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Understanding the Relationship Between Health Technology Reassessment and Knowledge Translation

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Understanding the Relationship Between Health Technology Reassessment and Knowledge Translation

by

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Abstract

Until now, it was not well understood how the field of Knowledge Translation (KT) would be applicable to Health Technology Reassessment (HTR). This thesis reports on three studies to determine how KT approaches are used to translate HTR outputs to achieve the desired outcomes.

The first study was a scoping review of full-spectrum (phases of planning/design, evaluation, implementation, sustainability/scalability) KT Theories, Models, Frameworks (KT TMFs). Thirty-six KT TMFs were identified and categorized according to five approaches: process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks. It provided a starting point for the selection of KT TMFs for HTR.

The second study employed a modified Delphi process and expert survey to review the 36 full-spectrum KT TMFs and determined which may be suitable for HTR. The three-round modified Delphi process resulted in 16 KT TMFs. Twenty-two international experts (11 KT and 11 HTR) were surveyed. None of the 16 KT TMFs reached ≥ 70% agreement when ratings of "yes" were considered. However when ratings of "yes" and "partially yes" were combined, the Consolidated Framework for Implementation Research (CFIR) was considered the most suitable by both KT and HTR experts (86%). One additional KT TMF was selected by KT experts: the Knowledge-to-Action framework. HTR experts selected two additional KT TMFs: the co-KT framework and the Plan-Do-Study-Act cycle.

The third study involved 13 one-to-one semi-structured interviews on characteristics of KT TMFs that were important to consider for the HTR outputs of decreased use or de-adoption of a technology. Four foundational principles, three levers of change, and five steps for knowledge to action emerged as KT TMF traits for HTR. From the KT TMFs that were mapped onto the characteristics, CFIR had the most characteristics (11/12) missing only the ability to map to the micro, meso, macro levels.

This is the first body of work that examines the relationship between HTR and KT. The findings offer guidance to users on the application of KT TMFs to the HTR process and implementation of its outputs. Practical use of these KT TMFs to the HTR process will provide further advancement in this area.

Preface

This body of work includes two publications and two manuscripts that are currently under review. For each of the papers, Rosmin Esmail conceived and designed the studies, conducted the studies, collected and analyzed the data, interpreted the data and drafted the manuscripts. Manuscript one, three and four were conducted with guidance from her thesis committee (Drs. Fiona Clement, Heather Hanson, Jayna Holroyd-Leduc, and Daniel Niven). Manuscript two was conducted with guidance from her thesis committee and three additional collaborators, Dr. Sharon Straus, Lisa Strifler and Sage Brown. All authors listed below contributed important intellectual content and provided critical review of the manuscripts. All authors have approved the manuscripts for inclusion in this thesis. Manuscripts number one and two are published under the BMC License Agreement and the Creative Commons License (https://creativecommons.org/licenses/by/4.0/legalcode), wherein authors retain copyright.

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Finally, I would like to thank His Highness, the Aga Khan…who has taught me that "it is not what you achieve but what you have enabled others to achieve".

Dedication

~ To my extraordinary partner and soul mate, Nurul. You have stood by me through happy and tough times throughout this journey. You have been my rock. ~

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List of Abbreviations

AHRQ-Agency for Healthcare Research and Quality

BeHEMOth-Behaviour of interest; Health context; Exclusions; Models or Theories

CADTH-Canadian Agency for Drugs and Technologies in Health

CBPR-Community-Based Participatory Research

CDC-OPS-Center for Disease Control and Prevention's Obesity Prevention Strategy

CCM-Community to Community Mentoring Model

CFIR-Consolidated Framework for Implementation Research

CHIP-Community Health Improvement Process

CIHR- Canadian Institutes of Health Research

COM-B-Capability, Opportunity, Motivation and Behaviour

COREQ-Consolidated Criteria for Reporting Qualitative Research

DIT-Diffusion of Innovations Theory

EBI-Evidence-based interventions

EDCHIP-Evidence-Driven Community Health Improvement Process

EQUATOR-Enhancing the Quality and Transparency of Health Research

HICM-Healthcare Improvement Collaborative Model

HTA-Health Technology Assessment

HTAi-Health Technology Assessment International

HTR-Health Technology Reassessment

IOR-Interorganizational Relations Theory

KT-Knowledge Translation

KTA-Knowledge-to-Action framework

NCCMT-National Collaborating Center for Methods and Tools

NCHPAD N-KTAS-National Center on Health, Physical Activity and Disability Knowledge, Adaptation, Translation and Scale-up framework

OMRU-Ottawa Model for Research Use

PAPM-Precaution Adoption Process Model

PARiHS- Promoting Action on Research Implementation in Health Services

PDSA-Plan-Do-Study-Act

PEFL-Policy Effectiveness Feasibility Loop

PRECEDE-PROCEED- Predisposing, Reinforcing and Enabling Constructs in Educational Diagnosis and Evaluation. PROCEED-Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development

PRISMA-ScR- Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews

RE-AIM-Reach, Effectiveness, Adoption, Implementation, and Maintenance

RTA-Linking Research to Action framework

SE-Social Ecology Model of Health

SCT-Social Cognitive Theory

SLT-Social Learning Theory

SR-Self-Regulation Theory

TMF-Theory, Model, Framework

TTM-Transtheoretical Model of Behaviour Change

T-CAST- Implementation Theory Comparison and Selection Tool

SONAR-Social Networking App/Action for Resilience

SUS- System Usability Scale

UK-United Kingdom

USA-United States of America

VHA-Veterans Health Administration

WA-Western Australia

WHO-World Health Organization

Epigraph

In keeping with our past traditions, and in response to our present needs, we must to go out and find the best of the world's knowledge—wherever it exists.

But accessing knowledge, is only the first step. The second step—the application of knowledge, is also demanding. Knowledge, after all, can be used well or poorly—for good or evil purposes.

Once we have acquired knowledge, it is important that the ethical guidelines of faith be invoked, helping us apply what we have learned to the highest possible ends. And it is also important that those ends be related to the practical needs of our peoples.

Excerpt of Speech delivered by His Highness, the Aga Khan on June 15, 2006

American University in Cairo

CHAPTER ONE: INTRODUCTION

This chapter has been published as:

Esmail R, Hanson HM, Holroyd-Leduc J, Niven DJ, Clement F. Knowledge translation and health technology reassessment: identifying synergy. *BMC Health Serv Res*. 2018;18:674.

The work described in this chapter provides an introduction to the fields of Knowledge Translation (KT) and Health Technology Reassessment (HTR), and how KT approaches could be applied to HTR. First, HTR and KT terminology, the HTR model, and KT theories, models, and frameworks (TMFs) are described. Second, barriers and facilitators to KT within the HTR context are explored. Third, three examples of the application of KT to HTR at the micro, meso and macro levers are illustrated. The paper posits KT TMFs can be applied to the implementation of HTR outputs at the micro, meso, macro levels. It provides the argument for further dialogue, research, and lays the foundation for this thesis.

1.1 Abstract

Background: Health Technology Reassessment (HTR) is an emerging field that shifts the focus from traditional methods of technology adoption to managing technology throughout its lifecycle. HTR is a mechanism to improve patient care and system efficiency through a reallocation of resources away from low-value care towards interventions and technologies that are high value. To achieve this, the outputs of HTR and its recommendations must be translated into practice. The evolving field of knowledge translation (KT) can provide guidance to improve the uptake of evidence-informed policies and recommendations resulting from the process of HTR. This paper argues how the theories, models and frameworks from KT could advance the HTR process.

Discussion: First, common KT theories, models and frameworks are presented. Second, facilitators and barriers to KT within the context of HTR are summarized from the literature. Facilitators and barriers to KT include ensuring a solid research evidence-base for the technology under reassessment, assessing the climate and context, understanding the social and political context, initiating linkage and exchange, having a structured HTR Process, adequate resources, and understanding the roles of researchers, knowledge users, and stakeholders can enhance knowledge translation of HTR outputs. Third, three case examples at the individual (micro), organizational (meso), and policy (macro) levels are used to illustrate to describe how a KT theory, model or framework could be applied to a HTR project. These case studies show how selecting and applying KT theories, models and frameworks can facilitate the implementation of HTR recommendations.

Conclusion: HTR and KT are synergistic processes that can be used to optimize technology use throughout its lifecycle. We argue that the application of KT theories, models and frameworks, and the assessment of barriers and facilitators to KT can facilitate translation of HTR recommendations into practice.

1.2 Background

Health technology reassessment (HTR) is an emerging field that shifts the focus from traditional methods of technology adoption to managing technology throughout its lifecycle. HTR is defined as "a structured, evidence-based assessment of the clinical, social, ethical, and economic effects of a technology, currently used in the healthcare system, to inform optimal use of that technology in comparison to alternatives" (1-3). Therefore, HTR is a mechanism to improve patient care and system efficiency through a reallocation of resources away from low-value care towards interventions and technologies of a higher value (1, 3-6).

To harness the potential power of HTR to reassess technologies currently in use, the outputs and recommendations must be translated into practice. This 'translational' step of the HTR process is felt to be the most difficult (3). In a recent jurisdictional scan of HTR activities, Leggett et al report that of the 16 organizations that had developed a HTR program, 54% had advisory capabilities with respect to the HTR decision, with less than 5% able to directly implement the decision (2). Methods in knowledge translation (KT) could help to improve the uptake of evidence-informed policies and recommendations that result from a HTR process. In this paper we will argue, how the theories, models and frameworks from KT could advance HTR process. First, common KT theories, models and frameworks are presented. Second, facilitators and barriers to KT within the context of HTR are summarized from the literature. Third, three case studies are illustrated on how selecting and applying KT theories, models and frameworks can facilitate the implementation of HTR recommendations. To our knowledge there are no other

publications on this topic and the arguments presented in this paper provide critical and much needed debate in this area.

1.2.1 Clarifying the Terminology of HTR

Before we begin to understand how KT theories, models and frameworks could advance HTR, it is important to understand the myriad of terms describing the field of HTR. The terminology surrounding HTR is vast; terms including waste, low-value, obsolescence, too much medicine, unnecessary care, overuse, disinvestment, de-adoption and de-implementation have all been used (3, 6). In particular, terms such as disinvestment, de-adoption and de-implementation are used interchangeably with HTR. However, there are important differences among them. Disinvestment, is defined as the process of completely or partially withdrawing healthcare resources from currently funded areas that provide little benefit for their cost (7). Disinvestment can lead to full or partial withdrawal of a technology, contractual variation, restriction, or substitution and employs financial disincentives (5, 8). De-implementation is defined as the process where the use of low-value care is reduced or stopped on a structural basis in a planned process that uses a set of activities, which can include financial disincentives, but also uses other activities such as data feedback, education, and system interventions (8). Finally, de-adoption is defined as the discontinuation or rejection of a clinical practice after it was previously adopted (9). HTR is conceptualized as a process that offers a holistic approach to optimal technology use with disinvestment, de-implementation and de-adoption as possible outputs of the process (3).

1.2.2 Conceptual Model for HTR

Soril et al recently proposed a conceptual model for HTR (3). Briefly, the model has three phases: phase 1-technology selection (identification and prioritization); phase 2-decision (evidence synthesis and policy development); and phase 3-execution (policy implementation, monitoring and evaluation) (3).

Phase 1 involves the identification and prioritization of technologies. Technologies can be identified by clinicians, selected from pre-existing lists of low-value care, through horizon scanning or data driven mechanisms as benchmarking and practice variations (3, 7, 10). Phase 2 consists of a broad evidence synthesis using methods primarily from health technology assessment (HTA) to determine the clinical, economic, ethical and social effects of the technology being reassessed. It also entails a comparison of alternative technologies (3). Subsequently, based on the evidence synthesis and stakeholder input, a policy or practice recommendation is generated. At the end of this phase, there are four potential outputs: an increase in utilization or adoption, a decrease in utilization, no change in utilization, or withdrawing the technology completely (3). Phase 3 entails the implementation of the policy or practice recommendation followed by monitoring and evaluation. At the end of phase 3, the ultimate outcomes of the HTR process are assessed by determining if the change was achieved or not, or remained at status quo. Note, a distinction is being made between the outputs or activities

that are the result of the process in phase 2 and the outcomes or the impact that has occurred as a result of implementing the activities in phase 3.

The model proposed by Soril et al also has two cross-cutting foundational elements that span all three phases: meaningful stakeholder engagement and ongoing knowledge exchange and utilization. Stakeholder engagement involves individuals or groups throughout the HTR process who may be impacted by the decision. Stakeholders can include physicians, nurses, other clinicians, hospital managers, decision makers, government and the public (3). Continuous knowledge exchange is important throughout the HTR process and involves stakeholders in the selection, prioritization, and identification of reassessment topics, the development of research questions, knowledge generation, and interpretation of findings. Both foundational elements are necessary for the successful implementation of HTR recommendations (3). This paper addresses the question how do the outputs in phase 2 of this HTR model translate to the outcomes in phase 3 and can KT play a role here?

1.2.3 Relevant Knowledge Translation Theories, Models and Frameworks

KT is defined as a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of populations, provide more effective health services and products, and strengthen the healthcare system (11). Thus, KT has emerged as a field of medicine that bridges the gap between "what we should be doing" and "what we are actually doing" in practice (12, 13).

There are several KT theories, models, and frameworks that have been summarized in various narrative and scoping reviews. (11, 14-17). Depending on the criteria used, there are between 40 to 60 KT models currently described in the literature (11, 14-17). The most frequently cited models and frameworks are: RE-AIM (reach, efficacy, adoption, implementation and maintenance), translation research continuum or 'T' models also known as bench to bedside models, the Knowledge-to-Action (KTA) framework, the promoting action on research implementation in health services (PARiHS) framework, the evidence-based public health models, stages of progression (rocket model), interactive systems framework for dissemination and implementation, and the UK medical research council framework (17). These KT theories, models, and frameworks all acknowledge the gap between research and its application in practice and policy. They also acknowledge the challenge that exists in bridging this gap. Many provide a process through a description of key components or illustrate diagrammatically how evidence and evidence-based interventions can be applied in practice or policy. However, these KT theories, models, and frameworks often lack details of how to scale up interventions that are shown to be successful, none incorporate cost or cost-effectiveness as a factor in determining if an intervention will be adopted widely and many of these models have yet to be tested (17).

Knowledge translation science theories, models and frameworks can be classified using five categories of theoretical approaches (Table 1.1) (16). These categories classify KT theories, models, and frameworks based on their purpose and approach. The taxonomy provides a concise way to frame and select from the myriad of approaches that are available to the researcher based on the situation. Further, there may also be merit in combining approaches to understand and drive the implementation process. Thus, it may be entirely acceptable to use more than one

theory, model or framework. Moreover, the use of these theories, models and frameworks will depend on the knowledge users themselves (clinicians versus policy makers); their goals, and the level at which the change is being implemented. These levels can be at the individual (micro level), organizational (meso level), or policy (macro level).

Table 1. 1 Five Categories of Theoretical Approaches to Knowledge Translation

Category	Definition	Exemplar Model
Process models	Specify steps in the process of translating research into practice	Ottawa model on research use (18)-six key elements: evidence-based innovation; potential adopters; the practice environment; implementation of interventions; adoption of the innovation; and outcomes resulting from implementation of the innovation. Each element is assessed, monitored and evaluated before, during and after the decision is made to implement an innovation
Determinant frameworks	Classes or domains of determinants that are hypothesized or have been found to influence implementation outcomes	Promoting action on research implementation in health services (PARiHS) (19)-three determinants are evaluated context, evidence and facilitation from low to high to determine how they can impact change
Classic theories	Describe how change occurs without ambitions to actually carry out the change	Rogers' diffusion of innovation theory (9)-theory that explains how a change occurs
Implementation theories	Developed and adapted by researchers for potential use in implementation science to achieve enhanced understanding and explanation of certain aspects of implementation	COM-B – capability, opportunity and motivation framework (16)-these 3 factors explain whether a behavior change will occur
Evaluation frameworks	Provide a structure for evaluating implementation endeavors	RE-AIM (20)-reach, efficacy, adoption, implementation and maintenance are factors to

		evaluate the extent to which implementation has occurred

The field of KT and its application to HTR is currently untouched and underutilized. We argue that KT approaches be used in the HTR process to bridge the gap between the generation of recommendations regarding technology use and their implementation. We posit that the methods in KT are essential to the success of HTR. KT's role within the HTR context is central, driving the entire process as described in Figure 1.1. Subsequently, KT models, theories and frameworks when applied to HTR could be used to move knowledge into practice.

1.3 Barriers and Facilitators to Knowledge Translation within the context of HTR

Prior to applying KT approaches to HTR, understanding the barriers and facilitators to KT within the context of HTR is important initial step. Assessment of these barriers and facilitators need to become common to the practice of HTR. Yet, making this happen remains elusive. To frame this discussion, we have used the World Health Organization's classification of barriers and facilitators (Table 1.2) (11).

HTR involves the evidence synthesis of technologies that are currently used in the system. However, for some technologies, there may be a lack of evidence regarding their effectiveness and/or cost-effectiveness (21, 22). A good evidence base for the identification of potential technologies is essential (3, 23). Alternatively, mechanisms to obtain this evidence through 'evidence generation activities' could be undertaken (7, 21). Additionally, there may be a lack of understanding and expertise of HTR, a lack of methods to identify and prioritize technologies, and a lack of transparent approaches to conduct a HTR (2, 21, 22). Thus, a transparent, structured, evidence-based process for the reassessment of technologies with clear identification

and prioritization criteria is required (3, 7, 10, 23). In addition, the consideration of time, human and financial resources is needed to sustain a viable HTR process (22-24).

Climate and context in which the proposed change is to be implemented manifests itself in HTR through barriers related to a health care provider's attitudes towards the change, the social, and political context. Although providers may have the best intentions to adhere to HTR recommendations, intentions do not automatically equate to behaviour change, particularly if they involve the decreased use or elimination of a technology. Providers may be resistant or reluctant to dismiss technologies (4). There may be a lack of incentives to decrease or remove technologies from the system (25). Psychologically, it is harder to stop something in practice (8). Additionally, providers could succumb to pressure from the patient in providing unnecessary tests or treatments. Facilitators to overcome these barriers include the use of KT strategies such as clinical champions to increase buy-in, and providing knowledge of the net benefit to patients if the technology is removed or decreased (2, 5, 8). Knowledge translation and implementation of HTR recommendations could also be motivated by explicitly stating that the intention is to improve efficiency, patient safety and patient outcomes, rather than cost savings (24). A shared dialogue between providers and patients may also be required (24). Lastly, as part of the KT plan development, providers could be asked from their perspective, what their beliefs, knowledge, skills, experiences, attitudes and motives are with respect to a technology prior to undertaking a HTR (26).

Understanding the social and political context within which a HTR is being undertaken is also key (2, 22-25). There could be public pressure or the need for government to follow another jurisdiction's decision on a particular technology. Political support, collaboration with government, and building relationships are important mitigating factors (2, 5, 23, 24). In addition, policy regulations and restrictions in funding could be the policy change levers used to implement HTR recommendations (3, 8).

A lack of appropriate linkage and exchange with all stakeholders (providers, patients, policy makers and other stakeholders) is another barrier to HTR. Meaningful stakeholder engagement and on-going knowledge exchange have been emphasized as cross-cutting foundational elements of the HTR model (3). Broad and early stakeholder engagement, trusting and respectful relationships, and face-to-face interactions are facilitators to ensure ongoing linkage and exchange. From a provider perspective, strong leadership, the use of clinical champions, and understanding their perceptions is key (2, 5, 23). From the public/patient perspective, the concept of HTR or 'low-value care' may not be well understood (27). Moreover, cost savings as an objective of HTR is also viewed as unfavorable (27). Hence, having public representatives involved in the process to increase their knowledge and understanding, a shared dialogue amongst patients and providers, and framing low-value practices not as a 'waste' resulting from financial costs associated with unnecessary tests and treatments but as 'harm', including physical, emotional and financial harms, are strategies to support linkage and exchange (2, 23, 24, 27, 28). From a policy maker perspective, encouragement of political discussion and raising

awareness before and during implementation (23), coordination, collaboration, and professional understanding would all be important facilitators for ongoing linkage and exchange (5, 24). Researchers involved in HTR may not understand their role within the process. Furthermore, these individuals may lack the necessary skills to communicate and interact with stakeholders. They may also lack knowledge in the use of KT theories, models, and frameworks or skills to facilitate implementation. Capacity building of these individuals in the fields of KT and change management is one way to address this barrier (1). Additionally, understanding KT theories, models, and frameworks and the use of effective and multifaceted KT interventions to implement HTR policy or practice recommendations is needed (1). Researchers, with stakeholder input, could develop a well-planned overall KT strategy that is aligned with the initial goal of the HTR, uses KT approaches, and is tailored to stakeholders to ensure the uptake of HTR recommendations (23, 25).

Stakeholders play a key role in the uptake of HTR evidence. Barriers such as lack of skills and the system's poor capacity to access HTR exist (2, 22, 24). There may also be the absence of strong leadership to undertake a HTR or implement its recommendations within an organization (23). These barriers can be mitigated through capacity building of stakeholders, raising awareness of HTR, and leadership support at all levels (1, 23). The use of change agents or knowledge brokers to bridge the gap between those involved in the HTR process and decision makers could also enhance HTR efforts (12). Knowledge translation and implementation within the health system may not be the problem, but rather it is ensuring that operationalization of the recommendations occurs within a functional decision-making infrastructure (29). Decision-

makers need to understand the HTR process and provide the support and mechanisms to implement its recommendations within the health care system.

As described in table 1.2 there are several barriers and facilitators of KT within the context of HTR. Those that are significant to the implementation of HTR recommendations have been identified in the literature (23). Within the context of HTR, our position is that these are all critical and important to address if the recommendations from the HTR are to be implemented in practice.

1.4 Application of KT to HTR – Three Examples

To better understand how KT theories, models and frameworks could fit within the context of the HTR, we propose three examples to illustrate the process at each of the three different levels within the healthcare system (individual-micro, organizational-meso, and policy-macro levels).

1.4.1 Individual Level – Micro System Example

The overuse of antipsychotics to treat the behaviour and psychological symptoms of dementia in long-term care settings is a major concern (30). With the assistance of the University of Calgary's Health Technology Assessment unit, Alberta Health initiated a HTR (30). Subsequently, a practice recommendation was generated that results in the appropriate use of antipsychotics in long-term care settings. At this micro level, a process KT model could be applied to change this practice at a long-term care setting. The Ottawa model for research use

(OMRU) could be used to assess, monitor and evaluate potential innovations to influence the prescribing patterns of providers. This model is useful to facilitate knowledge translation at the local context and its focus is on the continuity of care intervention which by its very nature is complex bridging sectors, settings and provider groups (18). The model has six key elements: evidence-based innovation; potential adopters; the practice environment; implementation of interventions; adoption of the innovation; and outcomes resulting from implementation of the innovation. KT interventions may include the use of clinical champions, clinical practice guidelines, staff education, monthly inter-professional medication reviews, clinician reminders, care plan reviews, involving family, and audit and feedback (5, 6, 21, 31-33). In addition to this model, a combination of KT theories, models, and frameworks may be beneficial to assess barriers and facilitators to prescribing practices of these medications (16). In this example, prior to selecting interventions, interrogating which behaviour change interventions are effective may be useful. In fact the authors of the OMRU model suggest just that through the concept of 'theoretical pluralism' where other theories, models, frameworks could be applied to components of the model (18). The theoretical domains framework is based on a review of 33 psychological theories and constructs to determine those most relevant to behaviour change (16, 34, 35). Fourteen domains of behaviour change, such as knowledge, skills, intentions, goals, etc. have been mapped to 137 behaviour change techniques. So, if knowledge was identified as a behaviour domain, education and information are behaviour change techniques that could be used to influence the prescribing patterns of providers (35).

1.4.2 Organizational Level – Meso System Example

Primary care networks in Alberta embarked on a HTR to reassess imaging for low back pain (36). A practice recommendation was generated to decrease imaging for patients with low back pain at all primary care practices in the province (28). At this meso level, a modified version of the KTA framework, the synthesis model for the process of de-adoption, could be applied (6). To our knowledge this is the first de-adoption model that has been created and the model may be useful to apply in the de-adoption of imaging for low back pain. This model was developed through the identification of themes common to frameworks from a scoping review on de-adoption and modification of the KTA framework. The de-adoption model focuses on the identification and prioritization of low-value clinical practices with stakeholder engagement and follows the action cycle of the KTA framework to move these low-value practices into action or to reduce their use (6). It is intuitive and easy to understand, however is has yet to be tested in practice. De-adoption change interventions could include information leaflets for patients, provider education, clinical decision support, a reduction toolkit, audit and feedback, and low back pain guideline changes for family physicians. These interventions would be tested, implemented, monitored and evaluated as part of the action phases of the KTA framework (6).

1.4.3 Policy-Level – Macro System Example

The Australian government initiated a review of the policy on in-vitro fertilization (37). At present, Australians are eligible for this subsidy regardless of age and prior treatment. Through the Medical Services Advisory Committee that makes recommendation to the Health Minister on which medical services should be publicly funded, a HTR was undertaken with key stakeholders.

Subsequently, based on deliberative engagements with three key stakeholder groups, a policy recommendation to only publicly fund in-vitro fertilization for women between the ages of 21 and 45 was generated (37). At the macro level, the implementation of this recommendation may require a different KT model to be applied. The Linking Research to Action framework (RTA) is selected as it assesses efforts and provides activities to consider to inform health policy decisions (11). At the policy level, there are other factors that need to be addressed that may be different from the micro and meso levels. This model considers these factors through four elements: climate for research use, production of research and appropriate synthesis for policy makers, linking research to action strategies-push/pull/exchange efforts, and evaluation. The RTA framework could be adapted to assess the climate, including ethical considerations and perspectives of providers/patients; determine the level of research evidence required for policy makers; ascertain strategies to implement the policy, such as funding restrictions, and evaluate the policy post-implementation.

Thus, we contend that the selection of a KT theory, model or framework within the context of HTR will depend on the HTR outputs and the levels at which knowledge needs to be translated (i.e. individual, organizational, policy). These three examples provide suggestions of potential KT theories, models, and frameworks that could be used. None have been applied within the context of HTR, which has been identified as an area for further research (3, 6, 25, 38). Moreover, KT theories, models and frameworks may need to be adapted and utilized early on within the HTR process (6, 26, 39).

