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Rethinking food and nutrition science

The Australian food and nutrition knowledge hub: a critical piece of national infrastructure for nutrition science

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The Australian Food and Nutrition Knowledge Hub:

A critical piece of national infrastructure for nutrition science.

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Executive summary

Food and nutrition science requires effective use, synthesis, and translation of nutrition evidence. However a number of barriers currently exist, including a lack of integration of currently collected nutrition data, delays in synthesis of nutrition research evidence, and limited translation of nutrition science into practice. In order to address these challenges, we propose the development of a **Food and Nutrition Knowledge Hub**, which would serve as a critical piece of national infrastructure underpinning food and nutrition science in Australia. The Knowledge Hub is proposed to consist of three inter-related domains: Data, Synthesis, and Translation. The Data domain will serve as a repository for storage and integration of food and nutrition research data. The Synthesis domain will encompass the review and development of frameworks for the integration of nutrition evidence, and the development of a system for ongoing and continuous review of evidence. The Translation domain will support translation of nutrition evidence from the preceding domains to a diverse range of stakeholders. Development and implementation of the hub will require consultation with a wide range of food and nutrition science stakeholders, as well as consideration of hub custodianship, data quality issues, and implications for workforce planning.

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Context and scope

Nutrition guidelines, policies and interventions to promote the nutritional health of the population must be informed by scientific evidence. Nutrition science is defined as the study of food systems, foods and drinks, and their nutrients and other constituents; and of their interactions within and between all relevant biological, social and environmental systems (Beauman et al. 2005). Given this breadth, evidence in food and nutrition science may be generated from both quantitative and qualitative research methods, observational and experimental study designs and in vitro and in vivo studies using animal and human models (Boushey et al. 2006, Harris et al. 2009). However, the goal 'to create food and nutrition security for all Australians as a fundamental human right' depends on effective use of this diverse evidence base, and will depend on maximising the use of data from multiple sources, critical appraising and synthesising the evidence, and translating this evidence to a diverse range of stakeholders.

Focus of the paper

The current food and nutrition science system faces a number of challenges in generating, utilising, synthesising and translating the body of evidence. Firstly, food and nutrition data at a national level are collected at irregular intervals with variations in data collection methods (Webb et al. 2006). Although a range of other data are collected (for example, consumer surveys), there is a lack of connection between these and other datasets which limits their utility, and opportunities for data linkage, integration and timely application are missed. Secondly, the diversity and volume of evidence relevant to nutrition science is large and growing, which creates significant problems in timely synthesis and critical appraisal for the development and monitoring of evidence-based policies and guidelines. Finally, there is limited translation of the evidence base into practice, leading to inadequate uptake and lack of understanding of best practice in implementation science as it applies to the food and nutrition system.

In order to address these challenges, we propose the development of a **Food and Nutrition Knowledge Hub**, which would serve as a critical piece of national infrastructure underpinning food and nutrition science in Australia. The Knowledge Hub will be based on the principles of non-duplication, learning from others, meeting ethical standards, consistency with Sustainable Development Goals (SDGs) and equitable access for all users. Knowledge Hub users are anticipated to include consumers, health professionals, the food industry, educators, policy makers and researchers. The Knowledge Hub and themes related to the hub are also considered in discussion papers on 'Empowering food choices' and 'Critical evaluation of food and nutrition science'.

The Knowledge Hub

The Knowledge Hub will be a fit-for-purpose tool aimed to ensure effective synthesis, appraisal and translation of food and nutrition science knowledge, underpinned by the concept of equitable access for all users. Development of the Knowledge Hub would also inform other components of the food and nutrition science system, including the food environment, empowering food choices, effective governance, and food and nutrition science (refer to 2017 Theo Murphy High Flyer Think Tank systems perspective map). The Knowledge Hub is proposed to consist of three interrelated domains or areas of focus: Data, Synthesis, and Translation. Each of these will be discussed below.

