From evidence to practice: Exploring translation pathways for clinical medical science and public health research

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National Foundation for Medical Research and Innovation

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EXECUTIVE SUMMARY

Research translation puts evidence into practice and delivers community benefits. Despite a large and growing body of medical science evidence, timely incorporation of evidence into policy, practice, service provision and healthcare education remains a consistent challenge.

Translation is complex and requires strategic collaboration between scientific and non-scientific stakeholders that provide required resources, networks and capability. It currently takes too long – between 10 and 17 years – and costs too much – up to one billion dollars per project – to translate. Translation processes lack a systematic framework able to increase efficiency and reduce costs by identifying key requirements, challenges and opportunities.

Strategic multidisciplinary collaborations drive successful translation processes and improve community impact. Without defined pathways for translation, projects cannot be strategically designed to overcome challenges. As a result, opportunities are not identified and the projects cannot meet their intended purpose. An exception is the pathway from biomedical research towards innovation, as it is well established and has allowed funders and stakeholders to better address translation barriers. However, in research areas where translation is not closely interlinked with commercialisation, frameworks remain poorly defined.

This report explores conceptual pathways for translating clinical medical science and public health research. These two research areas create large community benefit, yet have little commercialisation potential:

- Translating clinical medical research informs and improves clinical practice guidelines in the health workforce, such as techniques, diagnosis and treatment regimens.
-Translating public health research, on the other hand, has the potential to provide community benefits through implementation of evidence-based health policy and services.

These proposed pathways provide a framework towards success but are challenging to implement due to a lacking availability of infrastructure, funds and managing bodies required to build and maintain necessary collaborations and resources.

Within these frameworks, emphasis is placed on comprehensive and multidisciplinary planning and evaluation of both translation processes and outcomes. An overriding requirement is strong management and coordination, which helps to overcome challenges presented by the complex and collaborative nature of translation. We are not aware of any research institutions that have established an office of translation with leadership, infrastructure and capacity to systematically manage and support the non-commercial translation of research findings into the community.

At present, translation responsibilities often fall on researchers, who may not have the time, networks, resources or skills to carry out such comprehensive and multidisciplinary tasks. There is a critical need for leaders within the research space that have expert communication and project management skills to take on a leading role as translation manager, build capacity, secure funding and oversee translation projects through to completion.

Funders must recognise that solely funding research is not sufficient for driving translation. Foundations, charities and other funders have the opportunity to drive translation, not only via improved funding structures and grant application processes, but by influencing and supporting the systems, staff and capacity to proactively lead translation in research institutions and within their organisations. This represents a major paradigm shift within the research space, but would ultimately result in research impact and community benefits.

FOREWORD

The National Foundation for Medical Research and Innovation (NFMRI) is grateful for the opportunity to work with Hannah Borle and Daniela Valdés who have been instrumental in conducting cross-sector literature reviews and interviewing multidisciplinary stakeholders to inform and create this report.

Hannah and Daniela are Master of Biomedical Science students at Monash University who volunteered to undertake the background research and preparation of this report as interns with NFMRI.

Whilst the translational pathway for biomedical innovations (including the development of new drugs, devices, vaccines, diagnostics and biologicals) is well known to NFMRI and to the medical research sector, the pathways to translate non-commercial research findings into clinical practice, policy, education and other community-focused outcomes is less clear.

This report is intended to provide a starting point enabling informed discussion for purpose-focussed funders of health and medical research where translation is a priority.

The report explores strategic concepts, pathways, key stakeholders, barriers, gaps and opportunities for research that may translate through changes in clinical medicine and practice, as well as research that may be implemented through public health initiatives.

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INTRODUCTION

Research translation can be defined as creating and disseminating knowledge to put it into practice (1). In medical science, successful research translation benefits the community and healthcare system. Impact-driven research extends beyond scientific exploration and discovery, and instead considers how science can be incorporated into societal systems to create positive impact in communities.

Whilst Australian researchers rank highly on international measures of research quality, our ability to translate research and form collaborations ranks considerably below potential. Translation takes time and translation processes vary between different research areas. New medicines and medical devices take an average of 12 years to translate from discovery to commercialisation. In addition, an average of 17 years is needed for research to be translated into clinical practice or public health policy (2).

Translating research into clinical practice or public health policy takes an average of 17 years

Translation requires significant time investments; however, the current length of our translational pipelines is unnecessary. This inflated journey to impact can often be due to a lack of long-term planning during initial research phases, or inefficient capability and capacity building in translation teams.

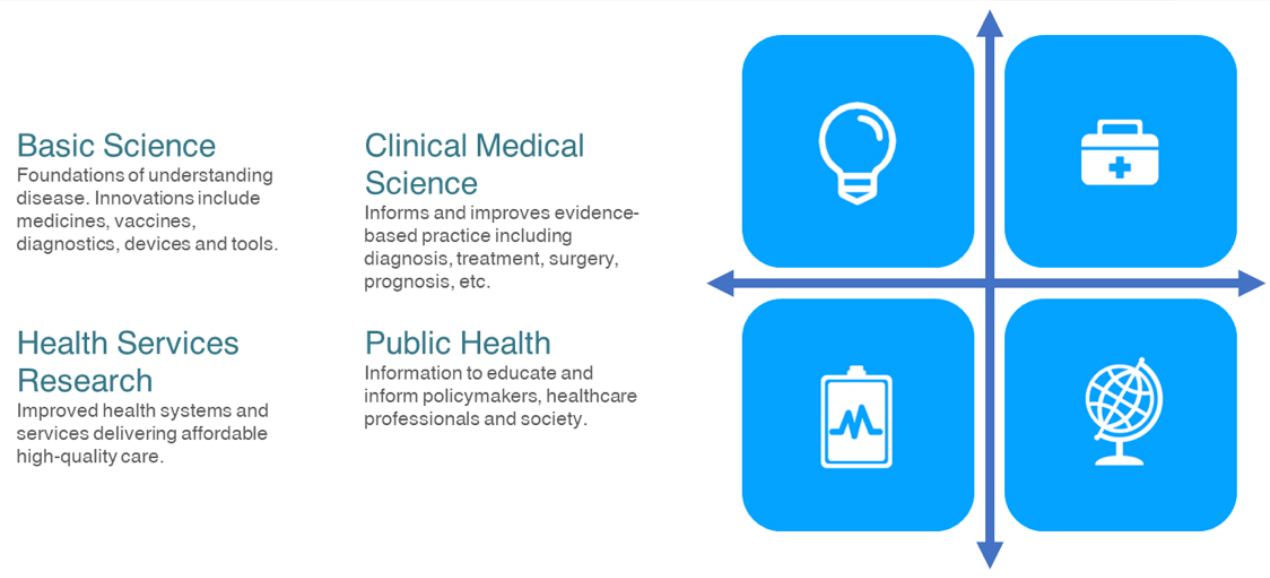
Since the support of taxpayer dollars and philanthropic donations is maintained by the promise of real community impact, it is important to remember that institutions, researchers and intermediates including foundations, trusts and charities are not the final intended recipients of monetary support. Instead, they should consider themselves as entrusted conduits to delivering greater health benefits. With this view, translation should become more efficient.

Medical research is diverse

Research creates knowledge and enables translation. It can provide data to support medicine discovery, improve clinical practice and evidence-based policy and service implementation. Research is able to convey whether a theory works as expected and if translated correctly it can lead to better health in the community.

To define health and medical research, four broad areas have been identified by the Australian and New Zealand Standard Research Classification system:

- Basic Science,
- Clinical Medicine and Science,
- Health Services Research, and,
- Public Health.

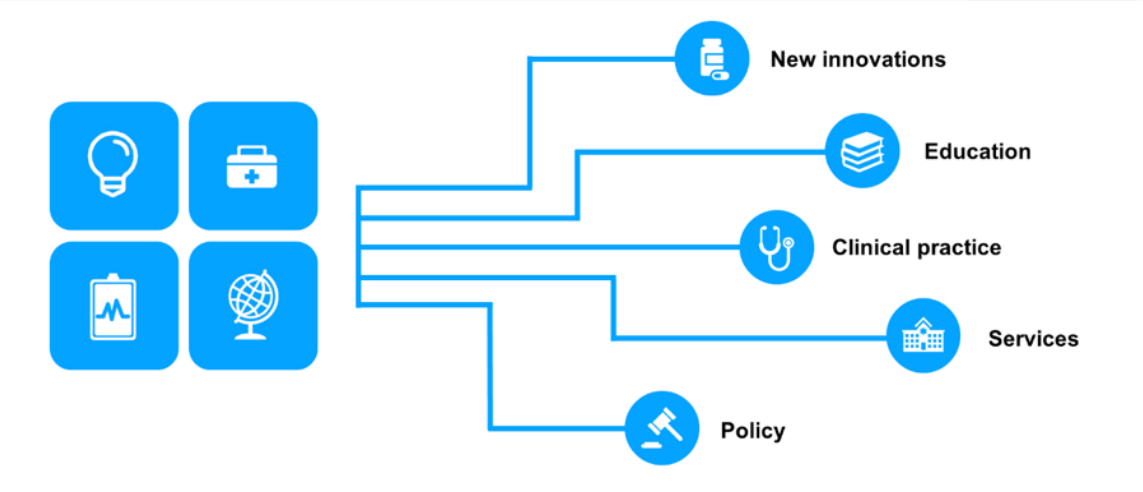


Each area relates to the type of fundamental research being conducted, providing an indication of how outcomes could be translated and implemented. Since not all research is the same, pathways toward translation should be considered independently for each field.

Beyond discovery: pathways towards impact

It is important for everyone involved in translation to understand the type of research being conducted and how it can create change in the community. Goals of translation – in other words, what "success looks like" to key stakeholders – should be a key consideration when planning and carrying out translation.

A "one-size-fits-all" approach could not simultaneously lead to the commercialisation of a personalised therapy, the integration of disease prevention policy into communities and the incorporation of new evidence into Australian health workforce curriculums. Translation pathways should therefore be shaped based on the main area of research and the sectors such research intends to influence.



The figure above represents endpoints where translation has most impact. Impactful outcomes of translation can include:

New innovations:

Innovation denotes novel, improved and more effective ways for problem-solving. In health, this means developing safer and improved medicines, vaccines, diagnostics and medical devices or tools that will help to address complex healthcare problems.

Education:

Health education helps groups and individuals in the community to adopt behaviours that promote, maintain and restore good personal and community health. This includes informing healthcare professional curriculums, patient education and community health programmes with relevant and robust scientific evidence.

Services:

The delivery of safe, accessible, high quality and integrated health services. Services can be both clinical and community-based. They can deliver health promotion and disease prevention measures, prompt diagnosis, rehabilitation and palliative care, home care, community care and hospital care to members of a community.

Clinical practice:

Using evidence to inform and improve surgery techniques, diagnosis, prognosis and treatment regimes in standardised clinical practice guidelines for doctors, nurses and all other health professionals (3).

Policy:

Development of evidence-based health policies, which are decisions, plans and actions aiming to achieve specific healthcare goals to establish medium- and long-term community health targets. Policies also outline roles and responsibilities of different groups in addressing health problems, helping to build consensus and informed action among individuals and organisations.

If translation is carried out effectively, these outcomes can deliver community impact by improving patient health, establishing cultural change and advancing opportunities within the healthcare system.

Achieving translation in each broad area of research

Scientific data on its own is rarely usable, scalable or translatable. Translation is not simply a research-to-consumer model, since applying evidence in practical settings is complex and involves many parties. These include experts, managers and a range of next-step partners who offer the resources, networks, capability and capacity needed for translation. A research-to-business-to-consumer model therefore applies, and management of processes is complex and challenging.

> "Research does not leap from the pages of journals into daily behaviour"
>
> – Woolf et al. 2015 (4)

For translation, non-research activities and important stakeholders and partners must be considered in addition to research activities (5). To effectively, efficiently and consistently achieve impact, translation pathways must be established for each field of science, which may serve as a "roadmap" to success. By mapping out translation pathways, key process requirements and challenges can be clearly determined and systematically addressed.