1.5 Conclusions

This paper demonstrates the synergy between KT and HTR and the role KT can play in the translation of HTR recommendations. We posit that KT theories, models and frameworks in the implementation of HTR recommendations can be applied to facilitate implementation of HTR outputs at the micro, meso and macro levels. That is, in the HTR conceptual model, KT could facilitate the translation of outputs from phase 2 to the outcomes in phase 3. Research regarding which KT theories, models, and frameworks may be best suited alongside the HTR process is critically needed. Overall, HTR and KT are complimentary processes that could be used to optimize technology use throughout its lifecycle. Let the dialogue begin!

1.6 Research Question

This project will determine how KT approaches are used to translate HTR outputs to achieve the desired outcomes.

1.7 Study Objectives

1. To review and identify KT theories, models, and frameworks (KT TMFs) and approaches for use with HTR and the translation of its outputs in health services.
2. To validate a potential KT model.

1.8 Outline of Thesis Contents

This research project will entail three sequential studies employing a multiple methods design. Each subsequent chapter is a published or submitted manuscript that examines the research question. The second chapter presents a scoping review of full-spectrum (phases of planning/design, evaluation, implementation, sustainability/scalability) KT TMFs. It provides a starting point for the selection of KT TMFs for HTR. The third chapter presents a study that employs a modified Delphi process and expert survey to review the full-spectrum KT TMFs and determine which may be suitable for HTR. The fourth chapter presents a study that involves one-to-one semi-structured interviews on characteristics of KT TMFs important to consider for the HTR outputs of decreased use or de-adoption of a technology. Chapter five provides a summary of the key findings from these three studies, strengths and limitations of this work, how to translate these findings, and implications for future research.

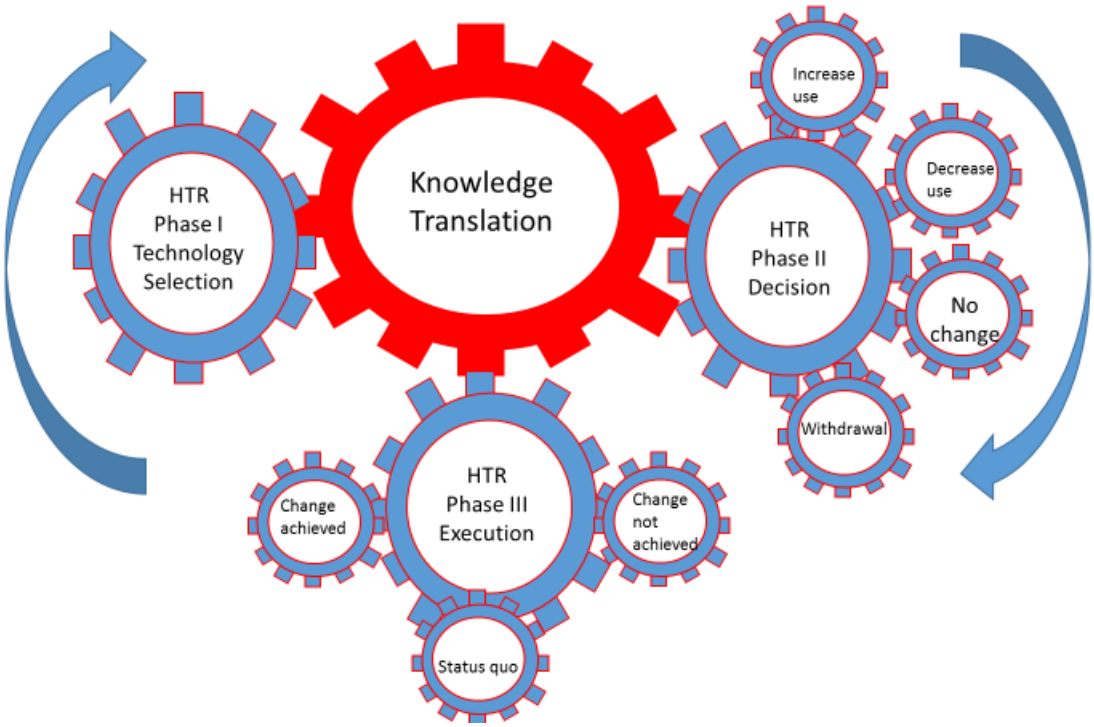
Table 1. 2 Barriers and Facilitators to HTR, Disinvestment, De-implementation, De-adoption*(Barriers specific to implementation of HTR recommendations)

Modified WHO Classification (11)	Sub-Categories	Barriers	Facilitators
Climate and Context Individual's negative attitudes, overall sense of political will, and openness to research	**Health Care Providers**	Physicians are reluctant to dismiss outmoded devices and procedures (4) Lack of incentives to decrease or remove technologies (25)	Use of clinical champions (5) Involve clinicians to increase buy-in(2) Address perceived net benefit to patients (8)
	Patients/Public	Removal of technologies and procedures may cause concern for health professionals and patients who will view the exercise as a reduction of available health services (25)	Shared dialogue (24)
	Political/Social/ Decision makers	Political and social barriers/push back (2, 22, 25) Absence of political drive (24) Lack of support from decision makers (23)* Lack of collaboration (22, 24)	Political support (5, 24) Government interest (2) Local/national relationships (5) Policy regulations and restrictions (3, 8) Encouragement of political discussion and raising awareness before and during implementation (23)*
Linkage and Exchange Underlying linkage and exchange		Lack of a well-planned implementation strategy that involves all stakeholders and is aligned	Broad and early stakeholder engagement (2, 23) Meaningful stakeholder engagement and on-going knowledge exchange (3)

between researchers and knowledge users, policy makers and stakeholders		with the initial goal of the program (23)* Absence of strong leadership (23)* Concept of low-value care not understood (27) Cost savings viewed as unfavourable (27)	A dissemination strategy tailored to target groups (23)* Consideration of local contexts (23)* Use of clinical champions (5) Address perceived net benefit to patients (8) Public representatives involvement in the process to increase knowledge of the HTR process (2) Shared dialogue (24) Do not frame as 'waste' but focus more on 'harm' and staged testing and treatment (28) Coordination/collaboration/professional understanding (5, 24)
Research Evidence, a Structured HTR Process, and Resources Timeliness, relevance and local applicability of research		Lack of methods to identify technologies with uncertain cost-effectiveness (22) Lack of understanding and expertise of HTR (2, 22, 24) Lack of approaches to conduct a HTR that are transparent (24) Lack of relevant evidence of the technology itself (21, 22)	A structured evidence-based process that includes transparent methods for identification, prioritization, and assessment of ineffective health technologies (23)* Good evidence base for identification and recommendations (23)* Mitigate with clear identification and prioritization criteria (7, 10) Additional human and financial resources for sustainable implementation (23)*

Role of Researchers and HTR The role of researchers to facilitate the transfer of research which includes views of their own role, communication skills, and packaging of the research results		Researchers may not understand their role Financial resources for HTR (23) Lack of resources and human resources to support HTR (22, 23)* Large investment in work and time required for HTR (22, 24) Difficulty in communicating with a variety of audiences and public perceptions (2, 5)	Capacity building in KT and change management (1) Understanding KT theories, models and frameworks and use of effective and multifaceted KT interventions (1) Development of a KT strategy to ensure uptake of HTR recommendations ((23, 25)
Role of Stakeholders, Knowledge Users and the Health System in HTR Skills and expertise		Lack of skills (2) Lack of resources and human resources to support HTR (22-24)* Absence of strong leadership (23)*	Raising awareness and leadership at all levels (1, 23) Use of change agents or knowledge brokers (12) Decision makers need to understand the HTR process and provide support

Figure 1. 1 Linkage between Knowledge Translation and Health Technology Reassessment



CHAPTER TWO: A SCOPING REVIEW OF FULL-SPECTRUM KNOWLEDGE TRANSLATION THEORIES, MODELS, AND FRAMEWORKS

This chapter has been published as:

Esmail R, Hanson HM, Holroyd-Leduc J, Brown S, Strifler L, Straus SE, et al. A scoping review of full-spectrum knowledge translation theories, models, and frameworks. *Implement Sci*. 2020;15(1):11.

The work in this chapter describes a scoping review of full-spectrum Knowledge Translation theories, models, and frameworks (KT TMFs). The review also categorizes these KT TMFs into five approaches: process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks. It is a resource that users can refer to when undertaking a KT project or intervention. For this thesis, it also provided a starting point of which KT TMFs may be suitable for the application of health technology reassessment (HTR).

2.1 Abstract

Background: Application of knowledge translation (KT) theories, models, and frameworks (TMFs) is one method for successfully incorporating evidence into clinical care. However, there are multiple KT TMFs and little guidance on which to select. This study sought to identify and describe available full-spectrum KT TMFs to subsequently guide users.

Methods: A scoping review was completed. Articles were identified through searches within electronic databases, previous reviews, grey literature, and consultation with KT experts. Search terms included combinations of KT terms and theory-related terms. Included citations had to describe full-spectrum KT TMFs that had been applied or tested. Titles/abstracts and full text articles were screened independently by two investigators. Each KT TMF was described by its characteristics including: name, context, key components, how it was used, primary target audience, levels of use, and study outcomes. Each KT TMF was also categorized into theoretical approaches as process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks. Within each category, KT TMFs were compared and contrasted to identify similarities and unique characteristics.

Results: Electronic searches yielded 7160 citations. Additional citations were identified from previous reviews (n=41) and bibliographies of included full text articles (n=6). Thirty-six citations describing 36 full-spectrum were identified. In 24 KT TMFs, the primary target audience was multi-level including patients/public, professionals, organizational, and

financial/regulatory. The majority of the KT TMFs were used within public health, followed by research (organizational, translation, health), or in multiple contexts. Twenty-six could be used at the individual, organization, or policy levels, five at the individual/organization levels, three at the individual level only, and two at the organizational/policy level. Categorization of the KT TMFs resulted in 18 process models, eight classic theories, three determinant frameworks, three evaluation frameworks, and four that fit more than one category. There were no KT TMFs that fit the implementation theory category. Within each category, similarities and unique characteristics emerged through comparison.

Conclusions: A systematic compilation of existing full-spectrum KT TMFs, categorization into different approaches and comparison has been provided in a user-friendly way. This list provides options for users to select from when designing KT projects and interventions.

2.2 Contributions to the Literature

- There has been a proliferation of knowledge translation (KT) theories, models and frameworks (TMFs) creating confusion for users on which to select.
- This scoping review provides a compendium and comparison of full-spectrum KT TMFs defined as those that have been used in the literature by study authors to inform their KT work and guide all four phases of knowledge translation from planning/design, implementation, evaluation, and sustainability/scalability.
- The review findings contribute to the field by providing a concise reference source for those undertaking a KT project or designing a KT intervention to assist with KT TMF selection.

2.3 Background

There are gaps between evidence and practice. Knowledge translation (KT) has emerged as a field to bridge these knowledge-practice gaps (40, 41). The Canadian Institutes of Health Research (CIHR) defines KT as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products, and strengthen the healthcare system" (42).

The field of KT is marred by a profusion of terms. In fact, 100 terms have been found to describe knowledge translation research (43). In the literature and amongst different jurisdictions, KT has been used interchangeably with terms such as research utilization, knowledge transfer and uptake, knowledge utilization and exchange, and implementation science (IS). In particular, KT's relationship to IS has caused confusion (12). KT and IS are related and overlapping terms (44). IS may be considered a sub-speciality of KT (45). IS defined as "the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice to improve the quality and effectiveness of health services and care" (46). In this paper, as with the previously published scoping review by Strifler et al, KT has been considered broadly to include implementation practice (implementing research evidence into practice) and implementation science (study of methods to promote uptake of research findings into practice) (47). The full-spectrum KT TMFs covered in this review encompass the entire continuum of KT activities including IS. KT and IS TMFs have been referred to as KT TMFs, collectively. Further, for the practitioner, the use of these KT TMFs requires consideration of their purpose and context.

Many of KT theories, models and frameworks, collectively referred to as "TMFs" hereafter, exist. Although four reviews have been conducted in this area to date, none of these reviews provide a comprehensive list of TMFs that include all four KT phases (planning/design, implementation, evaluation, and sustainability) (14, 15, 17, 47). A non-systematic review used a snowball sampling method to develop a list of 61 dissemination and implementation research TMFs (14). A second review, which included literature from 1990-2014, found 41 different frameworks and models from 98 papers with a focus on research translation frameworks (17). Further, a scoping review of published and grey literature between 2009-2013 identified 51 classification schemes (23 taxonomies, 15 frameworks, eight intervention lists, three models and two other approaches) on KT interventions that could be used to integrate evidence into practice (15). The most recently published scoping review was limited to TMFs used in cancer and chronic disease management and prevention, identifying 159 articles that met the inclusion criteria of the review (47). Each of these studies used different research methodologies (two were narrative reviews and two were scoping reviews), literature search strategies, dates in their searches and different inclusion/exclusion criteria. Moreover, the overlap of the KT TMFs captured in all four of these reviews was low with different TMFs included in each synthesis piece. In addition, Wensing and Grol note that the development in the fields of KT and IS has been hindered by the proliferation of TMFs for implementation, transfer and improvement without testing, refinement and integration (44). It is likely that users would use, test, and or refine existing TMFs if there was a concise resource to add in their selection of a TMF. Thus, a compendium of full-spectrum KT TMFs, is required. This study employs scoping review methodology to identify, describe, and compare the available full-spectrum KT TMFs.

2.4 Methods

A protocol outlining the methodology of this scoping review was developed using the Arksey and O'Malley methods and registered with PROSPERO (CRD42018088564) (48). The Preferred Reporting Items for Systematic Reviews and Meta Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines were followed (49).

2.4.1 Search Strategy

Strifler et al's search strategy was adapted and applied to the same databases of MEDLINE, EMBASE, and PsycINFO (47). This required eliminating terms related to cancer and chronic diseases, limiting the search to English language and human studies, and conducting an updated search from when Strifler et al's search ended (i.e. from January 2016 to February 10, 2018) (Appendix A). Hand searches were conducted within KT TMF review articles published after the Strifler et al. review (11, 17), and within bibliographies of included articles. The Canadian Agency for Drugs and Technologies in Health's (CADTH) grey matters approach, supplemented by known KT grey literature resources, was used to guide the grey literature search (50) (Appendix B). KT experts reviewed the list of KT TMFs to ensure the comprehensiveness of the final list of included studies.

2.4.2 Study Selection

Titles and abstracts were screened independently by two investigators (RE, SB). The inclusion criteria were:

1. English language articles.
2. Described a KT TMF as defined by Nilsen (16). The definitions are: A theory is defined as "a set of analytical principles or statements designed to structure our observation, understanding and explanation of the world." A model is "a deliberate simplification of a phenomenon or a specific aspect of a phenomenon." Lastly, a framework is described as "structure, overview, outline, system or plan consisting of various descriptive categories"(16). As an entity, we considered 'TMF' together as the unit when reviewing them as full-spectrum.
3. Full-spectrum. Specifically, a full-spectrum KT TMF is one that has been used in the literature by study authors to inform their KT work and guide all four KT phases: i) planning/design (identifies a knowledge gap, engages stakeholders, develops an intervention), ii) implementation, iii) evaluation, and iv) sustainability/scalability (47).
4. Used at any level within a system (clinical, organizational, policy).
5. Applied prospectively rather than retrospectively; A TMF that was applied only retrospectively to determine fit after project completion or for refinement was not considered. Only TMFs that were applied prospectively to support a project during its lifespan were considered.
6. Was not included in the scoping review by Strifler et al. (47).

7. Published journal articles, books, book chapters, reports, conference abstracts and study protocols where study results (preliminary or full) had been published. Abstracts, letters, editorials, opinion articles, dissertations and reviews were excluded.

Prior to full screening, reviewers completed a calibration exercise on 10% of retrieved articles, and inter-rater reliability was calculated for title and abstract screening using the Kappa (κ) statistic. A moderate level of agreement (0.41 to 0.60) was considered acceptable due to the variability of this topic in the literature (51). Titles and abstracts identified by either reviewer were included in the full text review. Full text articles were retrieved and reviewed in duplicate by the same two investigators (RE, SB). Reasons for exclusion of title/abstracts and full text articles were documented using Microsoft Excel. Again, a κ statistic was calculated to measure agreement. Any disagreements were resolved through consensus by RE and SB. When consensus could not be reached, a third reviewer (FC and/or HH) assessed the article for eligibility.

2.4.3 Data Extraction Items and Process

Data were extracted in duplicate by two investigators independently (RE and SB). Any disagreements were resolved through consensus by RE and SB through discussion. Data elements included: study characteristics (author, year, geographic region, funding source), aims of study, developmental approach, KT TMF characteristics (name, terms used to describe it-theory/model/framework), context, key components of the KT TMF, description of how it was

used, primary target audience or user, levels of use, and study outcomes. As the focus of this review was identification of all full-spectrum KT TMFs, quality appraisal was not conducted nor does a tool to assess quality exist.

2.4.4 Data Analysis and Synthesis

Data were summarized based on study characteristics and KT TMF characteristics. The KT TMFs were then categorized by two researchers (RE and JHL) according to the five categories of theoretical approaches described by Nilsen (16). The categories include: process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks (Table 2.1). Any disagreements were resolved through consensus by RE and JHL through discussion.

The KT TMFs within each category were described based on their primary target audience or user, context, how it has been used, and levels of use (individual, organization, or policy). Further, each KT TMF was compared and contrasted within each category with respect to its similarities and unique characteristics.

2.5 Results

The 26 full-spectrum KT TMFs from the Strifler scoping review were assessed for inclusion within this review. Of the 26, three full-spectrum KT TMFs were excluded: one as it was action research which described a KT approach to change rather than a specific KT TMF (52), and, two were applied retrospectively (the Interactive Systems Framework (53) and the Three-World View Model (54). The remaining 23 full-spectrum KT TMFs were included (9, 12, 55-75).

2.5.1 Search Results

The updated database search from January 2016 to February10, 2018 yielded 9286 articles. When duplicates were removed, 7160 unique citations were assessed ($\kappa = 0.482$) and 50 full-text articles were identified for further review ($\kappa = 0.458$) with a moderate level of agreement. After full-text review, 42 citations were excluded: 38 did not describe a KT TMF, two were duplicates, one had not been tested or used, and one KT TMF was not full-spectrum. Therefore, eight full-spectrum KT TMFs were identified (76-83). Of the 47 references, 41 from the Milat et al review and six articles from the hand search of the reference lists of the eight articles identified from the database search, five met the criteria for inclusion (84-88). Eighteen were already cited in Strifler et al's scoping review or through the electronic database search, eighteen were not full-spectrum, and six did not describe a KT TMF. The final data set included 36 full-spectrum KT TMFs (Figure 2.1). Of note, there were 19 KT TMFs identified in the search that were not included in the final data set as they did not meet the criteria of full-spectrum. In particular, all

19 KT TMFs did not have the sustainability/scalability phase and two of these KT TMFs also did not have the evaluation phase (Supplementary Table 2.1).

2.5.2 Description and Categorization of TMFs

The 36 full-spectrum KT TMFs were published between 1952 and 2018, with 30 KT TMFs published since 1997 and six KT TMFs published from 1952 to 1996 (9, 57, 60, 64, 68, 69) . Twenty-three TMFs were developed in the United States (9, 56, 58-61, 64, 65, 67-71, 73, 74, 76, 80, 82, 84-86), five in Canada (12, 55, 75, 78, 88), five in Australia (57, 63, 77, 79, 83), one in India (81), and two did not have a specific geographic location (66, 87). In 24 of the KT TMFs, the primary target audience or user was multi-level including patients/public, professionals, organizational, and financial/regulatory. The majority of the KT TMFs were used within the public health context followed by the research context (organizational, translation, health), or in multiple contexts. Twenty-six could be used at the individual, organization, or policy level (Figure 2.2). Categorization of each KT TMF resulted in 18 process models (12, 55-61, 63, 77-83, 87, 88), eight classic theories (9, 64-69, 71), three determinant frameworks (62, 72, 86), three evaluation frameworks (73, 74, 85), one that fit both the process model and classic theory categories (70), two that fit the classic theory and determinant framework categories (75, 76), and one that fit the process model and evaluation framework categories (84) (Table 2.2, Figure 2.3). There were no full-spectrum KT TMFs that fit the implementation theory category. Additional details of each KT TMF are described in Tables 2.3 to 2.6.

2.5.3 Process Models

Eighteen full-spectrum KT TMFs were process models (12, 55-61, 63, 77-83, 87, 88) (Table 2.3). Fourteen of these had multi-level target audiences (12, 55-58, 60, 61, 63, 79, 80, 82, 83, 87, 88), whereas four had a more focused target audience, including individual/organizational, health care, public health or health systems (59, 77, 78, 81).

The 18 process TMFs in this category were group further based on their specific focus or similar characteristics.

2.5.4 TMFs that Build on Existing TMFs

Twelve TMFs incorporated components of or built on existing TMFs. For instance, six TMFs have been used for quality improvement purposes and five incorporate the Plan-Do-Study-Act (PDSA) cycle (56, 58-60, 77, 81). Another four TMFs incorporated or provided variations on the KTA framework (12). The KTA framework was incorporated into the CAN-IMPLEMENT (55), the Community Based Knowledge Translation Model (88), the National Center on Health, Physical Activity and Disability Knowledge, Adaptation, Translation and Scale-up Framework (NCHPAD N-KTAS) (82), and the Translational Model of the Black Dog Institute (83). In addition, the CollaboraKTion Framework (78) which focuses on population health incorporated the co-KT framework (79), making it a more iterative rather than linear process as depicted by the co-KT framework.

2.5.5 TMFs that use Stages to describe the KT Process

Three TMFs described the KT process specifically as stages (57, 80, 87). The Stages of Research and Evaluation is focussed on the evaluation of an intervention with six stages (87) . The Staged Model of Innovation Development's focus is on organizational development. Its four stages are similar to the Stages of Research and Evaluation with stage 1 (basic research and design) covering the first three stages (problem definition, solution generation, intervention testing). (57). The KT Framework for AHRQ Patient Safety Portfolio and Grantees' focus has three stages that are similar to the other TMFs, but its focus is on moving end of grant research findings into practice (80).

2.5.6 Meta-framework or Network TMFs

Lastly, there were two TMFs that were distinct from the others in this category. The Quality Implementation Framework was a meta-framework of the synthesis of 25 implementation frameworks (61). The Western Australia Health Policy Development and Implementation Cycle is a network model that incorporated the concept of a community of practice approach to build relationships between stakeholders. Both of these TMFs did not incorporate or build on other TMFs and did not consist of stages to drive process change.

Therefore, users seeking full-spectrum KT process models to provide a step by step 'how to' approach to translation of knowledge into practice may wish to determine their focus and select the process KT TMF accordingly. In this category, there may be more updated versions of KT TMFs or variations of KT TMFs to contemplate and select from.

2.5.7 Classic Theories

Eight full-spectrum KT TMFs were found in this category (9, 64-69, 71) (Table 2.4). Three theories could be used for a multi-level target audience (9, 69, 71). Three theories had a target audience at the individual level (64, 66, 68). One provides an explanation of how change could occur with the organization or policy target audience (65), and the other was at the individual, clinic or community level (67).

The eight theories within this category can be described as formal theories described as theories that are structured, technical and provide formal accounts of concepts (89). Further differentiation between these theories is dependent on their purpose and level of change. For example, if the focus of the change is happening at the organizational or community levels, the Diffusion of Innovations (DIT), the Interorganizational Relations Theory (IOR), or the Social Ecology Model (SE) for Health Promotion, would be applicable (9, 65, 69). If theories are required for individual health behaviour, the Transtheoretical Model (TTM) of Behaviour Change and Precaution Adoption Process Model (PAPM) would fit this purpose (67, 71). If

theories are being sought on the interpersonal environment that affect an individual's health behavior, Social Cognitive Theory (SCT), the Self-Regulation (SR) Theory ,and Social Learning Theory (SLT) would be suitable (64, 66, 68) .

DIT is a foundation theory upon which other theories are based (9). The IOR is similar to DIT through its broad components and focus at the organizational level and SE model as it is directed at the social ecology of multiple organizations within communities (65). Of the eight theories, the IOR is the only one that specifically provides criteria of effectiveness. The SE model is similar to DIT in terms of social systems and incorporates the notion of consequences. Its unique characteristic is the ecological analysis of health promotion (69).

The TTM and PAPM are stage theories and similar to the KT TMFs described in the process category that also specifically use stages to describe the change process (57, 80, 87). The PAPM differs from TTM in the number of stages and its conceptualization (90). It also considers the stage in which people may be unaware of a risk and includes a stage where people decide not to act. It does not consider commencement of risky behaviour as with TTM (67). A notable characteristic of the TTM is that it provides ten processes of change, which can be used at each stage (71). The TTM has been criticized as not having evidence of effectiveness as demonstrated by reviews (89, 90).

Four theories (SR, SLT, SCT, SE) are focussed on behaviour change and the environment which is key to understanding the context in which change is occurring. SR is focused on self-regulation or taking a response or behaviour and replacing it with a less common, but more

desired response (66). It considers the environment like the SE model and IOR in shaping behaviour (65, 69). Its second dimension of self as it relates to others is similar to SLT and SCT (64, 68). SLT is about learning and meaning. SCT is based on SLT and bridges the gap between learning and behaviour (68). SCT also adds the notion of self-efficacy and self-regulation like SR (64).

Therefore, users seeking full-spectrum KT theories, to explain how change occurs need to consider these factors when selecting from these eight theories. As Davidoff et al describe, it is not about using theory but about making explicit the particular theory, that is actually used (89). More importantly, it may not just be a selection of one theory but a blending of theories that may be required (89, 90).

2.5.8 Determinant Frameworks

Three full-spectrum KT TMFs were found in this category (62, 72, 86) (Table 2.5). All three had multi-level target audiences.

All three frameworks provide determinants that could influence change and implementation. The Social Marketing Framework uses the principles, techniques and tools of marketing (62). It overlaps with CFIR on the identification of target audience, internal factors (degree of readiness), external factors (self-efficacy), and perceived risk. As with CFIR, it also integrates both qualitative and quantitative research methods. In addition, the Social Marketing Framework considers price in terms of incentives and disincentives, whereas CFIR considers

costs in terms of the intervention. However, the Social Marketing Framework also has distinguishing features such as how the five Ps are inter-related and additional determinants such as audience segmentation, competition, and exchange (62).

