National Collaborating Centre
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CRITICAL EXAMINATION OF KNOWLEDGE TO ACTION MODELS AND IMPLICATIONS FOR PROMOTING HEALTH EQUITY

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SUMMARY

Introduction

The purpose of this paper was to review and critically examine the usefulness of existing knowledge to action models for promoting health equity. Dramatic inequalities in health and social circumstances across Canada are well documented. Knowledge and effective interventions exist to address many of these inequities. However, awareness, uptake, and the use of interventions can be poor and poorer still with respect to interventions to improve the health of disadvantaged populations.[1] This gap between knowledge and action to improve health equity is of increasing concern to public health researchers and practitioners, globally.

What we did

We conducted a comprehensive literature search to identify pre-existing knowledge to action (KTA) models. Models were critiqued and given a health equity support score.

What we found

We identified forty-eight pre-existing models. Using the health equity score, six models scored between 8 and 10 of a maximum 12 points. Four out of the six promising models mentioned equity, justice or a similar concept. Attention to multisectoral approaches or actions were the factor often lacking in the identified models. The concepts of knowledge brokering, integrative processes, such as those in indigenous health research, and Ecohealth applied to KTA all emerged as areas of possible promise.

Models

- Knowledge Brokering Frameworks[2]
- Framework for Research Transfer[3]
- Joint Venture Model of Knowledge Utilization[4]
- Translational Research Framework to Address Health Disparities[5]
- Model of Knowledge Translation and Exchange with Northern Aboriginal Communities[6]
- Ecohealth Model applied to knowledge translation[7]

Conclusions

Existing models can help guide knowledge translation to support action on the social determinants of health and health equity. There is a need to further develop and test models. This process should be informed by Ecohealth approaches, participatory, and integrative research.

Implications for public health

- Existing knowledge translation models can help guide the application of knowledge to inform public health action to improve health equity. The six models identified are promising examples of knowledge to action models that can support action on the social determinants of health.
- The most relevant models are those with principles and values reflective of equity and social justice.
- Use of these models will enable public health organizations working towards addressing the social determinants of health to:
  - Identify equity as a goal;
  - Involve stakeholders;
  - Prioritize multisectoral engagement;
  - Draw knowledge from multiple sources;
  - Recognize the importance of contextual factors; and
  - Have a proactive or problem-solving approach.
- There is room to develop and test more robust equity supporting models. This conversation will require attention to the criteria proposed in this paper.

CONTENTS

INTRODUCTION

Each year, preventable disease and disability and shortfalls in the social determinants of health take the lives and diminish the health and well-being of millions of people globally. In Canada, for example, there are more than 1600 new cases of tuberculosis, 2500 new cases of HIV, and 29,000 children hospitalized for unintentional injury annually,[8-10] and these are largely preventable. In addition, nearly three million Canadians are living below the low income cut off[11] and 8.5% of 20-24 year olds have not completed high school.[12] There are, of course, dramatic inequalities in health and social circumstances across the Canadian population with disadvantaged groups often characterized as those experiencing social and economic exclusion and could include people living in poverty, people with disabilities, racialized peoples, and indigenous peoples. Knowledge and proven, effective interventions exist to address many health concerns and disparities, however, awareness, uptake and use of interventions can be poor and poorer still with respect to interventions to improve the health of disadvantaged populations.[1]

The difference between what is known about a particular health issue or possible intervention, and what is being done for health promotion and disease prevention is termed the "know-do gap". This gap between knowledge and action is of prime concern to public and global health researchers and practitioners, and pertains increasingly more prominently to what is not being done to improve health equity including improving health for disadvantaged populations. "Knowledge to action" is a broad term used to refer to the process of bridging the know-do gap. This concept has been described in many different ways including the translation, dissemination, implementation, transfer and exchange of knowledge, the diffusion of an innovation or idea, and the use of knowledge or research evidence to inform decision making[13-15] Knowledge to action scholarship has increased significantly over the past 20 years.[16-18] In 1990, fewer than a hundred articles were retrieved in a knowledge translation keyword search in Medline. In February 2006, several thousand articles were found with the same search strategy.[19] In August 2012, we retrieved nearly 110,000 articles with the keywords: knowledge translation, knowledge transfer, dissemination, evidence-based, and knowledge to action. While there has been a plethora of papers on models and frameworks for knowledge to action, thus far, there has been very limited research exploring which strategies or components may be most effective for supporting health equity.[20] The evaluations that do exist have primarily occurred for evidence-based medical practice in high-income countries.[21] Yet, there is significant potential for knowledge to action theory, models, and methodologies to contribute to the discourse, and inform action to address health inequities in Canada and globally.[22]