The translation pathway from basic research to innovation is well-established. The National Foundation for Medical Research and Innovation (NFMRI) have utilised this pathway to identify major gaps in funding and support that frequently act as barriers to translation, as shown in Figure 1 below.

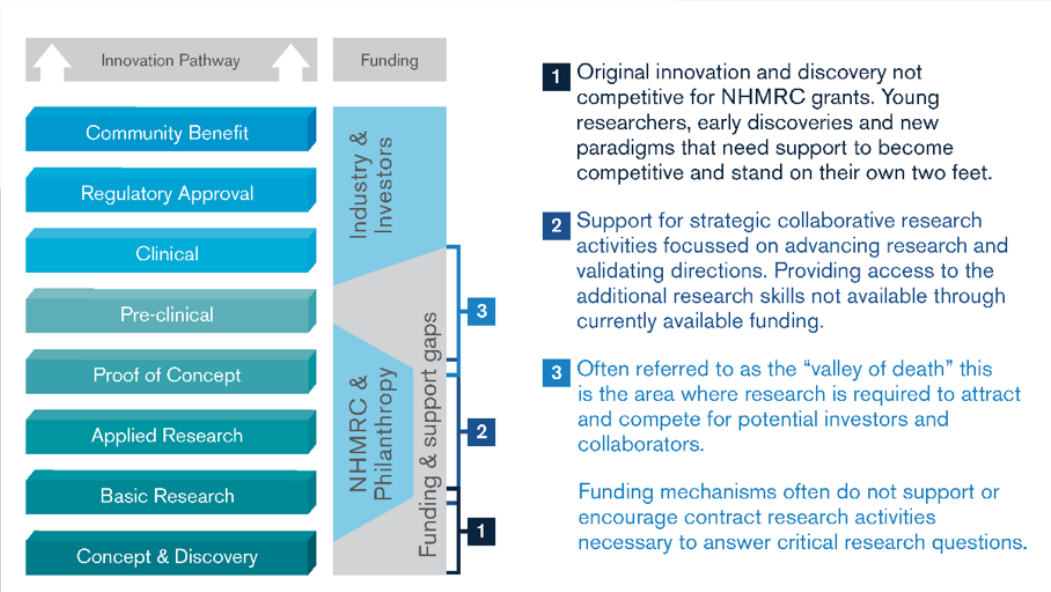


Figure 1: the pathway from basic science research to innovation is well-established, and has been utilised by National Foundation for Medical Research and Innovation (NFMRI) to guide targeted funding strategies which address three key areas where funding gaps have been identified.

This framework has allowed NFMRI to develop targeted funding strategies that address such gaps. This has consistently resulted in impactful giving, with funding supporting innovation and translation in a range of areas including cancer, asthma, blood diseases, cardiovascular diseases and Alzheimer's disease.

However, the four broad areas of research differ substantially, and translation pathways are correspondingly varied. Unlike the pathway from basic research to innovation, translation pathways for clinical medical science, health service research and public health research are less defined. Consequently, effective planning, collaboration and management of translation in these fields is difficult, and unfortunately, translational activities are not frequently carried out. In addition, many other challenges exist for translating research, including funding protocols, healthcare governance structures and academic culture, which contribute to the success and complexity of translation.

The targeted funding strategy employed by NFMRI has had consistent and measurable success in translating basic science research into innovations. There is an opportunity for a similar approach to be developed in other research areas. By identifying unique translation activities and pinpointing areas of their pathways where funding and support could be strategically targeted, key stakeholders can better plan and execute translation.

Working towards translation

Australian funders, including governmental bodies, have turned their focus towards impactful giving and support. Translation-focused grants are now provided by NHMRC and MRFF initiatives, among others. While impact-focused giving is optimal for translation, significant questions still surround how to best develop funding structures and application processes that drive translation in the different research areas (6).

In addition, governance of research and healthcare systems within Australia are inherently complex. Health research, policies and issues are regulated by a wide range of governing bodies, including multiple levels of government, NGOs, industry and academia. Working in such complex systems is difficult, and presents administrative and managerial challenges to researchers new to translation (that is, a significant proportion of medical and health researchers in Australia).

More broadly, academic science culture does not strongly encourage translation (7). Researchers are often trapped in the "publish or perish" framework, where they have little time, resources or career incentive to carry out translation. From the undergraduate level upwards, there is an opportunity to educate scientists and researchers about **how** and **why** to translate, and for research bodies to support translation by providing or improving required infrastructure and capacity.

This is especially true outside of innovation, where returns on translation investments are social, rather than monetary. While Technology Transfer Offices (TTOs) at many universities support the translation of innovations, few equivalent facilities exist to assist researchers in translation towards health policy or healthcare services.

The lack of well-established and effectively utilised translation pathways for all research areas means that efficient processes, borders and gaps have rarely been systematically identified and addressed by research institutes, managers and funders.

There is an opportunity for researchers and funders interested in translation outside of the basic science field to overcome barriers in a systematic and strategic manner, using an approach similar to that employed by NFMRI within the basic science field. However, more work needs to be done to define pathways, identify gaps, and build the resources, networks and capacity needed for translation.

This report provides a conceptual overview of key translation processes, considerations and challenges outside of basic science.

Part 1 explores clinical medical research translation to education and clinical practice.

Part 2 discusses public health research translation to policy and services.

Part 3 focusses on considerations for the scalability and sustainability of translation.

The following sections outline key opportunities and considerations regarding these two translation pathways: clinical medical research and public health research.

PART 1:

CLINICAL MEDICAL SCIENCE: FROM RESEARCH TO TRANSLATION

What is clinical medical science research?

Clinical medical research informs and improves surgery techniques, diagnosis, prognosis and treatment regimens. Evidence from this field is used to update clinical practice guidelines used by doctors, nurses and all other health professionals. In addition, it addresses patient care from social and behavioural perspectives. Thus, the translation of clinical medical research greatly improves clinical practice and health workforce education and training.

Definitions for clinical medical science research vary between locations and fields. Arguably, the most widely accepted definition of this research field is outlined below (8)

Clinical research embraces a continuum of studies involving interactions with patients, diagnostic clinical materials or data, or populations in any of the following categories:

1. Disease mechanisms
2. Integrative translational research (clinical trials)
3. Clinical knowledge, detection, diagnosis and natural history of disease
4. Therapeutic interventions, including clinical trials of drugs, biologics, devices and instruments
5. Prevention (primary and secondary) and health promotion
6. Behavioural research
7. Health services research, including outcomes and cost-effectiveness
8. Epidemiology, and
9. Community-based trials

Source: Graylyn Development Consensus Conference, 1998

Therapeutic interventions and clinical trials form an important part of clinical medical research, highlighting this field's role in validating the safety and efficacy of medications or devices through human clinical trials. These trials are a crucial step when translating biomedical research into innovations.

Since the pathway to innovation is understood, this report will focus primarily on how clinical research translation informs clinical practice and influences health workforce education.

Translating clinical medical science research

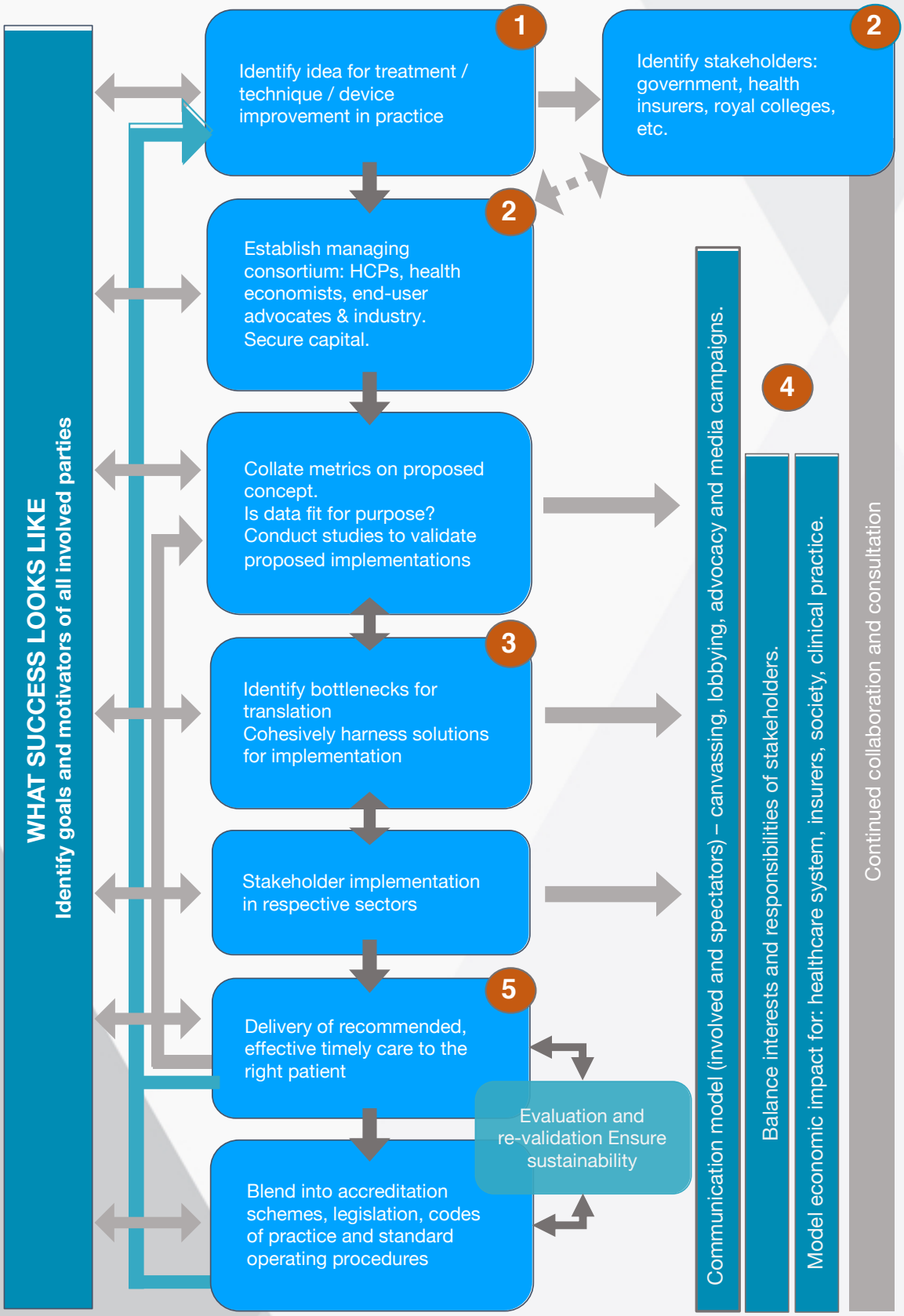


Figure 2: A conceptual pathway to translate clinical medical science research into evidence-based clinical practice and healthcare professional education.

1 Because of the wide breadth of clinical medical research, its translation is one of the primary means for fulfilling community healthcare and health economic goals. Clinical medical research translation improves procedures, treatments and devices to deliver effective and prompt patient care. In addition, translation can routinely update vocational, tertiary and specialised health curriculums, to maintain high quality practice. Considering these potential benefits, work must be done to increase incidence of translation in this field.

Translation should not be an afterthought of research, but rather the purpose that drives research. In a well-functioning healthcare system, clinical medical research is closely interlinked with policy, health economics, clinical practice and professional healthcare education. Evidence from clinical medical research can establish safer and more appropriate patient care. Better clinical treatment regimens can then be taught to other professionals and be incorporated in routine practice.

Without translation, research cannot benefit the community, as knowledge gained will not reach health professionals or become clinical practice. Translation requires strategic collaboration with varied scientific and non-scientific partners including healthcare industry bodies, the Australian Royal Health Colleges, health insurers, peak bodies and community advocates, among others. Therefore, meaningful impact and change can only occur if stakeholders understand what the goals of translation are.

Translating medical research into evidence-based practice

What does successful translation look like?

