and there is a two week holiday break between each school term.

Objective 3: Emergent bilingualism

Tamariki in the intervention cohort (described in objective 2 above) who are emergent bilingual tamariki (English/Māori or English/Samoan) (expected to be at least 30 tamariki in each cohort) will participate in additional project activities. This descriptive project will determine factors that support bilingual language learning as measured by development in the tamariki's linguistic skills in both languages through computer software analyses (Systematic Analysis of Language Transcripts: SALT) for English language and vocabulary measures for Te reo Māori and Samoan language as well as parental, teacher and tamariki interview data and data collected through the project activities. Language samples collected from the tamariki's engagement in project activities in English can be compared to a data base of New Zealand tamariki's oral language stories as part of the SALT language data base (134,135).

Language elicitation activity

During the relationship-building phase of the intervention study prior to school entry, the tamariki will be supported with a speaker of their second language (Māori or Samoan) to 'host a tour' of their early childhood centre, Kōhanga reo, or Samoan language nest with the researcher. Here, the environment of their familiar early childhood centre will provide the stimulus for a language elicitation activity. The language(s) used by the tamaiti will be recorded and the adult prompts in both English and Māori or Samoan will include seeking the tamaiti's views (where possible) about when they communicate in either language, and whether they engage with digital technologies in either language (e.g. games on tablets or mobile phones). In addition, interviews with a teacher and a parent (or other caregiver) will cover the same topics, including understanding the child's language experience at home and school.

Vignette of tamaiti's bilingual language use

Relevant resources will be gathered, such as items from the tamaiti's preschool educational portfolio that may show differing language use, details of software used in Samoan, Māori, or English, examples of stories read in main or second language, as well as relevant guidance available to the whānau, health professionals and teachers relating to bilingual language use when engaging with the tamaiti. The evidence gathered will be analysed from at least four perspectives (language, literacy, indigenous studies, and whānau theory) to produce a vignette about an emergent bilingual tamaiti's experiences, as they approach the school setting. This process will be repeated during the tamaiti's first term of school using the tamaiti's classroom as the stimulus for the language elicitation activity.

Digital stories

The emergent bilingual tamariki participating in the planned interventions during their first school year will be supported by the researchers and other participants, to gather oral and pictorial information on mobile devices to make a digital story of their second language learning. The story will be made in English and then remade in the second language. The making of these digital stories will be in the second half of their first year at school and the tamariki's language analysed in each language at a detailed linguistic level (using SALT computer software) as well as story structure level (136), as per established assessment protocols (136).

Objective 4: Collaborative management of tamaiti's health needs using digital technologies

To determine how health and education services may be more integrated (to ensure health issues that interfere with tamariki's literacy learning are well managed) the following will be implemented:

- 1. Interview and focus groups to determine facilitators and barriers to managing health issues in vulnerable tamariki and whānau through the preschool to school transition period and to determine current use of digital technologies in supporting information sharing or health management;
- 2. To create an information sharing platform and pathways between primary health care providers and teachers/schools about health problems (notably including hearing, vision, attention deficit disorder and chronic illness information) and literacy problems to minimise the impact of poor health on literacy;
- 3. To explore ethical issues in sharing information across primary care and education providers;
- 4. Collaborations with Christchurch Health Precinct Advisory Group, Canterbury Health District Board and Canterbury Development Corporation M-health platform Development Group (137) to assess the potential value of a shared information platform for vulnerable tamariki in year 1 pilot intervention cohort study;
- 5. Pilot use of enhanced digital technologies to track management of identified individual health issues in areas that affect literacy learning (vision, hearing, speech, and sleep behaviour).

F. 2019-2024 research plan

Variables that contribute to successful outcomes for individuals and their whānau will be carefully explored, along with findings from other relevant research that interacts with the BeST Challenge (e.g. Developing in Digital World (2015) MBIE funded project and Ministry of Education funded research related to Professional development for year 1 teachers). These findings, together with feedback from communities involved, will inform further adaptations and improvements to the interventions prior to a larger scale study.

Large-scale multi-site intervention: Outcomes of the first stages of the research will inform a large-scale multi-site efficacy study of Eke Pānui, Ake Tamaiti, (including strategies for increasing emergent bilingualism) through an extension of the research platform into the second five-year period. The findings from the first five-year period will provide the basis of a manualised account of the intervention, setting out the procedures, processes, and quality control used in the programme implementation.

Extension of digital technologies for health management strategies: Findings relating to the collaborative management of health issues using digital technologies and protocols developed in the first research period will inform a larger scale investigation of digital technology use to support greater integration between health and education services to support the learning of young vulnerable tamariki.

Expressions of interest for research teams and school and health communities from across the country to contribute to this second phase will be undertaken.

G. Research outcomes

- 1. Sophisticated insight into inequity in health and educational outcomes among tamariki in New Zealand, as well as better understanding of the factors that facilitate success despite vulnerability;
- 2. Vulnerable tamariki with identified pre-school health issues will receive appropriate follow-up treatment or management of their health issues during year 1 through more integrated health and education services;
- 3. Reading and early writing skills of vulnerable tamariki will be within or above age-appropriate levels at the end of year 1. At the end of year 1, emergent bilingual tamariki will have a stronger vocabulary (range and complexity) in their second language to support their continued use of bilingualism, while having stronger foundational literacy skills to support the potential for written language development in both languages;
- 4. The development of the first guide for parents, educators, and health professionals to encourage emergent bilingualism, including recommended strategies for use and regulation of digital devices;
- 5. There will be robust evidence to inform system wide change for more integrated education and health policies, practices and interventions in the early school years to ensure our most vulnerable tamariki consistently experience early literacy success and build strong foundations for life-long learning and healthy well-being.

Objectives	1	2	3	4	5	6	7	8	9
Objective 1: Determinants of literacy success									
Objective 2: Pilot intervention									
First cohort									
Second cohort									
Objective 3 Emergent bilingual									
Objective 4: Health management									
Objective 5: Large scale intervention									
Integrated Health and education services: mHealth strategies									

H. 9-year plan diagram

MENTAL HEALTH: HABITS

1. Overall goal

The goal in this programme of research is to improve short- and long-term outcomes in adolescents' mental hauora, and reduce the personal and societal burden of poor mental health through the provision of an accessible and appealing digital platform. This e-screening tool to detect adolescents at risk of mental health disorders, (notably anxiety, depression and substance abuse), will be designed via the progressive development and testing of prototypes, so that the platform will be ultimately acceptable and engaging to adolescents (particularly including Māori and Pacific people). The developed platform will increase detection of common mental health problems such as depression and anxiety, provide a first-tier intervention for adolescents, while providing monitoring and feedback on progress to the individual undertaking these interventions.

2. Background and science rationale

Adolescence is a key development stage, which sets the scene for the decades ahead. Mental health problems are common in adolescence affecting at least one in four young people (138). They are a major cause of disability (139,140), major risk factors for youth suicide (141,142), and constitute a significant cost to society (26,143), yet most are untreated (144). Māori and Pacific peoples are at particular risk for mental health problems (23,24) and have some of the poorest access rates to services (145,146).

Our solution is to increase detection of mental health problems in adolescence and increase access to evidence-based interventions, by partnering with Māori and Pacific communities to jointly facilitate a codesign⁵, approach to develop, and test a digital platform of e-health interventions. We thus address key components of BeST. The platform will consist of e-screening⁶ as well as access to effective interventions using Behavioural Intervention Technologies (BITS) and will include the "back-end"⁷ system to support these, as well as the application programmer interface (API)⁸ that will allow programmers to use predefined functions to interact with the operating system (instead of writing them from scratch). This will facilitate the modification of existing interventions and addition of further interventions as time goes on. Although the focus is on mental health initially, this approach will be developed with the intention of including interventions to support physical health as well. The BITS will be based on known effective interventions with a focus on building resilience and wellness. The vision is that this will ultimately be the 'go to' place for youth well-being. Our digital platform is intended as a first-tier intervention and will link with second- and third-tier services using the stepped-care model, for the young people who require more than an e-health approach delivered by the digital platform. By increasing access to therapy available 'anywhere and anytime', we aim to improve health and resilience in the short term, and go on to demonstrate improved long-term outcomes, including better school retention and employment rates, improved health, as well as reduced rates of self-harm, substance abuse, antisocial behaviour, and mental illness. Technology offers great promise in terms of increasing reach (147) such as the Txt2Quit smoking cessation programme (148). BITS are a potential game changer in health, but this promise is yet to be realised with current short-term funding, which leads to piecemeal development of individual interventions with no evidence base, integration, or long-term measures of success.

In New Zealand, we already lead the world with the first nationally available e-therapy programme for depression for young people (48), and the development of the widely used mobile phone intervention for smoking cessation (148). The National Science Challenge provides an opportunity for researchers to partner with communities to build on this success. The longer-term funding will allow for a process from co-design of the digital platform with the community, through testing of individual components (e-screening and prototype e-health interventions), to developing the whole platform (in the first four years)

⁵ Co-design is an approach to design in which there is an attempt to actively involve all stakeholders (e.g. endusers, whānau, communities, primary health care providers, school personnel) in the design process to help ensure the result meets their needs and is usable.

⁶ The e-screen would use a technology interface (computer, tablet or mobile phone) to screen for physical or mental health problems.

⁷ The "back-end" is that part of a hardware or software system that is farthest from the user; the internals rather than the user interface. In this case we envisage that this will include a data-base to store encrypted data, and software that will allow for calculations of scores from the e-screen, the rating scales used to monitor progress while doing the interventions, a system of feedback to users and so on.

⁸ An API is a set of commands, functions, and protocols that programmers can use when building software for a specific operating system. The API makes the programmer's job easier, as it allows programmers to use predefined functions to interact with the operating system, instead of writing them from scratch.

and then piloting and carrying out a cluster randomised controlled trial testing the whole platform, and developing a system for gathering data on long-term impacts of the intervention. While this proposal includes the development of two demonstration interventions, the intention will be to partner with investigators developing other interventions to broaden the overall reach of the platform.

The collaborative nature and scope of this project, inclusion of Māori and Pacific investigators, and the codesign approach will allow us to ensure applicability across communities. We will also work with providers in educational, social, and cultural settings, to ensure that the platform fits their priorities and dissemination opportunities. This aim thus addresses Vision Mātauranga hauora/Oranga and fits with the mission of BeST.

3. Research proposal

A. Research team

Kaumātua

Rawiri Wharemate, Werry Centre for Child and Adolescent Mental Health

Principal investigators

Professor Sally Merry (Lead); Head of Department, Department of Psychological Medicine, University of Auckland

Dr Theresa Fleming, Senior Lecturer, Department of Paediatrics and Department of Psychological Medicine, University of Auckland

Dr Karolina Stasiak, Research Fellow, Department of Psychological Medicine, University of Auckland

Professor Felicity Goodyear-Smith, Head of Department of General Practice and Primary Health Care, University of Auckland

Professor Jim Warren, Professor of Health Informatics, University of Auckland

The principal investigators have extensive experience in the area of youth mental health research These include evaluating and testing opportunities to improve population mental health through scalable approaches, developing the internationally leading e-therapy for adolescent depression (SPARX) and an innovative mobile phone-based intervention for depression (MEMO), mentoring and supporting youth driven projects (Lifehack), advising on national developments (National Depression Initiative, Lowdown) and collaborating on major international projects with world leaders in their respective fields. Professor Felicity Goodyear-Smith has considerable experience in the development, evaluation, and validation of escreening for mental health, managing problematic substance use, and other lifestyle issues, as well as expertise in a range of translational research projects in primary care. Professor Jim Warren brings to the project 25 years of experience in health information systems design. Our kaumātua will help ensure this project is conducted in accordance with the Treaty of Waitangi, and Māori and Pacific investigators will ensure Māori and Pacific input at all stages of the project.

Key Scientists

Dr Grant Christie, Child and Adolescent Psychiatrist, Community Alcohol and Drug Youth Service, Waitemata District Health Board

Dr Ainsleigh Cribb-Su'a (Māori), Senior Clinical Child Psychologist with over 9 years' of experience

Associate Professor Dawn Garbett, School of Curriculum and Pedagogy, Faculty of Education, University of Auckland

Dr Sarah Hetrick, Senior Research Fellow, Orygen, The National Centre of Excellence in Youth Mental Health

Professor Chris Frampton, Statistician, University of Otago

Denise Kingi-'Ulu'ave (Tongan) Clinical Lead, Le Va, lead for Te Rā o Te Waka Hourua

Dr Kahu McClintock (Waikato/Maniapoto, Ngāti Mutunga and Ngāti Porou), Research Manager, Te Rau Matatini, lead for Te Rā o Te Waka Hourua

Dr Karlo Mila (Pacific), Postdoctoral Research Fellow, University of Auckland

Dr Stephanie Moor, Senior lecturer, Child Psychiatrist, University of Otago

Professor Robyn Munford, Professor of Social Work, Massey University

Dr Matt Shepherd (Māori), Lecturer in Social Work, Faculty of Education, University of Auckland

Dr Hiran Thabrew, Senior lecturer, Child Psychiatrist and Paediatrician, University of Auckland

Dr Robyn Whittaker, Programme Leader for Health Informatics and Technology, National Institute for Health Innovation, University of Auckland

The team brings together those with clinical expertise in mental health, service delivery oversight, and seniority in, psychiatry, primary care, psychology, social work, and computer science, as well as Māori and Pacific youth mental health, and substance abuse. The team includes key Māori and Pacific investigators, who have track records across public health research in the area of tamaiti and adolescent physical and mental health. Much of the research has taken place in schools and other educational settings, and many in the team are internationally renowned for their work around digital technology (SPARX to treat depression; Txt2Quit for smoking cessation; eCHAT for primary care mental health and lifestyle screening). The team will ensure ongoing partnerships in educational, social, and cultural settings, to facilitate the development of a platform that can be used flexibly in a variety of settings.

B. Hypothesis and aims

The **aim** is to improve short- and long-term outcomes for adolescents, and reduce the personal and societal burden of poor mental health in the first instance, and health more generally in the longer term, through the provision of an accessible and appealing digital platform that will increase intervention rates by:

- 1. Increasing the detection of mental health problems;
- 2. Providing at least two prototype evidence-based IT interventions for common difficulties as the first tier in a stepped care model of interventions;
- 3. Providing monitoring and feedback on progress to the individual undertaking these interventions;
- 4. Providing information on when, where, and how to get extra help if needed; and
- 5. Providing population-level data on use and effectiveness.