Health inequities are "differences in health that are judged to be unfair or the result of some form of injustice (current or historical)."[23] They have also been defined as unfair and avoidable inequalities.[24] Striving for health equity means working so that everyone can reach their full health potential and not be disadvantaged from attaining this because of their class, socioeconomic status or other socially determined circumstance.[24-25] People may be more vulnerable to health inequity because of their place of residence, race or ethnicity, occupation, gender, religion, education, socioeconomic status, sexual

orientation, level of social capital, or access to health services, and other resources for health.[26] The fact that disadvantaged populations are not meeting their health potential is a health inequity. In the past five years, there have been key publications such as *Closing the Gap in a Generation: Health equity through action on the social determinants of health*[27] *and Integrating Social Determinants of Health and Health Equity Into Canadian Public Health Practice*[28] that have specifically called for action to bridge the gap between what we know about health inequities and what is being done to address and reduce them. Specifically, these reports have indicated a need for an explicit focus on equity in decision and policy making; inclusive and participatory approaches recognizing varied forms of knowledge and perspectives; the need for interaction across jurisdictions and sectors; and the need to consider social, political and economic factors that support or deter efforts towards health equity. What is less clear is exactly how current knowledge translation models and theory can inform action to address these challenges.

The purpose of this project was to review existing knowledge to action models and critically examine a promising subset of them as to their utility for promoting or supporting health equity in Canada and globally.

METHODS

A literature search was conducted for preexisting knowledge to action models or frameworks. Given the numerous conceptualizations and diverse terminologies used in the field, the search and subsequent accumulation of models was not limited to "knowledge to action" itself but included other derivations and conceptualizations such as knowledge translation, knowledge transfer and exchange, dissemination, diffusion, evidence-based practice, and implementation. A snowball sampling technique was used to amass a list of models or frameworks cited over the past 15 years (1997 to 2012) when the vast majority of scholarship specifically on knowledge to action has taken place. The sampling began with a number of initial seminal articles and evolved based on the reference lists and key citations used. Scholars knowledgeable in the field also informed the search. Models were, therefore, identified in three ways:

1) a title and abstract keyword search in four scientific databases (Ovid MEDLINE(R), PsycINFO , AMED Allied and Complementary Medicine and EBSCO Host CINAHL), and on Google Scholar;
2) a review of the reference lists and cited articles of identified papers; and
3) discussions with experts in the field, including those who peer-reviewed this manuscript.

Modifications of the following search string were used for the database searches: ("dissemination" or "knowledge to action" or "knowledge translation" or "knowledge transfer").mp. and ("model" or "framework").m_titl. The database searches were limited by year (1997-present) and language (English). This search strategy is outlined in Table 1.

Table 1: Search Location and Results

SEARCH LOCATION	SEARCH RESULTS
Ovid MEDLINE(R) 1946 to August Week 2 2012	464 relevant documents
PsycINFO 1967 to August Week 2 2012	89 additional documents
AMED (Allied and Complementary Medicine) 1985 to August 2012	3 additional documents
EBSCO Host CINAHL August 2012	89 additional documents
Google Scholar (first 6 results screens)	26 additional documents (no year limitation)
Review of reference lists of identified documents	18 additional documents (no year limitation)
Expert consultation	4 additional documents (no year limitation)

The search strategy identified a total of 693 documents. Upon further review, 114 documents were identified as specifically introducing, discussing, testing, or critiquing a unique model or framework for some derivation of "knowledge to action". A list of all unique models was then constructed.