Translating research into evidence-based health workforce education and practice is complex. Translation efforts in creating innovations benefit from specialised teams and resources within universities and Medical Research Institutes (MRIs) that facilitate industry engagement and commercialisation. However, multidisciplinary teams and resources to support and enable the translation of research through non-commercial pathways are currently rare in universities or MRIs. Without a potential financial return, and with little or no funding to support translation, leadership and support in this area is poor. To increase clinical medical science translation, we must therefore **identify whose role it is to translate.** Translation may need to be undertaken through new paradigms.

Trying to find a “one-size-fits-all” pathway to impact is futile as a single pathway cannot accommodate successful outcomes for differing projects. Metrics that measure progress and success also need to be specific to the pathway and its goals and objectives. A consolidated and systematic approach for translating research should be defined, and past translation efforts should inform future projects.

Pathways for translating clinical medical research have not been comprehensively defined. The literature and industry experts share a viewpoint: the pathway is inherently complex, poorly defined, and cannot be undertaken alone by a single individual or organisation.

> "It takes a community to translate"
> – Erica Kneipp

A conceptual pathway of clinical medical research translation is provided in Figure 2 above. This pathway was developed based on the best available literature and expert opinion. Although each pathway is unique, the overarching steps required for success could be similar. The pathway identifies the need to co-ordinate and harness skills from many disciplines.

For instance, the establishment of a managing consortium is necessary in all translation projects. This group of qualified individuals should plan and drive the project, oversee the completion of project milestones and identify other relevant stakeholders for ongoing collaboration and consultation. Translation barriers and the research designs required to address these will change significantly between projects.

Could funders take a proactive role in facilitating translation?

Translation often requires further research to answer important questions identified by the consortium. Planning should result in structures and systems that adhere to realistic milestone cut-offs, align to translation goals, and promote stakeholder accountability and task completion.

Another important consideration revolves around who should be responsible for leading translation. Since clinical medical research translation offers few avenues for commercialisation, it becomes less clear who the financial driver of the pipeline should be.

The following sections aim to dissect important elements of this translation framework, to explore how greater efforts are required to comprehensively inform our healthcare system and workforce education and training with evidence.

Important next-step partners and stakeholders

2 Successful translation needs next-step partners, as research cannot directly impact health professionals and end-users (9). Researchers and their institutions must think beyond their typical research activities and connect with stakeholders that can bring the resources, networks, skills and capacity needed for translation.

Collaboration between stakeholders is challenging and requires intricate communication models that consider involved and spectator stakeholders' goals (10). Communication can be delivered through institutional canvassing, end-user (e.g. patient, community, health care professional) advocacy and media campaigns. However, it is currently unclear who should develop and oversee such collaborations.

Any institution, organisation, private or governmental body that has direct involvement with the translation of an idea is an important next-step partner. Those with indirect involvement must also be considered, as they are powerful allies that can contribute to the scalable implementation of translation. Examples of relevant next-step partners when translating clinical medical research are outlined below in Figure 3.

Figure 3: Common and important next-step partners, end-users and other stakeholders who may be involved in the translation of clinical medical science research.

Involved stakeholders may have moral, financial or organisational motivators that influence their purpose. While some stakeholders may be well-aligned; others may not. A project that aims to improve healthcare services and minimise delivery costs may be shared between the Commonwealth and State/Territory government health policy and program portfolios, portfolio agencies (such as the Australian Safety and Quality in Healthcare Commission), hospitals and health services, Primary Healthcare Networks and national private health insurers. It is important to discuss what purpose or "success" is for each of these stakeholders and consider these prior to and during translation. It is also important to engage with these stakeholders as early as possible so that the methodology is informed by translational needs and requirements to maximise impact.

Without attracting next-step partners, opportunities for translation may be halted. It is therefore crucial that goals and expectations of stakeholders are understood early, so research resources and activities are tailored towards this shared purpose.

Changing paradigms: how health insurers can drive translation

Funding research benefits health insurers and national health systems. It can lead to improved health service provision, delivery and administration which benefits contributors and the community as a whole.

In the absence of a consolidated and systematic approach to clinical medical research translation, health insurers are well-positioned to take more involved roles. They have the ability to leverage their internal capacity and pre-existing relationships with stakeholders including government, providers, health professionals, researchers, advocates and end-users, to facilitate translation.

The Hospitals Contribution Fund of Australia (HCF) is a valuable example of how organisations can *support* research for translation. HCF is a non-profit insurer, meaning that capital gains are redirected to the fund rather than divided between shareholders. These funds are used to provide and maintain health and wellbeing services, such as weight loss programmes and smoking cessation campaigns.

The HCF Research Foundation was established in 2000, and in 2012 the Foundation partnered with the Royal Australian College of General Practitioners (RACGP) as they had identified a gap in grant funding. Together, they strategically support projects that are driven by general practitioners (GP) to inform practice, medical development and training.

For example, HCF Research Foundation grants have supported the Home Medicines Review Service – an initiative that helps people with complex treatments form medication management plans – to reach Aboriginal and Torres Strait Islander populations. They have also supported projects that reduce unnecessary hospital admissions in elderly people, minimise hospital-acquired malnutrition and provide low-cost mental health programmes for women with pre-natal depression.

The HCF Research Foundation and many other organisations continue to explore measures to increase translation and community impact. Could the answer lie in proactively *driving* translation, rather than solely providing external grants that support it?

Supporting translation is good for business. Successful translation can increase efficiency, reduce health-related costs, bring benefits to existing members and motivate the public to become contributors. Funders also have the opportunity to collaborate with other insurers to initiate and oversee translation in larger-scale projects. The incentive here is that risks of investing in research are shared and together they can increase resourcing by pooling funds.

Changes in system paradigms may be needed to answer:

- Who is responsible for leading translation, especially when responsibilities between next-step partners overlap?
- Could translation become more effective, cost-efficient and have greater impact if insurers and other funding bodies lead and manage it?
- Should funders and researchers include translation plans/directions when applying for grants?

Research for impact

Organisations are social units of individuals working towards a collective goal. Because of this, a consortium of stakeholders that pool their time and resources for a common goal in translation should be considered an interim organisation of its own.

Modern organisational theory – in other words, the structural, environmental, technological and cultural frameworks adopted by an organisation that align to its purpose (11)– was pivotally informed by the Hawthorne studies. These studies highlight the fact that social factors are just as important as financial motives in defining the motivation and productivity of individuals within an organisation.

Organisational theory and the Hawthorne studies

In 1920, sociologists and psychologists from Harvard University investigated human aspects of work and working conditions at the Hawthorne factory of Western Electric Company in Chicago, USA. Over seven years, behavioural and experimental studies evaluated the impact of social and mental needs in workforce motivation. Overall, these studies concluded that "a human/social element operated in the workplace and that productivity increases were as much an outgrowth of group dynamics as of managerial demands and physical factors" (12).

This provided great advances in understanding organisational values and aims, emphasising the need to consider human nature when setting employee obligations and expectations. Its translation to practice has shaped the way in which modern organisations operate, as it has encouraged organisations to consider the value of interpersonal relationships in teams; especially that of leadership and behaviour in managers.

Since then, many businesses and institutions have re-structured the environmental, cultural and structural approaches of their organisations to incorporate underlying social and behavioural considerations. In healthcare management, three main change officers have been identified: change agent, change manager and change leader (Figure 4). Successful organisations can identify the need for change, master its implementation and identify responsible individuals involved throughout the change process.

Australia has taken the first step towards supporting translation

2 The change manager plays a key role in translation, as they promote translation purpose, deal with arising conflict between agents and leaders, and consider driving and resisting forces for impact. In medical research translation, these roles often change based on the project and stakeholders involved, and those involved can choose to take on one or more of these roles.

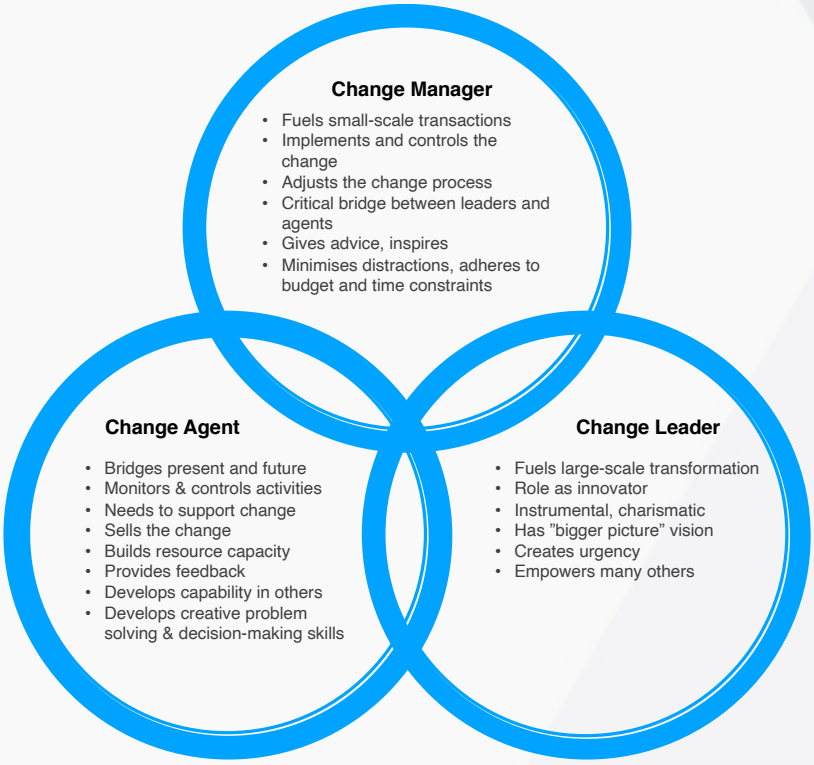


Figure 4: The three main change officers involved in healthcare management. Source (13).

Australia recognises the value of collaborations between researchers, clinicians, community advocates and end-users for improving translation processes and creating change in healthcare systems. Drawing on successes in Europe and North America, the NHMRC established a recognition scheme for Accredited Translation Centres (ATC). ATC accreditation is gained by demonstrating international competitiveness in providing research-based healthcare and training across all areas of health. Since 2014, seven Advanced Health Research and Translation Centres (AHRTCs) and three Centres for Innovation in Regional Health (CIRHs) have been accredited, and have formed the Australian Research Alliance (AHRA). AHRA's goal is to ensure Australia's healthcare system is entirely informed by health and medical research.

Is it reasonable to expect stakeholders such as researchers to act as expert mediators and change-driven organisational managers during translation?

These roles have been historically filled by researchers and medical professionals. While such staff may be highly skilled in research management, translation is often a large-scale and multidisciplinary project with a large non-scientific component. Researchers and medical professionals may not have adequate training, resources or time to complete these broader project management tasks. If there is a lack of structure in translation, increased stakeholder workload could compromise the efficiency and success of the pathway.