Data

The Data domain of the Knowledge Hub aims to be a data repository for collation and sharing of existing datasets to facilitate data linkage, a repository for best practice tools and methodologies in data collection, and in the long term will facilitate data collection for the development of new longitudinal cohorts for monitoring and surveillance of the food and nutrition system. Data relevant to food and nutrition is diverse and data representing a comprehensive food and nutrition system is desirable (for example Figure 1). This will include data relating to the food supply and distribution (covering all aspects relevant to the available food supply including food environment mapping), food selection and consumption (food purchasing and consumption patterns, and their determinants), nutrient composition of foods (available in Australia), nutritional status (such as anthropometric and biochemical measures) and health outcomes (including disease prevalence and incidence, risk factors for disease and utilisation of health services). Currently there is no established frequent and routine monitoring and surveillance of food and nutrition data at the state or national levels (Webb et al. 2006, Marks 1991), and variations in data collection methods impact on the ability to explore temporal changes in food and nutrient intakes and other risk factors for chronic disease.

Food and nutrition data in Australia are collected and stored by a diverse range of sources and organisations including government bodies such as the Australian Bureau of Statistics, state and territory health departments, Food Standards Australia New Zealand, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), non-government organisations such as the National Heart Foundation of Australia, and academics and researchers in universities and medical research institutes. Data are also collected by commercial organisations such as health insurers, consumer research organisations and the food industry. As a result, there is significant variability in the accessibility and availability of data, and approvals required for access. There are likely to be significant opportunities for data linkage across many sources, although there will be a range of issues relating to research integrity, intellectual property and ethical issues to consider and address systematically. Data repositories and open access to data is increasingly being pursued and promoted (for example the National Health and Nutrition Examination Survey in the United States (Centers for Disease Control and Prevention 2017)), and a Knowledge Hub will be consistent with these directions in international and national research agendas.
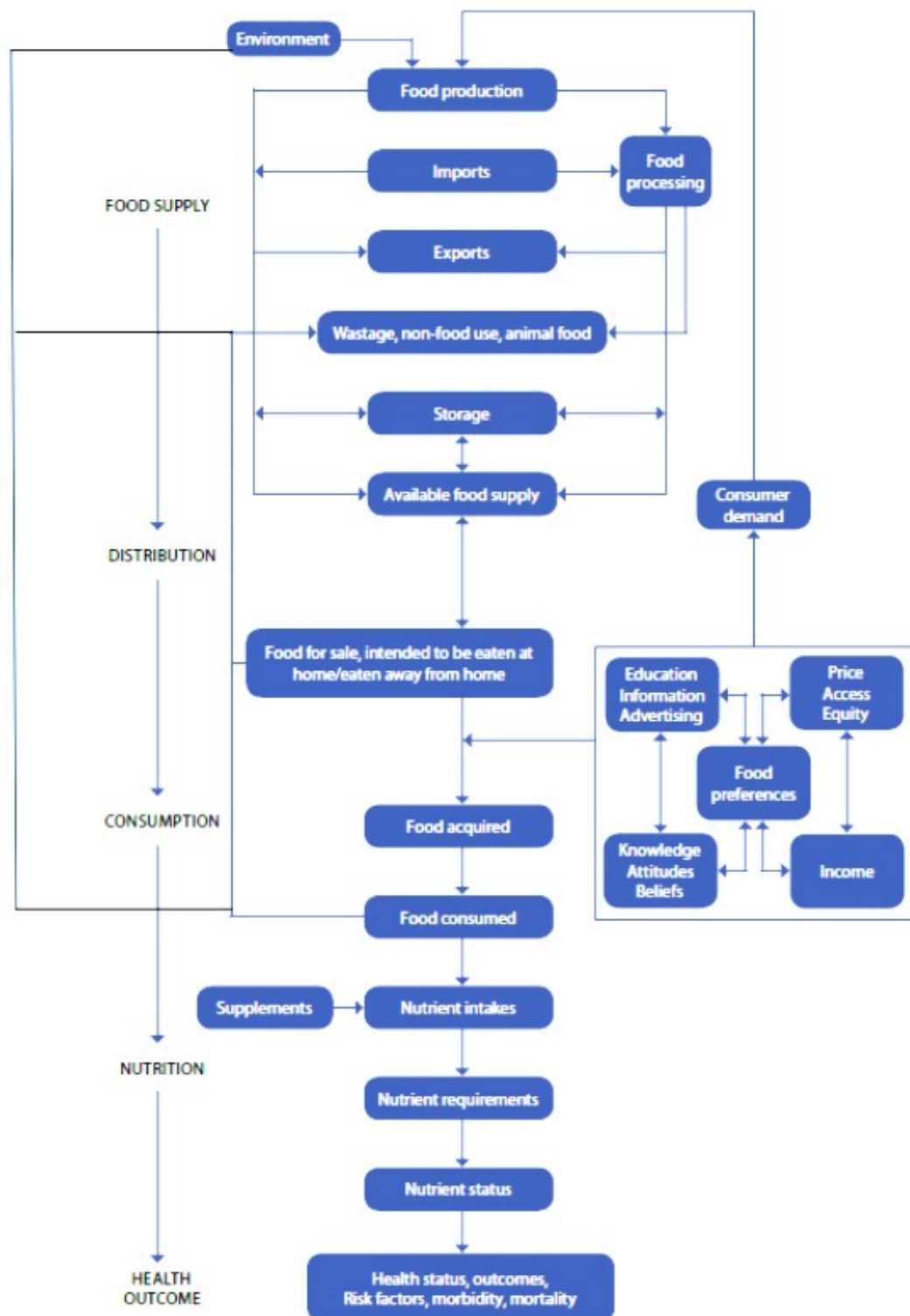
Figure 1 Food and Nutrition System. From (Australian Institute of Health and Welfare (AIHW), 2012).