The **hypotheses** are:

- 1. The IT based approach and the platform will be acceptable to adolescents.
- 2. The e-screen (which is founded on psychometrically-proven measures) will be feasible to deliver, acceptable to Māori, Pacific and other young people and their communities and will increase detection of common mental health problems.
- 3. The prototype e-health interventions will be:
 - i. Acceptable and engaging to Māori, Pacific and other young people and their communities; and
 - ii. Effective in reducing target symptoms
- 4. The platform, including e-screening, the interventions, the database and the related APIs will be:
 - i. stable, secure, and able to be used for future BITS; and
 - ii. effective in improving short- and long-term overall functioning of young people using the site.

C. Research plan (mid 2015 - mid 2019)

Objective 1: Establishing an appropriate process to ensure that the prototype demonstration interventions for mental health are developed in appropriate cultural context (year 1)

- a. Milestone 1: Engaging with key Māori and Pacific leaders and researchers;
- b. Milestone 2: Community hui to establish working partnerships with key communities.

Objective 2: Development of the first-generation software (year 1)

- a. Milestone 1: Consultation with adolescents, whānau, communities (with a particular focus on Māori and Pacific), schools, and IT experts to determine the appropriate 'look and feel' of the overall platform including:
 - The e-screening tool;
 - The first prototype intervention (emotional health by using evidence-based interventions for depression and anxiety);

- b. Milestone 2: Consultation and scoping with IT experts about the design of the IT platform, the "back-end" and the APIs to inform the development and integration of the BITS;
- c. Milestone 3: Using co-design principles, build first-generation platform that provides access to the interventions and the e-screen and that links to the "back-end" data base and software supporting the overall system;
- d. Milestone 4: Establish acceptability and feasibility of e-screening in association with the IT webplatform.

Objective 3: Test first-generation software (year 2)

- a. Milestone 1: Test acceptability and feasibility to Māori, Pacific and other young people, whānau, communities, schools and primary care sites of the platform and e-screen;
- b. Milestone 2: Test efficacy of the first prototype (emotional health).

Objective 4: Build second-generation software including a second prototype (year 3)

- a. Milestone 1: Refine existing platform, e-screen and first prototype;
- b. Milestone 2: Build second prototype BIT (to address problematic substance use) using information from first-generation software and with ongoing co-design.

Objective 5: Test second-generation software (year 3)

- a. Milestone 1: Test acceptability and feasibility to Māori, Pacific and other young people, whānau, communities, schools and primary care sites of the platform and e-screen;
- b. Milestone 2: Test efficacy of the second prototype (problematic substance use).

Objective 6: Third-generation software development and pilot trial to test the entire platform (year 4)

- a. Milestone 1: further refine software based on finding of the test of the second-generation software;
- b. Milestone 2: Pilot trial of the whole platform
 - Recruitment of pilot sites;
 - Implementation and refinement of trial procedures;
 - Pilot data collected, analysed and used to refine methodology for the definitive randomised controlled trial (RCT) planned for the second five years. Technology tested and refined if needed.

D. Vision Mātauranga and Pacific engagement

Engagement, uptake and effectiveness of the intervention and components among Māori and Pacific users will be critical. Our team is culturally diverse and includes Māori and Pacific key scientists and tauiwi (non-Māori) investigators with strong community connections and proven track records who have been included from the start.

Community stakeholder engagement with well-informed and well-connected providers is important. An initial consultation process has led to an identified interest, willingness and the opportunity for working with Lifehack, a youth-driven technology for the mental health project and the Otara Networking Action Committee (ONAC, led by Bill Takarei) and potential interest from Raukura O Tainui. The research team includes senior staff at Te Rau Matatini and Le Va who have facilitated and supported these relationships and will help ensure that appropriate community relationships are supported and developed. At this point the ONAC and Lifehack have signalled interest in helping to recruit young people and community advisors for focus groups and advisory roles. They have an interest in having an ongoing relationship in which they help to shape the intervention and ensure its relevance to diverse end-users. These stakeholders will inform the first-generation of development of platform. The process of consultation and community engagement will be developed in an iterative way, in consultation with the Māori and Pacific investigators.

Māori and Pacific young people will be consulted and encouraged to help shape the interventions via focus groups and consultation processes. These will be co-facilitated or facilitated by Māori or Pacific researchers and use kaupapa Māori or Pacific processes. Māori and Pacific whānau and communities will also be

consulted. Intervention content, design and dissemination processes and the methods and measures of evaluation will be considered with Māori and Pacific scientists and stakeholders. Studies will be designed to maximise opportunities to recruit Māori and Pacific young people to test the interventions and to allow investigation and reporting of the acceptability and impact of the intervention specifically for that group.

We will develop Māori and Pacific mental health research workforce by encouraging Māori and Pacific students to apply for PhD and Masters scholarships available in this proposal and by ensuring that Māori /Pacific students have access to Māori/Pacific support and supervision.

Interpretation and implications of findings will be discussed with Māori and Pacific scientists and advisors and dissemination of findings will include strategies to ensure that these reach appropriate Māori and Pacific stakeholders/communities. Possible dissemination and implementation of the intervention will be considered from the start and strategies to ensure dissemination and implementation are appropriate and effective for Māori and Pacific communities will be developed in years 1-2.

E. Research methodologies

The proposed research methods are novel in that they include a "braided rivers (he awa whiria) approach" to bring together Kaupapa Māori methods, ongoing co-design with stakeholders, aspects of the innovative Multiphase Optimisation Strategy (MOST) (149), and the RE-AIM framework (Reach, Efficacy, Adoption, Implementation and Maintenance) (150). Over ten years the investigators propose to:

- Develop and test individual components of an integrated evidence-based digital platform (years 1-3)
- 2. Build the integrated platform (year 4)
- 3. Pilot the platform (year 5)
- 4. Carry out a pragmatic trial of effectiveness (years 6-10)
- 5. Establish a method and gather preliminary data to measure longer-term 'real world' outcomes of uptake and overall effectiveness (years 6-10)

Such an approach goes beyond 'business as usual', in which individual interventions are developed and tested in isolation. Instead, it is proposed that the investigators will develop a system designed for national delivery across multiple sites that: (i) addresses a number of common mental health and potentially physical health problems, (ii) allows for co-morbidity, (iii) links to other services, (iv) moves from development to implementation, and iv) measures long-term outcomes. Once established, this will allow greater collaboration, faster development and testing, quicker dissemination and a more integrated user experience than existing standalone approaches and will allow for easier integration of other interventions as they are developed and tested.

The team includes Māori and Pacific people, including researchers, from the outset, to ensure a proper partnership approach. Consultation will be undertaken at schools, maraes, primary health services, and NGOs to ensure broad applicability and good links to support the tiered approach. The investigators propose to use stages in MOST methodology (149) to develop and pilot an integrated platform, in preparation for a definitive pragmatic randomised controlled trial with longer-term outcomes. Computer programmers, web and graphic designers, health informatics experts, and education experts will be consulted throughout the project.

Stage 1 (Objective 1) – Identification and scoping phase. We will identify through literature searches and consultation with young people, the community, schools, and IT experts the necessary components and the 'look and feel' for:

- 1. The e-screening tool (taking into account work underway on eCHAT) to identify mental health problems (151), Indigenous Hauora Instrument (E-IHI), and the structure of HEEADSSS (152);
- 2. The prototype interventions.

The requirements for the software architecture for the 'back-end' will be scoped, in a project led by the software team at the National Institute for Health Innovation (University of Auckland). This will be informed by BeST practices in related architectures (e.g. for home telemonitoring⁹ and mHealth¹⁰) including the API specification, and will build on experience with the national implementation of SPARX.

The co-design process at this stage will involve generation and evaluation of concepts and the development of an overall consistent framework for delivery. The software will be designed to take into account Māori models of mental health (including frameworks such as Te Whare Tapa Wha and the

⁹ Telemonitoring includes the collection of clinical data and the transmission of such data between a patient at a distant location and a health care provider through electronic information processing technologies.

¹⁰ mHealth is an abbreviation for mobile health, a term used for the practice of medicine and public health supported by mobile devices.

Takarangi Framework) and Pacific models (such as the Fonofale Model of Health). Because there are concerns that some young people may over-use the internet, care will be taken to ensure that the proposed interventions are designed in such a way as to not create difficulties in terms of internet and gaming addiction.

Stage 2 (Objectives 2-6) - Iterative refining, developing and testing prototypes in conjunction with development of first-, second-, and third-generation architecture designs. There will be a continuation of a collaborative co-design process where, using the components identified in Stage 1, *prototypes* will be generated for:

- 1. The e-screening tool;
- 2. The core platform (i.e. to collect and store usage and outcome data);
- 3. Two prototype interventions targeting emotional health (targeting resilience to depression and anxiety) and problematic substance use.

Three generations of architecture design are envisaged, with progressive inclusion of demonstration prototypes targeting specific areas of health. We will fund two prototypes but will seek partnerships and co-funding to incorporate other interventions, for example targeting bullying, social skills, anger management, and others. The IT architecture incorporating the *screening tool* will build on the effective approaches already used for eCHAT and E IHI, and will cover the domains of HEADDSSS (the tool promoted in the Prime Minister's Youth Mental Health initiative). The screening tool will incorporate self-rating scales with established psychometric properties, and where possible, those that have been shown to be acceptable to Māori and Pacific peoples (e.g. SACS (153), eCHAT (154)). Focus groups, advisory and consultation processes will be carried out with young people, whānau, school personnel, primary healthcare organisations, and non-governmental providers to determine the BeST and most practical design for the interventions. Input will be sought from social marketing, design, and IT experts. In parallel with the three generations of IT development, we will have a three-stage process of community engagement, with work with specific communities in the first set of designs, and with a snow-balling method of engagement through the next two generations.

The *two prototype interventions* will be based on current BeST evidence from Western science (e.g. the intervention for depression will include relaxation, problem solving, activity scheduling, cognitive restructuring, and mindfulness) and from Māori and Pacific paradigms of mental health and resilience. The prototypes with be developed iteratively, with one built for each new generation of software. The interface will be determined in consultation with young people, but we will build on the success of SPARX (48) and work with young people, communities, and mobile and computer specialists to determine the BeST approach to take. Approaches that will be considered will include whether to use "gamification" on handheld devices (155), an "app" based on previous work (156), or to adopt a new approach to better match the existing and predicted technology, and to fit most appropriately with the values and culture of Māori, Pacific, and other communities. The interventions will be designed so they can be used by young people on their own, but supportive materials will be available so the intervention can be completed with or supported by others (e.g. whānau members, support workers, and health professionals).

The core platform architecture will be informed by experience (particularly of the National Institute for Health Innovation) in related mHealth interventions (e.g. SPARX (48), physical activity promotion (157), and eCHAT (151)), as well as rapidly growing international experiences in telehealth monitoring platforms (158) and the Internet Of Things (IOT) generally (159). Development will be iterative, applying Agile software development methods (160) to allow incorporation of stakeholder input and experience from pilot studies to inform refinement, leading to the version supporting the definitive RCT. The development will be done collaboratively with Dr Geoff Chase, who is leading Medical and Health Technologies spearhead project on in-home care of type 2 diabetes as part of the Science for Technological Intervention Challenge to dovetail design as much as possible.

Particular attention will be paid in the design to take into account the potential for differences in uptake by different socioeconomic and/or ethnic groups. This is important to ensure that the platform does not increase inequity in healthcare delivery.

The e-screen, platform, and prototypes (Objectives 3 and 5) will be tested separately as follows:

Study 1. Testing the platform incorporating the e-screening tool.

The primary aim of this study will be to test acceptability and feasibility within selected schools, primary care sites, and in community sites such as marae and churches. Target sites will have high numbers of Māori and Pacific participants and socioeconomic disadvantage, to ensure uptake can reduce disparities. Qualitative and quantitative methods will be used to determine satisfaction with the overall concept and fit with the organisations (such as schools, marae, churches, primary care sites) in four purposive populations: 1) school staff, 2) primary care staff, 3) adolescents, and 4) whānau. Questionnaires will be designed to allow rapid feedback on the 'look and feel' of the platform, e-screening tool and interface (such as smart phone and tablets). Focus groups will be conducted to gather feedback on approach, and

fit with organisational structures of the target sites and with community beliefs and priorities. We will ensure that there is specific feedback from Māori and Pacific people. The e-screening tool will incorporate measures already known to have adequate sensitivity and specificity, so that the main test will be that of acceptability and feasibility rather than criterion-based validity.

Studies 2-4. Testing each generation of software development and specific prototypes

Small-scale rapid tests (delayed intervention randomised superiority trials) (161) will be performed to evaluate the efficacy of each of the individual interventions (namely emotional problems, problematic substance use) within each new generation of design. These will all compare intervention with waitlist control. After the trial those on the waitlist will also be offered the intervention (i.e. the delayed intervention arm). These studies will also allow for some testing of software stability and usability.

Alongside these tests of efficacy we will conduct qualitative studies to gather feedback on the acceptability and feasibility of the interventions in the different sites and with different populations.

Participants: Adolescents aged 12-18 years with increased symptoms for the index intervention (emotional problems and problematic substance use).

Settings: Alternative education schools, teen parenting units, schools in socioeconomically disadvantaged areas, and youth health clinics.

Randomisation: Participants will be randomised to immediate or delayed intervention in a 1:1 ratio using a computer-generated sequence. Allocation will be stratified by study site and arranged in permuted blocks.