The Knowledge Integration Process illustrates a cycle of five overlapping phases from problem identification and discovery to population health outcomes (86). Each phase consists of determinants to consider, but it does not go into detail on the determinants. Similar to CFIR and the Social Marketing Framework, the Knowledge Integration Process considers stakeholder engagement.

Lastly, CFIR is meta-theoretical framework based on existing theories and empirical studies. It provides tools and a guide that can be used alongside the framework. CFIR can be used to assess barriers and facilitators for behaviour change. However, one drawback is that it does not depict interrelationships between these determinants (72).

Therefore, users seeking full-spectrum KT Determinant frameworks to identify barriers and facilitators that may influence implementation outcomes have three distinct frameworks to choose from. Moreover, there are other non full-spectrum KT determinant frameworks that may be useful to consider in addition to these three (91).

2.5.9 Evaluation Frameworks

Three full-spectrum KT TMFs fit this category (73, 74, 85) (Table 2.5). Two had multi-level (74, 85) and one had individual or organizational levels (73) as their primary target audience.

All three TMFs can be used to evaluate interventions and the extent to which the interventions are applied in practice. RE-AIM focuses on five elements and is the only full-spectrum evaluation framework that is solely quantitative in nature (73). This framework is unique as it allows for the assessment of intervention impact over time and for comparison of interventions. However, RE-AIM assumes that the five elements are equal, which may not be the case. In addition, the time interval for assessing implementation (six months to a year) and maintenance (two or more years), respectively, are arbitrary (73).

The Conceptual Framework for Planning and Improving Evidence-based Practices is focussed on planning and improving best practices. Its public health impact component is adapted from RE-AIM. In contrast to RE-AIM, it provides a series of questions for the five elements. However, not all the questions are comprehensive and some may not be able to be used for all practices (85). Further, it does not provide practical guidance on what to do with the information obtained.

Similar to the Conceptual Framework, PRECEDE-PROCEED also focuses on the adaptation of best practices. It provides a generic framework and logic model to assess the linkage between

activities and long-term impacts (74). In contrast to the Conceptual Framework, this framework describes phases to assist with generating information for subsequent decisions rather than posing questions that need to be addressed. Of the three evaluation frameworks, it is the only one that provides linkage between evaluation being part of implementation, monitoring and continuous quality improvement.

Therefore, users seeking full-spectrum KT evaluation frameworks to evaluate interventions may need to consider these factors when selecting from these three frameworks.

2.5.10 KT Theories, Models and Frameworks that fit more than one Theoretical Approach Category

Four KT TMFs fit more than one theoretical approach category (70, 75, 76, 84) (Table 2.6). Two had multi-level (75, 76), one had organizational level (70), and one had community (84) as their primary target audience.

In comparison to the other process category TMFs, the Stage Theory of Organizational Change is similar to the Staged Model of Innovation Development and the Stages of Research Evaluation (87), as it provides stages for moving research into practice and consists of four distinct stages. In relation to the classic theory category, it is similar to the DIT (9) and IOR (65), with its focus on how change occurs at the organizational level.

The Community Connection Model is not based on specific behavioural theories rather the author's reflection on the development and implementation of a chronic disease program. However, it does provide a broad overview of the components that necessitate change to occur similar to other theories. Its four components can also be considered determinants for change to occur. Moreover, one component is the alignment of policy to facilitate building partnerships, which is similar to the Social Marketing Framework that considers other providers and community organizations as a determinant of change.

In relation to the classic theories, the CCM is based on elements from DIT and the SCT TMFs including innovation characteristics, peer modeling to influence behaviour, and self-efficacy. CCM also incorporates Community-Based Participatory Research (CBPR) principles. It overlaps with the Community Connection Model through the partnership component. Moreover, it also provides three additional components of context, community-based participatory research principles and innovation elements that are also similar to the determinants within CFIR.

The Evidence-driven Community Health Improvement Process (EDCHIP) builds on CHIP and incorporates the search and organization of scientific literature and RE-AIM, respectively. EDCHIP is similar to the KTA process TMF (12) through the synthesis of scientific knowledge (the funnel) and specific implementation steps (the action cycle). Further, it replicates RE-AIM (73) within its analysis and implementation cycle. It is novel in that it incorporates elements from two distinct full-text KT TMFs from the process and evaluation categories and integrates them for a more comprehensive TMF.

Thus, these four cross-cutting KT TMFs offer yet other options and may be suitable for users seeking more than one theoretical approach in a KT TMF.

2.6 Discussion

2.6.1 Key Findings

Three key findings emerged from this scoping review: an up-to-date compilation of full-spectrum KT TMFs using scoping review methodology; categorization of these KT TMFs based on five categories of approaches; a detailed description of each KT TMF, and comparison within each category to assist with their selection for a KT project or intervention.

This scoping review identified 36 full-spectrum KT TMFs. The use of full-spectrum KT TMFs to anchor a KT project is considered an important and foundational starting point. Rather than the development of yet another KT TMF, users are encouraged to select from this current list and then share their experiences on application (Tables 2.3-2.6). This approach will help to further develop and improve the theoretical foundation that KT science is built on.

This review found that there are full-spectrum KT TMFs that fit all but one of the five theoretical categories. Although Nilsen emphasized that these categories can overlap, it is important to recognize the differences between them so that users can select the KT TMF most appropriate for the situation (16). Indeed, there were four KT TMFs that fit more than one theoretical

approach category (70, 75, 76, 84). Furthermore, half of the full-spectrum KT TMFs fall into the process category. Over the past decade, a major focus within the field of KT has been on developing steps and processes that support the application of KT TMFs (16).

The lack of a full-spectrum KT TMF within the implementation theory category may reflect that these KT TMFs are used in implementation science to understand and explain aspects of implementation. Thus, they may not cover all four phases of KT, but instead focus on the planning/design and implementation phases. An example is the COM-B (Capability, Opportunity, Motivation and Behaviour) (92). This framework posits that the presence of COM, can influence behaviour which in turn influences COM. It has been used to explain why and how implementation occurs.

Comparison of the KT TMFs within each category highlighted similarities and unique characteristics. Within the process category, two thirds of the KT TMFs incorporated other TMFs or provided variations of previous TMFs. Six of these TMFs had a focus towards quality improvement. The classic theory category presented TMFs that were foundational, such as the DIT. The theories within this category concentrated on the level of change at the organizational, community or behavioural change related to self. Both determinant and evaluation framework categories, had three TMFs each. The determinant category offered a meta-theoretical framework, with two simpler determinant frameworks. The evaluation category offered three very distinct TMFs, with one quantitative in nature. The final category afforded TMFs that

could fit more than one category. As such they would be useful for users seeking more than one theoretical approach.

This list of 36 full-spectrum KT TMFs and their categorization provides a starting point for any KT project or intervention. By providing a detailed description and comparison of TMFs within each category, users can scan the available TMF options and determine which may be best suited to their KT approach. For example, a user searching for a ***process*** KT TMF to apply within multiple target audiences at the ***policy level*** could select from three potential process TMFs, (KTA, Collaborative Model for Achieving Breakthrough Improvement, PDSA cycle) (12, 56, 60). Moreover, if users are looking for a KT TMF that has both a process and evaluation approach, they could select the EDCHIP model (84). Therefore, users have a concise list of KT TMFs to select from based on approach, purpose, context, and the level of use (93).

Birken et al has suggested a more complex process for selecting a KT TMF that involves 19 criteria (94). However, not dissimilar to how the KT TMFs were described in this review, the criteria ranked most important were: empirical support, application to a specific setting or population, explanatory power or testability, description of a change process, and analytical level (macro-policy level, meso-health care organization level, and micro-clinical level). Furthermore, the authors have developed the T-CAST: an implementation theory comparison and selection tool with 16 specific criteria, organized within four categories, applicability, usability, testability, and acceptability. Users of the T-CAST tool will find it helpful for deciding whether a specific TMF is relevant for their project or for deciding which of several TMFs is most relevant for their

project. As such the T-CAST aids in the selection of TMFs from among a candidate list (95). Thus, this scoping review provides a list for users to review the range of candidate full-spectrum TMFs available, and subsequently apply the T-CAST tool to compare and select a KT TMF.

Another consideration in selection of a KT TMF is the application of objective criteria on ease of use or usability. Although not a focus of this review, the usability of each KT TMF would provide an added dimension for users to consider when selecting KT TMFs. Usability has been defined as "the quality or state of being usable: ease of use" (96). The T-CAST tool includes usability criteria for practitioners and researchers. Each criterion is scored as 0 for poor fit, 1 for moderate fit, and 2 for good fit. This scoring system could be used to objectively identify usability from a user perspective and assist in KT TMF selection (95). Alternatively, drawing from the computer systems literature, the System Usability Scale (SUS) could provide another way to objectively rank each KT TMF for usability (97). The application of usability criteria to KT TMFs that are full-spectrum is an area that could be considered for future research.

Therefore, this scoping review can be used as a resource and starting point from which users can select a full-spectrum KT TMF. The T-CAST tool or a usability scale could then be applied by users to compare amongst these KT TMFs to assist with potential fit of the KT TMF or TMFs used in combination for their project.

2.6.2 Strengths

This scoping review followed a rigorous protocol, building on a previous high quality scoping review (47) in a unique manner that enabled the capture of full-spectrum KT TMFs. Moreover, whereas the previous scoping review (47) focussed on cancer and chronic disease, this scoping review modified the search strategy to identify KT TMFs regardless of context, provided details and comparison of each KT TMF. The comprehensive nature of the search included a search of the grey literature, examination of review articles published after the scoping review, and a review of the final list by KT experts, which helped minimize the risk of missing a relevant full-spectrum KT TMF. To our knowledge it is the only scoping review that provides a compendium and comprehensive description of full-spectrum KT TMFs. The scoping review also compares each KT TMF within categories to allow users to better understand and assist with their selection.

2.6.3 Limitations

Articles published in languages other than English were not incorporated into the search strategy due to lack of resources. So, the review may be subject to language bias. In addition, there may have been misclassification of TMFs during the search. However, the BeHEMOth search strategy utilizes different terms for theory, model, and framework to minimize the risk of

misclassification. Kappa agreement between the reviewers was moderate and could be attributed to the lack of clarity in the literature of how a KT TMF is defined.

Nilsen's definitions of a theory, model, and framework were used, but there are other definitions that could have been used to define these terms (98). Moreover, often these three terms are used inter-changeably in the literature and cause further confusion. These terms are not synonyms and there is a need for future research to provide guidance on how to determine which approach to use i.e. a theory, model or framework based on the research study and context prior to the actual selection of the TMF.

Categorization of TMFs was based on the definitions provided by Nilsen. This work is meant to be a guideline, and the distinctions among the categories are not precise. Hence misclassification could have occurred due to interpretation. However, two reviewers conducted this categorization in duplicate to ensure reliability and any disagreements were resolved through dialogue. The use of Nilsen's taxonomy can help as a starting point with selecting which full-spectrum KT TMF to use based on its purpose (16). For example, if the purpose is to employ a change in practice, a process model such as KTA could be used (12). Alternatively, if it is to understand or explain how a change occurs, the DIT could be selected (9). This scoping review has provided a reference and categorization so that users are not left to sift through the numerous KT TMFs. Moreover, further refinement of Nilsen's categories and categorization of commonly used KT TMFs that are not full-spectrum would be a beneficial piece for future research.

Providing a compendium of full-spectrum TMFs only may miss several commonly used TMFs such as those cited by Birken et al (94). In this study, CFIR, RE-AIM, and DIT have been cited as the top three most commonly used TMFs and they also were classified as full-spectrum in this scoping review. However, other commonly used TMFs such as Promoting Action on Research Implementation in Health Services (PARIHS) Framework (99) and Normalization Process Theory (100) did not make the full-spectrum list. PARIHS and Normalization Process Theory were cited by Strifler et al's scoping review. However, they were not classified as full-spectrum. PARIHS did not have the planning/design and sustainability/scalability phases and the Normalization Process Theory was missing the implementation and sustainability phases (47). Nonetheless, there is added value in presenting KT TMFs that are full-spectrum as they meet the criteria for all four KT phases considered important for users when implementing KT projects or interventions. In addition, users may want to explore the use of both full-spectrum KT TMFs and other commonly used KT TMFs. Combining KT TMFs for implementation has been shown to be beneficial given the context and complex nature of implementation science itself (101).

The full-spectrum definition of KT stages is based on the KTA framework (12), but other KT TMFs could have been used as a basis for defining full-spectrum. In addition, there may be different perspectives in the classification of a KT TMFs as full-spectrum. For example, although the RE-AIM framework was primarily designed to be used as an evaluation framework focussed only on the evaluation phase of the KT process, its use has evolved and is now used in planning, assessing progress and reporting results (102). Moreover, given that the Strifler et al scoping review did include it as full-spectrum (47), it was also included in this scoping review. Lastly,

although time and resources were invested to obtain the original source of publication of the actual KT TMF, it was well worth the effort.

2.7 Conclusions

This scoping review provides a summary of the full-spectrum KT TMFs that could be used as a foundation for clinicians, researchers, and policy makers, undertaking KT projects within the health care context. The application of an existing KT TMF is recommended for all applied KT projects and interventions (47). It is only by further understanding, utilizing, and evaluating these KT TMFs that the field of KT science can advance, and ultimately improve the implementation of evidence into practice.

Figure 2. 1 PRISMA flowchart summarizing study review and inclusion

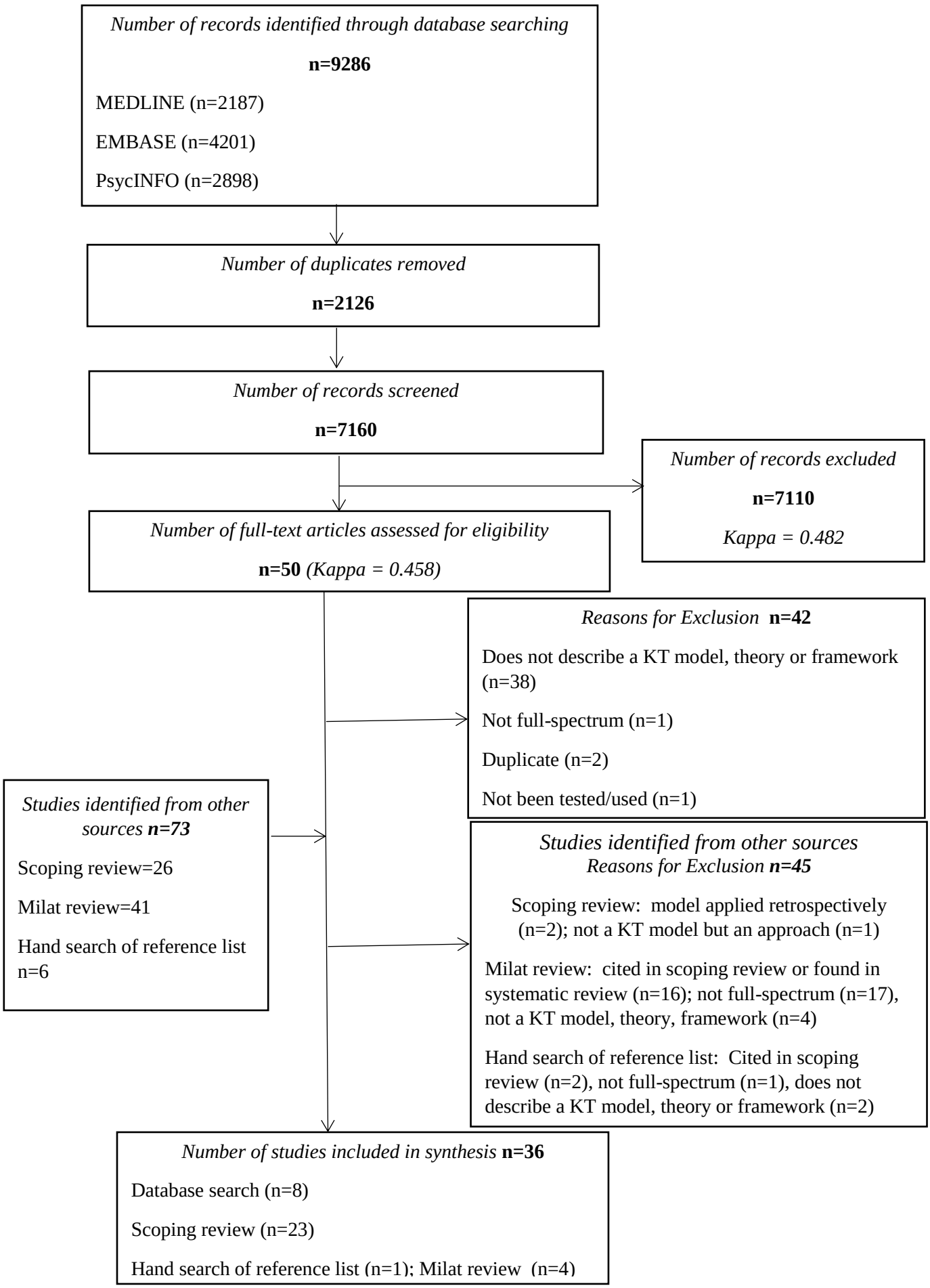


Figure 2. 2 Knowledge Translation Theories, Models, Frameworks by Level of Use

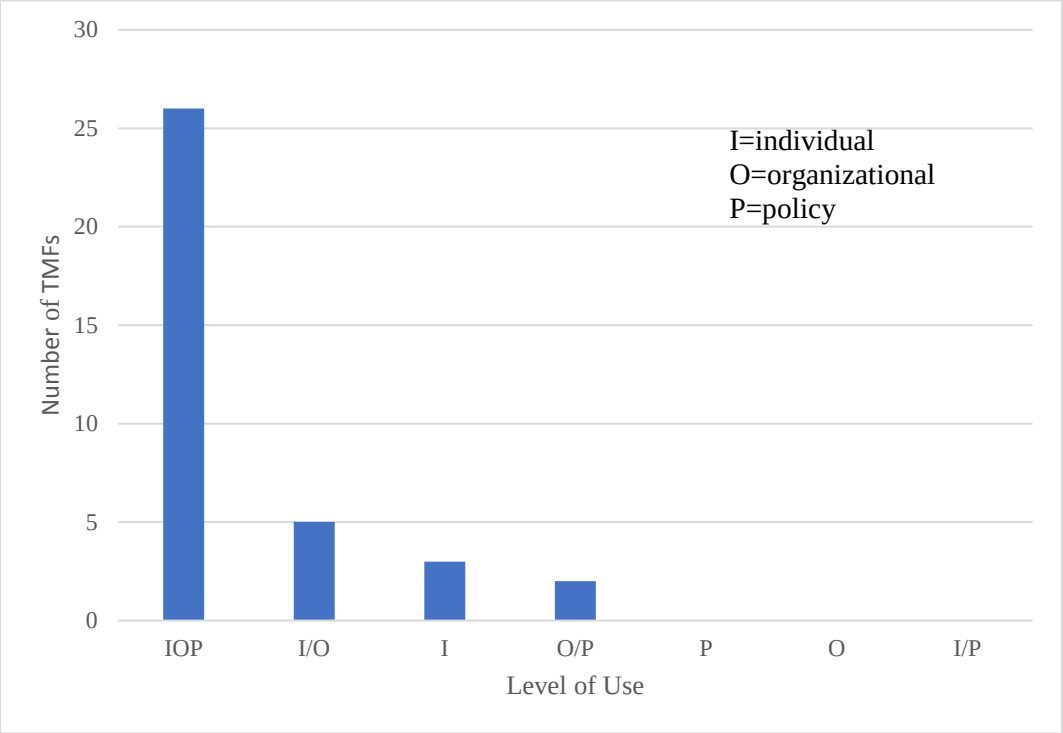


Figure 2. 3 Categorization of Full-Spectrum Knowledge Translation Theories, Models, Frameworks (n=36)

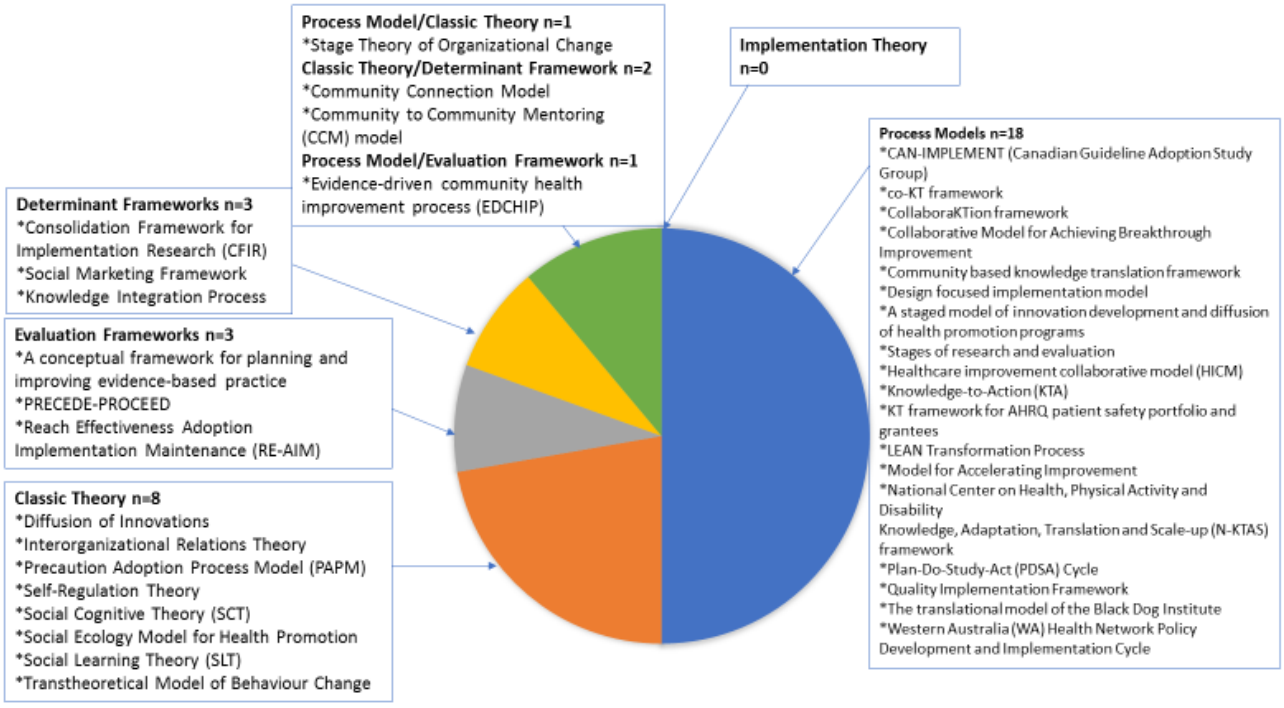


Table 2. 1 Theoretical Approaches Categories as Described by Nilsen P (16)

Categories	**Description**
Process models	Specify steps in the process of translating research into practice.
Determinant frameworks	Classes or domains of determinants that are hypothesized or have been found to influence implementation outcomes.
Classic theories	Describe how change occurs without ambitions to actually carry out the change.
Implementation theories	Developed and adapted by researchers for potential use in implementation science to achieve enhanced understanding and explanation of certain aspects of implementation.
Evaluation frameworks	Provide a structure for evaluating implementation endeavors.