A first step in the process of development may be a scoping study to assess existing nutrition data across the food and nutrition system and identify potential candidates for data integration. The study will include a review of access, availability and strategies for linking data. Expansion of current research registries such as the Australian New Zealand Clinical Trial Registry (Australian New Zealand Clinical Trials Registry) or Research Data Australia (Australian National Data Service) would assist in scoping nutrition research being conducted, and aid in developing strategies for data linkage and integration. Consideration of strategies for data integration used internationally will also be required to inform development and minimise unnecessary duplication. While the data domain of the hub will initially focus on linkage of Australian datasets, integration of published data from international studies will be required to ensure effective evidence synthesis for guideline development, as outlined below.

Integration of multiple datasets into a single location such as the proposed Knowledge Hub will improve food and nutrition researchers' abilities to explore the food and nutrition system and make better use of currently available data. This will avoid duplication of activity and maximise use of resources, and policy makers will be able to monitor the effectiveness of population based interventions and strategies. Linking data from a range of sources will allow for increased statistical power due to the ability to access larger sample sizes. It will also allow for the exploration of novel research questions. Strengthening food and nutrition science also requires development, evaluation and dissemination of novel data collection and analysis methodologies, and the development and application of novel statistical and epidemiological methods, which could be integrated into the hub (Franks and Atabaki-Pasdar 2016). The Knowledge Hub would also allow for capacity development across the health and medical workforce in using and interpreting food and nutrition data appropriately.

While linking information from a range of datasets has many benefits, it contains inherent concerns relating to data privacy, secure storage and data sovereignty (Dehling et al. 2015, Grundy et al. 2017). Existing best practice guidelines and principles such as the FAIR Data Principles, which address concepts of findability, accessibility, interoperability and reusability, may assist in development of the Knowledge Hub (Wilkinson et al. 2016). Retrospective linking of datasets may be impeded by ethical agreements that do not allow sharing of data beyond original study investigators. This may particularly be the case for data collected from specific groups, such as children and Aboriginal and Torres Strait Islander peoples (National Health and Medical Research Council et al. 2015). Development of the Knowledge Hub therefore requires careful consideration of data ownership, use and governance, with a need for investment in infrastructure to ensure secure management of data. While in the immediate future it may not be feasible to include all relevant nutrition data for the ethical and security reasons outlined above, the Knowledge Hub will aim for the integration of available data wherever possible. Development of the Knowledge Hub may also 'feed-forward' by encouraging future study development to consider options for data integration and linkage.

A challenge currently facing food and nutrition researchers is the large gap between representative national surveys, with over 15 years spanning between the two most recent representative surveys

of Australian adults and children. The Knowledge Hub would allow for better integration and use of existing data. However long-term collection of new data will be necessary, and developing a large-scale, longitudinal cohort should be considered using novel data collection technologies such as remote, online and automated methods, household- or store-level purchasing data, and wearable devices and sensors (Biswas et al. 2010, Özdemir and Kolker 2016, Zeevi et al. 2015). There is also a need to continue to use and develop nutrition science and technologies to build capacity in data collection and analysis.