Outcomes: All participants will complete pre- and post-measures of general functioning (Social and Occupational Functioning Assessment Scale; SOFAS (162)), depression (Patient Health Questionnaire-Adolescent; PHQ-A (163)), anxiety (Spence Anxiety Short Form (164)), substance use (Substance And Choices Scale; SACS (153)), as well as a semi-structured diagnostic interview (M.I.N.I. International Neuropsychiatric Interview (M.I.N.I. 6.0) online)

Primary outcome measures will be (i) emotional health PHQ-A for depression and Spence Anxiety Scale for anxiety (short form) and (ii) SACS for problematic substance use

Sample Size: Allowing for an attrition of approximately 20%, 50 participants per arm will be randomised into the studies of the emotional health interventions and 60 per arm into the study of problematic substance use. These sample sizes will ensure there is 80% power to show moderate effect sizes (0.67 - 0.80) as statistically significant (two-tailed, alpha=0.05). Effect sizes of this magnitude would equate to differential changes of three on the PHQ-A, three on the Spence Anxiety Scale, and four on the SACs. Each of these differences is considered as a the minimal clinically significant benefit from the respective interventions, within the context of an e-screen platform that provides access to the interventions and the e-screen and that links to the "back-end" data base and software that supports the overall system.

Qualitative studies: We will carry out interviews with purposive samples of young people, whānau, staff at the sites of the studies, and community stakeholders. We will use a semi-structured interview format to collect both free comment and also feedback on specific issues, such as practicality of the interventions, their cultural acceptability, and suggestions for future improvements.

Stage 3 (Objective 6) - Pilot study of the overall intervention

Study 5. A pilot study will be carried out to test the acceptability, feasibility, and efficacy of the overall intervention (platform housing e-screening and prototype interventions with appropriate APIs). Two matched schools and two matched primary care sites will be recruited to pilot the platform compared with usual care. The following outcomes will be assessed:

- 1. The stability and usability of the platform;
- 2. The rates of help seeking at the two sites;
- 3. Differential rates of access and acceptability;
- 4. The rate at which those who screen positively for difficulties use the recommended intervention:
- 5. The changes in target symptoms for the prototype interventions; and
- 6. The collection of data on educational outcomes (to be determined in consultation with school personnel, and with researchers from the Starpath project).

Participants will be young people aged 12-16 years, and the pilot study will be designed in collaboration with target sites to ensure the trial will fit with individual settings. At least 200 young people will be recruited (100 intervention and 100 usual care), providing data to inform accurate power calculations for the definitive cluster RCT planned for the second five years of the challenge, allowing for clustering, and yielding an accurate measure of the intraclass correlation coefficient (prior studies suggest this is likely to be 0.03 to 0.08). Outcomes will be the same as those for the testing of the prototypes, but will also include data on acceptability, feasibility, percentage of those who are screened out of the target

population, percentage uptake of interventions for those who screen positive, percentage of those who indicate wanting help and readiness to change, percentage of those who complete the interventions once started, and percentage who went on to use other services. Data on methods used at these sites to facilitate uptake and links to primary and secondary care will be collected to help refine the design of the cluster RCT. For the pilot study, we will explore how Big Data sets may be integrated (e.g. opportunities for linking with student ID and NHI numbers). While neither the pilot study nor the cluster RCT is likely to have power to make optimal use of these data sets, we will explore their potential use in the event of a national roll out.

F. Research outcomes

This is a proposal for an integrated platform that would provide a nationally available first step of a stepped care approach to mental health problems for young people, which will reduce barriers to care for the 80% of young people with mental health problems who never receive intervention. It is envisaged that if this concept is successful, it will be readily extended to include interventions for other common mental and physical health concerns.

E-screening will increase the detection of significant barriers to good long-term outcomes. The platform will enable the provision of treatment for mild to moderate common mental health problems, while providing monitoring of outcomes within interventions. Those with more significant problems will be referred for more intensive intervention. We hypothesise that this increased access to service will have an effect on long-term function, with improved academic performance, greater rates of school retention and subsequent employment, improved health as well as decreased rates of self-harm, substance use, and contact with the justice system.

Outcomes of this project will include:

- a. Good engagement with and acceptance from Maori and Pacific communities;
- b. A platform and demonstration prototype interventions that are appealing to young people;
- c. An application programmer interface that defines how additional interventions could 'plug in' to the HABITS platform, expanding both its e-therapies and capabilities for research data collection;
- d. Accurate detection of barriers to good long-term outcomes (e.g. detection of common problems), with the aim of promoting health and enhancing resilience;
- e. An increase in young people's willingness to tackle common problems, such as depression, anxiety and problematic substance use;
- f. Increased uptake of and adherence to the IT therapies available;
- g. Improved detection and referral of those with more serious difficulties;
- h. Short-term reductions in symptoms in defined areas (depression, anxiety, problematic substance use);
- i. Long-term improvements in social and occupational functioning.

As well as outcomes for young people, we hope to contribute to the development of the Māori and Pacific research workforce. We have included in the team Māori and Pacific researchers who are early in research career development. The budget includes provision for three PhD and three Masters stipends (including fees), and the research team will strive to recruit Māori and Pacific doctoral and masters students. Strategic alliances have been formed with Te Rau Matatini (Māori workforce development) and LeVa (Pacific workforce development). This will allow us to maximise opportunities to support workforce development and also to dovetail HABITS with their funded projects through Waka hauora. Therefore, there are excellent opportunities for people from these ethnic minorities to develop their research expertise over the next 9 years.

G. 2019-2024 research plan

The aim in the second five years will be to pilot and carry out a pragmatic implementation-focused cluster RCT to examine the effects of the interventions on short and long-term outcomes. The RCT protocol's will address all SPIRIT 2013 statement checklist items for clinical studies (165-167), as well as the PRECIS and RE-AIM framework criteria for pragmatic studies (150). It would be premature to discuss the design of the full trial at this point in time. It is hoped that the platform may, by this stage, include not only the two prototype interventions, but also others targeting both physical and mental health. The design of the trial below is indicative only.

Participants/setting

Schools and primary care sites will be recruited across the country in a purposive and pragmatic manner that ensures appropriate representation of all communities.

Outcomes

Our short-term and long term primary outcome measures will be determined in the first five years. Short term measures will include changes in motivation to address common problems, changes on the symptom scales outlined above and will also include measures of service delivery and uptake. They will also include measures of the prevalence of untreated mental health problems (using Youth 2000 surveys (25,168)); school retention; tertiary education; employment; physical health and well-being; involvement in youth justice system; mental health and well-being. In the first four years of the project we will explore the potential use of national datasets via NHI and student identification numbers to assess school retention and health outcomes using the Big Data platform described below.

Sample size

The pilot study will help inform the sample size calculation, but the definitive study will be large, at least 1,500 per arm (based on calculations done for previous studies. We will randomly allocate by site and attempt to recruit 10- 15 sites, with 200-300 participants per site. We have previously successfully conducted a study on a similar scale (156), so will be able to draw on this experience to conduct this large study.

Statistical analysis

All data analyses will be carried out on an intention-to-treat basis. Descriptive statistics will be used to summarise the key outcomes, by treatment group. Analyses will utilise generalised linear mixed regression models taking into account the clustering design effect. Information from participants with missing data will be incorporated into these models. The consistency of effects for Māori and non-Māori will be assessed using tests for heterogeneity.

H.9-year plan diagram

Project Years	1	2	3	4	5	6	7	8	9
Objective 1: Māori and Pacific acceptability									
Objective 2: Develop 1st-generation software									
Objective 3: Test 1st-generation software									
Objective 4: Build second-generation software & prototype 2									
Objective 5: Test 2nd generation software									
Objective 6: Build 3rd generation software & pilot entire digital platform									
Examine the effects of the intervention on a short- and long-term outcomes in an implementation-focused trial									

I. Contingency plan

Software development is notorious in leading to cost over-run. The risk of this can be reduced by accurate scoping at the start of the project and we have allowed time to try and ensure that our scoping is accurate and detailed. In the event of cost or time over-runs, we will focus on the first prototype, to show proof of concept, and to maximise the chances of a robust and appealing IT platform that can be expanded on over time. We will also seek co-funding.

BIG DATA

1. Overall goal

This project will develop a high-quality, integrated, and well-validated data system in New Zealand using existing national databases. This data system will provide support to the other projects being conducted by BeST: (i) risk and resiliency prediction models will be identified and validated for childhood obesity, literacy, and behaviour; (ii) the impact of community interventions around these themes will be evaluated and measured; and (iii) mediating and moderating factors for BeST outcomes will be identified to inform potential interventions. The framework and analytical capacity will be developed to measure and report community changes not only with regards to BeST themes, but also for other lifestyle community interventions occurring across the country.

2. Background and science rationale

A. Background

The Mission of BeST Challenge is to develop a portfolio of research targeted at improving the life course outcomes of young New Zealanders. Key topics that will be addressed within this portfolio of research include: obesity, mental health and behaviour, literacy and related outcomes. Setting the foundation of such an agenda requires the availability of high-quality population-level data describing key aspects of life course development. This information is critical to the development of BeST programme for a number of reasons.

- Individual-level population-wide data can enable the assessment of our key outcomes. This descriptive epidemiology (monitoring trends by time and place) can inform our understanding of both protective factors, risk and outcomes. Efficient, accurate and real-time evaluation of policy/interventions not only can examine temporal but also evaluate region-specific changes, as well as staged implementation of policy. An example of this is the use of national B4School check data to describe current levels of overweight and obesity in four-year-old tamariki (169).
- The availability of individual-level population-wide data from multiple administrative datasets makes it possible to understand processes that are occurring at a societal level. Thus, data linkage will produce rich datasets to test hypotheses of association/mediation/modification. An example has been the recent work of Professor Rhema Vaithianathan in the prediction of tamaiti abuse, using linked data provided by the Ministry of Social Development (170). A further example is Professor Tony Blakely's use of linked data sets to examine health inequalities (171-173).
- Individual-level population-wide data can be used to validate prediction models that identify vulnerable groups and test their validity across different New Zealand settings. An example of the importance of this issue is a critical debate in New Zealand developmental research as to whether findings from older South Island based studies are relevant to todays' different ethnicity and socioeconomic mix (174-176).
- One of the greatest strengths of childhood interventions is that the benefits of intervention can extend and compound through the lifecourse. The Big Data platform and expertise can model the health and economic benefits over the lifecourse to better measure the value and impact of early life interventions.

For these reasons, the development of individual-level population-wide linked and integrated data sets on childhood and adolescence will form a critical component of the development, implementation and evaluation of the BeST Challenge. This application describes a programme of research and consultation aimed at giving the BeST Challenges access to high quality data on childhood and adolescence.

This programme of work is possible because New Zealand has a well-developed system of collecting electronic information on childhood and adolescence. Key databases are:

- 1. National health datasets (each using the National Health Index (NHI) number) including:
 - a. Population cohort demographics
 - b. NHI and geocode addresses
 - c. Admission discharge data and chronic conditions including cancer registrations

- d. Perinatal and maternal datasets (including pregnancy problems, birth weight and gestational age, admission data, and congenital abnormalities and other perinatal outcomes)
- e. Mortality
- f. Pharmaceutical use
- g. Laboratory tests ordered (but not their results)
- h. Injury data (ACC)
- i. B4School check dataset (includes height, weight, BMI, hearing and vision checks and standardised assessment of development and behaviour).
- 2. Other administrative datasets that can be linked using the Statistics New Zealand Integrated Data Infrastructure currently include:
 - a. Education (early childhood education providers, primary, secondary, and tertiary education use)¹¹
 - b. Benefits (second- and third-tier and tamaiti benefit payments)
 - c. Personal tax
 - d. Whānau and households (including births, deaths and marriages, working for families, tamaiti protection data, tenancy)
 - e. Justice (including charges from 1992, Sentencing from 1998, Offenders from 2005, and victims from 2014)

There are obvious and serious concerns around how this data linkage occurs, what use it can be put to and by whom. Recently, the Government has determined that analysis of these datasets could significantly improve policy development and implementation. Considerable effort has been invested into identifying and putting in place a safe method for this data linkage to occur. Thus, Statistics New Zealand, with direct support and endorsement from the Prime Minister's Office and the Minister of Finance, has set up the Integrated Data Infrastructure (IDI) framework, which allows linkage and analysis to happen in a safe and confidential environment to authorised and ethically-approved researchers and projects. Public consultation has been undertaken on this work as well as involvement of the Privacy Commissioner. To take these developments to the next stage, the director of New Zealand's National Health IT Board (Graeme Osborne) and Professor Tony Blakely have hosted two national meetings to develop a Virtual Health Information Network. This network will support knowledge and research in this area, by having ongoing knowledge of the scope and quality of the available datasets, as well as being a repository of analysis codes that can be reused as projects progress. In this context, BeST Challenge is in a position to create a tamaiti- and whānau-focused node in this network, which will bring access to an unprecedented amount of data for the purposes of the Challenge as outlined below.

B. Science rationale

There is now growing recognition of the importance and place of 'Big' data sets in the development and evaluation of policy and the conduct of research. The aim of this application is to use the existing New Zealand administrative datasets on childhood and adolescence to develop a world-class data system that will support the ongoing work of the BeST Challenge, and also act as a resource for the understanding of childhood and adolescence. In the absence of the BeST Challenge, it is unlikely that the ability to use this breadth and depth of information would be developed.

The Science rationale for this project is that it will provide an important infrastructural context with which to develop, implement, and evaluate research being conducted by the BeST Challenge. In addition analyses using Big Data can be used to cross validate and extend the key findings from specific studies.

Access to large administrative data sets is a relatively new area of science with the international Population Data Linkage Network having its inaugural meeting in December 2008 (London, UK). There are key issues in this area starting with ethics (confidentiality and use of data for purposes they were not necessarily collected for), data quality (which is only improved as the data are used), and analytical methodologies.

There are four *major* outcomes to which administrative data of the type described can be used: (i) to evaluate investments intended to improve tamariki's health and well-being by analysing population or systemic level data, e.g. Healthy Families New Zealand; (ii) to increase our understanding of the association (causal and proximal) between background factors (e.g. mother's mental health history or poverty levels) and adverse outcomes for tamariki (e.g. obesity or poor self-regulation); (iii) to direct impact on the implementation of services and policies that improve resilience and mitigate against adverse outcomes; and (iv) to create a case for investment in tamariki (while providing certainty about their likely

¹¹ Note that, currently, it does not include standardised national testing but it may do so in the future.
impact) and for government's forward liability. Finally and of some importance, use of the data will lead by direct feedback loops to improvement in the quality of the original data collated for big data sets.