Table 2. 2 List of Full-Spectrum Theories, Models and Frameworks by Theoretical Approaches Categories (n=36)

Categories	TMFs
Process models (n=18)	CAN-IMPLEMENT (Canadian Guideline Adoption Study Group) (55) Co-KT Framework (79) CollaboraKTion Framework (78) Collaborative Model for Achieving Breakthrough Improvement (56) Community Based Knowledge Translation Framework (88) Designed Focused Implementation Model (81) A Staged Model of Innovation Development and Diffusion of Health Promotion Programs (57) Stages of Research and Evaluation (87) Healthcare Improvement Collaborative Model (HICM) (77) Knowledge-to-Action (KTA) (12) KT Framework for AHRQ Patient Safety Portfolio and Grantees (80) LEAN Transformation Process (58) Model for Accelerating Improvement (59) National Center on Health, Physical Activity and Disability Knowledge, Adaptation, Translation and Scale-up (N-KTAS) framework (82)

	Plan-Do-Study-Action (PDSA) Cycle (60) Quality Implementation Framework (61) The Translational Model of the Black Dog Institute (83) Western Australia (WA) Health Network Policy Development and Implementation Cycle (63)
Classic theories (n=8)	Diffusion of Innovations (9) Interorganizational Relations Theory (65) Precaution Adoption Process Model (PAPM) (67) Self-Regulation Theory (66) Social Cognitive Theory (SCT) (64) Social Ecology Model for Health Promotion (69) Social Learning Theory (68) Transtheoretical Model of Behaviour Change (71)
Determinant Frameworks (n=3)	Consolidated Framework for Implementation Research (CFIR) (72) Social Marketing Framework (62) Knowledge Integration Process (86)
Evaluation frameworks (n=3)	A Conceptual Framework for Planning and Improving Evidence-Based Practices (85)

	PRECEDE-PROCEED (74) RE-AIM (73)
Process and Classic Theory (n=1)	Stage Theory of Organizational Change (70)
Classic Theory and Determinant Framework (n=2)	Community Connection Model (75) Community to Community Mentoring Model (CCM) (76)
Process Model and Evaluation Framework (n=1)	Evidence-Driven Community Health Improvement Process (EDCHIP) (84)

Table 2. 3 Full-spectrum KT Theories, Models, Frameworks that fit the Process Models Category (n=18)

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
CAN-IMPLEMENT (Canadian Guideline Adoption Study Group), Harrison, Implementation Science, 2013 (55)	Knowledge-to-Action (KTA) Framework (Graham et al, 2006) (12) with integration of guideline adaptation; Guideline adaptation is embedded in the Knowledge-to-Action cycle as part of a new three phase model: - PHASE 1 Identification and Clarification of Practice Issue/Problem - PHASE 2 Solution Building - PHASE 3 Implementation, Evaluation and Sustainability	Multi-level	Cancer guideline implementa-tion	Five cases were purposefully sampled from self-identified groups and followed as they used a structured method and resources for guideline adaptation. Cases received the ADAPTE Collaboration toolkit, facilitation, methodological and logistical support, resources and assistance as required.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Integrated KT Framework, Kitson A, Implementation Science, 2013 (79)	The development of the integrated KT Framework (called the co-creating or co-KT Framework). The four areas are: 1. There is a need for explicit, theory informed approaches to KT within population health studies; 2. Formalized collaborative approaches need to be evident within any KT framework at each step of the research process; 3. The roles of stakeholders and researchers need to be negotiated, structured and formalized; and 4. KT frameworks need to explicitly describe what counts as evidence, how it is developed, and by whom. Five steps in study and researcher context: step 1 initial contact and framing the issue, step 2: refining and testing, step 3: interpreting,	Multilevel (policy and community)	Port Lincoln, Australia, chronic disease	It was applied to LINKIN study: management of musculoskeletal problems and the management of pain associated with chronic conditions.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	contextualizing and adapting the knowledge base, step 4: implementing and evaluating; step 5 embedding and translating.				
CollaboraKTion Framework, Jenkins EK, Health Research Policy and Systems, 2016 (78)	Based on the co-KT framework. Five components: contacting and connection, deepening and understandings, adapting and applying the knowledge base, supporting and evaluating continued action, transitioning and embedding- based on co- KT framework from Kitson et al. Kitson is linear process. It is an iterative and a non-linear process.	Community based organizations , public health, disease prevention, health of communities/ populations	Rural town in BC Canada	Requires ongoing empirical testing but the Kitson co-KT model was applied to the SONAR project. Used through adaptation of original framework in practice- SONAR.	IOP
Collaborative Model for Achieving Breakthrough Improvement/Break-through series	Breakthrough series model; Topic Selection, Faculty Recruitment, Enrollment of Participating Organizations and Teams, Learning	Multi-level	Multiple settings, health care improvement settings for	Multiple application. But model has been used extensively. 891 teams involved	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
model, Institute for Healthcare Improvement white paper; model developed in 1995, paper published 2003 (56)	Sessions, Action Periods, The Model for Improvement, Summative Congresses and Publications, Measurement and Evaluation.		multiple contexts	up to 2001.Model has been used in Quantum Leaps in Patient Safety, Quality Assurance Project—Russia, Health Disparities Collaboratives to eliminate health disparities for 12 million underserved Americans The Veterans Health Administration (VHA)	
Community based Knowledge Translation Framework, Campbell B, Journal of continuing education in the	The Ottawa Model of Research Use (OMRU), a knowledge translation framework, was used to guide the translation of that generative knowledge into action, and the more current knowledge-to-action (KTA) (12) conceptual framework	Multi-level	Community research	Child health in a rural community	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
health professions, 2010 (88)	provided the rationale for the graphical depiction of engagement of a rural community in knowledge translation. Five phases and five stages.				
Design Focused Implementation Model, Ramaswamy R, Int J Ment Health System, 2018 (81)	Development of a framework for implementation in low resource context-informed by review of existing frameworks. Three interlinked phases: design, implementation and improvement; evaluation is woven into each of these with appropriate evaluation questions for each component of the model. Phases used other models i.e. design phase: local theory of change, mental healthcare plan, service delivery process maps; implementation phase used interactive system framework; improvement	Low and middle-income countries delivery of health systems; low income/resource community/organization	Three levels of health system (community, primary care and district hospitals); mental health disorders	The model was then applied to implement a program for treatment of three mental disorders (depression, alcohol use disorder and psychosis) (a case study).	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	phase: customized version of lean six sigma; evaluation used principles of learning evaluation. Iterative improvements of the initiative (PDSA cycle and QI) monitoring system to manage/sustain the change.				
A Staged Model of Innovation Development and Diffusion of Health Promotion Programs/ A Staged Approach to Innovation Development and Diffusion/Diffusion of Health Promotion Innovations, Oldenburg B, Health Promotion Journal of Australia, 1996 (57)	This framework represents an adaptation of the more classical program development models along with other models that has been used to characterize organizational development and change. Stage 1: Basic research and program development; Stage 2: Innovation development; Stage 3: Innovation diffusion; Stage 4: Institutionalization and sustainability.	Multi-level	Public health, health promotion innovation research and implementa-tion	Applied retrospectively to 12 journals, case studies described, applied to Fresh start program	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Stages of Research and Evaluation, Nutbeam D Evaluation in a Nutshell 2006 book (87)	1. Problem definition; 2. Solution generation; 3. Intervention testing; 4. Intervention demonstration; 5. Intervention dissemination; 6. Program monitoring; Stages 1 and 2 indicate the importance of a range of different forms of descriptive research in the development of an intervention plan, as well as formative evaluation of the development of program components. Stage 3 -intervention testing represents the evaluation of the effectiveness of an individual program. This included process evaluation and assessment of impact and outcome of the individual program (outcome evaluation). On the basis of evidence produced at this stage, decisions can be made	Multi-level	Public health, health promotion, research and industry	Youth smoking	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	on whether its use and adoption should become more widespread. Stage 4 the intervention is replicated and tested in other settings to assess whether or not it works as well in other populations or places. Stage 5, the research focus is on the dissemination process and on maximising the reach of the intervention, thereby maximising the potential public health benefit. This requires a focus on understanding the processes of implementation in different settings, and a decreasing focus on assessing the magnitude of the impact on outcomes. Stage 6-when a program is widely adopted, it is the phase of program sustainability and maintenance (or program				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	monitoring). This phase highlights the importance of continued monitoring of quality processes but distinguishes between this more routine process and the more formal research and evaluation methods that are required in the preceding stages.				
Healthcare Improvement Collaborative Model (HICM), Edward K, International Journal for Quality in Healthcare, 2017 (77)	The model was developed using the conceptual framework of models put forward through the IHI Breakthrough College Series and the Johns Hopkins quality and safety research group's Translating Evidence into Practice (TRiP) model. This is a hybrid model of two models that resulted in the healthcare improvement collaborative model. The model comprises of frontline staff engagement and local	healthcare system	Multi-site, multi-state, multi-sector organization	The HICM was developed and piloted from 2012 to 2016 for the focused topic of the management of inadvertent perioperative hypothermia across nine hospitals within Australia	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	topic selection. These two points of difference to the IHI model are important since staff generate their own priorities (topic selection) and can focus attention to specific improvement foci that is particular to the site. Teams are engaged in both formal and informal environments. The HICM consists of topic selection, recruitment of expert advisors, connection period, action period and team support.				
Knowledge-to-Action (KTA), Graham I, Journal of Continuing Education in Health Professions, 2006 (12)	For conceptual and illustrative purposes, KTA process is divided into two concepts: knowledge creation and action, with each concept comprised of ideal phases or categories. The action phases may occur sequentially or simultaneously, and the knowledge phases may	Multi-level	Continuing education in health professional	Multiple applications	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	influence the action phases. The funnel symbolizes knowledge creation, and the cycle represents the activities and processes related to use or application of knowledge (action).				
KT Framework for AHRQ Patient Safety Portfolio and grantees, Nieva VF, Advances in Patient Safety, 2005 (80)	Developed the conceptual framework to assist in the dissemination of research findings among grantees and, more importantly, among point-of-care providers who directly influence the quality of patient care. The broad objective of this framework is to maximize and accelerate the utilization of results emerging from AHRQ's patient safety portfolio of grants and contracts. developed a framework that synthesizes concepts from various related literatures of knowledge transfer, social	Multilevel-administrators and managers, and health care professionals, such as physicians, nurses, pharmacists and laboratory technicians	Patient Safety portfolio and patient safety grantees; AHRQ USA	Facilitation of Evidence-Based Nursing Practice During Military Operations	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	marketing, social and organizational innovation, and behavior change. There are three major knowledge transfer stages: knowledge creation and distillation, diffusion and dissemination, and organizational adoption and implementation of innovations and institutionalization-process actors and activities.				
LEAN Transformation Process, Lean Enterprise Institute, 2011, website: http://www .lean.org/whatslean/principles.cfm (58)	The five-step thought process for guiding the implementation of lean techniques is easy to remember, but not always easy to achieve: 1.Specify value from the standpoint of the end customer by product family. 2.Identify all the steps in the value stream for each product family, eliminating whenever	Multi-level	Automotive industry	Multiple applications	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	possible those steps that do not create value. 3.Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer. 4.As flow is introduced, let customers pull value from the next upstream activity. 5.As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste.				
Model for Accelerating Improvement Associates in	Model for Improvement asks three questions: what are we trying to accomplish, how will we know that a change is	Clinical or organizational	Health care organizations	Multiple applications	IO

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Process Improvement Langley, 2009 website; http://www.ihi.org/resources/Pages/HowtoImprove/default.aspx Langley, the improvement guide: a practical approach to enhancing organizational performance, 2 edition 2009 (59)	an improvement, what change can we make that will result in an improvement; changes are then put through the PDSA cycle.				
National Center on Health, Physical Activity and Disability (NCHPAD) Knowledge, Adaptation,	Integrates the work it has been doing in knowledge creation and dissemination with the growing need to advance work in implementation facilitation. KTA framework by Graham et al (12) is integrated in N-	Multilevel: community-at-large, health care facilities, community-based institutions/or	People with disabilities/ rehab, health implementation focus	CDC example worked through theoretically.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Translation and Scale-up (N-KTAS) framework Rimmer JH, Journal of Neurologic Physical Therapy, 2016 (82)	KTAS. Four sequencing strategies: strategy 1—new evidence- and practice-based knowledge is collected and adapted for the local context (i.e., community); strategy 2—customized resources are effectively disseminated to key stakeholders including rehabilitation professionals with appropriate training tools; strategy 3—NCHPAD staff serve as facilitators assisting key stakeholders in implementing recommendations; strategy 4—successful elements of practice (e.g., guideline, recommendation, adaptation) are archived and scaled to other rehabilitation providers. In the aggregate, these 4 strategies are aimed at promoting Community Health Inclusion, which is	ganizations, schools and workplace			

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	defined as the opportunity for people with disabilities to have equal access to the same health/wellness initiatives offered to other members of the community.				
Plan-Do-Study-Act (PDSA) Cycles, Deming WE, website: https://deming.org/explore/p-d-s-a 2018; Mowan/Clifford Norman pub 1950; PDSA created from 1986 to 1993 (60)	The cycle begins with the Plan step. This involves identifying a goal or purpose, formulating a theory, defining success metrics and putting a plan into action. These activities are followed by the Do step, in which the components of the plan are implemented, such as making a product. Next comes the Study step, where outcomes are monitored to test the validity of the plan for signs of progress and success, or problems and areas for improvement. The Act step closes the cycle, integrating the learning generated by the	Multi-level	20th century industry	Multiple applications	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	entire process, which can be used to adjust the goal, change methods, reformulate a theory altogether, or broaden the learning – improvement cycle from a small-scale experiment to a larger implementation Plan. These four steps can be repeated over and over as part of a never-ending cycle of continual learning and improvement.				
Quality Implementation Framework, Meyers, Am J Community Psychol, 2012 (61)	Four phases and fourteen steps. Phase One: Initial considerations regarding the host setting Assessment strategies 1. Conducting a needs and resources assessment	Multi-level	Clinic, outpatient, multi-context not just healthcare, implementation research	Multiple applications	IO

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	2. Conducting a fit assessment 3. Conducting a capacity/readiness assessment Decisions about adaptation 4. Possibility for adaptation Capacity-building strategies 5. Obtaining explicit buy-in from critical stakeholders and fostering a supportive community/organizational climate 6. Building general/organizational capacity 7. Staff recruitment/maintenance 8. Effective pre-innovation staff training				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	Phase Two: Creating a structure for implementation Structural features for implementation 9. Creating implementation teams 10. Developing an implementation plan Phase Three: Ongoing structure once implementation begins Ongoing implementation support strategies 11. Technical assistance/coaching/supervision 12. Process evaluation 13. Supportive feedback mechanism				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	Phase Four: Improving future applications 14. Learning from experience				
The Translational Model of the Black Dog Institute, Werner-Seidler A, Frontiers in Psychology, 2016 (83)	Development of an Institute-specific translational model, the purpose of which is to guide staff in recognizing how their role contributes to the translational program, and to create a framework for translation. Pinwheel of six circles around edge connected to center by spokes all bidirectionally connected. Knowledge creation information and resources radiate from center to edges and outwards. Components include: knowledge creation in the center. Then a cycle of identify problem, select and adapt knowledge, implement programs, monitor knowledge	multilevel (community - based and organizational)	Mental Health/ Black Dog Institute Australia	Two examples provided where model is used Headstrong and a systems approach to suicide prevention.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	use, evaluate outcomes, sustainable knowledge use.				
Western Australia (WA) Health Network Policy Development and Implementation Cycle, Briggs AM, BMC Health Services Research, 2012 (63)	The aim of the WA Health Network is to involve all stakeholders with a shared interest in health to interact and exchange information with a view to collaboratively plan and facilitate implementation of consumer-centered i) development of the Model of Care, ii) policy uptake and, iii) policy implementation. At each stage, stakeholder engagement, through engagement and consultation, is critical health services and policies (locally, coined 'connect, share, improve'); therefore, this model may also be considered a	Multi-level	Chronic disease, service delivery	Western Health Network model applied to musculoskeletal health.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	community of practice approach.				

I=individual, O=organization, P=policy;

Table 2. 4 Full-spectrum KT Theories, Models, Frameworks that fit the Classic Theories Category (n=8)

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Diffusion of Innovations, Rogers, Diffusion of Innovations, 1983 (9)	Four elements in the diffusion of innovations: the innovation, communication channels, time and a social system. The innovation-decision process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. Five main steps in the innovation-decision process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation.	Multi-level	Diffusion research	Case illustrations presented; multiple examples in chapter and later articles	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Interorganizational Relations Theory, Steckler A book chapter, Mobilizing organizations for health enhancement: theories of organizational change. In: Glanz K, Rimer B, Lewis FM, eds. Health Behavior and Health Education: Theory, Research and Practice. 3rd ed. San Francisco, CA: Jossey-Bass; 2002:335---360 2002 and used website. http://www.med.upenn.edu/hbhe4/part4-ch15-	Interorganizational theory is a branch of organizational theory that focuses on how organizations work together. It is directed at the social ecology of multiple organizations that operate within communities. Collaboration among organizations often leads to more comprehensive and coordinated approach to public health than can be achieved by one organization. Components: Addresses change across organizations; Focuses on how organizations work together; Based on the premise that collaboration among community organizations leads to a more Comprehensive coordinated approach to a complex issue that can be achieved by one organization.	Organization/ Policy	Organizational research and industry	Grassroots coalitions of leaders from rural black churches, multiple hospital systems that reduce competition and provide flexibility in the face of accelerated changes in technology	OP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
interorganizational-relations-theory.shtml (65)					
Precaution Adoption Process Model (PAPM), The Precaution Adoption Process Model" by Neil D. Weinstein, Peter M. Sandman, and Susan J. Blalock, in Karen Glanz, Barbara K. Rimer, and K. Viswanath (eds.), Health Behavior and Health Education, 4th. ed. (San Francisco: Jossey-Bass, 2008), pp. 123–147 (67)	It is a stage theory. The PAPM attempts to explain how a person comes to decisions to take action and how he or she translates that decision into action. PAPM identifies seven stages along the path from lack of awareness to action. At some initial point in time, people are unaware of the health issue (Stage 1). When they first learn something about the issue, they are no longer unaware, but they are not yet engaged by it either (Stage 2). People who reach the decision-making stage (Stage 3) have become engaged by the issue and are considering tier response. This decision-making process can result in	Clinic, community, patients, home, mass media, clinical, individual	Community based, health behaviour research	Home radon testing and taking calcium for osteoporosis prevention but used theoretically not in practice.	IO

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	one of three outcomes: They may suspend judgment, remaining in Stage 3 for the moment. They may decide to take no action, moving to Stage 4 and halting the precaution adoption process, at least for the time being. Or, they may decide to adopt the precaution, moving to Stage 5. For those who decide to adopt the precaution, the next step is to initiate the behavior (Stage 6). A seventh stage, if relevant, indicates that the behavior has been maintained over time (Stage 7).				
Self-Regulation Theory, Baumeister R, book chapter, Baumeister, Roy; Schmeichel, Brandon; Vohs, Kathleen. "Self-Regulation and the	The activities and functions of the self, as well as the accumulated knowledge and understanding arising from research on the self, can be broadly grouped according to three main dimensions. These are presumably based on	Individual	Philosophy of human nature	Unclear	I

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Executive Function: The Self as Controlling Agent". Social psychology: Handbook of basic principles. Self-regulation, ego depletion, and inhibition 2011 (66)	three basic phenomena that give rise to selfhood. The first is reflexive awareness: consciousness can be directed toward its source, so that just as people become aware of and learn about the world, they can also become aware of and learn about themselves. The eventual upshot is a body of knowledge and belief about the self, often called the self-concept. Without this, a self would be inconceivable. Second, the self is used to relate to others. People do not in fact develop elaborate self-concepts simply by contemplating themselves or reflecting on what they have done. Instead, they come to know themselves by interacting with others. The third is executive function or				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	agent. The self exerts control over it environment by doing (making decisions and choices).				
Social Cognitive Theory (SCT), Bandura A, website: Bandura, Albert (1991). "Social Cognitive Theory of Self-Regulation" (PDF). Organizational Behavior and Human Decision Processes. http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories5.html (64)	It posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior. The unique feature of SCT is the emphasis on social influence and its emphasis on external and internal social reinforcement. SCT considers the unique way in which individuals acquire and maintain behavior, while also considering the social environment in which individuals perform the behavior. The theory takes into account a person's past experiences, which factor into whether behavioral action will occur. These past	Individual	Philosophy of human nature	Unclear	I

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	experiences influences reinforcements, expectations, and expectancies, all of which shape whether a person will engage in a specific behavior and the reasons why a person engages in that behavior. The first five constructs were developed as part of the SLT; the construct of self-efficacy was added when the theory evolved into SCT. 1.Reciprocal Determinism - This is the central concept of SCT. This refers to the dynamic and reciprocal interaction of person (individual with a set of learned experiences), environment (external social context), and behavior (responses to stimuli to achieve goals).				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	2.Behavioral Capability - This refers to a person's actual ability to perform a behavior through essential knowledge and skills. In order to successfully perform a behavior, a person must know what to do and how to do it. People learn from the consequences of their behavior, which also affects the environment in which they live. 3.Observational Learning - This asserts that people can witness and observe a behavior conducted by others, and then reproduce those actions. This is often exhibited through "modeling" of behaviors. If individuals see successful demonstration of a behavior, they can also				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	complete the behavior successfully. 4.Reinforcements - This refers to the internal or external responses to a person's behavior that affect the likelihood of continuing or discontinuing the behavior. Reinforcements can be self-initiated or in the environment, and reinforcements can be positive or negative. This is the construct of SCT that most closely ties to the reciprocal relationship between behavior and environment. 5.Expectations - This refers to the anticipated consequences of a person's behavior. Outcome expectations can be health-related or not health-related. People anticipate the				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	consequences of their actions before engaging in the behavior, and these anticipated consequences can influence successful completion of the behavior. Expectations derive largely from previous experience. While expectancies also derive from previous experience, expectancies focus on the value that is placed on the outcome and are subjective to the individual. 6.Self-efficacy - This refers to the level of a person's confidence in his or her ability to successfully perform a behavior. Self-efficacy is unique to SCT although other theories have added this construct at later dates, such as the Theory of Planned Behavior. Self-				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	efficacy is influenced by a person's specific capabilities and other individual factors, as well as by environmental factors (barriers and facilitators).				
Social Ecology Model for Health Promotion, Stokols D, American Psychologist,1992 (69)	Dimensions and criteria for health-promotive environments: physical health, mental and emotional well-being, social cohesion at organizational and community levels.	Multi-level	Health promotion, social ecology in healthcare	Smoking and protect natural resources and quality of public environments.	IOP
Social Learning Theory (SLT), Bandura A, website, https://www.betterhelp.com/advice/psychologists/albert-banduras-social-learning-theory 1952 (68)	Development of a theory to explain learning behaviours/processes. All learning is the result of observing and modeling the behaviors of others. See Social Cognitive theory above.	Individual	Psychology of learning	Unclear	I

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	Here are the stages of learning, according to Social Learning Theory. 1.Attention 2.Retention 3.Reproduction 4.Motivation				
Transtheoretical Model of Behaviour Change, Prochaska, JO, American Journal of Health Promotion, 1997 (71)	Uses a temporal dimension, the stages of change, to integrate processes and principles of change from different theories of intervention. The goal was a systematic integration of a field that had fragmented into more than 300 theories of psychotherapy. The transtheoretical model posits that health behavior change involves progress through six stages of change: precontemplation, contemplation, preparation, action, maintenance, and	Multi-level	Health promotion/ smoking cessation intervention	Applied to smoking cessation interventions.	IO

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	termination. Ten processes of change have been identified for producing progress along with decisional balance, self-efficacy, and temptations				

I=individual, O=organization, P=policy;

Table 2. 5 Full-spectrum KT Theories, Models, Frameworks that fit the Determinant or Evaluation Frameworks Category (n=6)

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Determinant Frameworks (n=3)					
Social Marketing Framework, Social Marketing National Excellence Collaborative, Turning Point National Program Office at the University of Washington, 2003Social Marketing and Public Health Lessons from the Field - SSWM https://www.sswm.info/node/1984 (62)	There are three components that are essential to any definition. First is the role of marketing techniques—which necessitate putting the primary audience or target audience (aka "customer") at the center of every decision. Second is that the focus of the endeavor is on voluntary behavior change. Third, is that the behavior change is for the benefit of an individual, group, or population, not for profit or commercial gain. Social marketing integrates the marketing mix of the 5 Ps (Product, Price, Place, Promotion, and Policy factors) as well as the exchange and competition	Multi-level	Public health	Twelve Case studies described	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	factors with the outcome of behavior change.				
Consolidated Framework for Implementation Research (CFIR), Damschroder L, Implementation Science, 2009 (72)	The CFIR is 'meta-theoretical'. It includes constructs from a synthesis of existing theories, without depicting interrelationships, specific ecological levels, or specific hypotheses. The CFIR is composed of five major domains: intervention characteristics, outer setting, inner setting, characteristics of the individuals involved, and the process of implementation. Eight constructs were identified related to the intervention (e.g., evidence strength and quality), four constructs were identified related to outer setting (e.g., patient needs and resources), 12 constructs were identified related to inner setting (e.g., culture,	Multi-level	No specific context, consolidating multiple framework constructs	Multiple application	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	leadership engagement), five constructs were identified related to individual characteristics, and eight constructs were identified related to process (e.g., plan, evaluate, and reflect).				
Knowledge Integration Process, Glasgow RE, Am J of Public Health, 2012 (86)	There are 5 overlapping, interrelated phases of research in advancing from scientific discoveries to population health. Whatever terms are used for these phases and whether public health or medical issues are under consideration, the diagram illustrates the highly iterative nature of the cycle from discovery to translation. The process starts with the identification of a problem and the "discovery" of an opportunity or approach to tackle a health issue (T0). These discoveries can result	Multi-level	Dissemination research, NIH, Public health	Lorig et al. program implementation and other examples in paper	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	from multiple sources and disciplines such as molecular or biological insights, behavioral research, or epidemiological research. The first translational research phase (T1) involves research allowing for the development of tests or other clinical interventions, but it can also lead to nonmedical interventions such as policy, behavioral, social, or other public health interventions. The second research phase (T2) involves a rigorous analysis and investigation of whether the new interventions improve health outcomes (in randomized trials or other study designs). The end result of T2 is evidence-based guidelines and recommendations by professional organizations				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	and independent panels. (National Institutes of Health often focuses primarily on T1 and T2 research, usually in the context of drug and other clinical interventions and incorporates all T2---T4 activities under T2).				
Evaluation Frameworks (n=3)					
A Conceptual Framework for Planning and Improving Evidence-Based Practices, Spencer, Prev Chron Disease, 2013 (85)	The workgroup produced a conceptual framework consisting of two interrelated components: public health impact and quality of evidence. The public health impact component of the framework consists of the following 5 elements: effectiveness, reach, feasibility, sustainability, and transferability. These elements are derived in part from the reach, effectiveness, adoption, implementation,	Multi-level	Public Health Translation-al Research	Center for Disease Control programs	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	maintenance (RE-AIM) model for translational research (73); the integrative validity model; and the systematic screening and assessment method. The quality-of-evidence component refers to where a practice lies on an evidence-based practice continuum. These elements represent four levels of evidentiary quality - weak, moderate, strong, and rigorous. At the intersection of impact and quality of evidence, a continuum of evidence-based practice emerges. This continuum represents the ongoing application of knowledge about what is working to strengthen impact in a given context. A continuum was created consisting of 4 stages				

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	- emerging, promising, leading, and best.				
PRECEDE-PROCEED, Green, book chapter, Green L, Kreuter M. Health Program Planning: An Educational and Ecological Approach. 4th edition ed. McGraw-Hill Higher Education; New York, NY: 2005 (74)	The framework has two components: the first set of phases consists of a series of planned assessments that generate information that will be used to guide subsequent decisions. This series of phases involves considerable sifting and sorting and is referred to as PRECEDE for predisposing, reinforcing, and enabling constructs in educational/ecological diagnosis and evaluation. The second component is marked by the strategic implementation of multiple actions based on what was learned from the assessments in the initial phase. The second component is named PROCEED for policy, regulatory, and organizational	Multi-level (practitioner, epi-demiologists, social, behavioural, economic, and political scientists)	Health Research	Used to guide planning efforts addressing health issues in communities, schools, health care settings and workplaces.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	constructs in educational and environmental development. Evaluation is an integral part of both phases and serves as the primary vehicle to ensure the quality of the planning process.				
RE-AIM, Glasgow, America Journal of Public Health,1999 (73)	It is an evaluation framework for public health. The public health impact of an intervention as a function of 5 factors: reach, efficacy, adoption, implementation, and maintenance. Each of the 5 RE-AIM dimensions is represented on a 0 to 1 (or 0% to 100%) scale.	Individual or organizational	Healthcare Public health	Multiple applications	IO

I=individual, O=organization, P=policy;

Table 2. 6 Full-spectrum KT Theories, Models, Frameworks that fit More than one Theoretical Approach Category (n=4)

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
Process Model and Classic Theory (n=1)					
Stage Theory of Organizational Change, Butterfoss FD, book chapter, Karen Glanz, Barbara K. Rimer, and K. Viswanath, 2008 Health Behavior and Health Education: Theory, Research, and Practice, 4th Edition (70)	According to stage theory of organizational change, adoption of an innovation by an organization typically follows several stages. Each stage requires a specific set of strategies that are contingent on the organization's stage of adoption, implementing, and sustaining new approaches, as well as on the socioenvironmental factors that may be outside the organization's control. To use stage theory effectively, the social environment and the innovation's stage of development must be carefully assessed before appropriate strategies are selected for each stage. 1.	Organization/ Policy	Organization change research /industry	Unclear	OP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	define problem (awareness stage); 2. initiate action (adoption stage); 3. implement change; 4. institutionalize change.				
Classic Theory and Determinant Framework (n=2)					
Community Connection Model, Liddy C, Public Health, 2013 (75)	This model of program implementation and sustainability consists of four components policy, partnership, planning and program that interact at all stages of program development and implementation. The Community Connection Model demonstrates how sustainable programs can 'be grown' by establishing and maintaining interaction between the four components	Multi-level	Chronic disease	Tested the Stanford Chronic Disease Self-Management Program; model developed. living health Champlain workshop.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	of policy, partnership, planning and program.				
Community to Community Mentoring (CCM) model, Delafield R, Progress in Community Health Partnerships: Research, Education and Action, 2016 (76)	The CCM model uses Community-based Participatory Research (CBPR) principles to orient an approach to dissemination with two objectives: (1) effectively disseminating Evidence-based interventions (EBI)s while (2) building organizational and community capacity to create sustainable changes required to improve the health and well-being of participating communities. Specifically, the CCM model combines elements of the Diffusion of Innovations theory, the social cognitive theory, and key concepts that are common to community organizing and	Multi-level	Community	It was used for the pilot study of five new community partners.	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	community building processes and practices. The CCM model uses a CBPR approach applied to EBI dissemination research. It does this through nesting the dissemination of innovations (in this case the EBI) within a CBPR orientation. There are four major components of the CCM model: (1) the context, (2) the CBPR principles, (3) the partnerships, and (4) the innovation elements.				
Process Model and Evaluation Framework (n=1)					
Evidence-Driven Community Health Improvement Process (EDCHIP), Layde, American Journal of Public Health 2012 (84)	This model started with the framework of the Community Health Improvement Process (CHIP). To incorporate current thinking on evidence-based public health interventions, this model modifies CHIP's planning	Community	Public health, community-based research	Community based applications	IOP

Name of KT Theory, Model or Framework, author, source, year	Description	Primary Target Audience or User	Context	How has it been used?	Level of use (I, O, P)
	and evaluation phases. Elements of evidence-based public health framework are incorporated into planning phase to make explicit the need to search the scientific literature and organize information. In addition, communicating to key community stakeholders' critical information on community patterns of disease and risk factors and on efficacious interventions identified from the literature. For evaluation, the reach, effectiveness, adoption, implementation, and maintenance (RE-AIM) model of Glasgow et al. is followed which has been used in translation research (73).				