Synthesis

Nutrition science is a quickly growing and emerging field with a large volume of research published each year. This creates a significant challenge for researchers, practitioners and the public in trying to synthesise and integrate the emerging evidence. Currently, national food and nutrition guidelines in Australia, such as the Australian Dietary Guidelines, are reviewed irregularly (National Health and Medical Research Council 1992, 2003, 2013). Synthesis and critical appraisal of nutrition evidence into guidelines and recommendations currently requires discrete systematic reviews when a new guideline is developed. The Synthesis domain of the hub would aim to be a resource for the collation and synthesis of evidence relating to food and nutrition science, allowing for regular review and incorporation into strategies, programs and policies aimed at improving the food supply and health of the population. The Synthesis domain would have two core activities: firstly, the review and development of frameworks for the integration of nutrition evidence, and secondly, the development of a system for ongoing and continuous review of evidence.

The first core activity entails review and development of frameworks used for synthesis of nutrition evidence. This is discussed extensively in the discussion paper on 'Critical evaluation of food and nutrition science'. Current frameworks used for developing food and nutrition guidelines by many organisations may not be optimal when applied to nutrition science (Yao et al. 2013), and tend to preference a medical and pharmaceutical model of a systematic review and/or meta-analyses of randomised controlled trials as the highest level of evidence (Penders et al. 2017). Other models of evidence synthesis that incorporate diverse studies designs, triangulation of results from epidemiology and mechanistic studies, such as used by the World Cancer Research Fund, should be explored. Consideration of the evidence rating systems used may be necessary to allow use of diverse data within evidence synthesis activities. Pooling of available evidence across a range of food and nutrition science designs and methodologies will help identify gaps in the evidence base where further research is needed, and minimise duplication of research efforts, ensuring more efficient allocation of future research funds. There is also a need for recognising the value of research conducted by government and non-government organisations which may not fit into traditional research models (for example quality assurance activities). Supporting the development and sharing of these research activities, in addition to their integration into the Knowledge Hub, will utilise research opportunities overlooked by current research frameworks.

The second core activity involves development of a system for an ongoing and continuous evidence review cycle. There is an opportunity to develop a system that encapsulates rolling or ongoing reviews of the literature, ensuring a flexible, adaptive tool that can be used for a range of purposes. Development of such a system would encourage a process of ongoing systematic reviews and meta-analyses that inform guideline and policy development to ensure these remain up-to-date, and ensure guidelines and recommendations have the ability to respond dynamically to changes in the evidence base. Currently, given the intermittent nature of food and nutrition guideline development, large amounts of work are required within very short timeframes to enable synthesis of the large volumes of evidence available, and there is significant loss of capacity and expertise in the workforce between review cycles. Development of an ongoing evidence review system would mitigate some of these concerns. This aligns with shifts which are already occurring in some areas of nutrition in Australia, such as a process of rolling reviews for the Nutrient Reference Values (National Health and Medical Research Council and New Zealand Ministry of Health 2006) and regularly updated reviews on specific topics such as salt reduction (Santos et al. 2017). Examples of similar systems exist internationally such as the World Cancer Research Fund Continuous Update Project (World Cancer Research Fund International) and the United States Department of Agriculture's Nutrition Evidence Library (United States Department of Agriculture). Recently, the concept of living systematic reviews, which are capable of being updated when new evidence is published, was proposed (Elliott et al. 2014), with living systematic reviews currently being piloted by a number of Cochrane review groups (The Cochrane Collaboration 2017). Application of the concept of rolling or living systematic reviews of both grey and published literature to the nutrition evidence base would require consideration of the evidence framework as outlined above, in addition to requiring an associated workforce to manage both scientific oversight and practical considerations of facilitating the reviews. A key consideration in the creation of the Knowledge Hub is the design of an appropriate process for prioritising research questions as well as the evidence reviews and analyses to conduct.