When the total list of models was compiled each was critiqued by the author, using the available description, for six characteristics related to health equity. These criteria speak to factors associated with health equity challenges and are informed by the World Health Organization (WHO) Commission on the Social Determinants of Health,[27] as well as previous work by the National Collaborating Centre for Determinants of Health,[28] and others. The characteristics included:

1) a specific focus, mention or consideration of equity, equality, justice, disadvantage or vulnerable groups;
2) an inclusive conceptualization of knowledge that ensures that different types of knowledge and/or ways of knowing might be considered in the evidence-base;
3) community members are represented and/or community participation is an explicit part of the model or framework;
4) interactions are supported across disciplines or sectors;
5) there is specific referral to the social, physical, political, and/or economic context of knowledge generation and use; and/or
6) there is an applied, proactive or problem-solving focus.

The models were assessed using a three-point scale 0 = no obvious mention or inclusion in the description available, **1 (•)** = some or partial mention or inclusion, and **2 (✱)** = this characteristic was clearly reflected. A total score was then calculated. This total score is referred to as the "health equity support" (HES) score.

FINDINGS

Overview

In total, 48 unique models or frameworks for knowledge to action were found. The majority of examples were developed within the last 15 years, however, because the Internet search scan of reference lists and consultations with experts were not date limited, some models do fall outside this time period. Appendix 1 provides a complete, chronological list of these models with a brief description and citation for each.

Overall, there is a great variety among knowledge to action models. The models vary in the way they define and conceptualize knowledge (e.g. research evidence, innovations, ideas) and knowledge to action (e.g. translation, transfer, evidence-based practice, exchange, implementation etc.). They also differ in their point of focus. Some conceptualize the use of knowledge (or research evidence) to solve problems or for tactical or political purposes; others focus on the interactions, barriers and facilitators that are involved when knowledge is to be used to inform decisions. Some are problem solving and applied in nature, while others are theoretical and philosophical in their approach.

It does appear that there has been some evolution in the field over the past 15 years. For example, our analysis identified at least four examples of models that have emerged or have built upon other models or frameworks over time (e.g. Canadian Health Services Research Foundation (CHSRF) Model of Knowledge Transfer and Exchange;[29] Canadian Institutes for Health Research (CIHR) Knowledge Translation in the Research Cycle Model;[30] Equity-Oriented Framework;[1] and Practical, Robust Implementation and Sustainability Model (PRISM)).[31] There also appears to be a more consistent focus on the context of knowledge to action as time has progressed.

Relevance of Models to Health Equity

Table 2 lists the 48 models and indicates their status with respect to six characteristics important in supporting health equity. Models could score a 0-2 value for each of the six equity variables. A total score was then calculated and this was termed the "health equity support" or HES score. Total health equity support (HES) score is indicated for all models and the top six HES scored models are highlighted. This approach was not meant to be definitive and exclusionary, but instead is used as a systematic way to help identify models, among a large number, that may have particular relevance for health equity while at the same time reporting some information about all models found.

The models with the highest HES scores are the Knowledge Brokering Frameworks;[2] the Framework for Research Transfer;[3] the Joint Venture Model of Knowledge Utilization;[4] the Translational Research Framework to Address Health Disparities;[5] the Model of Knowledge Translation and Exchange with Northern Aboriginal Communities;[6] and the Ecohealth Model applied to knowledge translation.[7] Details about why these models in particular might have relevance for health equity are provided (Table 2).