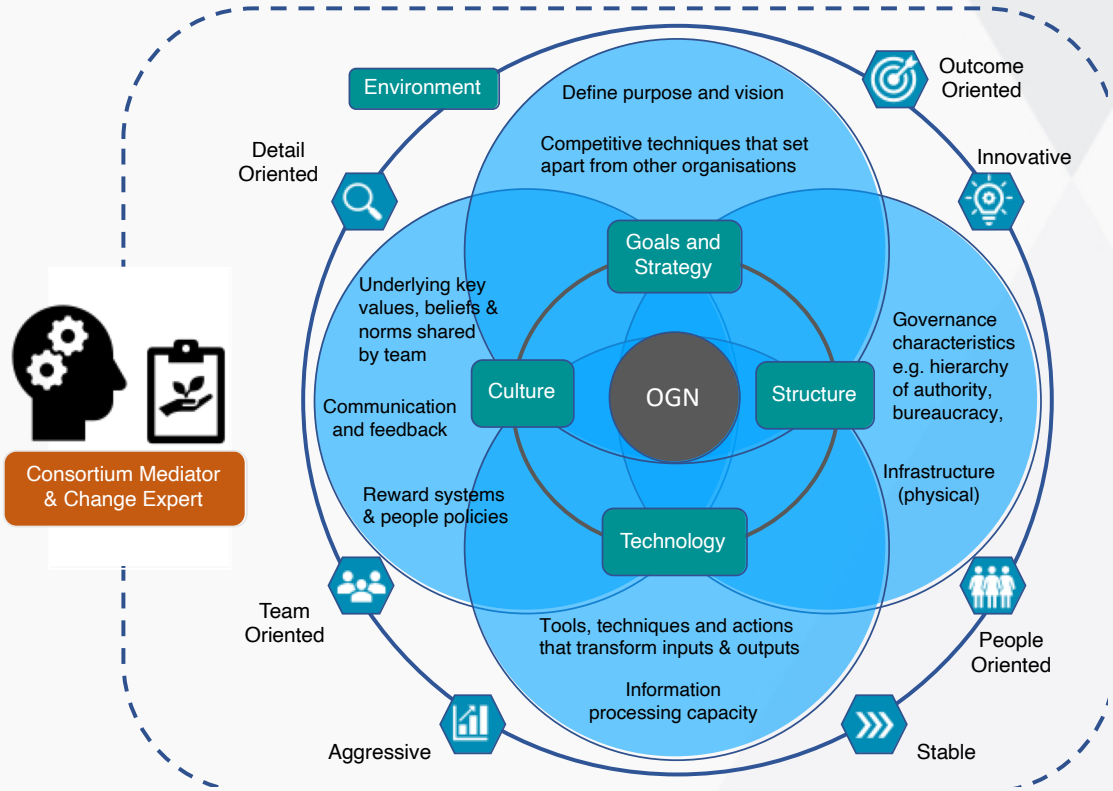


Figure 5. Factors that determine processes and direction of an organisation (OGN). The complexity of these requires direction from an expert mediator and organisational change professional. (14).

Another consideration is that modern organisations use varied communication codes. These codes define unique and sometimes contrasting interpretations of common language, which may lead to communication difficulties between stakeholders from different fields. Contingencies from different interpretations of information must be considered and addressed, if necessary. Knowledge brokers are crucial in translation to provide a communication interface between stakeholders.

Improving clinical research translation requires leadership and management training for mediating meetings, identifying overlapping responsibilities and delegating tasks so translation is completed on time and on budget. An expert manager ensures that the translation project is built for purpose.

Translational challenges and opportunities

3 Careful planning before translation provides proactive courses of action to respond efficiently and effectively to translation barriers. Planning for foreseeable challenges should take place early, as this can influence success. Comprehensive planning requires significant collaboration, coordination and time. Is it fair to place this responsibility on time- and resource-poor researchers? Who could take on this role?

Each translational pathway will have unique challenges depending on its goals. These should be evaluated during preliminary planning. Some challenges are common to many translation projects. Examples of such barriers are described below.

Modelling the economic impact of translation

4 Three common economic considerations in clinical research translation are:

1. The cost of translation is almost always underestimated. The translation pathway itself will incur direct and indirect costs to partners, institutions, and peak bodies of industry and government.
2. There are many indirect costs and pressures on the health system during research and translation. For example, skills and activities may be diverted from immediate clinical needs.
3. The impact successful translation will have on the Australian economy, public and private healthcare sectors, both in terms of cost and potential revenue.

These are often overlooked by researchers wanting to translate their work, where research funding is normally assessed and directed towards research not translation. Recognising their importance and interplay influences translation scalability and sustainability. Economic forecasts obtained from these models are also instrumental to inform the degree to which translation benefits the community and economy.

Australia has a developed and globally competitive economy. Within organisations, key performance indicators are often utilised at multiple levels to evaluate if goals are being met. These indicators can identify areas of slow or limited progress, and inform on targeted responses for improvement.

To make strategic decisions, it is vital to identify relevant translation performance indicators and communicate these with next-step partners (15). Purpose-specific economic modelling turns data into insights, to quantify the economic effects translation may have. This helps to inform decisions.

Next-step partners expertly trained in health economics, econometrics, cost-benefit analysis and economic impact assessment and appraisals are powerful advisors for translation. Late or absent collaboration with health economic experts has historically hindered clinical medical research

translation. Active participation and consultation with these experts throughout translation incorporates economic viewpoints that influence how realistic it is to attain impact.

Partnerships with health workforce regulatory bodies

Healthcare professionals work within a complex, challenging and demanding healthcare system. This requires ongoing training and an ability to solve intricate problems. The provision of optimal health care depends on the capability and qualification of workers. Capabilities are acquired through high quality education and training, and maintained by adhering to professional care standards.

Many stakeholders hold influence and responsibility for the education, training and accreditation standards of the Australian health workforce. These include universities and other tertiary education providers, professional colleges, registration boards and Commonwealth and state/territory governments, which are greatly supported by the Australian Health Workforce Fund.

The National Registration and Accreditation Scheme (NRAS) oversees the accreditation and function of most healthcare professions within Australia, undertaken by external accreditation authorities like the Australian Royal Colleges, the Nursing and Midwifery Accreditation Council and the Australian Medical Council. State and federal legislation further binds professionals to policies of practice and codes of conduct. Standard operating procedures may additionally vary between state of practice and can be enforced differently depending on the hospital or care facility.

One challenge for successful translation is to establish and maintain collaborations with these stakeholders from early on in translation. These organisations are powerful allies. Prioritising continued collaboration and consultation with them throughout the entirety of the translation process underpins the ability to achieve true community impact, as they can ensure findings and recommendations are incorporated into health workforce training and accreditation models. As a result, outcomes of the translation pipeline become standard clinical care practice.

The influence of professional reward structures

Reward models used to recognise professional success greatly motivate behaviour and practice in clinical medical research and development, health workforce training and education, and clinical practice. Their influence on research translation should not go underappreciated (16).

Currently, professional reward structures are not adequately geared to encourage translation. Fundamental changes may therefore be needed to create change in healthcare, governmental and academic sectors

Examples of translational barriers associated with reward structures include:

1. Healthcare professional accreditation programmes

Accreditation programmes delivered by Australian Medical Board, Australia Royal Colleges, hospitals and allied health facilities (e.g. aged care) are compulsory for health worker career progression. They can also directly influence healthcare professional education curriculums. Timely contact with accreditation bodies helps plan for high-quality project design, data processing and analysis. These are requirements for translation success. Only then would evidence be integrated in their reward structures, improving health professional education and clinical practice. In line with this, it is important that public and private hospitals are also engaged with early on, and are provided with a voice during translation.

2. Academic researchers live in a world of “publish or perish”.

Research is normally measured using outputs and easy to attain metrics such as publications. Publications are a good way to disseminate knowledge within scientific communities and to promote scientific progress. They are a major consideration when awarding research grants, and a scientist’s track-record of publications and past grants heavily influences their ability to secure future funding. This indirectly creates obstacles for impact-driven science, since the scientist’s focus is often placed on publishing and on projects that create publications. Additionally, scientists and research institutes seldom integrate translational purpose or outcomes in their budget layouts. This, in turn, reduces timely engagement with next-step partners and stakeholders, obstructing translation success. The “publish or perish” system places scientists wanting to translate in a suboptimal position, as they are urged by their employing universities and research institutes to adhere to this system, as it is often the primary avenue for career progression and stability in academia.

Whilst impact can also be assessed after translation is completed, few funders and institutions have introduced metrics to assess progress and effectiveness of research or translation, maintaining their focus on publish or perish metrics.

3. Impact of reward structures on interactions between research leaders and end-users

Medical research facilities are situated near hospitals and/or clinics to encourage researchers to work in close proximity to end-users and to shape their work towards addressing daily challenges that surround practice. Despite improvements in collaboration, there remains a divide between researchers, healthcare professionals and patients. Consulting with end-users to identify and develop translation ideas is needed to best identify practice and education problems. Late partnerships with community advocates and end-users during translation is counterproductive. Their input can require reshaping already approved plans, jeopardising project budget and time constraints. Hospitals, insurers, clinical colleges, patients and community advocates are critical for translation to achieve meaningful clinical impact.

4. Academic researchers often perceive translation as their responsibility.

Funding bodies have placed a greater emphasis on translation within the clinical medical science field; however, leaders who facilitate and coordinate translation are yet to emerge within this space. Consequently, researchers have often become the default leaders of translation projects, and may feel that they need to carry out translation in order to advance professionally. Research is key for:

- Identifying ideas to translate, and ensuring data is fit-for-purpose throughout translation;
- Evaluating translation outcomes and processes; and
- Using evaluation data to inform future translation projects.

Researchers in universities, medical institutes and private bodies work in high-pressure environments and are expected to deliver impact, whilst providing answers to our community's complex healthcare problems. However, it is impossible for researchers, healthcare professionals, hospitals, or anyone else, alone, to successfully drive translation from beginning to end. Such a perception can quickly develop a perverse cycle, whereby lobbying, ethical, legal or financial considerations (e.g. forming of collaborations, intellectual property and conflict of interest transparency) are not identified or managed, and act as challenges for translation.

One trap that should be considered is what is referred to as 'founder's syndrome' in commercial research where, for example, emotional attachment can influence decisions and pathways. Similarly, researchers and institutions are attached to their own research and caution should be taken to ensure independence is included in translation.

Who could play a role in driving such fundamental changes in these fields?

Building capacity towards translation in a "bottom-up" approach, where reward structures are tailored to meet needs, would create fundamental shifts in the way that healthcare, governmental and academic sectors achieve and evaluate translation impact and success.

When does translation finish?

5 If viewing translation as linear, it would be intuitive to assume that it has finished once the initial idea, observation or concept is implemented. However, this is like installing a new motor in a vehicle and expecting it to work indefinitely without ever servicing it.

In Australia, successfully translated clinical medical research is seldom later evaluated for its impact, scalability and overall success, whether that is economic, societal or academic. Recently, Accredited Translation Centres identified this gap and incorporated several standardised metrics to evaluate translation outcomes in their strategic plans, although results of this initiative are not yet available.

Evaluation and maintenance of translation requires substantial investment. Reward structures often encourage experts to move on to another project once the pathway is 'complete', resulting in decreased evaluation of translation.

As a result, two main considerations arise:

- Firstly, unexpected observations during the translation process are valuable feedback for other translation pathways, which may be lost if long-term follow-up is lacking.
- Secondly, it becomes impossible to later evaluate translation pathways themselves, which diminishes the ability for stakeholders and relevant parties to reflect on the translation process and objectively identify routes for improvement.

Failure in translation also provides important learnings which should be used to inform further work. The systematic evaluation of success and failure of different clinical medical research translation frameworks aids in establishing effective and sustainable strategies for achieving impact.

PART 2

PUBLIC HEALTH SCIENCE: FROM RESEARCH TO TRANSLATION

What is public health research?

The public health field strives to improve individual and community health through health promotion programs, services and policies. After a health problem is identified, a drug developed or a treatment regimen introduced, public health research evaluates its impact at a community level. This is done through health and social research, short- and long-term community-based studies, clinical datasets, or epidemiological data, among others.

Public health measures are diverse. Examples include:

- Vaccination programs
- Health & lifestyle education and media campaigns
- Tobacco and alcohol taxes
- Funding and provision of health services (physical & mental)
- Development and improvement of health guidelines in clinical, organisational and home settings
- Disease screening programs
- Dietary or systemic supplementation programs (e.g. water fluoridation)
- Case management and contact tracing of infectious diseases

As reflected by these wide-ranging measures, there are many determinants of individual and community health. For example, factors that can influence the health of a society include health and psychological services, environmental health standards, transport systems, diet and lifestyle promotions and town planning considerations. As such, the field of public health involves collaboration across many disciplines with a broad range of stakeholders.

In the public health space where there is no potential financial return for translation, who is currently funding and overseeing this challenging but important task?

When collaboration works well, effective public health measures underpinned by multidisciplinary evidence have the potential to improve community health and service delivery, and provide economic benefits to public and private health sectors. Public health is interdisciplinary, and must consider evidence from research fields aside from biomedical, health and social science. Political, economic, sociodemographic and other contexts must also be considered (17, 18). Translation relies on working closely with stakeholders whose interests or intents are at times not fully aligned.