I=individual, O=organization, P=policy;

Supplementary Table 2. 1 List of Excluded Theories, Models and Frameworks that did not meet full-spectrum KT phase (s) (n=19)

Theory, Model, Framework	Reference	Stages of KT - planning/design	Stages of KT - implementation	Stages of KT - evaluation	Stages of KT - sustainability/ scalability
From Electronic Searches (n=1)					
A Knowledge Translation framework on ageing and health	Ellen 2017				x
From Hand search of Reference List (n=1)					
Evidence Integration Triangle	Glasgow 2012				x
From Milat review (n=17)					
Evidence based public health (EBPH) models	Brownson 2009				x
Implementation Science	Sivaram 2014				x
Overarching knowledge translation framework	Colquhoun 2014				x
Policy effectiveness-feasibility loop (PEFL)	Bowman 2012				x
LEAD framework	Kumanyika 2012				x

Theory, Model, Framework	Reference	Stages of KT - planning/design	Stages of KT - implementation	Stages of KT - evaluation	Stages of KT - sustainability/ scalability
Policy-into-practice intervention for management of low back pain	Slater 2012				x
Research-Practice Integration framework	Vivian 2012				x
Evidence-informed decision making	Ward 2011			x	x
Translation framework for public health	Ogilvie 2009				x
Translation al research paradigm	Spoth 2008			x	x
Model for closing the evidence-to practice gap	Lang 2007				x
Knowledge integration model	Gauthier 2005				x
Evidence-informed policy and practice	Bowen and Zwi 2005				x
Framework for transforming	Neufeldt 2004				x

Theory, Model, Framework	Reference	Stages of KT - planning/design	Stages of KT - implementation	Stages of KT - evaluation	Stages of KT - sustainability/ scalability
knowledge into practice					
Contextual knowledge translation framework	Ho 2004				x
Program assessment feedback model	Sneden 2006				x
International Obesity Task Force Evidence requirements for obesity prevention	Swinburn 2005				x

CHAPTER THREE: IS THERE A KNOWLEDGE TRANSLATION THEORY, MODEL, OR FRAMEWORK SUITABLE FOR HEALTH TECHNOLOGY REASSESSMENT? RESULTS FROM AN INTERNATIONAL SURVEY

This chapter has been submitted for publication as:

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The work in this chapter describes the results of an international survey of Knowledge Translation (KT) and Health Technology Reassessment (HTR) experts to determine if there is a suitable KT theory, model or framework (KT TMF) for HTR. Although consensus on a KT TMF was not reached, this work illustrated that there are four potential KT TMFs that may be useful for HTR. Moreover, it may be important to further consider characteristics of KT TMFs for HTR.

3.1 Abstract:

Objective: Health Technology Reassessment (HTR) is an emerging field focused on managing a technology throughout its lifecycle for optimal use. The process results in four recommendations: increase use, decrease use, no change, or complete withdrawal of the technology. However, implementation of these recommendations has been challenging. This paper explores knowledge translation (KT) theories, models and frameworks (TMFs) and their suitability for implementation of HTR recommendations.

Design: Cross-sectional Survey

Participants: Purposeful sampling of international KT and HTR experts was conducted between January and March 2019.

Methods: Sixteen full-spectrum KT TMFs were rated by the experts as "yes", "partially yes", or "no" on six criteria: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability. Consensus was determined as a rating of ≥ 70% responding "yes". Descriptive statistics and manifest content analysis was conducted on open-ended comments.

Results: Eleven HTR and 11 KT experts from Canada, US, UK, Australia, Germany, Spain, Italy and Sweden participated. Of the 16 KT TMFs, none received ≥ 70% rating. When ratings

of "yes" and "partially yes" were combined, the Consolidated Framework for Implementation Research (CFIR) was considered the most suitable KT TMF by both KT and HTR experts (86%). One additional KT TMF was selected by KT experts: Knowledge-to-Action framework. HTR experts selected two additional KT TMFs: co-KT framework and Plan-Do-Study-Act cycle. Experts identified three key characteristics of a KT TMF that may be important to consider: practicality, guidance on implementation, and KT TMF adaptability.

Conclusions: Despite not reaching an overall ≥70% level of consensus, experts identified four KT TMFs suitable for HTR. Users may apply these KT TMFs in the implementation of HTR recommendations. In addition, KT TMFs characteristics relevant to the field of HTR need to be explored further.

3.2 Article Summary

3.2.1 Strengths and Limitations of Study

- This was the first study to survey HTR and KT experts on KT TMFs that could be suitable for HTR.
- Through purposeful sampling, an international survey was conducted and experts were asked to rate KT TMFs as "yes", "partially yes", or "no" on six criteria: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability.
- Descriptive statistics on ratings and manifest content analysis was conducted on open-ended comments.
- The sample size of international KT and HTR experts was small to generate ≥70% level of consensus on which KT TMFs may be suitable for HTR.

3.3 Background

Health Technology Reassessment (HTR) is the systematic process of evaluating technologies that are currently in the system to ensure that they are being used optimally (103). Recommendations from the HTR process can result in the increase use, decrease use, no change, or complete withdrawal of the technology (3). However, implementation of these recommendations has been challenging (3). It has been argued that the field of knowledge translation (KT) could play a role in the implementation process for HTR recommendations (93). KT has been described as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of [populations], provide more effective health services and products, and strengthen the healthcare system" (42). KT can be seen as complimentary to the HTR process, but there has been a paucity of research in this area (93). Moreover, there is a gap in our understanding of which KT theories, models, or frameworks (KT TMFs hereafter) would be best suited for the translation of HTR recommendations (93).

Reviews have reported from 41 to 159 KT TMFs depending on how they are identified and considered (14, 15, 17, 47). KT TMFs have been used in different contexts, settings, and populations (14, 15, 17, 47). Moreover, there has been some use of the KT interventions, strategies, and TMFs to decrease or remove low value care (104, 105). These KT TMFs have been used to help identify determinants, barriers and enablers to behaviour change related to HTR (106, 107). However, the use of these KT TMFs has not been applied consistently to the development of KT interventions or the field of HTR (93, 108). There are also no

recommendations about which KT TMFs could be used. Through an international survey of KT and HTR experts, this study aims to provide an understanding of which KT TMFs could be appropriate for the HTR process and implementation of its recommendations.

3.4 Methods

This study used three approaches to the selection of KT TMFs for HTR: identification of suitable KT TMFs, consensus on the list of KT TMFs through a modified Delphi process, and selection of potentially suitable KT TMFs through a survey of international KT and HTR experts.

Ethics approval was obtained from the University of Calgary's Conjoint Health Research Ethics Board [REB#17-0932].

3.4.1 Identification of Suitable KT TMFs

Only full-spectrum KT TMFs were included. "Full-spectrum" includes all four KT phases: planning/design, implementation, evaluation, and sustainability/scalability (8). These four KT phases are critical to the KT process and are thought to be necessary for the HTR process and implementation of its recommendations (93). A recent scoping review provided a preliminary list of 26 full-spectrum KT TMFs within cancer and chronic disease management contexts (47). A recent update resulted in 36 full-spectrum KT TMFs identified (109). Eighteen were process models, eight were classic theories, three were determinant frameworks, three were evaluation

frameworks, and four fit more than one approach category (109). This list of 36 full-spectrum KT TMFs provided the initial list of KT TMFs to assess for use when implementing HTR recommendations.

3.4.2 Modified Delphi Process

A three-round modified Delphi process was undertaken (110-112). The Delphi process is iterative and used to determine expert group consensus where there is a lack of evidence and expert opinion is important (113). The expert committee was composed of two HTR and three KT experts. The first and second rounds involved independent review of each KT TMF to determine which would be suitable for HTR. Each member rated the KT TMF as "yes" , "potentially yes", or "no" for HTR suitability. Consensus to keep the KT TMF was defined as 100% of the members rating the KT TMF as "yes" and/or "potentially yes". Consensus to eliminate the KT TMF was defined as 100% of the members rating the KT TMF as 'no" and/or 'potentially no'. Any KT TMFs that did not reach consensus were discussed in subsequent rounds. The third round entailed a two-hour face-to-face meeting held in October 2018. Prior to the discussion at this meeting, committee members agreed on ground rules, principles, and criteria for selection of KT TMFs for HTR suitability (Table 3.1). Committee members deliberated on the remaining KT TMFs until consensus was reached. Verbal consent to participate was obtained prior and the meeting was recorded.

3.4.3 International Expert Survey

Selection of Experts to Review KT TMFs for HTR

HTR and KT experts were selected through purposive and snowball sampling. Names were initially derived through the KT Canada website, Health Technology Assessment international (HTAi) Disinvestment Interest group, authors of relevant publications, and in consultation with other experts. A list of HTR and KT international experts was generated by country including Canada, US, UK, Australia, and European countries (Germany, Italy, Sweden, Spain). Experts were contacted via email to participate in the study. They were sent an email, invitation letter, and information sheet. If they agreed to participate, they were sent a consent form, a survey with the list of KT TMFs identified by the Delphi process to rate (Appendix C), and recent article on the topic as background information (93). If they were unable to participate, the next expert name on the list was contacted. This was done to ensure that there were at least two HTR and two KT experts from each of Canada, US, UK, Australia and four HTR and four KT experts from other European countries for a target sample size of 24. Experts contacted could also suggest additional names of experts to be surveyed through snowball sampling. These names were added to the list of experts and contacted, if required, to reach a representative sample.

3.4.4 Survey Development

The Enhancing The Quality and Transparency of Health Research (EQUATOR) good practice in the conduct and reporting of survey research guidelines were followed for the development of the survey (114). The survey included the list of KT TMFs, a description of each KT TMF, followed by a link to the paper that described the KT TMF, if one was available. Specific criteria used previously to select KT TMFs were used to rate each KT TMF (94). These included: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability. Each criteria was operationally defined and reviewed by FC and HMH (Appendix D). There was also a section for open-ended comments. The survey was developed in Excel and pilot tested by four participants to ensure flow and functionality.

3.4.5 Survey Administration

The survey was administered via email to the experts starting in January 2019. Based on the criteria, each KT TMF was rated by each expert as "yes", "partially yes" or "no' and additional comments could be provided. Experts were also asked to suggest additional full-spectrum KT TMFs that could be suitable for HTR and recommend other experts that could be contacted for the study. Consensus was determined as $\geq$ 70% experts selected "yes" for the particular KT TMF. The principles and criteria described in Table 3.1 were also shared with the international experts for information purposes. Experts were asked to return the survey within two weeks. Two additional reminders were sent. If surveys were not returned, then another expert on the list

was contacted to participate in the study. The survey was sent out to experts until March 31, 2019 to ensure that at least two HTR and two KT experts had agreed to complete the survey from the identified countries.

3.5 Data Analysis

Modified Delphi Process

After rounds 1 and 2 of the modified Delphi process, data were analyzed descriptively by tabulating the "yes", "potentially yes", and "no" responses for HTR suitability for each KT TMF reviewed by the expert committee members.

Survey Data

Survey data were analyzed descriptively by tabulating the "yes", "partially yes", and "no" responses for HTR suitability for each KT TMF and by HTR and KT expert sub-groups. KT TMF familiarity and missing data were also descriptively summarized.

Data from the open-ended comments section of the survey provided by the HTR and KT experts was analyzed using content analysis (115). As these data were limited in volume, content analysis was undertaken to provide a starting point in determining preliminary factors that may be important to consider for a KT TMF for HTR.

Initially, all comments from each expert were entered into Excel and categorized by KT TMF. These were read and reread to get familiarized with the data. Next, for each KT TMF, each comment was organized by response to HTR suitability as "yes", "partially yes", "no", and unfamiliar with the KT TMF. This categorization provided an understanding of what comments may or may not be important to consider for HTR suitability. Open coding and constant comparison were applied inductively to all the comments. A preliminary list of codes, sub-codes, and operational definitions were developed manually through independent review of the comments from three KT TMFs (Consolidated Framework for Implementation Research (CFIR), Stages of Research Evaluation, and Knowledge-to-Action (KTA) framework) by RE and HMH. A final taxonomy consisting of codes, sub-codes, operational definitions, and exemplar quotes was applied manually to the comments for the remaining KT TMFs by RE (Box 3.1). Manifest content analysis, defined as the development of categories as opposed to latent content analysis (defined as the development of themes), was determined to be best suited given the nature of the open-ended comments (115). Therefore, categories were created, grouping codes under higher order headings, and formulating a general description of these categories. In addition, the frequency of comments for each code in each category was also tabulated by HTR and KT expert to determine the top categories/codes. The most prominent codes and interpretation of the data were then determined through the frequency counts, discussion and consensus among FC and HMH.

3.6 Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research.

3.7 Results

3.7.1 Modified Delphi Process

The results of the modified Delphi process are presented in Table 3.2. The third round resulted in the selection of 16 full-spectrum KT TMFs. There were 12 process models, two frameworks, one classic theory, and one KT TMF that fit two categories (model and framework). Twenty KT TMFs were excluded. Fourteen were too vague and not descriptive enough, two were considered 'passive' and not 'active' KT TMFs to make change happen, two were not pragmatic, and two were too specific to a given context (i.e. guideline adaptation and disability research) (Appendix E).

3.7.2 International Expert Survey

Forty-eight KT experts and 31 HTR experts were invited to participate via email. A total of 22 experts (11 KT and 11 HTR) completed the survey. Experts were from Canada (4), US (5), UK (4), Australia (4), Germany (2), Spain (1), Italy (1), and Sweden (1). Fifty-nine percent were women, and all had graduate-level education (Masters or PhD).

Overall, of the 16 KT TMFs none received a "yes" rating for HTR suitability by ≥ 70% of the experts. The top three most highly rated KT TMFs were CFIR (72), KTA (12) and the Plan-Do-Study-Act (PDSA) cycle (60). Thirty-eight percent of the experts rated CFIR as "yes", followed by 27% each for the KTA framework and the PDSA cycle (60). The least rated KT TMFs by the experts were the KT framework for Agency for Healthcare Research and Quality (AHRQ)

patient safety portfolio and grantees (80), the Stages of Research Evaluation (87), the Staged Model of Innovation Development, and Diffusion of Health Promotion Programs (57) that all received 0% ratings for "yes" by the experts (Figure 3.1). Combination of the "yes" or 'partially yes' ratings found that 86% (19/22) of the experts selected CFIR as the top rated KT TMF for HTR suitability (72).

3.7.3 Stratified analysis by KT and HTR Expertise

KT experts favored KTA (82%, 9/11) as another KT TMF that would be suitable for HTR (12) in addition to CFIR (91%, 10/11). The HTR experts favored the Co-KT Framework (72%, 8/11) (79) and the PDSA cycle (72%, 8/11) (60) in addition to CFIR (82%, 9/11).

3.7.4 Content Analysis

Forty-nine percent of the comments provided by both KT and HTR experts were related to the TMF characteristics category, followed by the TMF attributes category (19%). Implementation and user categories both had 13% each (Figure 3.2).

Overall, the top code was pragmatic under the TMF characteristics category (14%) defined as the KT TMF not being theoretical but practical and application of the TMF outside of research or academic settings. This was followed by implementation (13%), defined as the KT TMF provides operation detail on how to 'do' the implementation to achieve the HTR outputs. This

also included exploring determinants, their inter-relationships, and the development of interventions or strategies based on these determinants. The third top code was HTR suitability under the TMF attributes category (8%), defined as a 'strong fit' to HTR and its determinants. It also included the ability to adapt the KT TMF and tailor it to micro (individual), meso (organizational) and macro (policy) levels (93).

More KT experts than HTR experts commented on pragmatic as an important characteristic for a KT TMF (56% versus 44%). There were both positive and negative comments related to pragmatic for a KT TMF that would make it suitable for HTR. For example, one KT expert who said "yes" to HTR suitability for the PDSA cycle noted the following positive affect:

> "A basic, simple but still very useful approach" [009].

In contrast, in reference to the Stages of Research Evaluation, one HTR expert who said 'no" to HTR suitability stated the following negative affect:

> "This is also difficult to be implemented in reality as it is far from explaining the characteristics of the healthcare systems and professional interactions" [017].

More KT experts than HTR experts provided comments related to implementation (78% versus 22%). There were both positive and negative affects of comments related to implementation for a KT TMF that would make it suitable for HTR. One KT expert who said "yes" to HTR suitability for the Quality Implementation framework stated the following positive affect:

> "I'm not familiar with specifics about this framework; it certainly covers the full-spectrum of considerations for implementing new interventions; could be adapted for de-adoption/implementation "[005].

On the contrary, another KT expert who said 'no" to HTR suitability with respect to Diffusion of Innovation theory stated the following negative affect:

> "I think (as it is a general theory rather than an implementation framework/model) that it lacks sufficient guidance on how to implement/de-implement" [007].

More KT experts provided comments to HTR suitability than HTR experts (60% versus 40%). There were both positive and negative affects of comments related to HTR suitability for a KT TMF. One HTR expert who said partially "yes" to HTR suitability for CFIR stated the following positive affect:

> "A lot of constructs have been included in CFIR, so in each case, it would probably require selection of the specific ones relevant for the HTR example" [021].

Whereas another KT expert who said 'no" to HTR suitability for the CollaboraKTion framework stated:

> "Depends on focus of work-this emphasizes need for community to decide on action whereas if you had a particular output in mind to implement/de-implement this might not be the best fit" [001].

However, HTR experts commented more on the ability to tailor the KT TMF to micro, meso, macro levels than KT experts (90% versus 10%).

3.8 Discussion

3.8.1 Key Findings

The focus of this study was to determine KT TMFs that could be suitable for implementation of HTR recommendations. Three key findings emerged: 1) ≥ 70% consensus (rated as "yes" by the experts) was not reached by the international KT and HTR experts on any of the full-spectrum KT TMFs; however when ratings of "yes" and "partially yes" were combined, CFIR was considered the most suitable KT TMF by both KT and HTR experts; 2) KT experts identified one additional KT TMF: KTA framework, whereas HTR experts identified two additional KT TMFs: co-KT framework and PDSA cycle as potentially suitable for the implementation of HTR recommendations; and 3) Overall, experts commented on three key characteristics of a KT TMF that may be important to consider: practicality, guidance on how to implement, and adaptability of the KT TMF to HTR.

3.8.2 Strengths

This study utilized a modified Delphi process and survey to illicit input from internal and international KT and HTR experts. Although, experts may not have sufficient knowledge of all

the KT TMFs, this was the first study that attempted to garner the opinions of experts in both fields of KT and HTR. The field of KT and its application to HTR has been proposed as a mechanism to advance the implementation of HTR recommendations into practice (93). The selection of one determinant framework (CFIR), and three process models (KTA framework, co-KT framework, and the PDSA cycle) provides a starting point of potential KT TMFs that could be used with HTR. However, as ≥ 70% consensus was not reached by the experts, these findings need to be considered as preliminary.

3.8.3 Limitations

The Delphi technique has been criticized for lack of guidelines on the determination of the size of the expert panel, lack of anonymity, what is meant by 'expert' opinion, and determination on the level of consensus (116). The sample size of five for the internal committee may have been too small to review and select KT TMFs from the list of 36 full-spectrum KT TMFs. The 100% consensus level may have been too high. There may also have been pressures of conformity at the face-to-face meeting. However, there was a wide-range of expertise within the internal committee including two physicians, health economist, epidemiologist, and social scientist all with backgrounds in HTR, KT or both. The use of a facilitator and establishment of ground rules, and principles upfront were important considerations to address pressures of conformity.

Although purposeful sampling was used for the survey, the sample size of international KT and HTR experts was small which may have reduced the ability to generate consensus. Both the KT and HTR communities are relatively new and small. Therefore, there is a limit to the pool of

experts one can select from. However, a wide net was cast to recruit experts and efforts were also made to ensure a representative sample from different jurisdictions and depth and breadth of knowledge in both KT and HTR. Lastly, the selection of 70% consensus was arbitrary and determined a priori to survey administration. This level of agreement has been considered appropriate in previous Delphi studies (117), but there is no acceptable level of consensus (116).

3.8.4 Implications of Findings

Among the list of 16 full-spectrum KT TMFs identified through a modified Delphi process, the international experts were unable to determine a clear KT TMF for HTR. Lack of familiarity with the KT TMFs could be one reason. Specifically, experts were not familiar enough with four of the 16 KT TMFs to rate them for HTR suitability. Over recent years, there has been a flurry of KT TMFs developed (47). This proliferation of KT TMFs makes it challenging for experts to keep abreast of them all. Moreover, there has been criticism of the development of KT TMFs without adequate testing, validation and research (44). Experts within the KT field may lean towards those KT TMFs that they are most familiar with (47).

Another reason experts were challenged to select a KT TMF could have been due to the lack of understanding of the HTR process. KT experts in particular, may have found it difficult to review the KT TMFs and then apply them to HTR, as they may not be familiar enough with the HTR process itself. HTR is a relatively new field and has been confused with terms such as ‘disinvestment’ and ‘de-adoption’, which are considered outcomes of the HTR process rather than the process itself (3). In addition, the field of HTR is under-developed and concepts have

yet to be agreed upon (93). An information sheet and background paper with a description of the fields of KT and HTR was provided to the experts prior to the survey. However, these materials may not have been reviewed in advance or been a sufficient knowledge resource.

CFIR was the only KT TMF selected by both HTR and KT experts as a potential KT TMF that could be used for HTR. CFIR has been used widely and is a well-operationalized, multi-level implementation determinant framework derived from theory (101, 118). The application of CFIR and its constructs may enable users to assess facilitators and barriers to the implementation of HTR recommendations, particularly when HTR recommendations result in decrease use or removal of the technology. The assessment of facilitators and barriers has been noted as an important step within the de-adoption process of low value care (6, 93). However, studies that apply CFIR to HTR projects are required to provide further understanding of its application.

The KTA framework was primarily selected as suitable for HTR by KT experts. Its selection could be due to its wide-spread use in the KT field (119, 120). In fact, one adaptation of the KTA framework has been the Synthesis Framework for Facilitating De-adoption (6). This framework has been proposed as one that could be used for potential HTR projects (93). However, it has yet to be applied in practice for HTR. Nonetheless, the KTA framework's ability to be adaptable may be another factor as to its selection primarily by KT experts.

The co-KT framework (79) and PDSA cycle (60) were primarily selected for HTR suitability by HTR experts. Both are process models (109). The co-KT framework is a linear process and may be considered simplistic to apply. The PDSA cycle has been used extensively in quality

improvement as a model for change (121). It is a simple and pragmatic model to use and is adaptable within other models (122). However, it is not without its limitations (121). Subsequently, selection of these KT TMFs by HTR experts may be due their ease of use.

3.8.5 Implications for Future Research

Although not the key focus of this study, three key characteristics: practicality, guidance on how to implement; and adaptability of the KT TMF to HTR were identified from the open-ended comments. Characteristics that may considered as important in a KT TMF for HTR use need to be investigated further. Moreover, future research on identifying these characteristics through expert interviews is needed to better understand which would influence and demonstrate an important role within the process of HTR.

Recently, there has also been a proliferation of disinvestment frameworks or frameworks to address overuse (108, 123, 124). Some are based on KT and Implementation Science principles (108). The focus of these frameworks has been on removing or reducing low value care from practice. The application of these frameworks is still in its infancy. Although, the list of full-spectrum KT TMFs that were examined in this study did not consider these disinvestment frameworks, there may be merit in doing so. In particular, the use of these frameworks for the HTR outputs of decrease use or complete removal of a technology.