3. Research proposal

A. Research team

Principal investigators

Professor Barry Taylor (lead), Dean and Professor of Paediatrics and Child Health, Dunedin School of Medicine, University of Otago. Professor Taylor has been an academic paediatrician for 28 years. He was the first chair of New Zealand's Child and Youth Mortality Review Committee that set up and continues run the data systems collecting and reporting on data from a range of government departments, as well as individual qualitative data from local mortality review data-groups in DHBs. Professor Taylor currently chairs the Southern DHB mortality Review group hosted by the University of Otago. He currently has an H-index of 32 (Scopus), over 160 peer-reviewed publications, having been cited >3,500 times.

Dr Barry Milne, Senior Research Fellow and Associate Director of the Centre of Methods and Policy Application in the Social Sciences (COMPASS) at the University of Auckland. Barry has over 15 years of experience working on tamaiti cohort studies such as the Dunedin Multidisciplinary Health and Development Study, the Twins Early Development Study (UK), and the GUINZ Study. More recently, he has undertaken micro-simulation work on tamaiti outcomes, and has sought to understand ethnic and socioeconomic inequalities by analysing whole-population health and social datasets. He has 49 peer-reviewed publications, has an h-index of 23 and >4,200 citations.

Professor Boyd Swinburn, School of Population Health, University of Auckland. He has 25 years of experience in conducting, supporting and evaluating community-based interventions in New Zealand, Australia and the Pacific. Professor Swinburn has been principal investigator in the evaluation of 14 wholeof-community programs for obesity prevention. In the last 15 years, he has been awarded \$AUD19 million for support and evaluation of community-based interventions, including three community programs rated by National Institute for Clinical Excellence (UK) as being the closest to systems-based interventions, as well as an award from the National Institutes of Health (USA) of \$USD 2.5 million to develop mathematical models for systems-based interventions using programs in Victoria and the US. Professor Boyd Swinburn has been an Expert Technical Advisor to WHO at more than 20 WHO consultations and meetings. He has an H-index of 48 (Scopus), over 300 publications, and has been cited >9700 times.

Key scientists

Jean Simpson, Director of the New Zealand Child and Youth Epidemiology Service, University of Otago.

Dr Gabrielle Davie, Biostatistician, Dunedin School of Medicine, University of Otago.

Consultants

Professor Tony Blakely, Department of Public Health, University of Otago, Wellington.

B. Hypothesis and Aims

There are two main aims of this project.

Aim 1: To develop high-quality and well-validated administrative data sets using existing national databases. The key application of this data system will be to provide support to the other projects being conducted by BeST. This includes research into the national prevalence of risk and protective factors as well as outcomes for:

- a. Childhood and Adolescent Obesity;
- b. Literacy and Health including positive and negative effects of increasing exposure to the digital world;
- c. Adolescent Mental Health.

Aim 2: To supply the framework and analytical capacity to measure and report community changes with regard to BeST themes. This will include lifestyle changes that are needed at the community level, and will link specifically to the proposed (but not yet confirmed) BeST Challenge involvement in the evaluation of the Healthy Families New Zealand project run by the Ministry of Health as well as other lifestyle community interventions that are increasingly occurring across the country.

In the future, this research team would also begin to explore other dimensions of Big Data. In particular, the use of information that can be gathered by access to analytics around social media, and the use of

digital devices that access the internet. Both of which having negative and positive implications for tamaiti health.

Aim 3: To undertake health and economic complex modelling of planned and successful interventions across the BeST three themes that will provide lifecourse estimates of benefits of early life interventions. This is planned for the second five year period of funding (2019-24).

Hypotheses:

- That administrative data can be used to identify risks and resiliency factors faced by individuals, whānau and communities who might benefit from targeted interventions aimed at improving outcomes;
- That administrative data can be used as a major component of the evaluation of community interventions;
- That administrative data can be used to give unique insight into mechanisms that underpin risk and protective factors for BeST outcomes.

C. Research plan (mid 2015 - mid 2019)

Objective 1: Identify and validate predictive risk models for tamaiti obesity, mental health and behaviour as well as literacy

a. Milestone 1: Identification of relevant datasets and the quality of their data;

b. Milestone 2: Determination of predictive models for identified endpoints and their validation in different ethnic groups. Initial analyses done from longitudinal studies within New Zealand¹²;

c. Milestone 3: Validation of models in an independent data source (e.g. a different year or set of years, or, where possible, administrative data sets).

Objective 2: To evaluate and measure the impact of community interventions around obesity, mental health, and literacy

a. Milestone 1: Development of a generic evaluation framework for Healthy Families New Zealand, which can be applied to other areas that are implementing healthy lifestyle community interventions; publication of baseline data;

b. Milestone 2: Development of evaluation framework for outcomes of social and educational interventions at the community level; publication of baseline data;

c. Milestone 3: Comparisons of outcomes from years 1 and 2 reported in areas of community interventions with matched communities (as well as the national average).

Objective 3: To identify mediating and moderating factors for BeST outcomes that will inform potential interventions

a. Milestone 1: Identification of mediating and moderating factors in the pathway to obesity at four-years of age;

b. Milestone 2: Identification of mediating and moderating factors in the pathway to literacy at 6 years of age;

c. Milestone 3: Identification of mediating and moderating factors in the pathway to childhood poor self-regulation at four-years of age.

Objective 4: Early work to develop the health/economic modelling of community and individual interventions to assess the lifecourse benefits

a. Milestone 1: Extension of the micro-simulation models developed by the COMPASS group with respect to the effect and remediation of socioeconomic and educational disadvantage;

¹² GUINZ is a longitudinal study which has collected extensive data from pregnancy onwards on 6,822 tamariki, who are currently having their four-year assessments. Similarly, the Prevention of Overweight in Infancy (POI.nz) study is a RCT involving 802 whānau looking at early prevention of obesity. The tamariki and whānau in this study have had extensive measures of body size, sleep, nutrition, and physical activity from pregnancy onwards, and are now having their five-year assessments. These include a focus on accurate measures of body size, their genome as well as gut microbiome, and measures of their self-regulation of apetite, activity, emotion, and thinking.

b. Milestone 2: Extension of this work with other foci (e.g. modelling the effect of obesity interventions) in the second 5 years.

D. Vision Mātauranga and Pacific engagement

Vision Mātauranga is a policy framework whose mission is to unlock the innovation potential of Māori knowledge, resources, and people to assist New Zealanders to create a better future. It is therefore important to have strong Māori input into the key questions being asked of Big Data and how they are interpreted and used. An interim Kāhui has been formed to support the three health National Science Challenges, and within this project they will have direct oversight of the new knowledge generated and how this is used. The four cornerstones of Māori Health (Te Whare Tapa Who as described by Mason Durie) are whānau, Tianna (physical health), hinengaro (mental health), and wairua (spiritual health); these will be used to define key questions that are asked of the Big Datasets.

There is currently few pacific researchers with a focus on Big Data analysis but we are acutely aware of the need for involvement and consultation with those who might be affected by analyses that will look at ethnic and socioeconomic differences and outcomes. To this end we will be working with the TAHA group in looking at key questions that emerge from the Pacific community as well as the interpretation of the analyses that are done with Big Data.

E. Research methodologies

Research Methodology for Objective 1 Identify and validate risk and resiliency models for tamaiti obesity, mental health and literacy.

For BeST Challenge, the Integrated Data Infrastructure (IDI) and separately held health datasets will be used to provide data to assess prevalence and construct predictive risk and resiliency equations for three childhood outcomes: (i) obesity; (ii) mental health including behaviour; and (iii) early literacy.

The Big Data team will work closely together with the PredPrev and Early Literacy proposal teams on this objective which is included in their objectives. Both obesity and behavioural problems are measured at four-five years of age as part of the Ministry of Health's B4School Check. The B4School Check includes >90% of four-five-year-old tamariki in New Zealand, recording anthropometric, behavioural, and other health data. It enables the assessment of body mass index (BMI) as well as behavioural scores on conduct problems, emotional problems, and hyperactivity (using the well-validated Strengths and Difficulties Questionnaire, SDQ (177). Each year, the B4School Check adds data on >50,000 four-five-year-old tamariki, having already gathered data on >300,000 tamariki since implementation.

Literacy is measured as part of Ministry of Education data collected on all tamariki enrolled in school. Tamariki are assessed against national standards for reading and writing at each year of school from year 1 (ages five-six) to year 8 (ages 12-13). Our focus will be on early literacy, i.e., reading and writing in years 1-4, for which there are data on >500,000 tamariki since 2007.

There are currently no detailed prevalence national data analyses for obesity, poor literacy and educational performance and behavioural (mental health) problems in preschool age (four to five years). In particular differences across ethnicities, population groups, urban and rural and socioeconomic status has not been assessed.

For each of the three outcomes (described above), the risk and resiliency modelling approach will be to develop regression equations using a range of IDI data. These will include demographic data (e.g. sex and ethnicity) from a range of sources; birth data from the Ministry of Health; socioeconomic data on the whānau from IRD (including income data and Working for Families payments), Ministry of Social Development (including benefit data) and Tenancy data; early tamaiti health data from the Ministry of Health; early education data from the Ministry of Education; and social service involvement data from the Ministry of Social Development.

Further analyses with longitudinal IDI data will be undertaken, using in particular quasi-experimental methods and longitudinal investigations of the impact of exposures. As an illustration of quasi-experimental methods, if early learning payments were offered to a minority of tamariki's whānau to access subsidised early childhood education, these tamariki could be followed over time in the IDI across a range of outcomes, including obesity, behaviour (from B4School Check), and educational achievements. These tamariki could then be compared with a set of 'controls' based on tamariki living in non-treated areas. In general, investigations of this kind will be possible wherever interventions or treatments for sub-populations (i.e., by school, region or random assignment) have been undertaken. The impact of community interventions will be able to be assessed in this way. Moreover, annual updates of IDI data will enable tests of the treatment effect over the long term. The benefits of such an approach have been demonstrated internationally.

As an illustration of longitudinal investigations of the impact of exposures, the wealth of socioeconomic data in IDI datasets will allow the identification of tamariki living in poverty (using standard definitions). It

will then be possible to assess longitudinally the effects of both (i) the timing of poverty (i.e., age of child) on later health, behavioural, and educational outcomes; and (ii) being lifted from poverty on later health, behavioural, and educational outcomes, with selection effects appropriately controlled for (e.g. through inverse treatment probability weights).

The steps to be followed are:

- 1. Develop a theoretical model to guide choice of variables;
- 2. Identify available datasets and the quality of their variables. At this stage, the research team has access to four longitudinal studies with extensive data, and can also use BMI at four-years of age (from the 90% of tamariki who now have this recorded in the B4School national dataset), as well as predictor variables from those that would be available at the time an infant is born and at one and two years of age. Currently, these could include information from health records (the full maternity data set, drug prescriptions, laboratory tests, admissions), social welfare, (benefits, tamaiti protection), tax (income), and education (preschool enrolment);
- 3. Investigate models of prediction that do not use theoretical or biologically-driven models (which may miss useful predictors that we do not yet fit theoretical or biologically driven understanding);
- 4. Develop models and validate against different datasets.

Research Methodology for Objective 2: Evaluate and measure the impact of community interventions around obesity, mental health and literacy.

A draft logic model for systems interventions for obesity prevention is presented in Figure 8. This has been adapted from an early version used in over 12 community-based interventions for childhood obesity prevention, which has been proven to be a robust model for building full evaluation frameworks.



¹ Intervention dose is either 1 or 0 (Healthy Families NZ or not) or continuous/graded (economic input or process indicators)

- ² Systems tools (e.g. network analyses, systems dynamics, agent-based models) for investigative research
- ³ Capacity is leadership, skills/knowledge, structures, resources measured by Community Readiness to Change score

⁴ Relevant environments are primarily schools and early childhood settings measured using standard audit tools

⁵ Many tools available but can be expensive and intensive

 $^{\rm 6}$ Weight, height to calculate BMI-z and prevalence of overweight/obesity

Figure 8 – Logic model for systems interventions for childhood obesity

Our first focus would be to work on an evaluation framework for childhood obesity that would build on the model above and would also work from and extend the framework developed by the New Zealand Child and Youth epidemiology service (120).

The priorities for development would be anthropometry, environments, and community capacity. There are already several sources available for capturing some of these data, but some data will need to be specifically collected. For example, anthropometry for school-aged tamariki is not routinely collected and

some mechanism to do so for baseline measurements will need to be developed. The tools for measuring 'systems change' parts of the logic model will be developed in collaboration with collaborators working in this area at the National Institutes of Health in the USA.

The main work under this objective will be in the examination of the community processes and outcomes of the major government investment in Healthy Families New Zealand. In Budget 2014, the Government allocated \$40 Million over four years to support the implementation of Healthy Families New Zealand. Healthy Families New Zealand aims to improve the health of tamariki and whānau where they live, learn, work and play, and involves a dedicated health promotion effort in 10 locations across New Zealand. The approach encourages voluntary and sustainable action. Healthy Families New Zealand supports local leaders to drive change within their community to support good hauora. It is expected that Healthy Families New Zealand will reach approximately 900,000 New Zealanders. The design for Healthy Families New Zealand draws on a growing body of evidence which suggests that concentrated, community-led health promotion, tailored to specific community needs and with action where people live, learn, work and play, can be successful in reducing risk factors for chronic disease. The BeST NSC has responded to a RfP from the Ministry of Health to co-create the assessment framework and go on and evaluate the progress and outcomes of the project, as we see this as a mutually beneficial activity. The learning about how to effectively change community processes and whether these will have direct benefit on health risk and outcomes would be an important part of delivering on our challenge goals.

Research Methodology for Objective 3: To identify mediating and moderating factors along the pathway to BeST outcomes that will inform potential interventions.

Once key outcomes are identified within the datasets mentioned above, we will examine the effects of mediating and moderating variables using both multivariate models and pathway analysis. For instance, having agreed on measures of self-regulation from the B4School check as an outcome, we would examine the effects of mediating variables (e.g. measures of socioeconomic status) as well as moderating variables such as type of preschool exposure or type of benefit received by the whānau. These will be explored using Bayesian network analysis and other techniques, as appropriate.

F. Research outcomes

The outputs from this project not only inform all the other projects in this challenge, but will also form the basis for describing the changes that are occurring in New Zealand society as well as assist in identifying what is working or not working at the policy level. They will assist in determining research impact.

Within themselves, the analyses will inform the development of new interventions.