Historically, challenges posed by interdisciplinary work, among others, have led to the limited incorporation of scientific evidence into public health policy and services, despite the large and ever-expanding body of public health research. This limited public health research translation capacity is not due to a lack of knowledge; rather, it is from the limited establishment of practices, systems, resources and infrastructure required to facilitate translation outside of the laboratory.

The following sections explore a conceptual pathway to facilitate the public health research translation towards public health policy and services. Key challenges and opportunities in implementing such a pathway are outlined.

Translating public health research

Public health research translation broadly involves the development and implementation of evidence-based health policies and services within organisations and at local, state and federal levels. Both legislation-bound ("Big P") policy and community based or organisational ("little p") policy can make large and positive impacts in communities. In addition, a wide range of health service providers contribute to public health translation and maintenance in different ways.

Despite a shared goal of improving health, what "success" looks like in public health translation may look different to varying scientific, governmental, private sector and community stakeholders. While health outcomes are a significant focus, economic, political and social outcomes are also important considerations. Evidence can support public health measures, but translation may not be cost-effective or feasible for other sectors (18, 19). It is therefore important that key considerations of the translation pathway are effectively incorporated in public health research, and are not left as an afterthought.

The following sections will explore what translation success looks like when working towards policy development and service provision. Roles and motivators of key stakeholders, next-step partners and end-users are discussed, and main challenges in translation are outlined.

Translating public health research into policy

What does successful translation look like?

Successful public health research translation results in evidence-based public health policy at organisational, local, state or federal levels. These policies may result in taxes, regulations, guidelines or subsidies (19). Motivators and goals may differ between stakeholders, as shown in Figure 6.

Identifying, addressing and balancing the goals and requirements of many different stakeholders is an extensive and challenging task. It requires expert planning, coordination and stakeholder engagement. In areas outside of basic science where translation has little monetary return on investment, managing bodies that oversee such tasks are rarely established and funded. Responsibility for driving translation usually falls on time-poor researchers whose skills may be put to better use elsewhere. **Whose responsibility should it be to carry out this work?**

To efficiently translate, involved parties must clearly understand what the goals of translation are for themselves and other key stakeholders. Notably, needs and goals of governments and end-users such as patients, communities and healthcare professionals should be considered at every step of translation, from initial study design right through to implementation and evaluation (5, 18).

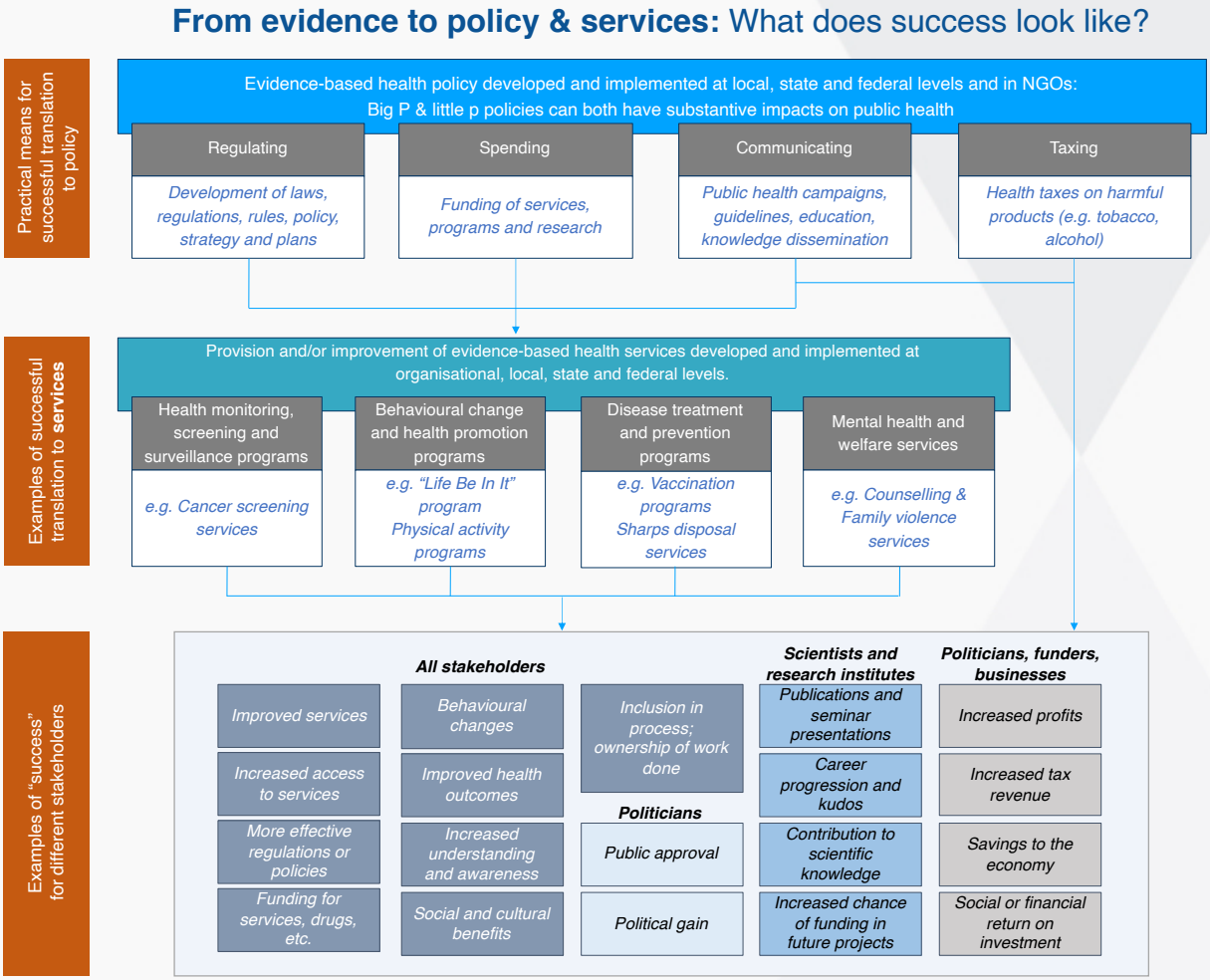


Figure 6: Methods of implementation and stakeholder goals when translating public health research into policies and health services. Sources: (19, 20)

Translation will not occur if researchers do not ask the questions important and relevant to involved parties.

Translation should be built into study designs right from the initial planning stages. It must be a key aim of research – not just an afterthought.

For example:

- **A healthcare worker may ask,** *'Will policy change lead to better health outcomes for my patients?',*
- **A scientist may ask,** *'Will evidence collection involved in the translation process lead to publication?',*
- **While a politician may ask,** *'Will policy change have economic benefits?'.*

Translation and knowledge dissemination documents developed for different stakeholders and next-step partners should be targeted to address key goals, interests and concerns of the stakeholder.

The pathway from evidence to public health policy and services

Considering the wealth of available but untranslated public health research, it is clear that systems need to be developed and implemented to increase translation capacity. Public health translation pathways should be highly collaborative and iterative, and frequently validate and evaluate implemented measures for improvement and sustainability (21).

Translation pathways are complex and varied, however a generalised conceptual public health translation pathway is outlined below (figure 7). This pathway incorporates aspects from many translation frameworks proposed by public health translation literature and experts.

Following such a pathway would allow stakeholders to systematically and efficiently inform policy and services. However, these coordinated efforts are challenging, as dedicated translation personnel, resources and infrastructure are rarely available to carry out tasks.

Key considerations therefore include:

- How can capacity be built to improve this pathway?
- Who should be responsible for driving and funding implementation?

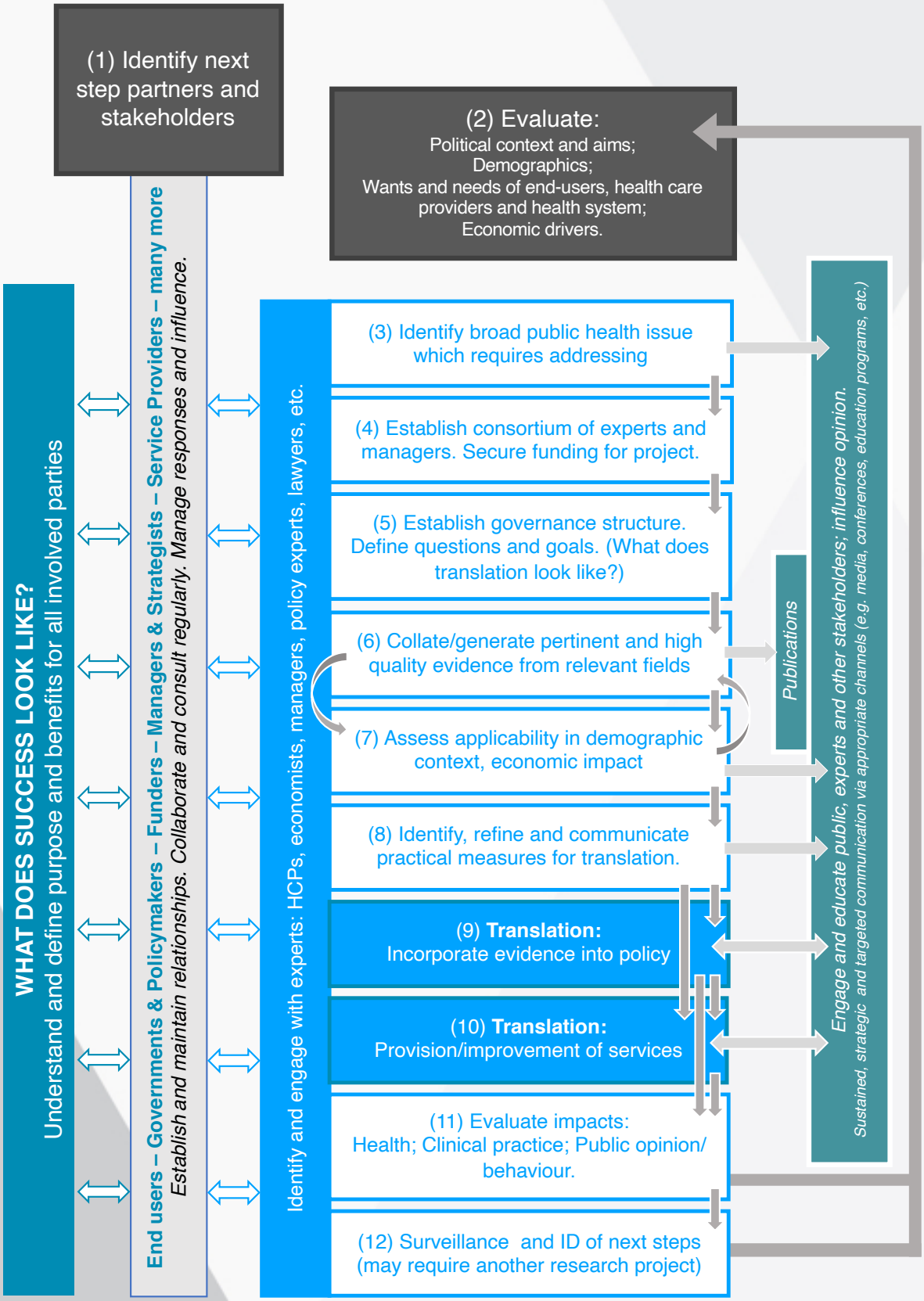


Figure 7: A conceptual pathway to translate public research into evidence-based policies and health services.

(1-3) The first and most important step in translation is to identify key stakeholders and consult with them to understand gaps in current policies or services and identify what questions need to be asked (4).

Researchers can identify pressing public health issues by establishing strong working relationships with key stakeholders. They can also understand the political, economic, demographic and organisational contexts surrounding these issues, to better address them and create change.

(4-5) Early on in translation, it is important to establish a consortium of multidisciplinary experts who are committed to work towards the shared goal of translation. Effective leadership and management during the process ensures that the project is carried out comprehensively and efficiently. The appointment of skilled managers is thus a key factor for success in translation.