3.9 Conclusion

This study provided insights into which KT TMFs may be suitable for HTR. Despite not attaining ≥ 70% consensus on the KT TMFs, experts selected four KT TMFs that could be used within the context of HTR. Familiarity, adaptability and ease of use may be some of the reasons that led to their selection. Moreover, characteristics of practicality, how to implement HTR recommendations, and adaptability of the KT TMF to HTR need to be interrogated to determine if they are important in a KT TMF for HTR. The process of HTR could vastly benefit from the field of KT and its application of KT TMFs in implementation of its recommendations. A better understanding and awareness of the application of KT to the field of HTR will provide much needed guidance and advancement in this area.

Table 3. 1 List of Criteria Developed by Expert Committee Members for Round 3 of Modified Delphi Process

Criteria
The final list of KT TMFs must have face validity (KT TMFs that are common and well-known should be included)
The KT TMFs must be active KT TMFs (passive KT TMFs were excluded)
The KT TMF must be feasible to apply to take something out of practice
The KT TMF was pragmatic (theoretical KT TMFs were excluded)
The KT TMF must be specific (vague or those that were not prescriptive were excluded)
The KT TMF could build on other KT TMFs but needed to be generic rather than for a specific context
The KT TMF is easily understood and practical
Any KT TMF that the committee was undecided on

Box 3. 1 Taxonomy of Codes and Sub-codes for Comments

Implementation	**TMF Characteristics**	**TMF Attributes**	**User**	**Survey Logistics/General Comments**
Codes in a KT TMF related to implementation of HTR	Codes related to elements or components in a KT TMF for HTR	Codes that are considered foundational in a KT TMF for to HTR	Codes related to the use of TMFs for HTR from a user perspective	Codes related to the process of survey administration or extraneous

• Implementation
  ○ Development of intervention or strategies
  ○ Inter-related determinants
	• Pragmatic real world application
	• Straightforward
	• Engagement of relevant (patient, public, clinician) stakeholders
	  ○ Synchronicity
	• Lack specificity/insufficient details
	• Complexity
	• Prioritization of HTR
	• Resources such as economic, evidence, funding, local factors.
	  ○ Additional support
	• Adaptation
		• HTR Suitability
		• Consideration of alternatives
		• Ability to tailor or applicability micro/meso/macro levels
		• Centrality evidence
		• Contextual fit
		• Motivation
		  ○ Challenge of removing something (feasible to apply -take something out of practice)
		• Values
			• Familiarity
			• Access
			• Use by novices
				• Survey process/method oriented
				• Non-dated data

	○ Additional TMFs • Sustainability • Evaluation • Influential ○ Originality (face validity)	• Generalizability • Not a KT TMF		

Table 3. 2 Summary of KT Theories, Models and Frameworks Included and Excluded from Rounds 1 to 3 of the Modified Delphi Process

Included in Round 1	**Excluded in Round 1**
Consolidated Framework for Implementation Research (CFIR) (Damschroder, 2009)	A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)
Stages of research evaluation (Nutbeam, 2006)	Interorganizational Relations Theory (Steckler, 2002)
Knowledge-to-Action (KTA) (Graham, 2006)	Self-Regulation Theory (Baumeister, 2011)
Quality Implementation Framework (Meyers, 2012)	Social Cognitive Theory (SCT) (Bandura, 1991)
Western Australia (WA) Health Network Policy Development and Implementation Cycle (Briggs, 2012)	Social Ecology Model for Health Promotion (Stokols, 1992)
	Transtheoretical Model of Behaviour Change (Prochaska, 1997)
Included in Round 2	**Excluded in Round 2**
Collaborative model for achieving breakthrough improvement (Institute for Healthcare Improvement, 2003)	LEAN transformation process (Lean Enterprise, 2011)
Included in Round 3	**Excluded in Round 3**
Diffusion of Innovations (Rogers, 1983)	NCHPAD (National Center on Health, Physical Activity and Disability)Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)
Healthcare Improvement Collaborative Model (Edward, 2017)	Community Connection model (Liddy, 2013)
Co-KT framework (Kitson, 2013)	Model for accelerating improvement (Associates in Process Improvement Langley, 2009)
Plan-do-study-act cycle (Deming, 1986)	Social marketing framework (National Excellence Collaborative, 2003)

A staged model of innovation development and diffusion of health promotion programs (Oldenburg, 1996)	Community-based Knowledge Translation framework (Campbell, 2010)
Evidence-driven community health improvement process (EDCHIP) (Layde, 2012)	Knowledge integration process (Glasgow, 2012)
RE-AIM (Glasgow, 1999)	Precaution Adoption Process model (Weinstein, 2008)
CollaboraKTion framework (Jenkins, 2016)	Social learning theory (Bandura, 1952)
KT framework for Agency for Healthcare Research and Quality (AHRQ) patient safety portfolio and grantees (Nieva, 2005)	CAN-IMPLEMENT (Harrison, 2018)
Design focused implementation model (Ramaswamy, 2018)	The translational model of the Black Dog Institute (Werner-Seidler, 2016)
	PRECEDE-PROCEED (Green, 2005)
	Community to community mentoring model (Liddy, 2013)
	Stage theory of organizational change (Butterfoss, 2008)
Total Included=16	**Total Excluded=20**

Figure 3. 1 HTR Suitability of KT Theories, Models, Frameworks (TMFs) by all Experts

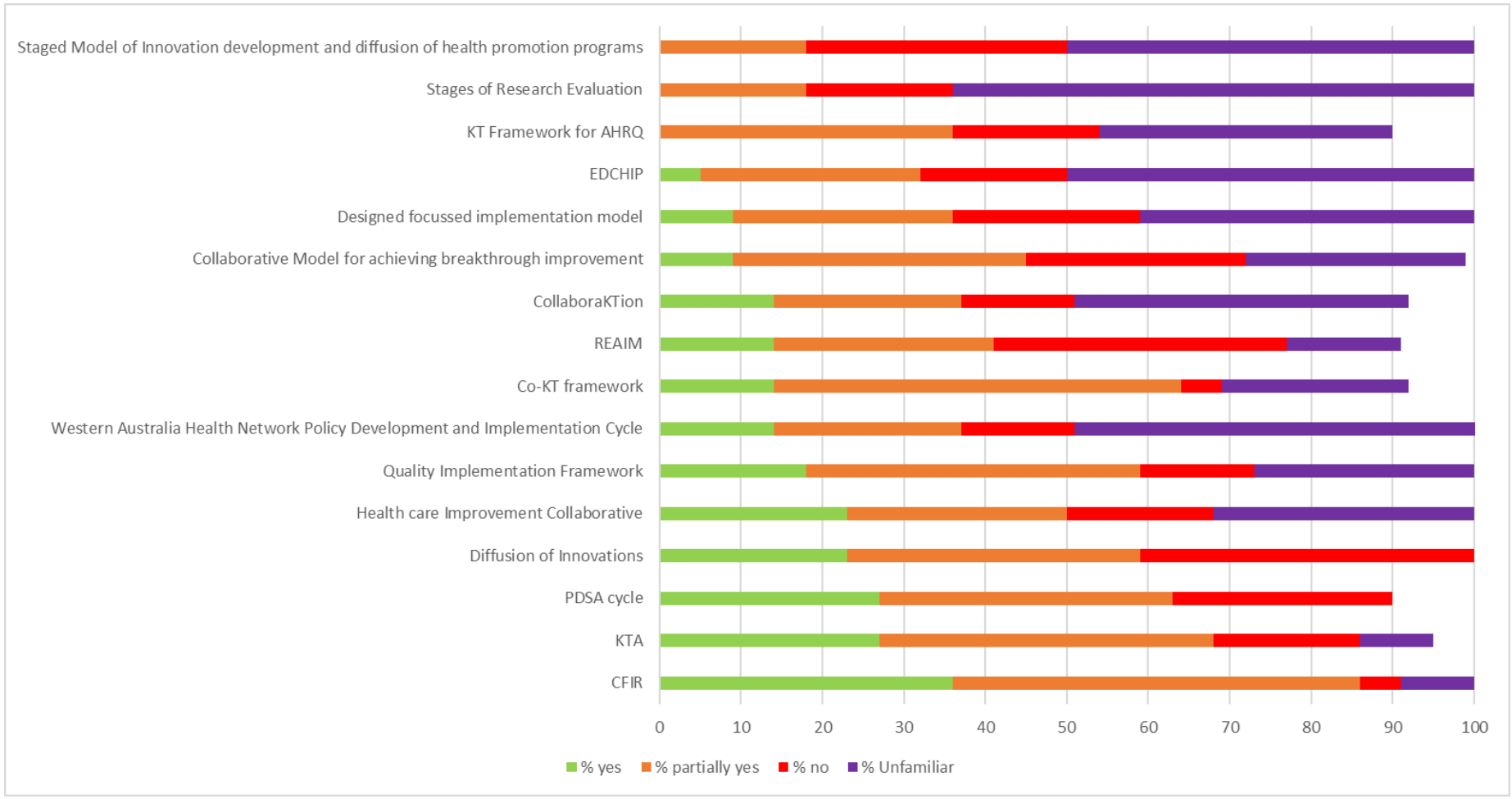
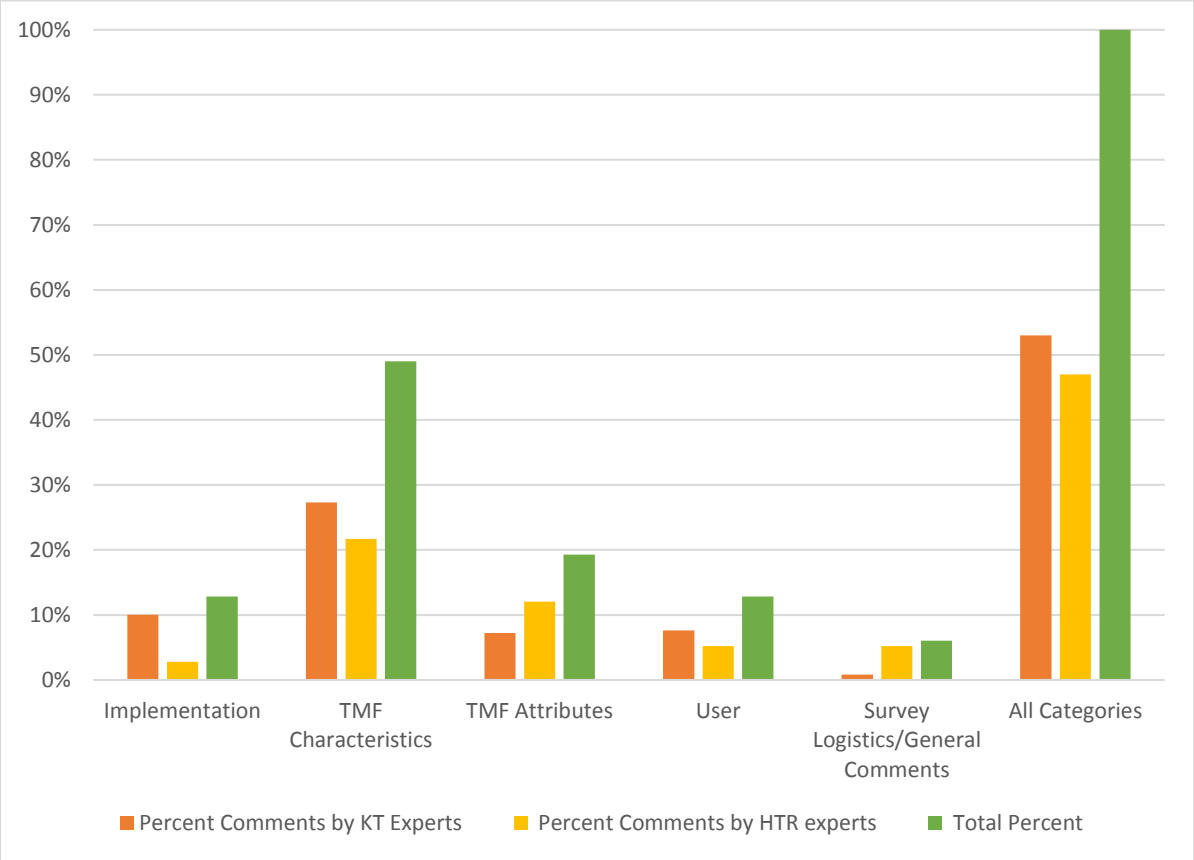


Figure 3. 2 Total Comments for Each Category Provided by KT and HTR Experts



CHAPTER FOUR: CHARACTERISTICS OF KNOWLEDGE TRANSLATION THEORIES, MODELS AND FRAMEWORKS FOR HEALTH TECHNOLOGY REASSESSMENT: EXPERT PERSPECTIVES THROUGH A QUALITATIVE EXPLORATION

This chapter has been submitted for publication as:

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The work in this chapter describes the results of a qualitative descriptive study. One-to-one semi-structured interviews with Knowledge Translation (KT) and Health Technology Reassessment (HTR) experts were conducted to determine characteristics that are important in a KT theory, model, and frameworks (KT TMF) for HTR, and in particular for the outputs of decrease use or de-adoption. Three themes emerged that illustrated the ideal traits of a KT TMF: principles that were foundational for HTR, levers of change, and steps for knowledge to action. Of the KT TMFs that were mapped, the Consolidated Framework for Implementation Research had most of the characteristics, except ability to apply to micro, meso, macro levels. Consideration of these characteristics within KT TMFs may guide users undertaking HTR projects.

4.1 Abstract:

Background: Health Technology Reassessment (HTR) is a process that systematically assesses technologies that are currently used in the health care system. The process results in four outputs: increase use or decrease use, no change, or de-adoption of a technology. Implementation of these outputs remains a challenge. The Knowledge Translation (KT) field enables knowledge into practice. KT could help with implementation of HTR outputs. This study sought to identify which characteristics of KT theories, models, and frameworks (TMFs) could be useful, specifically for decrease use or de-adoption of a technology.

Methods: A qualitative descriptive approach was used to ascertain the perspectives of international KT and HTR experts on the characteristics of KT TMFs for decrease use or de-adoption of a technology. One-to-one semi-structured interviews were conducted from September to December 2019. Interviews were audio recorded and transcribed verbatim. Themes and sub-themes were deduced from the data through framework analysis using five distinctive steps: familiarization, identifying an analytic framework, indexing, charting, mapping and interpretation. Themes and sub-themes were also mapped to existing KT TMFs.

Results: Thirteen individuals from Canada, United States, United Kingdom, Australia, Germany, Spain, and Sweden participated in the study. Three themes emerged that illustrated the ideal traits of a KT TMF: principles that were foundational for HTR, levers of change, and steps for knowledge to action. Principles included evidence-based, high usability, patient-centered, and ability to apply to the micro, meso, macro levels. Levers of change were

characterized as positive, neutral, or negative influences for changing behaviour for HTR. Steps for knowledge to action included: build the case for HTR, adapt research knowledge, assess context, select, tailor and implement interventions, and assess impact. Of the KT TMFs that were mapped, the Consolidated Framework for Implementation Research had most of the characteristics, except ability to apply to micro, meso, macro levels.

Conclusions: Application of KT TMFs to HTR has not been clearly understood. Characteristics that need to be considered within a KT TMF for implementing HTR outputs have been identified. Consideration of these characteristics within KT TMFs may guide users undertaking HTR projects.

4.2 Contributions to the Literature

- The application of the Knowledge Translation (KT) field to the process of Health Technology Reassessment (HTR) is unclear.
- This study identified three themes that illustrated ideal traits of a KT theory, model, and framework (KT TMF) specifically for the HTR outputs of decrease use or de-adoption of a technology: principles that were foundational for HTR, levers of change, and steps for knowledge to action.
- This is the first study that provides further understanding of characteristics within KT TMFs that could be considered by users undertaking projects to decrease or de-adopt technologies.

4.3 Background

Health Technology Reassessment (HTR) is an evidence-based approach that systematically reviews the clinical, social, ethical and economical effects of a technology to ensure it is being used optimally in health care (103, 125, 126). The process results in four outputs: increase or decrease use of a technology, no change, or removal of a technology (103, 125, 126). In recent years, HTR programs have been developed that focus on actual phases of the HTR process. A recent systematic review of HTR frameworks in seven countries identified four components: identification, prioritization, assessment, and decision dissemination strategies (126, 127). Within the decision dissemination component, both passive (such as posting recommendations on a website) (128) and active (such as point-of-care decision support tools) (129) dissemination strategies have been proposed (130). Despite growing interest in the HTR field, implementation challenges of its outputs continue to exist (2, 127, 129).

The field of Knowledge Translation (KT) may offer a mechanism to translate these outputs into practice (131). Knowledge Translation theories, models and frameworks (KT TMFs hereafter) have been used successfully to implement evidence into practice (44, 132). There are a myriad of KT TMFs available to select from (14, 15, 17, 47, 109). Some studies have suggested the use of these KT TMFs and strategies may be useful for the implementation of HTR outputs (126, 127, 130, 131, 133). Other studies have identified barriers and facilitators to HTR implementation and proposed strategies to address these barriers (23, 107, 131). However, understanding which KT TMFs may be useful for the implementation of HTR outputs into practice, especially as it relates to decrease use or de-adoption of a technology, is limited (131).

A recent survey of 22 KT and HTR experts explored if full-spectrum (includes planning/design, implementation, evaluation, sustainability/scalability phases of KT) (47) KT TMFs could be suitable for HTR (134). The survey found that ≥ 70% consensus was not reached on HTR suitability for any of the 16 KT TMFs that were reviewed. However, when responses to 'yes' and 'partially yes' were combined, the Consolidated Framework for Implementation Research (CFIR) (72) was considered the most suitable KT TMF by both KT and HTR experts. Moreover, the Knowledge-to-Action (KTA) framework (12) was selected by KT experts. HTR experts selected two additional KT TMFs: co-KT framework (79) and Plan-Do-Study-Act (PDSA) cycle (60). Comments provided by the experts highlighted many of the challenges related to selecting one or more KT TMFs for HTR (134). The experts offered three key characteristics of a KT TMF that may be important to consider: practicality, guidance on implementation, and KT TMF adaptability (134). This study emphasized that it may be difficult to find a KT TMF that addresses all of the KT considerations of the HTR process. Moreover, it may be more important to focus on specific characteristics of KT TMFs when implementing HTR outputs, in particular when decreasing use or de-adoption of technologies that are of low value (135). These characteristics may better inform users on how to actually decrease use or de-adopt a technology. This study aimed to determine what particular characteristics are important to consider within a KT TMF when implementing HTR outputs, specifically as it relates to decreasing use or de-adoption of a technology.

4.4 Methods

4.4.1 Study Design

A qualitative descriptive approach, specifically one-to-one semi-structured interviews, was used to ascertain the perspectives of KT and HTR experts on the characteristics of KT TMFs for decrease use or de-adoption of a technology (136). Interviews were selected as they provided an in-depth understanding of the phenomena and meaning of the key characteristics that would be critical within a KT TMF. The Consolidated Criteria for Reporting Qualitative Research Checklist (COREQ) was followed to ensure transparency, rigour, and comprehensiveness on aspects of the research team, methods, context of the study, findings, analysis, and interpretation (137) (Appendix F). Ethics approval was obtained from the University of Calgary's Conjoint Health Research Ethics Board [REB#17-0932]. Informed written consent of the participants was obtained prior to interviews. Verbal informed consent was obtained at the start of the interview using a predetermined script.

4.4.2 Participant Selection

KT and HTR experts were selected through purposive and snowball sampling. Names were initially derived through the KT Canada website, Health Technology Assessment international

(HTAi) Disinvestment Interest group, authors of relevant publications, and in consultation with other experts. A list of HTR and KT international experts was generated by country including Canada, USA, UK, Australia, and European countries (Germany, Italy, Sweden, Spain). Experts were contacted via a personalized email to verify their interest in participating in the study.

4.4.3 Data Collection

One-to-one semi-structured telephone interviews were conducted by RE from September 2019 to December 2019. Interviews ranged from 30 mins to 60 mins in duration. The interview focussed on gathering participants' perceptions on the following: which fields (KT or HTR) they identified themselves within, general experience in using KT TMFs for HTR, experience on using specific KT TMFs on HTR, general and specific characteristics of KT TMFs for decrease use or de-adoption, barriers and facilitators for selecting KT TMFs for decrease use or de-adoption, and additional comments regarding the selection and use of KT TMFs for HTR. An interview guide was developed and tested with two members of the research team (JHL, DJN) (Appendix G). Reflexive journaling and field notes were captured after each interview by RE. Anonymity was preserved by allocating all participants a code. Interviews were audio recorded and transcribed verbatim by a professional transcription company. RE also listened to the audio tapes to verify the transcription, and revise the transcripts and field notes accordingly.

4.4.4 Data Analysis

Data analysis occurred concurrently with data collection. The transcripts and field notes were entered into NVivo 12 plus qualitative data analysis software to organize and code data (QSR International, MA) (138). Framework analysis was used to analyze the data, as it allowed for a rich and in-depth analysis of the interview data through categorization of the characteristics (139-142). Framework analysis was initially developed by Ritchie and Spencer (143) and has been further developed by others (139, 140). It is a type of thematic analysis that has five distinctive steps: familiarization, identifying an analytic framework, indexing, charting, mapping and interpretation. Theme-based or case-based analysis, or a combination of the two, can be conducted through the development of charts (144).

Familiarization

RE and HMH reviewed two transcripts individually to familiarise themselves with the data and make any additional notes. Next, using an inductive approach, RE and HMH independently coded two randomly selected transcripts. Codes were generated through open coding. RE and HMH then discussed the coding together. Inter-coder reliability was found to be sufficient. This formed the basis of an initial coding structure that was applied to the rest of the transcripts that were coded by RE. Constant comparative method was used and any new codes were discussed

iteratively, refined, and added to the coding structure. Code saturation was reached when no new codes emerged (145).

Identifying an analytic framework

Codes were clustered together into categories using an iterative process. Tree charts were developed for each category. HMH then applied these categories to one randomly selected transcript. These categories were discussed iteratively. The final list of categories and their definitions were agreed upon by RE and HMH to form the analytic framework (Appendix H).

Indexing and Charting

Indexing occurred automatically using the categories as parent codes. NVivo's charting function was used to develop framework matrices depicting data by category and interview (case). Each matrix was exported into Microsoft Excel (Microsoft Corp., Redmond, WA, USA) for ease of readability. Interpretation and analysis between and within cases was conducted, employing the constant comparative method.

Mapping and Interpretation

Data was analyzed thematically by reviewing the extracts within and between each case for each category. Themes were determined using the entire data set. Level one and two analyses were conducted. In level one, collated extracts for each category were read to determine if there was a coherent pattern. In level two, the characteristics were presented as over aching themes. These characteristics were reviewed to assess if they reflected the meanings evident in the data and mapping connections between categories. The themes were named and defined. Theoretical saturation was reached when no new themes emerged (146). All decisions were made through consensus between FMC, HMH and RE. The findings were presented through a visual diagram of characteristics, themes, and illustrative quotes to exemplify each theme.

In addition, the characteristics were mapped against full-spectrum KT TMFs that had received ≥ 50% agreement for HTR suitability within an expert survey study (134), to determine if there was confluence between the KT TMF and the characteristics identified by the experts. The original citation of the KT TMF was reviewed to determine if it exhibited the characteristics identified. KT TMFs with more than 80% of the characteristics were queried in NVivo to explore if these KT TMFs and relevant characteristics were identified.

4.5 Results

4.5.1 Participant Characteristics

From September 2019 to December 2019, 13 interviews were conducted with KT (n=8) and HTR experts (n=5). Of the eight KT experts, three considered themselves as applied experts in KT, one as a theoretical expert in KT, and four as both applied and theoretical experts in KT. Of the five HTR experts, two considered themselves as applied experts in HTR and three as both applied and theoretical experts in HTR. Only one KT expert considered themselves as an applied expert in both KT and HTR. Whereas two HTR experts considered themselves as applied experts in both KT and HTR. Participant characteristics are presented in Table 4.1.

4.5.2 Characteristics of a KT Theory, Model or Framework

Within the characteristics of a KT TMF, three themes emerged that illustrated the traits that a KT TMF should ideally contain to be best suited for use in HTR: principles that were foundational for HTR, levers of change, and steps for knowledge to action. Within each theme, sub-themes were identified (Figure 4.1).

4.5.3 Theme 1: Principles that were Foundational for HTR

One key theme that emerged was principles of KT TMFs that were foundational for HTR. Four principles were identified within this theme: evidence-based, high usability, patient-centered, and the ability to apply the TMF to the context levels (micro, meso, macro).

Principle 1: Evidence-based

Participants reported that the KT TMF needed to be founded on evidence-based medicine. This entailed the qualities of face validity, transferability, generalizability and transparency. Face validity was characterized as the KT TMF was recognizable and familiar by users. The KT TMF also 'made sense' and could be applied in their particular setting. Transferability to other settings meant that the KT TMF could be applied to different settings and was also generalizable. Lastly, information on how the KT TMF was developed, where it has been used, guidance, tools, and instructions on the KT TMF that were available for the user reflected transparency. This was illustrated in the following excerpt:

> "And then, for those who are interested, there should be transparency. All the details about the model and everything should be available."[013]

There were some participants that felt that the guidance tools should not be too onerous to use and should be intuitive.

Principle 2: High Usability

Participants talked about the need for the KT TMF to be applied and useful. The KT TMF should not be too 'high level' or 'ivory tower'. They focussed on the need for the KT TMF to be simple, practical, and have the ability to be adapted to the particular context in which the change is occurring in. This was reflected by the following expert:

> "In the context of theories it probably means that theories are more pragmatic if they short, fewer factors and if they're easier to understand, meaning that more people can understand them, independent of their disciplinary backgrounds."[010]

Some participants noted that it may be difficult to adapt a KT TMF if it is too simple to begin with, such as the PDSA cycle. In addition, participants indicated that if it takes too much time to select a KT TMF and align it with a project, they may just select one that is easy or one they are most familiar with.