Understanding the changing epidemiology and exploring the interconnections and relatedness of health, education and social policy will be of use to government, social discourse and researchers.

G. 2019-2024 research plan

As the first three themes evolve, there will be continued need for evaluation of outcome and impact. As our society is changing quite rapidly and our environment may also be subject to significant change, within this project, there will be the ongoing task to use available data to inform both the ongoing research and the planning of the initiatives in the second five year period. There will be new questions to be answered by access to administrative data-sets as our knowledge evolves in the three theme areas, and it will be the task of the Big Data group to contribute to the overall picture.

In the Healthy Families New Zealand sites, it is the long-term outcomes that are most important and so the evaluation of outcomes and community changes over 8 years will be important.

Health economic longitudinal modelling will be increasingly feasible as our knowledge of the depth and quality of information increases. This will allow micro-simulation of the effect of different social, community and or government actions.

Finally, we plan in the last five years to explore the Big Data that sits within the frequent interactions that our young people have with the internet and social media. This "google analytics" type approach has potential for understanding circumstances and events that now shape the modern youth. As an example, exploration of the social media use that precedes adolescent suicide compared with usual use will potentially be useful in understanding what might be useful interventions in this area.

We anticipate that the development of the research questions to be answered in the second five year period will occur over the first four-years and lead to collaborative developments to answer these evolving questions – probably using competitive RfP's around specific questions.

H.9-year plan diagram

Project Years	1	2	3	4	5	6	7	8	9
Stakeholder engagement/sector communication									
Dataset definitions and quality of data									
Prevalence, risk factors and predictions									
Impact of community interventions									
Mediating and moderating factors									
Modelling and simulation									
Use of web analytics and digital world usage									

I. Contingency plan

The main risk in this project is that proposal for co-funding with the Ministry of Health for developing the evaluation framework for the Healthy Families New Zealand project and then actually doing the evaluation will not be successful. Should this happen, we would continue to develop our own framework of outcomes related to tamaiti and youth obesity and the community changes that are occurring and use this to report temporal and regional changes independent of the Ministry of Health processes. The feedback of this information to regional groups that are promoting improved life-style outcomes will be offered at cost and allow evaluation of outcomes at community level that would otherwise not be possible. This would fit well with plans for investment in this area by groups such as a current Auckland consortium developing regional plans for obesity prevention and the South Island Regional Health alliance which is doing the same.

BUSINESS PLAN

BUSINESS PLAN

OPERATING STRUCTURE

BeST is a multi-party virtual research centre structured to engage effectively with the educational health and social research capabilities relevant to the Challenge across New Zealand. In addition the Challenge is designed to engage with stakeholders (including next and end-users) at local and national levels to ensure the research is relevant and able to be effectively implemented. The operating structure is designed to create the necessary momentum directed towards achieving the mission.



Figure 9 - BeST operating structure

OPERATING AGREEMENTS

The University of Auckland as Challenge Contractor has entered into a National Science Challenge Investment Contract (NSCIC) with MBIE (or the Ministry) for the delivery of the Challenge and a Challenge Programme Agreement (CPA) for the commencement phase.

The deliverables of the commencement phase CPA included a Collaboration Agreement agreed between the Challenge Members and the Challenge Contractor (collectively the Collaborating Parties) that outlines the governance, management and operational basis for the implementation of the Challenge as a national research collaboration.

The Challenge Members or Parties are the University of Auckland, the University of Otago, AgResearch Limited, the University of Canterbury, Massey University, Waikato University, Auckland University of Technology, Victoria University of Wellington.

The Parties have drafted a Collaboration Agreement which will be executed following approval of the Challenge by the Ministry and subject to addressing any feedback or conditions from the Science Board. The Collaboration Agreement establishes the BeST Board and management structure as outlined in Figure 9. The agreement devolves responsibility for the operation and performance to the Challenge Board.

- BeST is a virtual centre, with central head office at the University of Auckland and operational activities across New Zealand Research, Science and Technology (RS&T) organisations;
- All New Zealand RS&T organisations, not just Collaborating Parties, can be sub-contracted to deliver the science;
- BeST is a New Zealand Inc. multi-disciplinary research collaboration to achieve the mission.

A copy of the Collaboration Agreement has been submitted to MBIE and should be read alongside this Business Plan. This document is available <u>online</u>.

HEAD OFFICE FUNCTIONS

BeST's role goes beyond investing in and managing research and it intends to play a range of roles to achieve its mission. Consequently there is a need for the Challenge to include leadership, management and technical competencies in addition to the demanding administrative and operational requirements to support the devolved funding operation.

Six broad functional categories have identified and are required for the effective operation of BeST to achieve its mission:

- National Research Leadership, with respect to its areas of focus and vulnerable tamariki;
- Community engagement including Māori, Pacific and other communities with disproportionate levels of vulnerable tamariki and young people;
- Stakeholder engagement with policy agencies and practitioners involved in delivering services to tamariki and in implementation of national level interventions;
- Governance and advisory;
- Communications, marketing and outreach;
- Administration, management and operations.

These functions have formed the basis of BeST's resourcing needs in addition to the main research investment categories articulated in the budget (<u>Appendix 2</u>).

BEST BOARD

BeST is in the process of establishing a Board which has the necessary background, breadth of skills and extensive experience to govern the Challenge. Pat Snedden has agreed to chair the BeST Board once funding is approved by the Science Board and has already been interacting with the EOG established by the Challenge Members to provide oversight of the development of the Challenge proposal. Pat's bio is available <u>online</u>. Pat is working with the Challenge Members to identify other members of the Board skills matrix to ensure the Board is balanced across all aspects required to provide effective oversight of the Challenge. All Board members will be bound by a Terms of Reference which outlines their roles and responsibilities. This Terms of Reference is appendicised to the accompanying Collaboration Agreement (the Collaboration Agreement is available <u>online</u>).

The composition of the Board is laid out in the Collaboration Agreement as follows:

By no later than 1 July 2015, the Parties will establish a Board to govern the Challenge as outlined below in clause 12. The Board will operate for the term of any Challenge Programme Agreement following the Commencement Phase. The composition of the Board will reflect any conditions of the Science Board including the need to contain strong science, Māori and Pacific expertise and an independent chair. The Board will be skills-based to carry out its functions and responsibilities as outlined in clause12 The initial Board will comprise the following members:

- a) An independent Chair acceptable to the Chair of the Science Board and to the Challenge Collaborators.
- b) A nominee of the Challenge Contractor to cover the legal liabilities of the contract holder.
- c) One nominee by agreement with all other Challenge Members with knowledge of the research organisation sector and research management and performance.
- *d)* Two appointees to ensure strong awareness of Māori and Pacific perspectives and approaches, including Vision Mātauranga, relevant to the Challenge mission.
- e) Two further independent strategic appointments to strengthen the skills and capabilities of the Board relevant to the mission, scope and domain of the Challenge. These strategic appointments will be appointed for an initial term of two years, which may be renewed for further three year terms by the Chair.
- f) In finalising the Board composition, the Chair shall ensure appropriate gender, ethnicity and skills balance, with a particular focus on ensuring effective Māori engagement. Consideration will also be given to common or overlapping appointments with the other two related National Science Challenges – Ageing Well and Healthier Lives to minimise overall costs and facilitate synergistic alignment across these Challenges.
- *g)* Apart from the nominee of the Challenge Contractor and Challenge Members, all Board appointees shall be made on the recommendation of the Chair and agreed by at least 75% of the Challenge Members.
- h) Unless otherwise stated, the Board members will be appointed for the term of the second Challenge Programme. Membership of the Board for any subsequent Challenge Programme Agreement terms will be agreed by the Challenge Members and follow a similar model and process as outlined here.

It is intended that the BeST Board will to advise on and approve strategy and investments, provide oversight and monitor performance to MBIE's stated expectations and contract agreements. In addition the Board:

- Will hold quarterly meetings, coinciding with the cycle of financial reporting and alignment of annual planning and reporting;
- Will meet annually with the SLT, the SAP, a Challenge Members Group and key stakeholders to ensure mutual understanding and buy in to the Challenge and its mission.

Robust governance processes will be established with standard review of conflicts register, approval of minutes, financial reporting, review of progress against plan, scrutiny and approval of management recommendations for all matters pertaining to the implementation of the research and business plans.

DIRECTORATE AND OPERATIONS

During the commencement phase, Professor Wayne Cutfield has been the Interim Director supported by two co-Directors (Professor Gail Gillon and Professor Barry Taylor) and chaired the SLT. Together with Dr John Smart (Director Research Partnerships) and Dr Elsa Kassardjian (Operations Manager) this operational team has been responsible for management and operational activities in the development of the Challenge to date including this revised Research and Business Plan.

The Director and two co-Directors will continue into the next phase of funding. Once the Challenge is approved, the Director will employ permanent head office staff that will support him operate the Challenge including fulfilling the Collaboration Agreement consistent with the expectations of the Challenge Contracts with MBIE.

INTELLECTUAL PROPERTY MANAGEMENT AND COMMERCIALISATION

The BeST parties have agreed to both the principles and practices for the protection and commercialisation of Intellectual Property (IP) created from Challenge investments ("Project IP"). The IP Management Plan is presented in the Collaboration Agreement. It is based on the underlying principle that BeST is to create benefit for New Zealand by achieving its mission.

Project IP will, to the extent reasonable, be commercialised by the owning/managing party in a manner consistent with this purpose. Such commercialisation may involve making the Project IP available to a suitable New Zealand company or agency, or publicly disseminating the Project IP.

As BeST is not a legal entity it will not own IP, consequently:

- Research organisations participating in the Challenge retain ownership of both Background IP and new Project IP created;
- Where multiple parties create IP then it is up to them to agree IP arrangements but the Challenge will have visibility of the outcomes of these discussions;
- Research organisations do their own technology or knowledge transfer or commercialisation;
- Where private businesses are involved in the creation and commercialisation of Project IP then the parties agree the IP and commercialisation arrangements which should be consistent with achieving the mission of BeST.

COMMUNICATION, MARKETING AND OUTREACH

A clear expectation from Government is that NSCs will engage stakeholders and the public in the role of science in addressing critical issues for the future benefit of New Zealand. This requires an active approach to communicating to these various audiences. BeST's communications objectives are to:

- Support the creation of BeST's identity to the various stakeholder groups;
- Support the establishment of BeST providing an "authoritative" voice on the relevant aspects of vulnerability of New Zealand tamariki and young people by building credibility in terms of science excellence, nationally and internationally;
- Facilitate engagement across partners and the New Zealand science sector as well as engagement with end-user communities and Government.

The role of communications is closely linked to the expectations of creating a recognised "centre of excellence" for the selected areas of focus which encompasses:

- The ability to rally and lead the national research agenda;
- Engage with national and international policy agencies and practitioner;
- Outreach through technical communications, with opinion articles, statements of evidence, systematic reviews and other publications that encompass the science activities of BeST and the broader environment relating to vulnerable tamariki in New Zealand;
- Marketing and communicating BeST as the national centre for evidence-based advice in the areas of relevance to the Challenge;
- Transferring knowledge to next and end-users (stakeholders and communities) effectively.

There is a significant expectation for the NSCs in general to play a prominent national role in promoting science to the public and BeST is expecting to work across the NSCs and other major science initiatives such as CoREs and take a coordinated and efficient approach.

BeST will implement a multi-tiered approach to communicating with the diverse sets of stakeholders engaged with the mission (researchers and research organisations, Government agencies, delivery

practitioners, communities and other interested parties) using subscription-based newsletters, web, social media and events. BeST will hold at least one major event annually – a science symposium to present progress and ensure open discussion of the science with all interested parties and stakeholders. This is likely to involve selected international experts and will align with a meeting of the International SAP. A more detailed communications plan is available <u>online</u>.

Complementing generic communications requirements will be technical knowledge transfer and technical communications. This will be an important opportunity for quick wins and also for providing stakeholder friendly and authoritative information of relevant research based evidence on aspects relevant to the mission-based on current international science as well as BeST research.

OPERATIONAL EXCELLENCE

OPERATIONS AND BUSINESS PROCESSES

The BeST EOG and Directorate have implemented robust business processes during the commencement phase.

Business processes

- EOG meetings with approval of minutes, financial reporting, review of progress against plan and scrutiny and approval of management recommendations for all matters pertaining to the development of the BeST research and business plans;
- SLT meetings to develop the research plan;
- Stakeholders meeting and discussions to review and provide feedback on proposals in development;
- Contracting processes via the University of Auckland Research Office to MBIE and related establishment of internal project accounting to monitor BeST finances;
- Subcontracting to Challenge Members and other parties using a template agreed within the draft Collaboration Agreement;
- Recruitment of BeST head office roles and procurement of goods and services within the University's procurement policies and under an approved BeST Board budget and financial delegations.

BeST has implemented a robust investment framework with prioritisation criteria and processes to inform the EOG decisions on research investments. BeST is conscious that NSCs are operating as devolved public funding agencies with the potential for external scrutiny that requires considerable care in how such decisions are made.

In 2015, BeST will develop both RfP and Closed Tender (or alternative contracting mechanisms) processes for contestable and strategic research programme and research project funding respectively. Contingency funding will be via a Board-approved process.

DRIVING PERFORMANCE

BeST has a number of roles to play to fulfil the Government's expectations and achieve its mission but they can be simplified down to investing in research and related activities to create the knowledge or evidence basis for community and national level interventions to improve outcomes for vulnerable tamariki and young people.

BeST's performance management system has to consider:

- The performance of the individual research activities against investment expectations;
- The wider performance and progression of the Challenge towards achieving its mission.

These two elements will be considered separately here.

1. Managing Research Investments

A. Defining clear expectations

All research investments made by BeST will be via subcontracts approved by the Board. Effective performance management of research investments will require that the expectations for subcontracts are clearly specified in a way that is aligned with the mission. It will involve the key elements below, which the Challenge will ensure are in place through subcontract negotiation.

- Research Objectives must state the intended results of the piece of research in a way that describes its contribution or progress towards the mission (as opposed to an open investigation);
- Milestones must define a critical achievement in the pathway to achieving the research objective without which the research objective cannot be achieved. Milestones must be time bound, failable and independently verifiable;
- Defined end-points must be the description of successful achievement of the research objective in a quantitative way that describes progress towards the mission. In other words it should define the parameters for assessing success. As with milestones it must be time bound, failable and independently verifiable;
- Stop/go milestones or gates to assess progress at critical points that allow for adjustments if required.