It is currently unclear who should be responsible for driving and managing translation. Also unclear is who should fund it, as philanthropy and other funders are often legally bound to provide funds solely for research, and therefore cannot direct grants toward the non-research activities needed in translation.

(6-7) Once shared goals are clearly defined, multidisciplinary consortium members including researchers, economists and policy experts should collate or generate high-quality evidence that support these goals and consider the sociodemographic context of target populations (17). While evidence from one field may support a public health measure, further research may need to be done to answer pertinent questions in other fields (for example, to model economic impacts or social outcomes of translation).

Key barriers to translation reported by policymakers, health professionals and service providers include:

- Providing evidence that is not comprehensive, useful or relevant to the target population for policy change.
- Providing evidence drawn from study designs that do not sufficiently incorporate real-world contexts.
- Pitching interventions that are overly expensive, difficult or impractical to implement in real-world settings (4, 17, 18).

Such factors can be overcome by thorough multidisciplinary collaboration, and should be kept in mind prior to and throughout translation. Translation success can be shaped by these considerations, especially where quality systems are in place to ensure that data is fit for purpose, robust and reproducible.

(8-10) Evidence can then be used to develop and refine practical measures and recommendations for translation. Recommendations must be communicated to policymakers and service providers in a clear and targeted manner, and should directly address the goals and interests of the target audience. Knowledge brokers and education experts are needed to develop and disseminate targeted communication materials to different stakeholders.

(11-12) After translation, outcome impacts should be evaluated to determine success and ensure sustainability of implemented initiatives. The process and progress milestones of translation should also be measured and evaluated using appropriate metrics. New research projects or reviews such as Cochrane Reviews may be needed to evaluate the community impact of translation. In combination with these, process assessments inform on emerging opportunities for improvement.

Important next-step partners and stakeholders

Understanding, addressing and managing the goals and requirements of stakeholders is vital throughout translation (19). This is currently a challenge, as the personnel and funding required to carry out extensive stakeholder engagement in public health are limited in many research bodies.
Multiple levels of government may be engaged in public health translation. Since public health benefits are delivered by "little p" policies, a range of organisations may also be important stakeholders.

Many next-step partners able to facilitate translation are involved in policy change. This includes governments, policymakers, political advisors, funders, translation centres, insurers, industry groups and experts from a number of disciplines. In addition, changing public health policy involves working with a wider range of stakeholders including researchers, communities, cultural groups, health service providers and industry.

Key stakeholders and next-step partners may change as the translation pathway progresses. Common stakeholders are shown in Figure 8. How should these stakeholders be brought together and consistently engaged throughout translation?

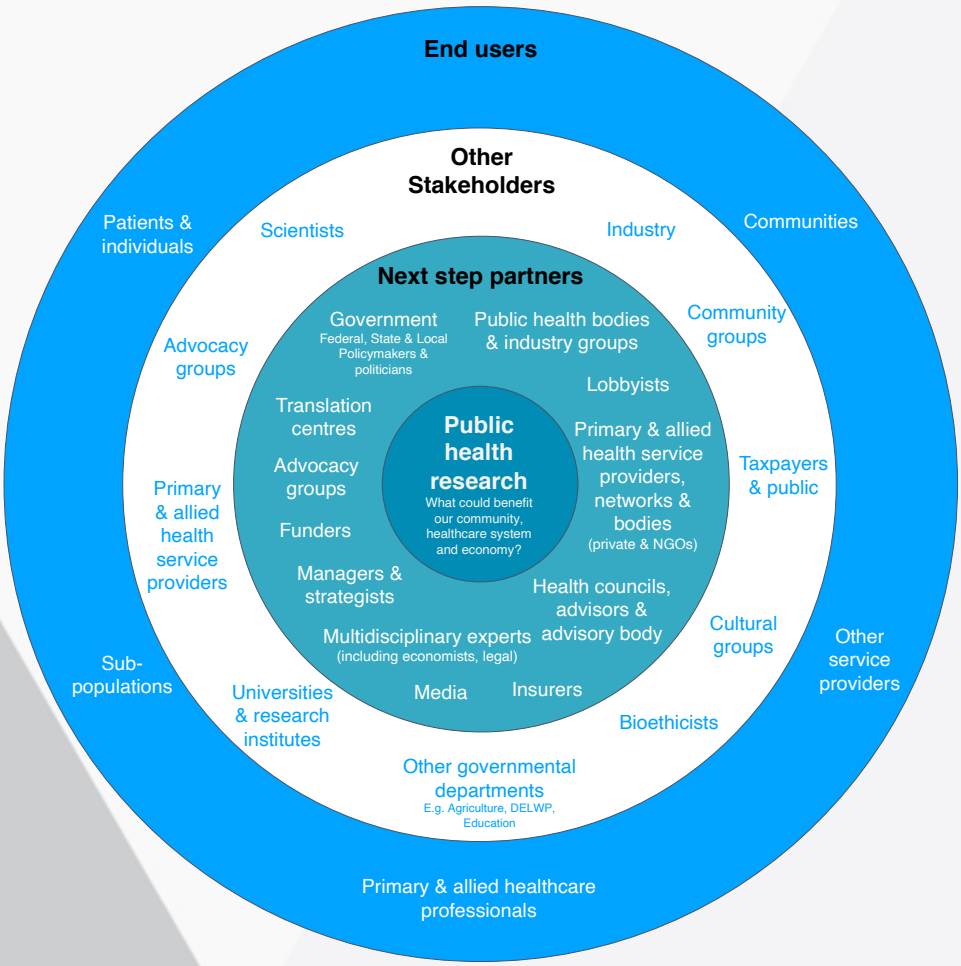


Figure 8: Common and important next-step partners, end-users and other stakeholders who may be involved in the translation of public health research.

Stakeholder analysis should be carried out before translation begins. Once translators understand who key stakeholders and next-step partners are, they should engage them from the start of translation and allow them to guide and shape processes to ensure policy is relevant, effective and implementable.

Key questions for engaging next-step partners, end-users and other stakeholders include:

Translating research into public health services

What does successful translation look like?

Like in public health policy, there is a wealth of existing information that could improve health services if translated effectively and systematically. This may be achieved using processes outlined above, but is also subject to various shared challenges such as funding, lack of leadership and lack of management.

The aim of translating health service research is to establish or improve high quality health services at organisational, local, state and federal levels. Health services are diverse and include health monitoring and surveillance programs, disease screening services, behavioural change and health promotion programs, disease treatment or prevention programs, mental health services, and welfare services.

Services differ substantially depending on the health issue they target and the resources involved. For example, breast cancer screening can be delivered in mobile screening facilities, bowel cancer screening tests are sent in the mail, and more recently, COVID-19 screening has been carried out in makeshift drive-through testing sites in Bunnings car parks!

While "successful" service delivery comes in many forms, key stakeholders will broadly focus on goals including:

- Improvement of current services;
- Improvement of health outcomes;
- Economic savings;
- Career benefits; and
- Public approval.

Translators should identify and address stakeholder goals and interests throughout translation, and target messages and information accordingly. Systems and infrastructure should also be built to facilitate translation.

Important next-step partners and stakeholders

Translating public health research to service provision involves a wide range of next-step partners, end-users and other key stakeholders, who may change during the translation process. Research institutes and supporting bodies can help build capacity to allow translators to engage with next-step partners and key stakeholders throughout the duration of a translation project.

Different public health services have varied delivery methods, personnel requirements, organisational involvement and costs. As such, it is important that translators "begin with the end in mind" and carefully consider who may be involved during every step of the project.

As service provision may involve significant upfront costs, health economists, business strategists and potential investors or capital sources should be identified and engaged throughout translation.

Translation is complex and evolving, and remains challenging for all key stakeholders.

While translational pathways provide a conceptual roadmap to success, they are not often followed in public health research. Incorporation of evidence into policy and services remains challenging, as required systems, infrastructure and resources to translate non-commercial scientific measures are not consistently provided by research institutes, universities, supporting bodies or target organisations (18). As there is little financial gain from public health translation for investors, it is not clear who should develop such capacity. However, it is crucial that skilled leaders emerge in this space, since effective translation can result in huge social and community benefits.

By developing and examining translation pathways, challenging areas can be discovered and factors contributing to these identified (e.g. lack of capital, resources, capacity or networks). These challenges can then be strategically addressed to improve and streamline processes, ensure that barriers are dismantled and to work towards successful translation.

Recently, COVID-19 has provided an example of how research and policy can work in driving behaviour change, bringing together cross-discipline and departmental collaboration with the collective aim of delivering community benefits from multiple angles. This emergency has also provided a real-time example for communities on the importance of research and translation across the four broad areas of research and how they each contribute to a safer community and the economy.

From community education, sharing data, science informing policy, strategic funding, regulatory changes, 'One Health', new potential innovations (diagnostics, drugs and vaccines) and more, research is playing a leading role. From adversity comes opportunity, and it will be important to learn, harness and apply the lessons - good, bad and ugly - from this pandemic.

The following section explores some key translational challenges and opportunities.

Translational challenges and opportunities

Many factors can hinder public health translation progress. These may vary between projects, but some common translation challenges include:

- Costs and resource requirements for service delivery and improvement.
- Improper management throughout the translation process.
- Inadequate multidisciplinary collaboration or engagement of stakeholders and end-users.
- Inadequate communication and collaboration between researchers and policymakers.
- Recommendations which are not practical and scalable, or do not address or align with underlying political contexts and aims.
- Lack of encouragement or facilitation of translation built into grants and funding structures.
- Governmental and academic research cultures which do not encourage or facilitate translational activities.

While the factors above do not provide an exhaustive list, these are some of the key challenges reported by those involved in different aspects of research translation (4, 17-19).

Capital and resources for translation

Health services often require technology, infrastructure, diagnostics, medications, or other resources, with many costs involved. Funding for resources and infrastructure should be discussed prior to translation and could be built into recommendations developed when striving for policy change. Clear cost benefits and practical means for service delivery should be included within disseminated recommendations, reports and educational materials.

Next-step partners able to provide the required capital may be consulted and engaged throughout the project to ensure that they maintain interest as translation progresses. Collecting and disseminating evidence that evaluates business or economic implications of translation is essential. A common downfall in translation efforts is the lack of economic data or practical feasibility of recommended measures (18).

Researchers and consortium members should not underestimate the importance of economic considerations when developing recommendations for translation. Health economists and expert analysts should be engaged to ensure that recommended measures are practical and implementable within the societal or institutional frameworks for which changes are intended.

Connecting research silos

Prior to and during translation, collaboration should occur between researchers of varying fields and key experts including clinicians, health economists, epidemiologists, demographers, social scientists, managers, etc. In addition, end-user input and validation should be included **at every step**. Coordinated multidisciplinary collaboration may be achieved through the formation of a consortium which works together to achieve translational goals. However, it currently remains unclear whose responsibility it is to establish or fund such consortiums.

Throughout their careers, researchers often strive to obtain a deep and complex understanding of specific issues within their discipline. Science can benefit from this intricate expertise, with field-specific researchers working together to identify and address specific research questions.

However, while this siloed approach to research is encouraged within biomedical research, it is not practical for translating public health science into real-world settings, where many different biological, social, political and economic factors determine the applicability and success of an intervention. The challenge is therefore to connect silos and encourage the collaboration required for translation.

Silos are intrinsic to scientific research. Rather than "breaking down" silos, how can they be effectively connected?

Multidisciplinary collaborations help identify and promptly address important barriers and opportunities during translation. For example, a novel disease prevention programme supported by public health research could be suggested to have poor uptake in the target population by social science evidence.

Connecting silos to encourage multidisciplinary translation could lead to many benefits including, but not limited to:

- Increased access to relevant, high-quality, robust, reproducible and useful data.
- Sharing of resources and infrastructure.
- A more comprehensive and multidisciplinary understanding of pertinent issues or gaps in policies/services relating to the field of interest.
- A better understanding of pertinent issues outside of the healthcare field such as cost-analysis information and economic impacts.
- Identification of unexpected or inventive solutions which incorporate expertise from different fields.
- Evaluation of demographic context and assessment of whether data is transferrable or fit-for-purpose.
- A better understanding of the practicality of suggested solutions, for example through end-user validation.
- Evaluation of social contexts and whether social factors influence the problems being addressed through translation or impact the effectiveness of proposed solutions.