Principle 3: Patient-centered

Participants reported that a KT TMF needed to have the ability to garner the active engagement of patients affected by the HTR process. This would also enable patients to provide ideas and

strategies on how to decrease or remove a technology. Moreover, it was important not only to have patient input on the HTR process, but that patients needed to be part of the interaction and discussion during the entire reassessment process. This was exemplified by the following excerpt:

> "We wanted to be patient-centered and so our focus was on identifying potential implementation strategies to de-implement low value care and we wanted to get patients direct input about what they thought would be a good approach for doing that. And then in a second session we invited patients and providers to work together to come up with more specific ideas. Basically, I mean we would call them the implementation strategies to de-implement specific services."[005]

Principle 4: Context Levels

Participants conveyed that a KT TMF needed to have the ability to be applied at the micro (clinical or individual level), meso (organizational such as the hospital or regional level), and macro levels (system levels such as the provincial, state or national levels). At each context level, there may be different determinants that should be considered. The notion of 'spread' was described by participants as important to the application of a KT TMF so that, once a reassessment is conducted at the micro level, there is ability to further spread the message and implement the findings at the meso and macro levels. Some participants felt that there could be a

KT TMF that can be used for all levels (micro, meso, macro). This was illustrated by the following excerpt:

> "But in terms of having an impact on the levels, one could envision either the same theory or framework being used in each of those three levels. So, for a blood transfusion, one could think a little bit about a framework that then thinks about the individual patient versus at a hospital level versus, let's say, a health system level. Right? Maybe it's the same framework that is applied at each of those levels, recognizing that, for example, the determinants, right, may be different at those three levels and could be completely different." [019]

However, some participants thought it may be challenging to have a KT TMF that can be applied to all context levels as noted by this expert:

> "I think it's really tricky for a theory or model to be applicable on all these levels because the requirement for changing things is so difficult on the micro level compared to the macro level. I believe we need different tools, different models to work on the different context levels." [009]

4.5.4 Theme 2: Levers of Change

Another key theme that emerged was levers of change that would facilitate change to occur. Three types of levers of change were identified: positive, neutral and negative (Figure 4.1).

Positive Levers of Change

Participants noted that within a KT TMF, positive levers of change that allowed the facilitation of HTR outputs were vital as they enabled change to happen. Training and education about the technology being decreased or de-adopted, the process of HTR, and guidance on the KT TMF that was being applied were all important considerations. Participants stated that a step-by-step way to make change happen that is self-guided would be useful. However, a 'cookbook' approach was not warranted, as flexibility within the KT TMF would be beneficial. Participants described using patient safety as an impetus for change to happen and providing the engagement required. Stakeholders and decision makers also needed to understand the relevance and benefits of the change. The use of both quantitative and qualitative methods to measure change was important. Lastly, alternatives to the technology being removed needed to be clearly communicated. This was exemplified by the following excerpt:

> "In particular, in relation to de-adoption, like I mentioned earlier, the alternatives are really important. So how we quantify or evidence the alternative options available is

> really important for the messaging, but also for actually putting this into practice. And whether you know that's physiotherapy or self-management or what, I think it really needs to be formally addressed. And then alternatives, as in when the resources are released, what does that mean, how do we quantify. And I think this is kind of in the messaging area, but if you're saying we'll release a 100 000 pounds for if we don't do knee arthroscopy, people feel like that that's been taken away from them rather than reduced all this harm…So you want to have a way of quantifying in a positive way, oh we've released 100 000 pounds and we're reinvesting it in something else. [018]

Neutral Levers of Change

Participants talked about levers of change to be included in a KT TMF that were neither positive nor negative, but could also be considered to influence change for the implementation of HTR outputs. One was the use of policy or accreditation standards that compelled providers to 'not do something'. Participants also stated to focus on a few underlying factors that could be ascertained by speaking with the stakeholders involved. These included: contextual factors (the setting in which the change is occurring), cultural factors (leadership, organizational culture, past experience with change), psychological factors (routines and habits), and technology-related factors (cost, methods used to decrease, setting, and type of indications).

Negative Levers of Change

Participants noted that within a KT TMF, elements may hinder the change to occur within a reassessment process. These negative levers of change include documentation of unwarranted variation and practice variation on different units, hospitals and between providers. This practice variation could hinder change. Subsequently, agreement on what the practice should be and convincing practitioners to change their practice would be necessary. Another was addressing the unintended consequences (positive and negative) of removing or decreasing a technology, which may impact or influence something else such as additional costs or other resources.

Participants discussed the nature of relationships between providers, the team or unit. For instance, when decreasing technology or removing technology, there may be a dynamic amongst providers, where some may want to continue to use the technology and others may not. This dynamic may drive the overuse of a particular technology by some providers, and if so, the intervention needs to target this dynamic. In addition, the notion of a power deferential between the provider, patient, and caregiver also needs to be understood. Acknowledging this power deferential and addressing it to ensure that the technology is not just being removed or decreased without engagement, and addressing patient concerns regarding technology replacement is required. Finally, understanding resistance and its causes was another lever of change. Making the case for why the technology needs to be de-adopted or decreased was imperative to address resistance. This was exemplified by the following excerpt:

> "So, I think any KT theory, framework, or model needs to have within it a lens of trying to deal with confrontation or resistance from certain stakeholders, and possibly multiple stakeholders. I think that needs to be fundamental to any model." [012]

4.5.5 Theme 3: Steps for Knowledge to Action

The third theme that emerged was that the KT TMF needed to provide steps of the knowledge to action process required for implementation of HTR outputs. There were five steps identified within this theme: i) build the case for HTR, ii) adapt research knowledge, iii) assess context, iv) select, implement and tailor interventions, and v) assess impact.

Step 1: Build the Case for HTR

This step involves prioritization of HTR to justify its requirement, as not all technologies will require a reassessment. Participants noted that criteria to prioritize reassessment such as geographic variation could be used and has been outlined in other studies (10, 126). They also added that this step focuses on identification and articulation of the problem through the synthesis of evidence on the technology and the evidence for why it should be reduced or removed. This was supported by the following excerpt:

> "I mentioned the evidence is more straightforward than the actual knowledge translation, but it is kind of difficult to synthesize. And a big part of our work is sort of synthesizing

> the evidence in order to spread the message…But maybe something to be able to say these are the harm, benefits, strength of the evidence, evidence of variation, that kind of thing would be very helpful". [018]

Experts also identified that buy-in from all the stakeholders impacted by the change, agreement on the problem, and engagement early on were all part of this step.

Step 2: Adapting Research Knowledge

This step ensures that evidence synthesis from the 'build the case' step is used to develop tools and products and is customized to the local context. Participants indicated that the products (whether they are guidelines, education materials, etc.) need to be tailored to the stakeholders that are part of the reassessment process, and different products and messaging may be required. As one participant stated:

> "There are many different messages that different stakeholders would want to get for that. So, we'd have to ... like all good KT ... recognize that we need different knowledge products for them. It's not about hiding things from anybody, but different people will have different interests. So, for example, let's say we're trying to decrease medical imaging. The radiologist ... There'd be something about patient safety in there. There'd be something about what the cost savings would go to. There'd may be something about ...

> You've got a backlog right now. We think we can clear this backlog with it. Things that, for them, would make sense. [013]

Step 3: Assess Context

This step involves evaluation of the context where the change is occurring, and identifying the barriers and enablers (determinants) to knowledge use within that context. Participants indicated that it is important not to end up with a long list of barriers, but to select from the barriers and facilitators that will have the most influence on decrease use or de-adoption of the technology. This was noted by one participant:

> "Factors that are important, and then you can also use it to map responses to figure out what are the barriers, the facilitators, so to use that."[008]

Experts noted that barriers to the reduction or removal of a technology could include cost and resource factors, behaviour and motivation factors, resistance factors, economic factors, opportunity costs, assessment of risks and unintended consequences, and personal beliefs of stakeholders. Some participants noted that the determinants would not be different from implementation of something new, but more resources would be required for decrease use or de-adoption of a technology. The levers of change identified above could also assist with understanding of barriers or facilitators to knowledge use.

Step 4: Select, Implement and Tailor Interventions

Participants articulated that barriers and facilitators could be used to tailor interventions. The details of the intervention needed to be explicit, so others could reproduce or adopt the intervention as needed. This was articulated by one participant:

> "So, more examples of the models in action, the concrete deliverables and activities associated with implementing the models. E.G. instead of just saying, "Consult the stakeholders," be clear. Did you have 15 meetings? Did you set up a committee with the public and patient representative? What did it look like? So, if I want to do the same thing, what might I do?" [013]

Experts stated that development of measures to ensure implementation success and measurement of individual performance of the provider, unit or organization through benchmarking were key.

Step 5: Assess Impact

In this step, participants suggested the ability to evaluate the impact of the intervention to decrease use or de-adopt a technology, and that this impact was operationalized within the context. Participants noted that sustainability of the intervention to ensure decrease use or de-adoption should be considered from the beginning of the KT TMF. As one participant stated:

"I think a lot of people are using these theories and frameworks within a research project and then once the, once that project finishes, there is nothing in place to keep it embedded or sustained." [002]

4.5.6 Mapping Characteristics to KT TMFs

Seven KT TMFs that had receive ≥ 50% agreement (yes or partially yes) from an expert survey study (134) were mapped onto the characteristics (Table 4.2). CFIR had the most characteristics (11/12), missing only the ability to map to the micro, meso, and macro levels (72). This was followed by the KTA framework (12), the Quality Implementation Framework, (61) and the Healthcare Improvement Collaborative Model (77), which all had the same 10 of 12 characteristics (missing patient-centered approach and the ability to apply to the micro, meso, and macro levels). The Diffusion of Innovation (9), the co-KT framework (79), and PDSA cycle (60) had the next least number of characteristics, missing some combination of high usability, patient-centeredness, ability to apply to micro, meso, and macro levels, and levers of change.

4.6 Discussion

4.6.1 Key Findings

This is the first study to interview experts in the KT and HTR fields about characteristics that need to be considered in a KT TMF for implementing HTR outputs. The study identified four principles, three levers of change, and five steps that may be important to consider when planning to reduce or remove a technology from the healthcare system.

These findings are consistent with previous research within the KT and HTR fields. In the development of a decision support tool for the selection of KT TMFs, Strifler et al. surveyed 24 KT experts from Canada, USA and Australia and found evidence, ease of use, and fit as factors that are important characteristics within a KT TMF (147). The principle of being patient-centered has also been articulated in the HTR literature (1). The need for stakeholder engagement as a foundational element within the HTR model has been described (3). Meaningful and effective stakeholder engagement needs to be throughout, with engagement being authentic and early on in the process (3, 148).

A synthesis of HTR approaches and stakeholder consultation provides six questions to guide and facilitate the HTR process from a user perspective (149). One of the six questions identifies seven levers of change to use in practice. These were drawn from the KT literature and include: clinical and/or decision-maker champions, clinical guidelines, educational initiatives, clinician

reminders, audit and feedback mechanisms, incentives/disincentives, and meso/macro-level policy change. The findings from our study expands on this list of levers by further categorizing them into positive, neutral and negative.

MacKean et al has also identified themes for moving the HTR agenda forward through shared experiences of experts from Australia, United Kingdom, and Alberta who have implemented HTR programs (1). These themes include HTR prioritization and strong evidence for the technology being harmful, processes that are context specific, meaningful stakeholder engagement, and post-implementation monitoring and evaluation. These themes correlate to the findings from this study in terms of the steps of building the case for HTR, assessing context, and assessing impact. Ward et al, through a thematic analysis of 28 KT TMFs, found five components in their revised model on knowledge exchange: problem, context, knowledge, intervention, and use (150, 151). These are consistent with the five steps recognized by the experts as important for a KT TMF to have for decrease use or de-adoption.

The findings of this study are also similar to characteristics identified within the de-implementation literature that has largely been driven by the advent of the Choosing Wisely Campaign (152). The Choosing Wisely lists include several recommendations in different sub-specialities focussed on reducing or removing low value care. (36). More recently, the Campaign has focussed on implementation of these recommendations with the use of effective strategies and models (8). The Choosing Wisely Canada Implementation Research Network (153) has developed a de-implementation framework of five phases that move these

recommendations into practice (133). Phases 0 and 1 are the identification of potential areas of low-value healthcare and identification of local priorities for implementation of recommendations, which translate into 'building the case and in this context for HTR'. Phase 2 (identification of barriers to implementing recommendations and potential interventions to overcome these) coincides with steps of 'assessing context' and 'select, implement, and tailor interventions' steps. Lastly Phase 3 (rigorous evaluations of implementation programmes) and Phase 4 (spread of effective implementation programmes) are also related to the step of 'assessing impact'.

Of the full-spectrum KT TMFs reviewed in this study, CFIR contained most of the characteristics identified. This was also supported by the experts who had rated this KT TMF as suitable for HTR in the survey study (134). CFIR has been identified as a highly operational framework within the implementation science field (101). In particular, an identifiable characteristic of CFIR is its focus on the identification of 39 constructs that outline the determinants of implementation. These determinants can enable the assessment of barriers and facilitators that is part of the 'assess context' step required for the HTR process. The CFIR also prioritizes patient-centered approaches.

Three other frameworks, KTA, Quality Implementation Framework, and the Healthcare Improvement Collaborative Model, contained the same combination of characteristics. Moreover, experts recognized the characteristic of identified steps as distinguishable within all three KT TMFs. Although, the Quality Implementation Framework and the Healthcare

Improvement Collaborative Model may be less familiar as KT TMFs, users could also apply these KT TMFs within the context of HTR.

All of the KT TMFs contained the five steps, albeit with some different labelling. This is consistent with categorization of them as full-spectrum KT TMFs that contain the four KT phases (planning/design, implementation, evaluation, sustainability/scalability). None of the KT TMFs had the ability to apply to the micro, meso, and macro levels.

The characteristics identified in this study may be useful for users to apply in the selection of a KT TMF for use in the decrease or de-adoption of a technology. Although none of the seven KT TMFs has all of the characteristics, it would be beneficial to study how the four KT TMFs with the most characteristics (CFIR, KTA, Quality Implementation Framework, and Healthcare Improvement Collaborative Model) are used in practice within the context of HTR. Case studies that focus on the KT TMF approach used, interventions developed, and lessons learned need to be further studied and shared, so that findings can be used to guide the application of KT to HTR (6, 22, 25).

4.6.2 Strengths

This was the first study to specifically ask KT and HTR experts to comment on characteristics of KT TMFs that could be used for implementing HTR outputs. As such, it has advanced the

literature on the application of the KT field to HTR. This study interviewed international KT and HTR experts to ensure that there was a depth and breadth of knowledge and understanding, thereby enhancing the transferability of findings. The study applied framework analysis as a systematic method to organize, categorize, analyze the data with the assistance of an experienced qualitative researcher, which enhanced the rigor and quality of the findings. Lastly, the study mapped the characteristics identified by the experts to existing KT TMFs that may be suitable for HTR.

4.6.3 Limitations

Although all the experts who participated in the original survey were contacted, only 13 of the 22 experts agreed to participate in this study. However, the sample was considered acceptable to answer the research question based on data and meaning saturation (146). As there were only five HTR experts and eight KT experts, the data could not be analyzed separately by KT and HTR expertise. This limited the ability for a more in-depth analysis of how the characteristics may or may not differ amongst these experts. In addition, KT experts may have limited knowledge of the HTR field given that it is a relatively new field (126). Experts were asked to use their knowledge and understanding of KT and provide their perspective on how to apply it to the area of decreasing use and de-adoption. As each researcher's own personal experience and perceptions may have influenced the data analysis, having RE and HMH code and categorize 23% of the transcripts in duplicate strengthened the analysis. Lastly, RE's background in HTR and KT could have influenced the findings. However, reflexive thoughts and transparency

regarding potential sources of bias were captured through journaling and field notes to minimize this potential.

4.7 Conclusions

Implementation of HTR outputs would benefit from the application of the KT field. This study's findings suggest that KT TMFs that present characteristics of evidence-based, are of high usability, are patient-centered, can be applied to the micro, meso, and macro levels, involve levers of change (positive, negative, and neutral), and include steps to put evidence into practice will be most useful for HTR. The application of relevant KT TMFs will enable the HTR field to move from an academic exercise to a process that ensures the optimal use of technologies within our healthcare system.

Table 4. 1 Participant Characteristics (n=13)

Characteristics	KT Experts (n=8)	HTR Experts (N=5)
No. of Participants	8	5
Female Sex	7	6
Location		
Canada	1	2
US	2	0
UK	1	1
Australia	2	1
Other	2	1
Level of Education		
Doctorate	7	4
Master's	1	1
Clinical (medicine, nursing, rehab)	2	2
Years of Experience in KT field	7 to 25 years	10 to 12 years
Years of Experience in HTR field	10 to 15 years	2 to 17 years
Self-reported activities		
Self-Identified in KT Field	7	0
Self-identified in HTR Field	0	0
Self-identified in both	1	5

KT=knowledge translation; HTR=health technology reassessment

Table 4. 2 Comparison of Characteristics for De-adoption and De-implementation Use within Seven Full-Spectrum Knowledge Translation Theories, Models, Frameworks (KT TMFs) that received ≥ 50% agreement (yes/partially yes)

KT TMF/ Characteristics	**Consolidated Framework for Research Implementation**	**Knowledge-to-Action Framework**	**Quality Implementation Framework**	**Healthcare Improvement Collaborative Model**	**Diffusion of Innovations**	**Co-KT framework**	**Plan-Do-Study-Act Cycle**
Reference	Damschroder, 2009	Graham, 2006	Meyers, 2012	Edward, 2017	Rogers, 3rd Edition, 1983	Kitson, 2013	Deming, 1986
Principles							
Evidence-based	√	√	√	√	√	√	√
High Usability	√	√	√	√		√	√
Patient-Centered	√					√	
Ability to apply to micro, meso, macro levels							
Levers							
Positive Levers of Change	√	√	√	√	√		
Neutral Levers of Change	√	√	√	√	√		
Negative Levers of Change	√	√	√	√	√		
Steps							
Build the case (for HTR)	√	√	√	√	√	√	√
Adapt research knowledge	√	√	√	√	√	√	√
Assess context	√	√	√	√	√	√	√

Select, Implement, and tailor interventions	√	√	√	√	√	√	√
Assess impact	√	√	√	√	√	√	√
Total # of characteristics	11	10	10	10	9	8	7

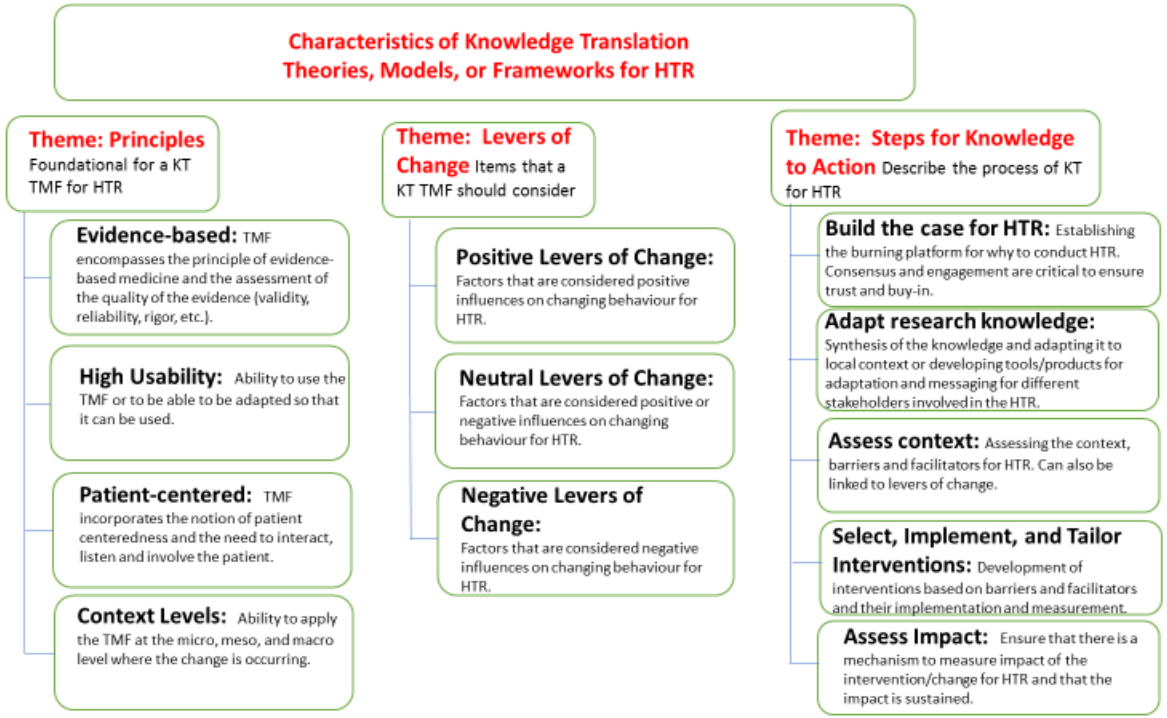

Figure 4. 1 Themes and sub-themes to consider for a Knowledge Translation Theory, Model or Framework (KT TMFs) for Health Technology Reassessment (HTR)

CHAPTER 5: SUMMARY

5.1 Summary of Key Findings

This PhD dissertation focussed on understanding the relationship between HTR, which is the process of re-evaluating technologies currently in the system, and KT, which is the process of putting knowledge into action. Employing a health systems perspective, this project studied and determined how KT approaches are used to translate HTR outputs to achieve the desired outcomes. This research is the first interrogation of KT mechanisms in the advancement of HTR and sheds light on the methods for implementation that could be used for HTR.

Three inter-related projects were undertaken to explore this body of work. The first study was a scoping review of KT TMFs to ascertain if any could be considered for the translation of HTR outputs (109). Thirty-six full-spectrum KT TMFs were found. Categorization of these KT TMFs resulted in 18 process models, eight determinant frameworks, three classic theories, three evaluation frameworks, and four that fit more than one approach. This is the first scoping review of full-spectrum KT TMFs and is foundational groundwork that provides a compendium of full-spectrum KT TMFs; it is a resource that researchers and other users can refer to when embarking on KT projects. For this thesis, the findings of the scoping review became the source of potential KT TMFs that that could be applied for the HTR process.

The second study was a modified Delphi Process and expert survey on the selection of these full-spectrum KT TMFs that may be suitable for HTR (134). The 36 full-spectrum KT TMFs

identified in the scoping review from the first study were used as a starting point to ascertain if any could be suitable for HTR. A three-round modified Delphi process was undertaken with expert committee members (2 HTR, 3 KT) to determine which of the KT TMFs were suitable for HTR (134). After the third round, 16 KT TMFs were identified. This list of 16 KT TMFs was provided through a survey to international HTR and KT experts recruited through purposeful sampling. Experts rated each KT TMF as "yes", "partially yes", or "no" on six criteria: familiarity, logical consistency/plausibility, degree of specificity, accessibility, ease of use, and HTR suitability. Twenty-two experts (11 HTR and 11 KT) from Canada, US, UK, Australia, Germany, Spain, Italy and Sweden participated. Although consensus was not reached on any of the 16 KT TMFs, CFIR was considered the most suitable KT TMF by both KT and HTR experts (72). KT experts also identified the KTA framework (12). HTR experts identified the co-KT framework (79) and the Plan-Do-Study-Act cycle (60). Moreover, three key characteristics of a KT TMF that may be important to consider for use in HTR were emphasized by the experts: practicality, guidance on implementation, and KT TMF adaptability.

The final study utilized qualitative methodology to garner the perspectives of international experts on the characteristics that may be important within a KT TMF for HTR, particularly for decrease use or de-adoption (154). Through purposeful sampling, 13 experts (5 HTR and 8 KT) were interviewed using a semi-structured interview guide. Framework analysis was applied which has five distinctive steps: familiarization, identifying an analytic framework, indexing, charting, mapping and interpretation (139, 140). Three themes were identified as traits that a KT TMF needs to consider: principles that were foundational for HTR, levers of change, and steps for knowledge to action. Principles included evidence-based, high usability, patient-centered, and

ability to apply to the micro, meso, macro levels. Levers of change were characterized as positive, neutral or negative influences for changing behaviour for HTR. Steps for knowledge to action included: build the case for HTR, adapt research knowledge, assess context, select, tailor and implement interventions, and assess impact. These findings were consistent with principles important to consider for the HTR process and characteristics identified in the de-implementation literature (107, 133, 147, 148, 155). When these findings were mapped to existing KT TMFs, CFIR had most of the characteristics, except the ability to apply to micro, meso, macro levels. Three other frameworks, KTA, Quality Implementation Framework, and the Healthcare Improvement Collaborative Model had all of the characteristics, except patient-centered and ability to apply to micro, meso, macro levels. This work suggests that these KT TMFs may be the best suited for HTR. Moreover, the characteristics provide a roadmap for users to consider when selecting and identifying KT TMFs to use for their HTR projects.

5.2 Strengths

This thesis has several strengths. First, it has raised awareness of the issue on identifying synergy between HTR and KT through its introductory paper (chapter 1) (131). The application of KT to HTR and its outputs of decrease use and de-adoption has been an area that has been largely neglected (1, 3). As such this work is leading edge providing a line of sight to methods for HTR implementation. Second, we used multiple methods involving a scoping review (chapter 2), a Modified Delphi process and survey (chapter 3), and semi-structured interviews (chapter 4) to obtain perspectives of international experts to understand the relationship between HTR and KT. The benefits of using multiple methods allowed us to build on the findings from

each study and provide more granular understanding of the relationship between HTR and KT. Lastly, rather than users blindly selecting KT TMFs for HTR, or selecting those KT TMFs that are most familiar, we provide guidance on theoretical support by mapping the characteristics to KT TMFs to identify those that may be most useful in this area (Table 4.2). Users can consult a compendium to review potential KT TMFs, determine which TMFs may be suitable for their HTR project, and use the identified characteristics to support their selection of a KT TMF.

5.3 Limitations

This thesis work also has limitations. Our first study was a scoping review that focussed only on full-spectrum KT TMFs, however there may be other commonly used KT TMFs that could be suitable for HTR (94). For example, the Promoting Action on Research Implementation in Health Services (PARIHS) (99) or the Normalization Process theory (100), that may not have all the KT phases could be useful in HTR or combined with full-spectrum KT TMFs. We used full-spectrum KT TMFs as a starting point, as they were considered to have all the KT phases that would also be important for the implementation of the HTR process. Second, KT experts were engaged in both the survey and interview, but they may have limited knowledge of the HTR field, given that it is a relatively new field. Moreover, only one of the KT experts self-identified themselves as an expert in both fields. Providing input into characteristics of KT TMFs for HTR may have presented a challenge for them. However, all experts were asked to use their knowledge and understanding of KT and provide their perspectives on KT TMFs characteristics and which would be relevant in particular the outputs of decreasing use and de-adoption. Third, a small sample of KT and HTR experts participated in both the survey and interviews. This may

have contributed to a volunteer bias, with those who participated having the most interest in this area. Moreover, for the survey, this may also have limited the ability to reach consensus on the KT TMFs. However, the pool of KT and HTR experts is limited and we purposively sampled broadly reaching out to experts to increase transferability of findings. Considerable efforts were made to recruit experts from different backgrounds and jurisdictions countries with a range of expertise to ensure a representative sample. Finally, in the interview study, we could not analyze the data in-depth between KT (n=8) and HTR (n=5) experts to identify if characteristics differed between them. HTR and KT experts, based on their knowledge and understanding of the fields may have selected different characteristics. This may be an area for further exploration.