B. Reviewing performance

It is through the reporting mechanism that BeST will be able to gather the data needed to assess performance and manage the investments, but also satisfy MBIE's expectations. MBIE will require an annual report in July each year as well as an annual plan in May. To support these processes, BeST will have a second subcontract report at a mid-year point to ensure subcontracts are on track prior to the reporting to MBIE. The two reports will have the following emphasis:

- Mid-year report focus on Objectives, milestones and endpoints only;
- Year-end report in addition to reporting on the objectives, milestones and endpoints include all the other qualitative and quantitative data required for both MBIE's annual report and any other performance monitoring requirements set by the BeST Board.

To ensure subcontracts are performing to plan BeST will review and manage performance in a systematic way:

- Mid-year reports will be reviewed by BeST Directorate to clarify any ambiguity in the reports against milestones and endpoints that were due in the period;
- Year-end reports will be given a greater degree of scrutiny as they form the basis of reporting to MBIE as well as the Board. In addition to the scrutiny of due milestones and endpoints these reports will also be reviewed by two independent members of the SLT;
- A third level of review will occur at the end of a subcontract to assess its overall performance. This will involve members of the SLT with one or two fully independent external reviewers. Their report will go to both the subcontracting party and the BeST Board via the Director and be a consideration in deciding on any future investments, and will also be used in determining if the final payment will be made (see below).

C. Managing change

BeST requires a dynamic approach to performance management to adjust to the realities of an uncertain activity such as research.

In simple terms the Challenge will use a reforecasting and contract variation approach to adjust for the uncertain path that research takes. Thus if a milestone is off track (either delayed or modified in some way) then it can be reforecasted and/or revised by request of the subcontractor and by approval of the Director. If the Director believes these changes put the successful achievement of any research objective and defined end-point at risk it will be escalated to the Board for approval and any consequences considered.

D. Financial incentive

Research contracts will have an agreed payments schedule, quarterly in advance, with the final quarterly payment held back until the final report is received and the end-point assessed as achieved by the review process. The final payment will be released upon approval from the BeST Board. This will put sufficient funds at risk to maintain incentives on the subcontractor to ensure BeST endeavours are made to perform. In addition, stop/go Gate reviews will be used to allow for mid-term adjustments and these will include the ability to adjust investment levels at that time.

2. Managing the Challenge's progress against achieving the mission

MBIE is developing a performance management framework for all the NSCs based on a standard policy intervention logic model. BeST has been working with the ministry to develop this framework and adapt it to this Challenge. The approach taken by MBIE has three distinct elements – Challenge specific indicators; generic NSC performance areas (and performance indicators); and general statistical information.

BeST has worked with the Ministry to develop a draft specific framework with a suite of performance indicators and aspirational targets that cover the progression from activities and outputs to short, medium and long term outcomes aligned with the BeST vision/mission and our intended impacts (see Figure 4). The performance framework envisages a progression of short-term, medium-term and long-term outcomes. In the short-term, we will measure the identification of potential intervention strategies and the involvement of end-users and co-funders. In the medium-term, we will measure the validation of intervention strategies and the commitment of next users to their implementation. This will lead to the long-term outcomes we are aiming for.

The long term outcomes

- Decline in levels of childhood obesity in intervention cohorts and wider test communities;
- Improvement in year one literacy in intervention cohorts and test communities;
- Reduction in targeted problem behaviours in adolescents in intervention cohorts and wider test communities;
- Statistically and clinically meaningful improvements in a suite of indices for each theme area from national data bases when compared with neutral control groups.

In addition to the specific performance monitoring and outcome assessment, MBIE are developing generic performance indicators for all NSCs across the following areas:

- Science quality;
- BeST team/collaboration;
- Stakeholders engagement;
- Māori involvement/Mātauranga;
- Governance and management;
- Public participation.

The draft NSC common performance areas under development by MBIE are shown in more detail in <u>Appendix 4</u>. We will adopt the performance metrics specified by MBIE across these six areas.

3. Qualitative Expert Review

Complementarily to metrics, BeST intends to use qualitative reviews by independent experts at appropriate timeframes. These reviews will be able to draw on the quantitative measures collected annually but also look at the quality of the content.

BeST intends to space such evaluative reviews over the term of the Challenge with the first in 2017 and then again in 2019, prior to the second contract period, a third in 2022 and the final review in late 2024 after the end of the second contract period. Sensibly the reviews draw from members of the original MBIE assessment panel as well as the BeST international SAP and representatives of key stakeholders to ensure continuity of assessment over time. As well as the annual reports and quantitative data described above, a special report could be prepared for each review outlining in more descriptive terms what has been achieved and the pathway to the mission and ultimately impact with recommendations to improve performance.

4. Risk management

To support the performance management approach BeST will develop a risk management framework to support governance and management to identify and seek to mitigate against potential events that would jeopardise to progress of the Challenge. A draft framework is provided in table 9 below as a work in progress that will be finalised by the incoming Board.

RISK	LIKELIHOOD	SEVERITY	MITIGATION			
Funding						
Failure to achieve HRC co- funding for the contestable process	L	L	Establish early dialogue between Challenge Board and HRC to ensure alignment of interests and mutually beneficial approach			
Failure to agree second Challenge Programme Agreement or any deliverables with MBIE leading to cessation of funding	L	н	Monitor precedents from other NSCs and work closely with MBIE contact to resolve any areas of potential difficulty			
Failure to achieve co-funding from other sources	М	L	Establish a co-funder model and relationship management plan and involve Board Chair if required to strengthen the relationships			
Stakeholder engagement (next-users and end-users/Communities)						
Failure to achieve endorsement by national agencies to the research programmes	L	М	Establish communications and engagement plan for the national stakeholder representatives to ensure ongoing engagement and a forum to resolve issues as they arise			
Failure to engage effectively with Māori communities relevant to the Challenge with resulting lack of support for the research programmes	М	н	Work with Māori kāhui to develop effective strategies to work with Māori communities involved in the Challenge			
Failure to engage effectively with Pacific communities	L	Н	Engage TAHA to facilitate engagement with Pacific communities			
Research relationships						
Failure to maintain quality relationship between the Board	L	M	Establish annual meeting between Board and Challenge members to			

 Table 9 – Draft risk management framework

and Challenge members including host			identify and resolve issues
Failure to meet expectations of researchers for Challenge funding	Н	L	Establish effective communications around Challenge activities and constraints
Research failure			

FINANCIAL MANAGEMENT, ADMINISTRATION AND OVERSIGHT

The parties to the Challenge are all significant research organisations with a long history of financial stability in New Zealand and considerable experience in the management of public research funds. Each is independently audited for the use of such funds according to the standards of the Office of the Auditor General and Controller. The funds for BeST will be managed on behalf of the Parties by the University of Auckland.

The University of Auckland will establish discrete accounts within its financial management system for Challenge funds and distribute funds to the parties (and other research organisations in New Zealand or overseas) via standard subcontracts using a template specifically designed for the Challenge. Any BeST research funding directed to the University of Auckland will be transferred to dedicated project accounts established on an equivalent basis to external subcontracts.

Expenditure of funds within University of Auckland accounts will be according to its internal delegations and procurement policies with the additional requirement that all internal and external expenditure will be subject to BeST Board approval (or under a Board approved delegation). The University of Auckland will monitor funds for any unusual expenditure and provide regular financial reporting on the use of funds to the Director and the BeST Board.

The BeST Directorate will be able to leverage the University of Auckland's financial management, research project management (including subcontracting), IT, HR and other internal systems and infrastructure. The University of Auckland will also provide dedicated uncharged administrative support to the Challenge and assign dedicated accounting and research management staff from their central functions to support the Challenge.

While all treasury functions are provided by the University of Auckland for BeST and financial administration is within their policies and practices the BeST Board will have full oversight of the financial performance of the Challenge and approve all BeST level budgets and expenditure against those budgets. The Board will establish financial delegations to the Director to authorise non-research expenditure with any personal expenditure by the Director being approved within the University system (i.e. via line manager) and reported to the Chair. All research funding decisions will be made by the full Board and then enacted by management via the research administration systems in place within the University of Auckland.

The resourcing model and budget (<u>Appendix 2</u>) is described in the next section and has been phased to align with BeST's expectations on how the Challenge will develop over time. The investment profile increases as the Challenge completes strategic analysis and science planning processes, contracts Priority Research and run contestable processes, and decreases once approaching the second funding period.

Following approval the annual cash flow profile will be broken down to a quarterly projected cash flow which will be included in the payments schedule from MBIE to the University of Auckland for the Challenge to invest.

RESOURCING AND BUDGET

The BeST Challenge will demonstrate national leadership and be involved in all aspects of achieving its mission and the roles that that implies (as outlined in the overview section). BeST will operate as a robust devolved funding agency with sound governance, management and business processes. Our resourcing plan and resulting budget have aimed at achieving a balance between the resourcing of these functions and services and the investment in research as outlined below.

Table 10 - Resourcing **Governance and advisory** A key expectation of the NSCs is for strong and independent governance supported by high quality international SAP. This requires budgeting for the direct costs of the independent members of the Board (fees assumed at \$40k for the Board) plus estimated travel and accommodation costs for an annual meeting of the international SAP. No fees are included for SAP members. **National science leadership** BeST has established a mixed model with both central national leadership/management supported by a distributed science leadership model. This model comprises the Director, the two co-Directors and up to four additional members of a SLT being involved in critical business processes including monitoring and reviewing research performance, supporting annual reporting and planning, assessing contestable proposals and acting as ambassadors to the Challenge. Director 0.4 FTE Co-Directors 0.1 FTE x 2 SLT 0.03 FTE x up to 4 Communications/stakeholder liaison and outreach There is a significant expectation for the NSCs in general to play a prominent national role in promoting science to the public. On top of this generic communications requirement is a need for some stakeholders relations expertise. These two related functions have been budgeted as one part-time role. Engaging, consulting and working closely with Maori and Pacific communities is also an important aspect of the success of the NSC, hence the need for a dedicated resource with specific skills. Stakeholder relations and communications manager 0.5 FTE Maori and Pacific liaison officer 0.1 FTE . **Management and operations** Operations management includes all business process relating to funding (priority, contestable and contingency funding processes, subcontracting, monitoring and managing performance and reporting), Board and Advisory processes and contract management with MBIE (note these are only elements beyond standard services provided by the University of Auckland as host). The office administration aspect will be resourced by the University of Auckland central services and is not charged to the NSC. **Operations Manager** 0.5 FTE

These resourcing requirements have been included within the overall budget outlined in Appendix 2.

1. Research Investments

The budget model in <u>Appendix 2</u> outlines the projected cash flow for the investment of research funds via priority research programmes, contestable research projects and contingency investments. It has assumed a gradual build up in research activities in the first funding period as priority research programmes are confirmed and established and the first Contestable Funding round completed. It is also based on these investments completing around early 2019 to allow for performance and strategic reviews as inputs to the planning for the second funding period from 2019 to 2024.

2. Budget Model

BeST has developed a detailed budget to support the resourcing model outlined above with year by year cash flow for the funding period to mid-2019 and then average indicative costs for the final funding period to mid-2024. This is presented in <u>Appendix 2</u>, and is based on full cost funding principles and relates specifically to the funds available to the Challenge from MBIE.

The indicative budget does not include any related or co-funding from third parties (including aligned CRI core funding) as this is not received by BeST but rather retained by each of the parties. Such related funding will be reported separately to MBIE to keep a clear differentiation between funding provided for BeST and that received separately by the parties.

NEXT STEPS (THE FIRST SIX MONTHS)

We are intent on moving quickly to ensure BeST transitions from planning to active research and stakeholder engagement following approval. This will involve a number of key initial steps as outlined below:

- 1. Establish the administrative team personal, office space, equipment and support;
- Establish the Governance Board. The Chair of the Board has been appointed (Mr Pat Snedden). Potential board members will be identified by the Chair, the Directorate and the EOS (interim governance subgroup). Recommendations for membership to the Board will be presented to the EOG for approval;
- 3. Facilitate and oversee the establishment of the permanent kāhui;
- Conduct hui across the research regions (Auckland, Canterbury, and Otago) to more deeply engage with local Māori and Pacific communities regarding the 9-year vision and mission of the Challenge and the 9-year science plan including the initial proposals;
- 5. Develop detailed research proposal protocols for the Strategic research programmes outlined in the science plan informed by step two and more in-depth budgets with comprehensive validation for approval by the incoming Board;
- 6. Confirm arrangements with the HRC to run a contestable funding round in 2016 and to further explore the co-funding model with Cure Kids, the National Heart Foundation and Starship Foundation;
- 7. Establish the BeST website and communications mechanisms;
- 8. Establish meetings and frequency and other interactions with the SLT, Board, SAP, key stakeholders;
- 9. As BeST gets started, all of the developments and changes will be shared with the research community and stakeholders through our email listerver.