Multidisciplinary research also presents challenges that must be overcome to ensure effective and beneficial collaboration. Examples of these challenges include:

- Collaborators from varying fields may have different and conflicting aims, interests, opinions or motivations.
- Clear and effective communication between collaborators and stakeholders whose specialties lie in different fields may present a challenge.
- Egos may be large, and hierarchical issues among stakeholders may arise throughout the collaborative process.
- When many collaborators are involved, a lacking sense of ownership or recognition may cause contributors to become disengaged or disenfranchised.
- Multidisciplinary research may be costly and time-consuming, so sufficient capital must be secured throughout the duration of the project.

Challenges from multidisciplinary work can be detrimental for translation, however, most could be effectively managed by maintaining strong governance throughout the translation process.

Who should manage and lead multidisciplinary translation?

Effective back-and-forth communication between researchers, clinicians and health care professionals is challenging. This is primarily due to practical complexities, such as connecting health care and research facilities and lack of time and resources.

Efforts to move towards a system where universities, research institutes, hospitals and service providers are more interlinked have been made. When considering the opportunities provided by technologies including collaboration tools, data sharing and artificial intelligence, how may such collaborative relationships look in the future? What might be required to achieve this?

Communicating with policymakers

Effective communication, collaboration and understanding between scientists and policymakers is complex and often challenging (18). Political goals and contexts should be a central consideration throughout translation, when shaping research questions, collecting evidence and developing guidelines and recommendations (19).

It is not controversial to claim that effective and efficient public health policies are evidence-based; however, there is significant room for improvement to achieve timely incorporation of scientific evidence into health policy. Governance of Australia's health system is complex, presenting challenges when translating public health evidence into policy. An intricate understanding of governance

structures is required to efficiently and effectively change health policy, and multiple networks may need to be engaged to achieve objectives.

How can the communicative divide between scientists and policymakers be systematically addressed?

Conversely, research institutions are often shrouded in multiple levels of academic hierarchy and tradition. Because of this, routes to establish meaningful relationships and collaborations with researchers are often not intuitive to those working outside of academic settings.

Policymakers must inform scientists

While researchers may be tempted to value their science above all else, scientific evidence must be considered alongside complex political goals and contexts when translating research into policy (4). Politicians and policymakers may be hesitant to implement or fund evidence-based policies and services if they are controversial, outside of political and public aims, or that are not expected to provide economic benefits. Policymakers and politicians should actively communicate with the scientific community to clearly state their current goals and focuses, and should seek guidance from the scientific community when developing future goals and focuses.

For translation, researchers and consortium members must understand the political framework they work within, as well as the focuses and goals of policymakers and politicians from the beginning and through every stage of translation. In addition, political, social or tradition-based factors that may influence translation processes should be clearly expressed and planned for. This may be done directly, or may be indirectly facilitated via knowledge brokers. **Significant opportunities exist to develop networks or infrastructure to facilitate cross-field communication.**

Scientists must inform policymakers

Health policy must incorporate comprehensive evidence from varied and highly specialised fields. While policymakers may hold a fantastic general understanding of medical or public health issues, they often lack the intricate understandings held by researchers. Efforts must be made to ensure that the best scientific evidence is made available outside of scientific circles.

Currently, scientific evidence dissemination occurs via the publication of papers in scientific journals. This means that accessing the most up-to-date evidence is exclusive and relies on an expert understanding of the topic. Language used in scientific papers infrequently allows the non-scientist to understand the limitations, practical applications or wider implications of a finding. Reliance of this method of knowledge dissemination has not proven a successful driver of translation (5).

The communication of science should not stop at the scientific journal, but should also be communicated effectively and appropriately to other stakeholders such as policymakers and end-users. Communicators should ensure information is accurate, understandable and balanced.

Information provided to encourage translation should be targeted to the stakeholder's interests and goals; for example, policymakers may be more interested in the economic impacts of policy change than other stakeholders such as advocacy groups or end-users.

While press releases and media campaigns may generate interest or increase awareness of research findings, they are not adequate stand-alone mediums for science communication.

Who should be responsible for creating and funding such specialised and time-intensive communicative roles?

Bridging the gap

By fostering strong relationships and lines of communication between researchers and policymakers, translation efforts may be increased and streamlined. Working within political contexts, it is inevitable that science will become politicised and goalposts will move with elections, changing ministers or shifts in public opinion. While this presents a real and significant challenge, active communication between researchers and policymakers may help both parties work towards the implementation of evidence-based policy.

While measures such as Science and Technology Australia's annual Science Meets Parliament event provide networking opportunities between researchers, policymakers and advocate groups, **strong and sustained working relationships are crucial for translation success in many cases** (5).

The COVID-19 emergency is an example of what can be done. The Rapid Response Information Forum in the Office of the Chief Scientist is an example of science influencing policy, as well as science responding to policy needs.

Reliance on direct and efficient communication between researchers and policymakers is an unlikely ongoing solution, due to constraints from high workloads and varied specialised knowledge and skillsets. Both parties may often be time-poor and building strong ongoing working relationships takes substantial time and effort.

While researchers should strive to be effective and collaborative scientists, it is not reasonable to expect them to also act as skilled media strategists, policy experts, political networkers or lobbyists. As such, administrative bodies that surround and support the researcher, and which facilitate communication between researchers and policymakers are sorely needed.

Recently established translation centres can act as an interface between researchers, healthcare delivery and policymakers. These centres strive to bring key stakeholders and next-step partners together to drive translation and govern the translation process. However, such centres are new and their strategies and operational procedures are still being developed. In addition, these facilities have not yet been incorporated in many research institutions and may be limited in their scope.

Management and oversight of large-scale, multidisciplinary translational projects is a complex and challenging task which requires a wide skillset. Specialised qualifications in translational science are emerging but not yet widely available. **Who is suitably trained to fill specialised roles in translation centres and similar facilities?**

Positive changes have occurred in this space, but critical questions remain:

How can we bridge such communicative divides efficiently, effectively and systematically?

Who is responsible for implementing and funding roles which help to bridge the communicative divide?

Training requirements involved in translation

In translation, changes in service delivery may be built into policy through the development of rules, guidelines, strategies or funding schemes. Shifts in service provision require extensive training and education. The effective incorporation of evidence into health workforce education frameworks can present challenges and must be approached in a targeted manner.

During translation, audience-appropriate educational materials should be developed and disseminated to service providers and health care professionals. These should inform the audience of research findings, and how to implement evidence-based practices into service provision. Such materials should consider the goals and motivations of service providers and health care professionals, and address these to encourage interest and uptake.

As some academics and researchers are highly skilled in education, this may be an activity well-suited to such professionals. Alternatively, specialised health educators or learning designers may be required. The need for such professionals may be a consideration early in translation, when forming a consortium and securing funding.

In addition, if translators have effectively engaged with stakeholders and end-users, these associates may become effective knowledge disseminators and educators, spreading findings, recommendations and educational materials within their professional or personal circles. This strategy can also be built into formal translation plans and agreements, and may be an efficient and cost-effective way to generate support, drive change and facilitate translation of evidence into policy, practice and education.

PART 3

CONSIDERATIONS FOR THE SCALABILITY AND SUSTAINABILITY OF TRANSLATION

Evaluating translational projects for improved outcomes

Evaluating project outcomes and processes informs future translation projects. Strategic evaluation promotes successful translation, and helps identify and address ineffective practices (22).

If a translational project fails to meet its expected outcomes, is that attributable to the project's feasibility or effectiveness, or is it a result of inadequate project process implementation?

Evaluation of translation often requires conducting an additional research project, such as a systematic review and meta-analysis to summarise evidence. These reviews, such as Cochrane reviews, inform on the efficacy and success of project **outcomes**. For instance, evaluation could quantify how effective a surgical technique is compared to the standard of care, or how much quality of life was influenced by a health promotion policy (23).

We must not only focus on the effectiveness of translational project outcomes, but on the effectiveness of project processes.

Outcome evaluations assess the effectiveness of a program in creating **change**. They focus on finding if and how well the initial objectives of a project were met, and help stakeholders understand if impact was achieved.

Measuring impact from medical research translation normally focuses on project outcomes and is done retrospectively. This strategy adequately informs on success of translation pathways from biomedical science towards innovation. Clinical trials are highly regulated and researchers must adhere to rigorous frameworks and policies developed to ensure the robustness and validity of results. If a novel medication, diagnostic or device does not perform better than the current standard of care after undergoing clinical trial standards, the evaluation of success based on outcomes is appropriate.

However, in clinical medical science and public health translation, outcome evaluations are inefficient for assessing **how** impact was achieved. For example, outcome evaluation questions for a smoking cessation initiative could include:

- Did the program succeed in reducing the number of active smokers?
- Were program outcomes different between different groups of people?
- What elements of the program were identified by participants as most beneficial?

If the **process** of translation is not documented and progress periodically reviewed, how the project achieved impact cannot be inferred. For the implementation of public health policy programmes, or incorporation of medical science research in clinical practice, robust and well-defined experimental

designs – such as clinical trials – are not consistently applied when processes vary and outcomes are used as isolated metrics for evaluating success (24).

Through process evaluations, stakeholders can measure the need for planning, who will benefit, the resources needed, milestones achieved, practical problems encountered and how these problems were resolved.

Process evaluations for a smoking cessation community initiative could include:

- What type of interventions enforced during implementation best addressed smoking cessation? If the intervention worked – how and why?
- What were the types of challenges encountered during project delivery? Were these well managed?
- Were stakeholders and key players educated to the level required by the project design? Did any additional skills facilitate program implementation more than others from beginning to end? Was there adequate support for the development of these skills during translation?

Process evaluation plays an important role in understanding how complex interventions were implemented. Despite awareness of how important it is to assess processes, significant room for improvement remains for its widespread use. Process metrics can help highlight system requirements, including capacity building or professional policies that support the translation pathways. Without it, contextual factors that may impact translation are missed, and cannot be used to inform and improve future projects.

Assessing project outcomes without evaluating how they were achieved fails to account for contextual factors involved in getting to good outcomes

Importantly, process evaluation provides a comprehensive picture of how impact was achieved, and how it could be replicated in differing scenarios. If used, the true economic cost of translation would become clearer, as financial evaluations could inform how to better invest in general operating and infrastructure support.

Evaluations highly motivate individual accountability (23, 24). Researchers are not the intended end recipients of grants or philanthropy, but are rather entrusted to undertake research for potential community benefit. Process evaluations help demonstrate value, build public trust and ensure that research translation benefits delivered by researchers and their organisations are tangible and real.

Conducting evaluations throughout translation enables stakeholders to learn, innovate and improve processes to make sure plans align with the translation purpose and end-user needs. However, it is important that translation teams have the time, resources and capacity to implement evaluation systems and structures. Without these, evaluation processes can become time-consuming and burdensome, negatively affecting translation.

Creating rewards systems that support translation

Reward systems have a significant impact on individual performance, as rewards provide the means to recognise an individual's competence, achievement and merit (16). Thus, reward practices are able to influence physical and mental behaviours. Since behaviours are able to transform the performance of individuals from ideas to actions, reward systems also act as good predictors for performance. However, traditional reward systems are underpinned by the desire to publish above all else. Changes are needed to shift the focus towards translation.

Reward structures - such as high-level publications for researchers; peer recognition, promotion and monetary incentives for health professionals; or investment returns after the commercialisation of a new medication - make an impact on culture and performance through increased motivation and engagement.

How can reward systems become purpose-oriented and measure community benefit as success?

Changes in the way rewards are measured in academia and philanthropy can help overcome challenges in translation.

Reward systems can:
(1) Significantly contribute to the creation and adequate maintenance of high-performance professional cultures, and
(2) Help influence and retain talented individuals as part of a professional community.