5.4 Knowledge Translation-The Way Forward

This work provides an in-depth, required theoretical grounding for HTR and KT. It is a reflection of where the HTR field is currently in terms of implementation. Moreover, the findings from this thesis have been necessary foundational pieces to support moving from the theoretical to the applied. First, for those embarking on HTR projects, it is suggested to select KT TMFs based on the characteristics identified in our work (CFIR, KTA, Quality Implementation Framework, and the Healthcare Improvement Collaborative Model), apply them to HTR work, and report on findings through publications of HTR case studies. Users should consciously reflect back on the KT TMF's utility, concrete deliverables and activities on how the KT TMF was implemented, and how this process could be improved the next time. Documentation of these reflections and experiences will further our collective understanding in this emerging field.

Second, a case study 'living' repository of KT TMFs for HTR is required. As others have suggested an inventory of KT TMFs for implementation (147, 156), this would be an inventory of KT TMFs specifically for HTR and its outputs of decrease use and de-adoption. This would entail a description of KT TMFs used, context, their strengths and limitations, input of the users as to if the KT TMF was successful in implementation of the HTR output or not and why. This repository would be useful to enable users to compare and contrast these KT TMFs across a variety of settings for HTR projects. The repository would also allow users to quickly review KT TMFs that have been used in particular contexts and select those that would be most applicable to their own context.

Third, as described in chapter one, the HTR model has three phases: phase 1 is the technology selection phase that includes the identification and prioritization of technologies; phase 2 is the decision phase that entails evidence synthesis and policy development; and phase 3 is where policy execution occurs (3). This thesis has focussed on identification of KT TMFs and their characteristics that could be useful from moving the HTR outputs of phase 2 into phase 3. To advance this understanding further, in phase 3, it is proposed that there is a 'requirement' to develop an implementation plan that considers a KT TMF, preferably one with the characteristics identified in chapter 4. The development of such a plan with a conscious and deliberate selection of a KT TMF in this phase of the HTR process, would provide structure and guidance to enable thoughtful and pragmatic consideration of policy implementation.

Lastly, none of this may be possible if there continues to be a lack of awareness and understanding in the application of KT to HTR. Therefore, there is a need to build capacity in this area (1). Lack of training in KT TMFs and skills to facilitate implementation have been identified as barriers for HTR (131). Education and training in KT and how it can be applied to the field of HTR is not only necessary, but critical to continue to raise its profile within the HTA/HTR community. Health Technology Assessment international (HTAi) has a disinvestment and early awareness interest group whose mandate is to build capacity in disinvestment (157). This group could take the lead with assistance from other HTA organizations such as the CADTH to provide KT training and education to HTA and HTR researchers (134). In addition, the use of knowledge brokers or change agents to facilitate the use of KT approaches for HTR is also recommended (131). These strategies would facilitate the engagement of KT and its application to HTR.

5.5 Implications for Future Research

There are several research questions that arise from this work. One area of inquiry posits whether the characteristics identified are of equal weight or if some are more critical to consider within the context of HTR. For example, levers of change (positive, neutral, and negative) also relate to the health care intervention, patient, health professional, and organizational factors that have been articulated in the de-implementation literature (155). Moreover, there may be specific levers of change in different contexts that are important to consider. Examination of these levers of change, development of strategies to address them, and evaluating their effectiveness in different contexts may be a fruitful future area of research.

In addition, the ongoing knowledge exchange and utilization has been identified as a foundational and cross cutting element of the HTR process that spans all three phases (3). KT has also been described as a driver of the entire HTR process (131). However, what does this really entail? The present dissertation primarily focussed on KT approaches that could play a role in the outputs of phase 2 to the outcomes of phase 3 of the HTR process, however, are there KT mechanisms and approaches that could be applied within all phases of the HTR model? There is a need for further research on how the field of KT could play a role in the entire HTR process to drive change.

Third, it is unclear if one KT TMF would be required for HTR or is there a need to draw on multiple KT TMFs throughout process and over time. There may be a need to combine and bring in KT TMFs as needed during the HTR process. Moreover, there may be a need to refine existing KT TMFs, build upon them, and potentially develop a unified or overarching KT TMF. Such a unified KT TMF would focus primarily on the important characteristics identified for implementation and address the dynamic nature of the HTR process.

5.6 Conclusions

To our knowledge, this is the first body of work that interrogates the relationship between HTR and KT. It has brought together two very disparate fields to identify synergy between them. It has garnered the perspectives of international experts in both fields to identify KT TMFs and characteristics within them for consideration. The process of HTR is still in its infancy and

continues to need to be part of managing the lifecycle of a technology. However, the HTR process is futile if its outputs are not implemented in practice and monitored on an ongoing basis. This work provides insights into how implementation of its outputs could be achieved by tapping into the field of KT. Moreover, this work supports clinical decisions on existing medical technologies for healthcare providers to ensure their optimal use. Indeed, this work also translates into optimal and appropriate care for the patients these healthcare providers serve.

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APPENDICES

APPENDIX A: Ovid MEDLINE Search Strategy Adapted from Strifler et al 2018 (CHAPTER 2)

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1946 to Present>

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1946 to Present>

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1 (knowledge adj2 (application or broke$ or creation or diffus$ or disseminat$ or exchang$ or implement$ or management or mobili$ or translat$ or transfer$ or uptak$ or utili$)).tw.

2 (evidence$ adj2 (exchang$ or translat$ or transfer$ or diffus$ or disseminat$ or exchang$ or implement$ or management or mobil$ or uptak$ or utili$)).tw.

3 (KT adj2 (application or broke$ or diffus$ or disseminat$ or decision$ or exchang$ or implement$ or intervent$ or mobili$ or plan$ or policy or policies or strateg$ or translat$ or transfer$ or uptak$ or utili$)).tw.

4 (research$ adj2 (diffus$ or disseminat$ or exchang$ or transfer$ or translation$ or application or implement$ or mobil$ or transfer$ or uptak$ or utili$)).tw.

5 ("research findings into action" or "research to action" or "research into action" or "evidence to action" or "evidence to practice" or "evidence into practice").tw.

6 Translational Medical Research/

7 Diffusion of Innovation/ or (diffusion adj2 innovation).tw.

8 (("systematic review$" or "knowledge synthes$") adj5 ("decision mak$" or "policy mak$" or "policy decision?" or "health polic$")).tw.

9 (("systematic review$" or "knowledge synthes$") adj2 (application or implement$ or utili?ation or utilize? or utilise? or utili?ing)).tw.

10 research utili?ation.tw.

11 ((evidence base$ or evidence inform$) adj2 (decision$ or plan$ or policy or policies or practice or action$)).tw.

12 or/1-11

13 (model* or theor* or concept* or framework*).tw.

14 12 and 13

15 limit 14 to english

16 limit 15 to yr=2016-current

APPENDIX B: Grey Literature Websites (CHAPTER 2)

In addition to websites listed in the CADTH grey matter approach, the following websites were searched:
KT Canada Clearinghouse (http://ktclearinghouse.ca/tools/uncategorized)
Implementation Central (http://www.implementationcentral.com/index.html)
Alberta Innovates Health solutions https://spor.albertainnovates.ca/the-alberta-spor-support-unit/knowledge-translation-platform/
Consolidated Framework for Implementation Research (CFIR) (http://cfirguide.org/)
National Collaborating Center for Methods and Tools (NCCMT)
(http://www.nccmt.ca/resources/registry)
Cochrane Community (http://community.cochrane.org/review-production/knowledge-translation/framework-and-implementation-plan)

APPENDIX C: Excel Survey Questions (CHAPTER 3)

Name of Full-Spectrum Knowledge Translation (KT) Theory, Model, Framework	Link to Published KT Theory, Model, Framework (if available)	Familiarity-Are you familiar with the KT, theory, model or framework? (yes, partially yes, no)	Logical Consistency/Plausibility-Does the KT theory, model or framework, include meaningful, face-valid explanations of proposed relationships? (yes, partially yes, no)	Degree of specificity-Does the KT theory, model, or framework include constructs that are comprehensive of implementation determinants or specific to a set of implementation determinants that could be applied to health technology reassessment (HTR)? (yes, partially yes, no)	Accessibility-Would non-experts be able to understand, apply and operationalize the KT theory, model, or framework to HTR? (yes, partially yes, no)	Ease of use-Can the KT theory, model, or framework be used easily? (yes, partially yes, no)	HTR Suitability-Based on your responses to the previous criteria, is the KT theory, model, framework suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology)? (yes, partially yes, no)	Comments
Consolidated Framework for Implementation Research								

(CFIR) (Damschroder, 2009) Stages of Research Evaluation (Nutbeam, 2006) Knowledge-to-Action (KTA) (Graham, 2006) Quality Implementation Framework (Meyers, 2012)- link to abstract only Western Australia (WA) Health Network Policy Development and Implementation Cycle (Briggs, 2012) Collaborative Model for								

Achieving Breakthrough improvement (Institute for Healthcare Improvement, 2003) Diffusion of Innovations (Rogers, 3rd Edition, 1983) Healthcare Improvement Collaborative Model (Edward, 2017) Co-KT framework (Kitson, 2013) Plan-Do-Study-Act (PDSA) Cycles (Deming, 1986) A Staged Model of Innovation Development and Diffusion of Health								

Promotion Programs (Oldenburg, 1996)-link to abstract only Evidence-Driven Community Health Improvement Process (EDCHIP) (Layde, 2012) Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) (Glasgow, 1999) CollaboraKTion framework (Jenkins, 2016) KT framework for Agency for Healthcare Research and Quality								

(AHRQ) patient safety portfolio and grantees (Nieva, 2005) Design Focused Implementation Model (Ramaswamy, 2018) Please feel free to identify any other full-spectrum KT theories, models, or frameworks that have been missed and could be used for HTR Please feel free to identify names of KT or HTR experts that could be contacted for this study								

APPENDIX D: Operational Definition of Criteria (CHAPTER 3)

Criteria	Operational Definition
Familiarity	Are you familiar with the KT, theory, model or framework?
Logical Consistency/Plausibility	Does the KT theory, model or framework, include meaningful, face-valid explanations of proposed relationships?
Degree of specificity	Does the KT theory, model, or framework include constructs that are comprehensive of implementation determinants or specific to a set of implementation determinants that could be applied to health technology reassessment (HTR)?
Accessibility	Would non-experts be able to understand, apply and operationalize the KT theory, model, or framework to HTR?
Ease of use	Can the KT theory, model, or framework be used easily?
HTR Suitability	Based on your responses to the previous criteria, is the KT theory, model, framework suitable for the dissemination and implementation of HTR outputs (increase use, decrease use or exit of the technology)?

APPENDIX E: List of Excluded KT Theories, Models, and Frameworks and Reason of Exclusion (n=20) (CHAPTER 3)

KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
A conceptual framework for planning and improving evidence-based practices (Spencer, 2013)	X			
Interorganizational Relations Theory (Steckler, 2002)	X			
Self-Regulation Theory (Baumeister, 2011)		X		
Social Cognitive Theory (SCT) (Bandura, 1991)			X	
Social Ecology Model for Health Promotion (Stokols, 1992)	X			
Transtheoretical Model of Behaviour Change (Prochaska, 1997)			X	
LEAN transformation process (Lean Enterprise, 2011)		X		
NCHPAD (National Center on Health, Physical Activity and Disability) Knowledge, Adaptation, Translation and Scale-up (N-KTAS) Framework (Rimmer, 2016)				X
Community Connection model (Liddy, 2013)	X			
Model for accelerating improvement (Associates in Process Improvement Langley, 2009)	X			
Social marketing framework (National Excellence Collaborative, 2003)	X			

KT Theories, Models and Frameworks Excluded	Too vague	Not pragmatic	Passive	Too Specific
Community based KT framework (Campbell, 2010)	X			
Knowledge integration process (Glasgow, 2012)	X			
Precaution Adoption Process model (Weinstein, 2008)	X			
Social learning theory (Bandura, 1952)	X			
CAN-IMPLEMENT (Harrison, 2018)				X (guideline focused)
The translational model of the Black Dog Institute (Werner-Seidler, 2016)	X			
PRECEDE-PROCEED (Green, 2005)	X			
Community to community mentoring model (Liddy, 2013)	X			
Stage theory of organizational change (Butterfoss, 2008)	X			

APPENDIX F: Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist (CHAPTER 4)

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Interviewer/facilitator	Rosmin Esmail	Methods
2. Credentials	BSc, MSc, PhD Candidate	Title Page
3. Occupation	PhD student/Provincial Trauma Epidemiologist for Alberta Health Services	N/A
4. Gender	Female	N/A
5. Experience and training	Rosmin Esmail is a PhD Candidate. She conducted this study as part of her PhD. She has training as an epidemiologist. Through her PhD she has received training in health services research and methodology. She also received formal training in qualitative methods.	N/A
Relationship with participants		
6. Relationship established	Rosmin Esmail contacted the participants by email to determine if they were able to participate and schedule the interview. Some of the participants were known to Rosmin Esmail.	N/A
7. Participant knowledge of the interviewer	Participants were aware of the purpose of the study, its rationale, and that it was being conducted as part of Rosmin Esmail's PhD thesis.	Methods
8. Interviewer characteristics	Rosmin Esmail disclosed her role as a PhD candidate at the University of Calgary and as the primary researcher for this project.	Methods
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	Framework analysis.	Methods
Participant selection		
10. Sampling	Participants were selected through purposeful sampling. During the recruitment, we were mindful to ensure representatives from different countries, knowledge and expertise, and roles. It was this group of participants who were also asked to participate in the interviews.	Methods

11. Method of approach	Participants were approached via a personalized email.	Methods
12. Sample size	13 participants.	Results
13. Non-participation	9 participants. Four participants refused to participate and 5 did not respond.	Methods
Setting		
14. Setting of data collection	Phone interviews were conducted from Rosmin Esmail's home or office at Foothills Medical Center. Participants conducted the interviews from their preferred location.	Methods
15. Presence of non-participants	No.	Results
16. Description of sample	See Table 4.1. Most of the participants had a doctorate degree. They had a range of experience in knowledge translation and/or health technology reassessment.	Results
Data collection		
17. Interview guide	See Appendix G. A semi-structured interview guide was developed and tested with two member of the research team, both of whom were clinicians. The interview questions were informed by the open-ended comments from the previous study that surveyed the experts.	Methods
18. Repeat interviews	No.	N/A
19. Audio/visual recording	The interviews were audio-recorded and transcribed verbatim by a professional transcription company. Rosmin Esmail also listened to the audio tapes to verify the transcription.	Methods
20. Field notes	Field notes were made by Rosmin Esmail during and after each interview. These notes were referred to during the data analysis and interpretation.	Methods
21. Duration	Interview duration was between 30 to 60 minutes.	Methods
22. Data saturation	Code saturation was reached when no new codes emerged. Any new codes that were derived from the final interview transcript were checked with the existing coding structure to determine if they were new codes or had been already derived. Thematic saturation was reached when no new themes emerged.	Methods
23. Transcripts returned	No.	N/A

Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	Data were inductively coded by Rosmin Esmail. 15% of the transcripts were coded independently by a second investigator. Categories for the analytic framework were generated by Rosmin Esmail. See Appendix H. A second investigator applied these categories independently to one randomly selected transcript and these were discussed iteratively.	Methods
25. Description of the coding tree	A coding tree was developed. A description of the coding tree was not provided but will be made available upon request.	Methods
26. Derivation of themes	Themes and sub-themes were derived from the data.	Methods
27. Software	NVivo 12 plus qualitative data analysis software (QSR International, Cambridge, MA) was used to organize and code the data.	NVivo
28. Participant checking	No.	N/A
Reporting		
29. Quotations presented	The direct quotes from participants were provided in the transcript to support the themes. Participant ID numbers were provided for each quote.	Results
30. Data and findings consistent	There was consistency between the data presented and the findings through the codes, tree chart, analytic framework and development of themes.	Results/Discussion
31. Clarity of major themes	See Figure 4.1. The major themes that depicted characteristics of KT TMFs included: principles or foundational for a KT TMF for HTR, levers of change that a KT TMF should consider, and steps that describe the process of KT for HTR.	Results/Discussion
32. Clarity of minor themes	See Figure 4.1. The major themes were further categorized into sub-themes. For example, the principles theme, four sub-themes emerged: evidence-based, high usability, patient-centered, and context levels.	Results/Discussion

APPENDIX G: Telephone Interview Guide for Semi-Structured Interviews with HTR/KT Experts (CHAPTER 4)

Study ID: _____
INTRODUCTION

Thanks for agreeing to speak with me. I wanted to re-iterate the purpose of this study. I am conducting a study on understanding the relationship between health technology reassessment (HTR) and knowledge translation (KT). Understanding the relationship between HTR outputs and KT is important as it provides a mechanism for determining what and how the two are linked and if KT can play a role in the advancement of HTR. If you recall in the first round you critically reviewed full-spectrum KT theories, models, or frameworks.
Analysis of the data from round one of the modified Delphi process indicates that ≥ 70% consensus was not reached on HTR suitability for any of the 16 KT theories, models and frameworks (TMFs). The comments that were provided in the survey by you were invaluable and highlight the challenges in selecting one or more KT TMFs for HTR. This process has also emphasized that it may be difficult to find a KT TMF that addresses all of the KT considerations of the HTR process. As a result, for round two of the modified Delphi process, we would like to further investigate the ***key characteristics*** of a KT TMF for HTR that maybe important to consider. In particular, we would like to examine of the KT TMFs that you reviewed, what were the elements, attributes, constructs that you think would influence and demonstrate an important role within the process of HTR.
As an expert on <*KT or HTR*>, meeting with you is important to provide your input. The interview will take about 30 to 60 mins. Do you have time available today? <*If response is no then offer to reschedule*>.
The interview will be recorded and transcribed. Is that okay? <If response is no then indicate that I will be taking notes>. The information you provide to me today will be kept strictly confidential and your identity will be protected. In the analysis, I will not be identifying the person or site. Please keep in mind that you are able to withdraw at any time during the interview process.
Do you have any questions about this interview or study before we begin?

Opening Questions

1. Which field do you identify yourself in Knowledge Translation (KT), health technology reassessment (HTR) or both?

2. How long have you been in this field/doing research in this field/both of these fields?

3. Do you consider yourself an applied KT/HTR expert or do you consider yourself more an expert on the development of KT TMFs/the development of the HTR process?

***General* Experience in using KT theories, models, frameworks for HTR**

As you are aware, health technology reassessment is about reassessing technologies (drugs, medical devices, diagnostic tests, i.e.) that are currently being used in the system. In the

survey, you had an opportunity to review 16 KT theories, models, and frameworks to assess their suitability for HTR. Now I'd like you to think about these KT theories, models or frameworks in general within the context of HTR.

4. What has been your experience in general in using KT theories, models or frameworks for HTR projects in particular?

   If the respondent says they have experience in using KT theories, models or frameworks for HTR go to question #5
   If the respondent says they have no experience or minimal experience in using KT theories, models, or frameworks for HTR go to question #8

Experience in using *specific* KT theories, models, frameworks for HTR

Now we will focus on the *specific* KT theories, models or frameworks within the context of health technology reassessment (HTR).

5. Please describe your experience in using *specific* KT theories, models or frameworks used within the context of HTR?

   If the respondent says they have experience in using specific KT theories, models or frameworks for HTR go to question #6
   If the respondent says they have no experience or minimal experience in using specific KT theories, models, or frameworks for HTR go to question #8

6. Why did you select these specific KT theories, models, or frameworks?

7. In your view, what made the KT theory, model or framework appropriate to use in HTR? <go to question #8>

***General Characteristics* of KT theories, models, frameworks for Decrease Use or De-adoption**

8. In HTR there are four outputs (increase use, no change, decrease use or de-adoption). Today we are focussing on the outputs of decrease use and de-adoption. When using a KT theory, model or framework, what are the particular characteristics <give example if needed: such as ease of use or adaptability> that are important to consider specifically for the outputs of decreasing use or de-adopting a technology? *Probe:* why did you consider these as important?

***Specific Characteristics* of KT theories, models, frameworks for Decrease Use or De-adoption**

Now we will focus on the *specific characteristics* of KT theories, models, or frameworks that you mentioned in the previous question.

9. What does the <particular characteristic(s)> mean to you? *Probe:* how would the particular characteristic(s) be demonstrated to you?

There were several *specific* characteristics that were highlighted in the survey responses that I received for the KT theories, models, and frameworks that were reviewed. These were considered as important for the HTR process in round one.

10. One of them was **pragmatic**. What does **pragmatic** mean to you in the context of a TMF? *Probes:* How would pragmatic be demonstrated in a TMF? What does comprehensive or process-oriented mean to you?

11. Another ***characteristic*** was that a TMF should provide ***guidance in implementation*** (how to do the work) of its outputs. What does implementation mean to you in the context of a TMF? *Probe:* How would guidance on implementation be demonstrated in a TMF?

12. Another ***characteristic*** was that a TMF should have ***a strong fit or adaptability to the HTR process.*** What does strong fit/adaptability to HTR mean to you in the context of a TMF? *Probe:* How would strong fit/adaptability be demonstrated in a TMF?

13. Another TMF ***characteristic*** that was highlighted was the need for the TMF ***to engage stakeholders***. What does that mean to you? *Probes:* How would the TMF involve stakeholders? Who would these stakeholders be?

14. ***Understanding determinants (for example barriers or enablers that might influence an implementation outcome*** **such as knowledge or intention)** that would facilitate implementation was another ***characteristic***. What are your thoughts on the determinants for developing interventions/strategies for the HTR process? *Probes:* What would these determinants be? How would their inter-relationships be expressed?

15. Another TMF ***characteristic*** was the ***ability to apply the TMF at the micro, meso, macro levels.*** What do these levels mean to you? *Probes:* How would you define these levels? What about the ability to tailor the TMF at these levels? What does this mean to you?

Application of KT theories, models, frameworks for Decrease Use or De-adoption

Now we will focus on the *application* of KT theories, models or frameworks within the context of the decrease use and de-adoption of the HTR process.

16. In general, what approaches or decision-making processes would you use to go about identifying and selecting a KT theory, model, or framework for the outputs of decrease use or de-adoption?

17. In general, how would you go about applying a KT theory, model, or framework for the outputs of decrease use or de-adoption?

Barriers and Facilitators

18. Overall, what do you think are the greatest challenges to identifying, selecting and using KT theories, models or frameworks for decrease use or de-adoption? *Probes:* How and why are these factors major issues or barriers to success? How do you think they could be addressed?

19. What factors do you think facilitate the identification, selection and use of KT theories, models, and frameworks for decrease use or de-adoption? *Probe:* How and why are these factors facilitators to success?

Additional comments and wrap-up

20. Before we wrap up, do you have any additional comments to add regarding the selection and use of KT theories, models or frameworks for HTR?

21. Is there anything else you feel we did not cover that I need to know?

Thank you for your time.

APPENDIX H: Analytic Framework (CHAPTER 4)

Category	Demographic-related	Principles	Levers of Change	Steps	Factors associated with the use	Other Clarification	Other Tangential
Operational Definition of Category	Codes (text) that are related to the participant characteristics.	Codes (text) that are that TMF should have as necessary and foundational for HTR.	Codes (text) that the TMF should consider for HTR.	Codes (text) that are the steps in a KT TMF that describe the process of KT for HTR.	Codes (text) that are related to using KT TMFs for HTR, their purpose, their selection, challenges, facilitators to enable use.	Codes (text) that seek clarification of concepts.	Codes (text) that are peripheral to the research question. They do not address the research question specifically.

KT=knowledge translation; HTR=health technology reassessment; TMFs=theories, models, frameworks

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Kind regards,
Heather

From: Rosmin Esmail
Sent: Thursday, September 3, 2020 10:41 AM
To:
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Rosmin

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Sincerely,

Dr. Fiona Clement

From: Rosmin Esmail
Sent: Thursday, September 3, 2020 10:39 AM
To:
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Thanks and let me know if you have any questions.

Rosmin

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From:
Sent: Thursday, September 3, 2020 9:58 AM
To:

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Dan

From: Rosmin Esmail
Sent: September 3, 2020 9:29 AM
To:
Subject: Your response needed-Manuscripts Permission Request Again

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Rosmin

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Sent: Thursday, September 3, 2020 9:33 AM
To:
Subject: RE: Your Response Needed-Manuscripts Permission Request Again

---

Hi Rosmin

Yes I give my permission

Jayna

From: Rosmin Esmail
Sent: Thursday, September 3, 2020 9:33 AM
To:
Subject: Your Response Needed-Manuscripts Permission Request Again

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From:
Sent: Monday, August 31, 2020 7:09 PM
To:
Subject: Re: Manuscript Permission Request

Hi Rosmin,

[redacted] I definitely give permission for you to use the citation. [redacted]

Warm Regards,

Sage

On Aug 31, 2020, at 5:08 PM, Rosmin Esmail wrote:

Hi Sage, [redacted] I will need your permission for the manuscript we worked on.
Please see below.
Thanks
Rosmin

From:
Sent: Friday, August 28, 2020 12:21 PM
To:
Subject: Manuscript Permission Request

Dear co-authors,

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Rosmin

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From:
Sent: Sunday, August 30, 2020 7:51 AM
To:
Subject: Re: Manuscript Permission Request

---

sure, this is fine with me

thx
sharon

On Friday, August 28, 2020, 02:21:29 p.m. EDT, Rosmin Esmail wrote:

Dear co-authors,

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Thanks and let me know if you have any questions.

Rosmin

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From:
Sent: Saturday, August 29, 2020 12:10 PM
To:
Subject: Re: Manuscript Permission Request

Hi Rosmin,
You have my permission - congrats!
Hope all is well,
Lisa

From:
Sent: August 28, 2020 2:21 PM
To:
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Dear co-authors,

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