RESPONSES TO MBIE SCIENCE BOARD FEEDBACK

Feedback from Science Board	Challenge response to that feedback	Page number(s) in the revised proposal containing that response
A more coherent conceptual framework enabling the integration of themes and activities within and across the themes, looking particularly at how best to integrate small projects into larger, more coherent, cross-disciplinary, and potentially internationally significant	Better Start-E Tipu e Rea's (BeST) three themes selected now have greater clarity and focus on three major issues facing New Zealand's tamariki and are summarised in Figure 2. The proposals selected in the first four years in each theme and the integrating platforms are also shown in Figure 2 and explained in "science Plan" section A "Overview".	<u>Page 17</u> <u>Page 32</u>
activities	The justification for choosing these three themes is provided in "Context for BeST" "Why was obesity chosen?", "Why was literacy chosen?" and "Why was mental health chosen?"	<u>Pages 18-19</u>
	Previously theme 2 had broadly addressed education and literacy, social disadvantage and adolescent mental health and theme 3 addressed digital technologies. Now theme 2 focuses on literacy and theme 3 on mental health. These three themes were unanimously reinforced by all of our engaged stakeholders as the three most important issues facing our tamariki ("Context for BeST", last paragraph).	<u>Page 18</u>
	The total number of projects has been reduced substantively from 34 in the original proposal down to 12. Within each proposal there is a clear evolution of sequential projects described in "Science Plan", section "B. Development of Research Proposals."	Page 33
	Integrating activities across themes is outlined in "Science Plan" section C "Braiding of science rivers".	<u>Page 33</u>
	Each proposal includes international collaborators each of which will make a meaningful contribution to each proposal. See "International Linkages"	<u>Page 24</u>
Less emphasis on early life and more	Addressed in "9-years Strategy" section D	<u>Page 33</u>

on a lifecourse perspective	"Lifecourse".	
	Summary figures show lifecourse approach for obesity and literacy with explanation in "Science Plan" sections "E. Obesity' and "F. Literacy"	<u>Pages 34-36</u>
A more apparent level of integration of the obesity topic across the themes given that it appears in a conceptual diagram but is not articulated well	The Prediction Prevention (PredPrev) proposal is the first proposal for the obesity theme in the first four years. Adolescent obesity will follow in the 2019-2024 funding period.	<u>Page 34</u>
	The PredPrev integrates with the Big Data Platform proposal (see figure 2) and its integration with the Literacy and Mental Health themes are discussed in "Science	<u>Page 17</u>
	Plan" section C "Braiding of science rivers" and 'Research Proposal' "Obesity: PredPrev" "Background and science rationale".	<u>Page 33</u> <u>Page 44-45</u>
The need to build on the positive commitment to Vision Mātauranga evident in some aspects of the proposal	We have provided more detailed braiding of Vision Mātauranga throughout the proposal as summarised below:	
	Inclusion of Māori researchers in the Directorate, Science Leadership team and Science Advisory Panel (see Tables 1-3).	<u>Pages 12-13</u>
	Engagement with a kāhui advisory group who have assisted in addressing Vision Mātauranga throughout the proposal. Their role and ToR are detailed in Appendix 1.	<u>Page 14</u> <u>Pages 102-104</u>
	The braided rivers approach (figure 1) in "Context for BeST".	<u>Page 16</u>
	"Investing in Research for Our Communities", "Vision Mātauranga" and "Agreed principles for Vision Mātauranga and Māori Engagement".	<u>Pages 39-40</u>
	Vision Mātauranga is addressed specifically in a discrete section in each research proposal and is braided throughout the proposals.	Pages <u>47</u> , <u>56</u> , <u>65</u> , <u>75</u>
	Māori research training in "Skills development"	<u>Page 24</u>
	Links to Māori Education and Māori Health Strategies and resources to support proposed interventions	<u>Page 39</u>
The need to more fully integrate the 'braided river' concept at all levels of the proposed research, including consideration of whether it could be a useful mechanism to describe the integration of the existing themes and	The concept of braiding Vision Mātauranga throughout the submission and is in a "Vision Mātauranga and Pacific Engagement" section within each proposal.	Pages <u>47</u> , <u>56</u> , <u>65</u> , <u>75</u>

present a more coherent and cross- disciplinary programme	The "braided rivers" concept has been extended into a section entitled "Braiding of Science Rivers"	<u>Page 33</u>
More robust processes for prioritising projects and budget allocation, not just on the basis of science quality but also their economic, social, and wider public policy impacts	Following the Board's recommendation, a rigorous prioritisation process was undertaken with the principles and process detailed in "Prioritisation".	<u>Pages 41-44</u>
The seemingly mixed quality of the science proposed, in particular in theme 3 where several projects were seen as potentially unachievable with the expertise and resources available. The project could be served better by theme 3 underpinning or being incorporated within the other themes	As suggested by the Science Board the Digital World theme 3 has been removed as a separate proposal and has been addressed by underpinning and integrating into various projects. See the digital technologies for literacy development in emergent bilingual tamariki, management of health issues for vulnerable tamariki, Big Data project and mental health digital platform project.	Page 60 Page 60 Pages 62-78
Clearer methodological descriptions within the proposal of the intended approaches of several of the individual project proposals	There are far fewer total projects and these are all more detailed in each proposal in the "Research Proposals" section.	<u>Page 33</u> <u>Page 43</u>
Clearer articulation of the relationships with, and utilisation of, existing longitudinal studies and the COMPASS project to leverage greater delivery against the Challenge objective	Growing Up in NZ (GUINZ) is an integral component of the PredPrev and Early Literacy proposals. Prof Susan Morton the Director of GUINZ is a PI on the PredPrev proposal and an associate investigator on the Early Literacy proposal. The Pacific Island Families Study is also integrated into the Early Literacy theme with the support of Professor Phillip Schluter. Professor Barry Milne is a senior COMPASS researcher and a PI on the Big Data proposal. His skills and the integrative database approach of COMPASS are pivotal to the Big Data projects.	Pages <u>46</u> , <u>54</u> <u>Pages 44 to 51</u> (PredPrev) <u>Pages 51 to 62</u> (Literacy) Pages <u>73</u> , <u>74</u>
Clear description of how the proposal will fit relative to existing research and research strategies in New Zealand, and particularly internationally, and the distinct value- add provided by this proposal	The fit of the Challenge and proposals with existing research is detailed in "Fit With Existing Research" and also "Research Plan" "Theme One: Obesity", "Theme Two: Literacy" and Theme Three: Mental Health".	<u>Page 21</u> <u>Pages 34-36</u>
Potential to consider health inequality throughout the Challenge, in addition to its recognition within the obesity theme.	Health and educational inequalities are now major foci of the Challenge and all proposals. Obesity, poor literacy and mental health problems are all more common in Māori, Pacific and those of lower socioeconomic status. Research in all proposals predominantly includes these groups as detailed in the "Research Plan".	<u>Pages 44-80</u>
Additional points raised by the MBIE General Manager Science Investments	Challenge response to that feedback	Page number(s) in the revised proposal containing that response
Information exchanges and learning between the governance group, advisory panels, directors	The governance model and interactions between A Better Start Directorate, Science leadership team, Board, Science Advisory Panel, kāhui, TAHA and stakeholders is	<u>Online</u>

and leadership teams	detailed in the Collaboration Agreement.	
Incorporation of Pasifika representatives alongside Māori within the advisory groups	The new Board will contain a Pacific representative (see Collaboration Agreement) and in addition TAHA The Well Pacific Mother and Infant Service is providing strategic advice and engagement with Pacific communities. Pacific researchers and advisors are included in the research proposals.	<u>Online</u> Page 54 Page 24
A more fit-for-purpose, skills-based governance structure, with an independent chair – some shared governance members between some of the health- and well-being- related Challenges would be advantageous	The governance Board model has been completely revised and is detailed in "BeST Board" and in the Collaboration Agreement (separately submitted document). An independent Chair has been appointed (Mr Pat Snedden) and Board members will soon be appointed. BeST has its own Governance Board, separate from the other health related Challenges.	<u>Page 81</u>
A need for consistently high-quality science and integration of New Zealand research with existing international research and the world view and literature in relevant areas	A Science Advisory Panel of international experts has assessed the science quality of submitted proposals using prioritisation criteria (see "Prioritisation") to ensure only high quality research is funded. The SAP using these criteria with other external reviewers will assess all future proposals.	<u>Page 13</u> <u>Pages 41-44</u>
	The contestable funding rounds will be open to all researchers in New Zealand to give all of New Zealand's researchers the opportunity to contribute to BeST and ensure the country's best research within BeST's themes are supported.	<u>Page 25</u>
Engagement with the public regarding research directions and outcomes.	A 0.5 FTE communications and stakeholder engagement officer will be appointed to the Challenge reflecting the commitment we have to engaging with the community.	<u>Page 89</u>
	We are also committed to translation from research to reality by working with stakeholders and communities to convert research into a meaningful positive change in the community. This is included in the research proposals and summarised in "Research Plan" "Translation".	<u>Page 37</u>

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APPENDICES

APPENDIX 1 – TERMS OF REFERENCE OF THE KĀHUI

1. Background

A key element of the National Science Challenges is the expectation they will give effect to the government's Vision Mātauranga (VM) policy:

The VM policy aims to unlock the science and innovation potential of Māori knowledge, resources, and people for the benefit of New Zealand. It focuses on four themes:

(a) indigenous innovation – contributing to economic growth through distinctive science and innovation

(b) taiao/environment – achieving environmental sustainability through iwi and hap \bar{u} relationships with land and sea

(c) hauora/health – improving health and social well-being

(d) mātauranga – exploring indigenous knowledge and science and innovation.

It is expected that Māori researchers/research organisations, end users, and/or stakeholders will play a vital role in the delivery of the Challenge at all levels. In giving effect to the VM policy, demonstrate how the proposed research responds to distinctive issues and needs of Māori and Māori communities and identify how Māori, both individually and collectively, can participate in research initiatives to achieve the outcomes sought.

It is important to assess VM-related research opportunities and methodologies in the early stages of research planning for the Challenge. This will require strong leadership of VM initiatives to ensure that VM is integrated within a Challenge collaboration, and not in an isolated manner. Explain how you will integrate Māori knowledge and perspectives into the Challenge and identify research with potential to deliver VM outcomes. These VM outcomes may include, depending on the Challenge: • distinctive products, services, or systems derived from Māori knowledge

- new knowledge to support kaitiakitanga
- approaches and solutions to Māori health and social well-being
- enhanced capability of Māori businesses to increase productivity.

In developing the initial research plans for the three Health and Well-being related National Science Challenges the Collaborating Parties (13 in total working through an Establishment Oversight Group(EOG)) agreed to the following principles relevant to the Vision Mātaurangaaspects of the Challenge and to how we intend to engage and consult with Māori:

- Support Vision Mātauranga Policy objectives for the benefit of New Zealand through a commitment to:
 - Māori and non-Māori inclusion at the governance level, consistent with Te Tiriti o Waitangi.
 - Employing Māori worldviews, tikanga, knowledge and language where relevant and practicable.
 - Meaningful involvement of Māori in decision making in the planning, implementation evaluation and dissemination of the challenge research.
 - Building long-term positive relationships and consulting as appropriate with Māori stakeholders.
 - Include Māori research methodologies and protect and enhance Māori knowledge of healthy well-being.
 - Undertaking future-focused interdisciplinary research that will inform equitable transformation of health, education, and well-being for Māori and all New Zealanders.
 - Helping to build Māori research capacity, capability and research leadership.

During the development of the initial research plans, some of the Māori researchers involved formed a Kāhui to consider options to support the three related Challenges, give effect to Vision Mātauranga and to

capture synergies between research areas and communities of interest involving Māori; this is additional to researcher and stakeholder support provided within each Challenge and through a *Tira Rangahau Haora* collective of Māori researchers across the Challenges. Following the MBIE decisions to fund commencement or establishment phases for each Challenge, the EOG providing interim governance oversight for these related Challenges have agreed to support an *Interim* Kāhui to facilitate the next stages of each Challenge by undertaking dialogue with MBIE and the Science Teams, in the spirit of good-will and to ensure that the Challenges are optimally positioned in relation to Vision Mātauranga and engagement with Māori communities and agencies during the Establishment or Commencement Phases.

This document sets out a proposed Terms of Reference for the establishment, roles and functioning of the Interim Kāhui in support of the Health and Well-being National Science Challenges.

2. Kāhui Membership

a) The Interim Kāhui

The EOG approved the membership of the Interim Kāhui to be comprised of the following volunteers as members noting that they have expertise relevant to the three Challenges and that they are all independent of any direct involvement in the research of the Challenges:

Helen Moewaka Barnes (Chair) Moe Milne Garrick Cooper Richard Faull

Interim Kāhui the members must not be playing any other active role in the Challenge such as direct research or governance or management roles or as paid consultants (or similar) in delivery of Challenge services or activities. Members will also be under a duty to act independently of any grouping and not represent the interests of any particular groups but to support achievement of the objectives of the Challenges and the Vision Mātauranga Policy.

The Interim Kāhui may co-opt further members in agreement with the EOG.

The Interim Kāhui will remain in place until such time as it is replaced by a permanent Kāhui as outlined below or if the three H&W Challenges are not funded beyond their establishment or commencement phases by MBIE.

b) Transition to Kāhui Tuturu

The Interim Kāhui will work with the Chairs, Directors and SLTs of the three H&W Challenges to propose the membership of any subsequent Kāhui (Kāhui Tuturu) that will be active beyond their establishment or commencement phases (this should be completed within 3 months). This permanent Kāhui should be comprised of up to five members with knowledge of both the research sector and strong working relationships with the relevant Māori communities and agencies likely to be involved with the Challenges.

The Directors shall consult with the Interim Kāhui on the Terms of Reference for the permanent Kāhui and recommend them to the three Governance Group Chairs for approval. The Chairs will consult with their full Governance Groups and may seek changes prior to approval. It is likely that the future Terms of Reference will be based on the principles agreed by the Challenge Parties and these Terms of Reference. The membership of the permanent Kāhui will be approved by the Chairs of the three H&W Challenges after consultation with their Boards and Challenge Members and formally appointed by the Challenge Hosts. The Members of the Kāhui will meet with the Challenge Board Chairs to agree the Chair of the Kāhui.

The Chairs may take advice from the Challenge Directors in making their decisions on all these matters.

3. Roles and Functions of the Interim Kāhui

The EOG and Interim Kāhui have agreed that the roles of the Interim Kāhui during the establishment or commencement phases of the Challenges shall be strategic, facilitatory and consultative. These roles are further defined here to ensure clarity of expectations. They are not intended to replace the responsibilities of the Challenge Governance Groups or Management but to support and work alongside them.

a) Strategic advisory functions

a. The Interim Kāhui shall have the opportunity to review and provide feedback or advice on draft Research and Business plans for each Challenge prior to submission to the relevant

Board, therefore prior to submission to MBIE and in sufficient time to allow the advice to be considered and incorporated into the final plans where appropriate. The advice or feedback shall be focussed on the aspects of the Challenge that give effect to Vision Mātauranga, engagement with Māori communities and agencies and equitable transformation of health, education, and well-being for Māori and all New Zealanders. The advice shall be given to both the Directors (and SLTs) and the Establishment Oversight Subgroups. While the advice is not binding it shall be considered in good faith according to the principles and commitments set out by the Collaborating Parties in their 2014 Heads of Agreement (and to be embodied in the NSCIC and Collaboration Agreement).