Examples of reward system modifications to aid translation include:

- Evaluating translational impact, community health benefit and social return of projects as part of the process for awarding and continuing research grants.
- Assessing how the skills and experience of non-scientific individuals can be harnessed to facilitate translation.
- Measuring the extent to which the intended recipient or end-user of research is projected to benefit from an investment in a research project.

Using academia as an example, it is clear that researchers cannot progress professionally without high numbers of publications, since publications allow them to secure funding and create collaborations. This pressure to publish has slowly decreased research quality and has contributed to a reproducibility crisis.

In health research, reproducibility means that results or conclusions obtained by a scientist, computationally or experimentally, can be replicated by others in the field if published methods are

adhered to. For the past ten years, awareness of irreproducibility has encouraged researchers to provide more detailed methodologies in publications, increase their statistical literacy, and use facilities that adhere to experimental gold-standards.

The need for continuity of publications and grants is also a leading factor in discriminating against scientists that may have had absences from academic research for reasons such as illness, working in industry, or parental leave.

Traditional reward systems underpinned by the desire to publish, and not on translation, are flawed if the intent is to deliver community benefits. Building reward systems that deliver recognition through feedback and provide opportunities for skill development would be beneficial. Changed reward systems should regard non-financial rewards as highly as financial revenue, and ensure that capital invested in translation results in community impact and benefit.

How can key fundamental changes in reward structures be encouraged and achieved?

Strong relationships and strong governance

Translation is a team effort, involving multidisciplinary experts, next-step partners, end-users and other stakeholders. The way that stakeholders are engaged and relationships are built throughout the translation pathway can make or break translation efforts (18). While the appointment of skilled leaders is a key factor for success in translation, it is seldom clear whose responsibility it is to fill such roles, and oftentimes researchers are left to take on this task.

Considering the highly specialised and demanding role of researchers, is it reasonable to expect them to also lead translation?

Many individuals and organisations may be involved at different stages of the pathway, so translation requires personnel skilled in collaboration, engagement and time management. Leading a multidisciplinary team and engaging many stakeholders can present challenges, as moments of conflict, confusion and inefficiency are almost inevitable. Early on in the process, each party should be made aware of their responsibilities and expectations so that the project is carried out comprehensively and efficiently.

When appointed to oversee translation, successful managers can:

- Work with all collaborators and stakeholders to define a clear set of aims and expectations.
- Develop formal agreements to deal with issues such as responsibilities, accountabilities, compensation and intellectual property.

- Identify the goals and rewards that motivate individuals working within the team, and identify ways to maintain ownership, drive and satisfaction for each individual.
- Facilitate communication between collaborators, stakeholders and next-step partners.
- Identify which collaborators, stakeholders and next-step partners are relevant at different stages of translation.
- Resolve interpersonal conflicts or issues arising throughout the project.
- Ensure the project is on schedule, on budget and on track to achieve the established goals.

Individuals with appropriate leadership, project management and communication skills, who have experience managing a multidisciplinary team and working with wide-ranging stakeholders and next-step partners, including politicians, policymakers, industry and the health workforce are needed to deliver these benefits.

At present, there is a critical need for leadership and resources for translation, to help oversee processes and build the networks, resources and capacity needed for impact.

Impactful giving and the importance of measuring success

Funding can drive translation

Interest in funding translation has increased, with the NHMRC, MRFF and other foundations placing greater emphasis on the value of delivering community benefits. While this is a step in the right direction, many funders and charities are legally required to provide grants solely for research purposes. Considering that translation is lacking despite the vast body of research in clinical medical science, public health science and translational science fields, **solely funding research is not enough to drive translation.**

Translation requires strong leadership and management to build networks, secure resources and increase capacity outside of the research field. The infrastructure and personnel needed to carry out important translation tasks auxiliary to research are frequently insufficient or do not currently exist at the vast majority of universities and research institutes. If funding for these auxiliary tasks cannot be supplied via grants, who will fund such activities? And even if funding was available, who should it be directed toward? These questions present a principle challenge for many funders.

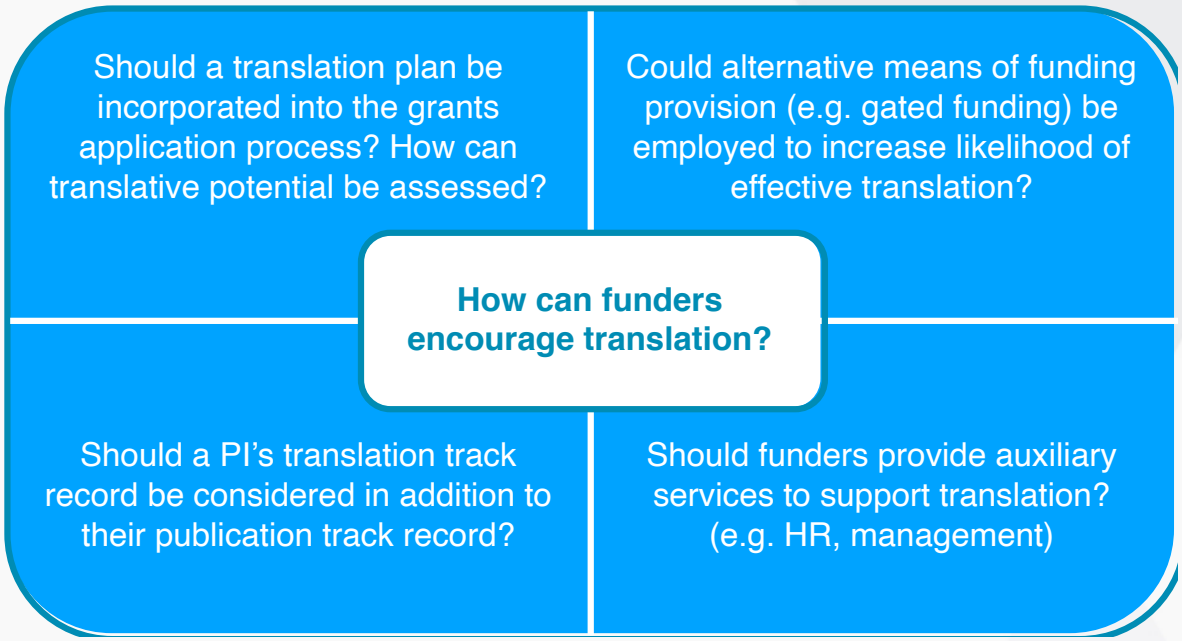
There is a critical need for organisations to systematically support translation. They must establish translation facilitator or manager roles and provide the required teams and resources. A dedicated and skilled translation body will have the potential to markedly improve efficiency and frequency of public health and clinical medical science translation.

Could funders establish expertise, resources and capacity to actively take on the role of managing translation?

As it is not currently commonplace for funders to fill this role, it is generally assumed to be undertaken by the researcher and their institution. Given that many charities and funders are limited in their ability to provide grants to support such roles in research institutes, alternative means of capital provision must be considered.

It is encouraging to see that the NHMRC, MRFF and many other foundations have been increasingly incorporating translation-relevant considerations into grants in recent years. However, many opportunities exist to improve grant application processes and funding structures to further drive translation.

While funders may attempt to encourage translation through a number of approaches, little focus has been placed on empirically evaluating the effects of each approach. More work is needed to identify how funding schemes and processes could be further adapted to ensure giving is purpose-driven, minimises waste, is impactful and facilitates translation (6).



Understanding where money needs to be strategically spent for successful research translation is equally as important as securing capital for the translation pipeline, which is likely to change from project to project. Funders have the opportunity to increase the impact of provided grants by working with next-step partners, end users and translators to identify areas of need, and providing advice on how to direct funds.

Funding can sustain translational outcomes

Practices or services that result from translation may be associated with considerable ongoing costs. In such cases, it is essential that reliable funding sources are identified during translation to ensure delivery is scalable and sustainable.

Where services or practices have the potential to result in social benefits and long-term cost-savings, Social Impact Bonds (SIBs) may provide an alternative funding source for NGOs as their popularity grows in Australia. These are funds provided by investors with the aim of creating social benefit. SIB investors will only be paid a return if projects achieve measurable social benefits. Returns are provided to investors by governments, and are partially generated via governmental cost savings resulting from translation.

As mentioned above, it is crucial that project success, both in terms of process implementation and outcomes, is evaluated via appropriate metrics (21). This will help to justify sustained funding for health services and programmes, as it ensures ongoing community benefit. Evaluations can also identify areas for improvement, such as how to streamline service delivery and increase efficiency.

By measuring success, those overseeing projects can ensure that funds are directed towards their intended recipients and community benefits are consistently delivered.

CONCLUDING REMARKS

Translating research puts evidence into practice, delivering benefits to the community. However, scientific evidence alone is not enough to achieve translation as it is sometimes not relevant to target populations, is not drawn from studies that incorporate real-world contexts or may not be feasible to implement in the community. Translation also requires systematic support including non-scientific expertise, skills and resources that are mostly missing.

Despite a large and growing body of data in public health and clinical medical research fields, timely incorporation of evidence into policy, practice, service provision and healthcare education is a consistent challenge. This is partly due to the complexity of translation, which requires strategic collaboration with scientific and non-scientific stakeholders who offer the necessary resources, networks, capability and capacity for translation. As stakeholders are many and varied, definitions of translative "success" may vary between parties. Defining goals is therefore critical for meaningful impact.

Successful collaborations between researchers, clinicians, community advocates, government and end-users drive improvements in both translation processes and community impact. The translation of clinical medical research informs and improves clinical practice guidelines in the health workforce, such as techniques, diagnosis and treatment regimes. Public health research, on the other hand, has the potential to provide community benefits through implementation of evidence-based health policy and services.

Defined pathways for translation serve as tools for identifying challenges and opportunities in translational projects, and allow for strategic planning of translation. The pathway from biomedical research towards innovation is well established and has been used by NFMRI to provide strategic funding to address translational barriers. However, in research areas where translation is not closely interlinked with commercialisation, frameworks remain poorly defined. This lack of structure hinders the systematic identification of translational processes and challenges.

Within this report, conceptual translational pathways have been provided for the public health and clinical medical science fields based on existing literature and multidisciplinary expert advice. These pathways provide a framework towards success, but are challenging to implement due to a lacking availability of infrastructure, funds and managing bodies required to build and manage necessary collaborations and resources.

Identifying challenges and opportunities associated with each pathway informs on the key structures, policies and processes that must be considered when planning translation. For instance, healthcare governance, legislative jurisdictions or available resources may be important considerations. Equally as important is evaluating the processes used for implementing projects to understand if and how success was achieved. Unlike the commonly used outcome evaluation metrics, process metrics inform on the contextual factors involved in change and how results could be replicated in other similar

complex scenarios. In addition, evaluation promotes stakeholder accountability, which improves transparency and efficiency during translation.

Translation is complex and therefore requires strong management and coordination. While technology transfer offices exist for the commercialisation of basic science innovations, dedicated translation teams for fields outside of basic science are not common in research institutions. Consequently, translation management responsibilities often default to researchers. However, researchers may not have adequate time, training or resources to lead and oversee these complex and multidisciplinary translation projects which often incorporate both scientific and non-scientific components. Without effective and strategic management, carrying out translation is difficult.

Therefore, there is a critical need for leaders within the research space to take on a leading role as a translation manager, to develop and oversee translation projects through to completion. A specialised managing body is needed to ensure efficiency and overcome the challenges involved in translation. Such bodies would be instrumental in effectively planning translational tasks and facilitating multidisciplinary collaboration. They could also help to secure funds and resources for costly projects which provide social, but not necessarily monetary, returns on investment. Ideally, these bodies would ensure pertinent practical needs associated with translation or identified by stakeholders are addressed, helping to secure translative success and sustained positive change.

Funders have the opportunity to drive translation via funding structures and grants application processes that help to build translative capacity. However, solely funding research is not sufficient for driving translation; translation requires strong leadership, as well as resources for building capacity outside of the research field. The best body to drive clinical medical science and public health translation remains unclear. However, funders may take the opportunity to diverge from a role that focuses solely on fund provision, and instead build up the staff and capacity to proactively lead translation within their organisations.

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