Translation

Translation of science to effect change is increasingly recognised as a critical, often missing element in the research pathway, acknowledged by research funding agencies and government (Australian Research Council 2015, Campbell et al. 2009, National Health and Medical Research Council 2016). It is widely accepted that nutrition guidelines, policies and interventions to promote the nutritional health of the population should be informed by scientific evidence. However, in all areas of nutrition, uptake of evidence into practice has been slow and inconsistent (Roberto et al. 2015) and it is estimated that it often takes 17 years for research findings to be translated into routine practice (Zoellner et al. 2015). There are a variety of barriers to translating evidence to policy and practice, including lack of resources and expertise, which may be common across disciplines. There are also considerable system-related factors influencing uptake and translation in the food and nutrition system such as poor political commitment, competing stakeholder agendas and reliance on evidence frameworks that prioritise randomised controlled trials (Baker et al. 2017, Cullerton et al. 2016).

Translation needs to consider evidence from across the food and nutrition system using a socio-ecological framework. It must address key settings, population groups and multiple modes of delivery and apply evidence-based strategies to overcome mapped barriers with effective interventions (for example http://epoc.cochrane.org; http://www.behaviourchangewheel.com). In addition to the nutrition research data integrated in the Data domain of the hub, the Translation domain should encompass a repository for sharing best practice, evidence-based resources and tools for end users, and allow for tailoring to specific circumstances, settings and population groups and upscaling in the community. The domain should provide a forum for sharing, learning from others and an opportunity to upskill researchers and stakeholders in a reciprocal relationship to build capacity (Wolfenden et al., 2017). It would also provide an avenue for the fostering of 'knowledge integrators' (individuals who span knowledge types across multiple disciplines) and 'knowledge translators' (individuals who translate research to the public, practitioners and policy makers (Pearson et al. 2012)) in support of food and nutrition science. A key issue in the development of the Translation domain of the hub would be an adequate appraisal system for application to the resources and tools to be hosted within the hub, and the exploration of methods for the appropriate promotion, dissemination and knowledge transfer of the resources. In addition to facilitating effective translation of nutrition research into guidelines and policy, the Knowledge Hub could act as a resource for education and support for a range of stakeholders, including government, industry, health professionals, educators and consumers. A key initial step required for the development of the Translation domain would be the scoping of potential stakeholders, and consultation with relevant groups to identify their needs and encourage engagement and ownership of the Knowledge Hub.

A critical component of the Translation domain would be incorporation of a process to evaluate the impact of the Translation domain to inform future translation activities. It is desirable to generate a positive feedback loop to ensure translation remains responsive to stakeholder needs (Apollonio and Bero 2017). The Translation domain should draw on implementation science, which is an emerging field of research, and may be defined as 'the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services' (Bauer et al. 2015). This would allow the hub to also generate new evidence to address questions such as: Are resources accessed by those who need to use them? What strategies are effective to translate the data/knowledge into change at system/organization/population, community/team, and individual levels? Development and application of existing measures of implementation science constructs to food and nutrition interventions would be required (Jones et al. 2017), and would place Australia as an international leader in the development of implementation science as it applies to food and nutrition.

Key questions to address

As previously highlighted, the current model for generating, sharing and translating food and nutrition science has a number of challenges. The lack of linkages between data currently being collected, long lag periods between collection of nationally representative data and updating of evidence reviews, and limitations in current translation strategies result in an evidence base which is

not being fully leveraged to address Australia's food and nutrition science issues. Given the current burden of conditions in Australia such as chronic diseases and health inequalities in vulnerable groups, alternate models with the potential to result in a dynamic, equitable and efficient nutrition evidence base and translation strategies must be considered. The proposed Knowledge Hub addresses these challenges inherent to food and nutrition science in Australia, however, there are a number of key issues to address to allow for its development.