- b. The Interim Kāhui shall have the opportunity to advise on Māori membership of the proposed permanent Governance Group, the permanent SLT, the SAP and any other named appointments (as appropriate) within the Research or Business Plans in relation to ensuring their capability to enact Vision Mātauranga policy and assure effective Māori engagement and consultation.
- c. The Interim Kāhui may be asked to provide input on other matters from time to time by mutual agreement with the Directors and or Governance Group Chairs.

b) Facilitatory functions

- a. The Interim Kāhui may act as a facilitator between the Challenges and any groups representing Māori interests relevant to the Challenge by mutual agreement with the Directors or Chairs where they are able to add value as an independent group with skills in Māori engagement and facilitation.
- b. The Interim Kāhui may assist with discussions between the Challenges and MBIE over the approach to Vision Mātauranga and Māori engagement or consultation by mutual agreement with the Directors or Chairs.

c) Consultative functions

a. The Kāhui may assist with developing and reviewing processes for engaging with specific Māori stakeholders, communities, groups, entities or agencies in relation to the development, execution and potential uptake of any research.

d) Other roles

a. The Interim Kāhui may take on other roles from time to time by specific agreement with the Directors or Chairs

4. Suggested Operation and Resourcing of the Kāhui

a) Meetings

- *a.* The Interim Kāhui should meet as a group to develop any feedback or advice to the Challenges on their draft Research and Business Plans and provide feedback on nominations of relevant Challenge appointments (if this cannot be achieved face to face then by tele or video conference)
- *b.* At the first meeting the Interim Kāhui should establish a workplan to meet its other roles during the establishment or commencement phases of the Challenges, informed by prior discussion with the Directors of each Challenge. The resulting workplan should be provided to the Directors to arrive at a mutual agreement, to ensure it is workable for all parties.

b) Resourcing

a. As volunteers, the Interim Kāhui members' time is unpaid (as is the case with SAP members for comparison). However, the costs of travel and accommodation for attending approved meetings or activities on the agreed workplan shall be met by the Challenges in a mechanism to be determined by the Directors.

Second Funding Period

APPENDIX 2. BUDGET

DRAFT Generic Budget for ABS NSC	Budget Category	First Funding Period (assuming \$3.4 M pa)					(assuming \$4.1 M pa)					
All 1 July to 30 June years		2015 Y1	15/16 Y2	16/17 Y3	17/18 Y4	18/19 Y5	Total \$	%	pa a	average \$	%	Total
EXPENDITURE				\$000's								
A. Central Administration and Management												
Operatio	ons Manager (0.5 FTE)	12	102	105	110	110	\$439k					
General Administration /Office/Travel/Meeting/A	Accomodation costs etc	10	40	40	40	40	\$170k					
	Subtotal	22	142	145	150	150	\$609k	4.4%	\$	155	3.8%	775
Uncharged direct r	ole (0.5 Administrator)	17	50	51	52	54	\$224k					
B. Governance and Advisory			1	1		1						
Independ	lent Board member fees	0	40	40	40	40	\$160k					
SAP Costs (no fees but assumme an annual meeting	ig in NZ with travel and	0	10	10	10	10	± 101					
	accomodation)	0	10	10	10	10	\$40K	1 50/-	¢	FF	1 20/-	375
C. Communications / Stakeholder Liaison and Outre	Subtotal	U	50	50	50	50	\$200K	1.5%	13	55	1.5%	2/5
Stakeholder Relations and Communicat	ions Manager (0.5 FTF)	0	88	112	115	117	\$432k		T			
Maori and Pacific L	iaison Officer (0.1 FTE)	0	20	20	20	25	\$85k					
	Publishing costs	0	5	10	10	6	\$31k					
Eve	nt costs (annual forum)	0	20	20	20	20	\$80k					
	Subtotal	0	133	162	165	168	\$628k	4.6%	\$	170	4.1%	850
D. Science Leadership												
	Director (0.4 FTE)	20	200	205	210	215	\$850k					
C	o-Directors (2x0.1 FTE)	10	95	100	105	110	\$420k					
Science Leaders Group (up to 4 x 0.03FTE (assu	iming \$180k pa average		10	10	10	45						
salary) plus rela		0	40	40	40	45	\$165K	10 40/	<i>ф</i>	400	0.00/	2000
	Subtotal	50	335	345	335	370	\$1,435 К	10.4%	₽	400	9.0%	2000
SUBTOTAL NON R	ESEARCH ACTIVITIES	52	660	702	720	738	\$2,872k	20.9%	\$	780	19.0%	3900
F Research Funding												
Strategic R	esearch Programmes	0	1,600	2,900	2,900	1,600	\$9.000k	65.5%	\$	2,750	67.1%	13750
Open	Contestable Funding	0	150	550	550	150	\$1,400k	10.2%	\$	500	12.2%	2500
	Contingency Funds	10	100	120	120	120	\$470k	3.4%	\$	70	1.7%	350
SUBTOTAL R	RESEARCH ACTIVITIES	10	1850	3570	3570	1870	\$10,870k	79.1%	\$	3,320	81.0%	16600
	TOTAL	62	2510	4272	4290	2608	\$13,742k	100.0%	\$	4,100	100.0%	20500
REVENUE available from MBIE												
	Assume pa average						\$3,400k		\$	4,100	100.0%	
NET REV	ENUE - EXPENDITURE						\$0k	0.0%				
Funds Available Firs	t Period (2015/2019)						\$13,742k					
Funfds Available Second	d Period (2019/2024)						\$20,500k					
	GRAND TOTAL						\$34,242k					

<u>Note:</u> all related costs have been budgeted at 7% of salary costs and indirect costs (ie overheads) have been budgetted at 111% of salary costs. <u>Note:</u> This is minus the 500k allocated to the Commencement Phase

APPENDIX 3. PRIORITISATION CRITERIA AND RATINGS

1. Prioritisation criteria

a) General points

The criteria were developed to ensure equal emphasis on the Mission and the Science.

- b) Prioritisation criteria detailed below:
 - A. Alignment with BeST mission and impacts
 - a. Aligned with mission and impacts
 - b. Clear pathway from science to mission to impact
 - c. Solution focused on the unique New Zealand context (and national scale impact)
 - B. The potential scale of impact on health and/or education and/or social benefits
 - a. Potential for change in health, education and/or social policy
 - b. Potential for achieving identified health, education and/or social outcomes for vulnerable tamariki in New Zealand
 - c. The capacity to meet the needs of vulnerable tamariki (including Māori and Pacific Peoples)
 - d. Potential to demonstrate national and international leadership in policy and practice relating to improving outcomes for vulnerable tamariki.
 - C. Science stretch and innovation
 - a. How is the research different from business as usual (multidisciplinary, integrated/braided, novel)?
 - b. Science excellence including the quality of the research team
 - c. Capacity and expertise to deliver
 - d. Embedding of Vision Mātauranga approaches where appropriate
 - e. Research should be empowering, enlightening and engaging with communities
 - D. Stakeholder and community engagement
 - a. Degree of stakeholder (next-users e.g. policy and delivery agencies, practitioners) engagement from research design to implementation –
 - b. Degree of end user/community involvement

All criteria are equally weighted.

2. Ratings


APPENDIX 4. NSCS COMMON INDICATORS

Performance area	Key questions	Examples of potential indicators and other information Common indicators across Challenges are shown in bold	What information we may see in annual reports - examples		
1. Delivery of Challenge objective	To what extent has progress been made towards achievement of the Challenge objective? a) Challenge activities focus on and contribute to achieving the Challenge objective b) Challenge consortium has a clear pathway to achieve the Challenge objective c) Challenge programme delivers science and outputs that contribute to the Challenge objective d) Challenge is making significant progress towards its objective	Challenge-specific indicators a greed between MBIE and each Challenge	Progress made to date against each specific indicator Reasons for falling behind in any area and remedial action taken Any future risks of non-delivery and mitigation action In general - major highlights (ie achievement or not)		
The areas below are assessed within the context of achieving the Challenge objective					
2. Science quality	To what extent is the Challenge achieving world-leading, ground-breaking science? a) The Challenge delivers high-quality, ground-breaking science of a strategic nature b) International science expertise is used where appropriate	Common indicator: Mean citation score for journals in which the Challenge has published (bibliometric analysis undertaken by the Challenge) Common indicator: Field-weighted citation index of Challenge publications (bibliometric analysis under taken by the Challenge) The number of publications in peerreviewed journals with an impact factor >2 (or field-specific equivalent) per \$1M invested per annum Share of world's top 10% most cited publications attributed to Challenge researchers	What science quality reviews have been undertaken Major highlights/achievements (egevidence of peer recognition such as awards etc) Quality control and assurance processes applied Steps taken to improve quality Any quality failures – and remedial steps taken Role/input from science advisory group (if this exists) Any emerging risks to science quality		
3. Best team collaboration	To what extent is New Zealand's best team working on delivering the Challenge objectives? a) Challenge team works together across disciplines and member institutions (relationships are built that did not exist previously) and draws on and aligns capabilities and resources outside the Challenge b) Challenge team has the right capability, gaps are filled, and Challenge tests itself with new ideas, approaches, and mechanisms c) Emerging talent has opportunities (in research or leadership roles)	Common indicator: Percentage of publications by collaboration type (NZ institutions, international) on a 12-month rolling average (bibliometric analysis undertaken by the Challenge) Satisfaction among Challenge researchers, other researchers and stakeholders, with the team working on the Challenge (biennial survey conducted by MBIE)	What teams are working a cross organisations, disciplines Evidence of linkages with international research partners, eg MoUs, agreements entere dinto Contestable process – what processes were run, what were results, new parties brought into the research What has been done for early-career researchers Risks associated with capability (personnel and other, eg equipment) – action taken to address risks, or emerging risks		

Performance area	Key questions	Examples of potential indicators and other information Common indicators across Challenges are shown in bold	What information we may see in annual reports - examples
4. Stakeholder collaboration	To what extent is the Challenge engaging with stakeholders and to what extent are stakeholders using the Challenge research results? a) Stakeholders inform and influence Challenge priorities and research agenda b) Stakeholders take up and use research results c) Challenge influences activities and investments of external stakeholders	Common indicator: Satisfaction among stakeholders with research priority setting (biennial survey conducted by MBIE) Common indicator: Satisfaction among stakeholders with knowledge and technology transfer (biennial survey conducted by MBIE) Co-funding value and growth rate (data provided by the Challenge) Growth in number of stakeholders reporting significant improvements to their operations as a result of Challenge- generated knowledge and technology Value of stakeholder research aligned with Challenge	What has been achieved with key stakeholders, eg: - bow are the key stakeholders? - agreements, MoUs entered into - other less formal arrangements, egjoint board meetings, staff secondments etc - co-funding and non-cash support, external revenue earned - future plans Any relationship issues and how resolved Any emerging relationship issues, risks Role/input from stakeholder advisory group (if this exists)
5. Māori involvement and mātauranga	To what extent are Mãori and mãtauranga Mãori engaged to achieve the Challenge objective? To what extent is the Challenge addressing the needs and asoirations of Mãori? a) Mãori are involved in the Challenge or at least add influence - where appropriate - as researchers, stakeholders, governance entity members, advisors b) Challenge research unlocks knowledge, resources, and potential of Mãori c) Mãtauranga Mãori is used in the Challenge research, where appropriate	Common indicator: Satisfaction among Māori stakeholders with research priority setting (biennial survey conducted by MBIE) Common indicator: Satisfaction among Māori stakeholders with knowledge and technology transfer (biennial survey conducted by MBIE) Value of Challenge funding dedicated to research and related activities specifically targeting Māori needs and aspirations and/or employing mātauranga Māori	As per Stakeholder Collaboration above (as Māori are a stakeholder subset) Also informal arrangements (as Māori may not want formal arrangements), eg discussions held with iwi, hui, seminars Research projects a chieved/under way using Māori resources, mātauranga Activities of Māori advisory group, Māori involvement at other levels Role/input from Māori advisory group (if this exists)
6. Effective governance and management	To what extent do the right governance and management arrangements exist and work effectively? a) Governance entity operates effectively b) Effective processes are in place (such as performance reporting and monitoring, financial management, audit)	Common: Qualitative assessment of governance processes	Significant changes in governance and management arrangements (eg membership, structure) Results of any reviews of govemance group performance Results of Challenge reviews, audits Major risks identified – mitigation action implemented or under way Governance group's monitoring of project/milestone delivery (ie headline results of Challenge's own reporting and monitoring) Any changes to strategic plans/direction, priorities
7. Public participation in the science process	To what extent is there effective engagement between the Challenge and the public? a) Challenge undertakes an appropriate programme of public engagement b) Members of the public are involved in the Challenge where appropriate, and engaged in the aspirations of the Challenge	Common indicator: Index of public attitudinal and behavioural engagement in science (regular (possibly triennial) survey of New Zealanders conducted by MBIE) Number of articles related to the Challenge in the popular press Awareness and understanding among target audiences of the learnings from the Challenge	Major activities undertaken – details of activity, target group, participation, results etc Upcoming events Risks – how resolved, emerging risks

LIST OF DOCUMENTS AVAILABLE ONLINE

- 1. <u>Directorate and Science Leadership Team</u>: Brief bios of the Director, co-Directors and SLT members (4 pages)
- 2. <u>SAP</u>: Role of the SAP and brief bios of SAP members (4 pages)
- 3. <u>Notes from the stakeholders forum</u>: Notes taken during the national forum held on 17 February 2015 (3 pages)
- 4. <u>Prioritisation process</u>: Detailed information on prioritisation process undertaken (5 pages)
- 5. <u>Board Chair</u>: Brief bio of Pat Snedden (2 pages)
- 6. <u>Communications Plan</u> (4 pages)
- 7. <u>TAHA March 2015 report on consultation with key Pacific stakeholders about BeST</u> (10 pages)
- 8. <u>Terms of Reference for the BeST National Science Challenge Board</u> (4 pages)
- 9. Conflicts of interest policy and process for the BeST Challenge (3 pages)
- 10. Eke pānui, ake tamaiti Stakeholder Engagement Report for University of Canterbury (17 pages)
- 11. Collaboration Agreement (50 pages)

12. Projected costs (2 pages)