- How would the Knowledge Hub be funded? There would be considerable cost associated with development and implementation of the hub, as well as its ongoing management. A business case demonstrating the substantial benefits of the hub would be required, in addition to an implementation strategy that leverages current research activities within universities, research institutes and government, to minimise the need for additional structures to support the hub.
- What governance structure is required for appropriate implementation and management? Custodianship of the Knowledge Hub (and its contents) would be a key issue to address, given key principles of equity of access, security and long-term sustainability and viability. Equitable access to food and nutrition research across all stakeholders is a key component of working towards food and nutrition security for all. This concept of equitable access is proposed to underpin all aspects of the hub, with an emphasis on involvement of a range of users in its development and application, to encourage trust and commitment from a diverse spectrum of stakeholders.
- What are the workforce implications of implementing the Knowledge Hub? What are the skill gaps in relation to creation, use, and interpretation of nutrition data and evidence? What expertise would be required to develop and implement all domains of the hub? What are the key ethical issues associated with data security and integrity for access and availability of data relating to the Data domain of the proposed hub? Data linkage across a range of datasets contains inherent security concerns relating to data privacy and secure storage and there would be a need for investment in infrastructure to ensure secure management of data. There would also be a need to develop collaborations between the disciplines of nutrition and data sciences and in use and application of 'big data', to result in a transdisciplinary workforce capable of addressing current and future challenges in food and nutrition.
- Who are the key stakeholders for translation of nutrition evidence that the Knowledge Hub should try to assist and impact?

Initial strategies for development and implementation of the Knowledge Hub could include:

1. Creating a working group to drive the development of the hub. The working group should include those with expertise spanning nutrition data collection, synthesis and translation, with representation from research, industry, government and consumer engagement domains. The working group would need to examine a wide range of barriers and enablers,

and should consider examination of existing models for developing and implementing the hub.

2. Scoping currently available nutrition research data to identify opportunities for data integration. This could also involve exploration of currently available repositories of research data such as Research Data Australia (Australian National Data Service) to identify options for leveraging current data storage options.

3. Engaging with stakeholders to identify needs and potential barriers to the involvement in the development of the hub.

Conclusion

The proposed Knowledge Hub will serve as a fit-for-purpose tool aimed at ensuring effective integration, synthesis and translation of food and nutrition science knowledge. Creation of the Knowledge Hub will address current challenges facing food and nutrition research in Australia and more broadly, and will facilitate effective and responsible use of food and nutrition science knowledge towards improved nutrition policy and practice.

Out of the box

A number of additional potential opportunities relating to the Knowledge Hub also require further consideration. These include:

- Integration of data would initially involve linking of data currently collected via national surveys. However there is also the potential to include a much greater variety of data sources, including purchasing patterns, agricultural data including water supplies and effects of climate change, food waste, and urban planning data.
- Opportunities for stakeholders to contribute to evidence synthesis, for example by encouraging experts to contribute to updating living systematic reviews. Governance structures would be required to maintain the fidelity of information within the Hub, for example by using a blocked-chain approach.
- To support the ongoing management of the Hub, tiers of membership could be integrated. Those seeking to use data or synthesised evidence for commercial purposes could be required to pay a fee to access the Hub. This concept would however need to be balanced with the principle of equitable access for all.
- Updating of living systematic reviews or other contributions to the Knowledge Hub could be conducted by tertiary nutrition students through use of research projects, and work-integrated learning opportunities such as placements and internships. This could provide an opportunity for both cost-effective contributions to the Knowledge Hub, in addition to contributing to the training of the next generation of nutrition researchers, and allowing nutrition students an opportunity to actively engage in the development of nutrition research infrastructure in Australia.

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About the 2017 Theo Murphy High Flyers Think Tank: Rethinking food and nutrition science

The Australian Academy of Science has been hosting annual High Flyers Think Tanks on nationally important topics since 2002. These two-day events bring together outstanding early- and mid-career researchers with expertise in a broad range of disciplines to discuss novel applications of science and technology, and to identify gaps in knowledge that need to be addressed.

The 2017 Think Tank, *Rethinking food and nutrition science,* was held in Perth on 26-28 July with participants examining the field from four perspectives:

- Critical evaluation of nutrition science
- Key control points for healthy, equitable and sustainable food and nutrition
- Essential goals for achieving effective solutions
- Tools for change

Following the event, participants continued to work together to develop a series of discussion papers, of which this is one. The discussion papers are designed to create a productive dialogue and contribute to the consultation process during the development of a decadal plan for the discipline of nutrition.

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The Think Tank and the subsequent drafting of discussion papers was overseen by the National Committee for Nutrition, The Theo Murphy High Flyers Think Tank Steering Committee and the following experts:

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Professor Mike Gidley, Centre for Nutrition and Food Sciences, University of Queensland
Professor Paul Griffiths, University of Sydney
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