Table 2: Health Equity Analysis of Knowledge to Action Models

	Model	Explicit focus on equity or related value	Inclusive conceptualization of knowledge	Stakeholder engagement	Explicit focus on interactions across jurisdictions or sectors	Context emphasised	Applied, pro-active, problem-solving	Total HES Score
1	Diffusion of Innovations Model		●	●		●	●	4
2	Knowledge Translation within a Communication System Paradigm						●	1
3	Six Knowledge Utilization Models		●	●		●		3
4	Two-Communities or Two-Cultures Model			●		●	✻	4
5	Four Levels of Knowledge Utilization		●			✻	✻	5
6	Knowledge Brokering Frameworks	✻	✻	✻	●	✻	●	10
7	Measuring Knowledge Utilization Model		✻			●		3
8	Ottawa Model of Research Use	●	✻			✻	●	6
9	Research Utilization Model					●	✻	3
10	Locally Based Research Transfer Model			✻	●	✻	✻	7
11	Framework for Changing Implementation Behaviour				●	✻	●	4
12	Technology Transfer Model	●	●			●	●	4
13	CHSRF Model of Knowledge Transfer and Exchange			✻		✻	✻	6
14	Iowa Model of Evidence-Based Practice			✻			✻	4
15	Framework for Research Dissemination and Utilization			●		●	●	3
16	Model of Research Utilization			●		✻	●	4
17	Five-Point Knowledge Translation Framework		●	✻			●	4
18	Pathman-PRECEED Model for Knowledge Translation		●	●		●	✻	5
19	User-Context Framework for Knowledge Translation		●	✻		✻	✻	7
20	Knowledge Translation as part of the Research Cycle Model	●		✻		✻	●	6

Table 2: Health Equity Analysis of Knowledge to Action Models CONT.

	Model	Explicit focus on equity or related value	Inclusive conceptualization of knowledge	Stakeholder engagement	Explicit focus on interactions across jurisdictions or sectors	Context emphasised	Applied, pro-active, problem-solving	Total HES Score
21	Conceptual Model for Considering the Determinants of Diffusion, Dissemination, and Implementation.			✻		✻	✻	6
22	ACE Star Model of Knowledge Transformation		✻			✻	●	5
23	Promoting Action on Research Implementation in Health Services (PARIHS) Framework		✻	●		✻	✻	7
24	Reach, Efficacy or Effectiveness, Adoption, Implementation, Maintenance (RE-AIM)		●	●		●	●	4
25	Advancing Research and Clinical Practice through Close Collaboration (ARCC) Model of Evidence-Based Practice in Nursing and Healthcare			✻		✻	✻	6
26	A Framework for Research Transfer		●	✻	●	✻	✻	8
27	Framework for Translating Evidence into Action		●			✻	✻	5
28	Knowledge to Action Process Model		✻			✻	✻	6
29	Equity-Oriented Knowledge Translation Framework	✻	●			✻	✻	7
30	Joint Venture Model of Knowledge Utilization		✻	✻	●	✻	●	8
31	The Knowledge Value Chain		✻	●	●	●	✻	7
32	Outcomes-Focused Knowledge Translation Intervention Framework			✻			✻	4
33	Model of Strategic Change		✻	●		✻	●	6
34	The Trinity Evidence-Based Practice Model		✻			✻	✻	6

Table 2: Health Equity Analysis of Knowledge to Action Models CONT.

	Model	Explicit focus on equity or related value	Inclusive conceptualization of knowledge	Stakeholder engagement	Explicit focus on interactions across jurisdictions or sectors	Context emphasised	Applied, pro-active, problem-solving	Total HES Score
35	Stages of Research Utilization Model			●		●	✻	4
36	Replicating Effective Programs Framework		●	✻		●	✻	6
37	The Sticky Knowledge Framework		●	●		✻	✻	6
38	Model for Large-Scale Knowledge Translation	●	●		✻	✻	●	7
39	Tehran University of Medical Sciences (TUMS) Knowledge Translation Model		●	●		✻	✻	6
40	Collaborative Model for Knowledge Translation between Research and Practice Settings		●	✻		●	✻	6
41	Interactive Systems Framework for Dissemination and Implementation		✻	✻		●	●	4
42	Practical, Robust Implementation and Sustainability Model (PRISM)		●	●		✻	✻	6
43	Translational Research Framework to Address Health Disparities	✻	✻			✻	✻	8
44	Translational Framework for Public Health Research						✻	2
45	Framework for Transferring Knowledge into Action		✻			✻	✻	6
46	A Model for Knowledge Translation and Exchange with Northern Aboriginal Communities	✻	✻	✻		✻	●	9
47	A Model for Evidence-Based Practice Implementation					✻		2
48	Ecohealth Model Applied to Translate Knowledge	✻	●	●	✻	✻		8

LEGEND 0 = no obvious mention or inclusion in the description available, 1 (●) = some or partial mention or inclusion, 2 (✻) = this characteristic was clearly reflected

The Knowledge Brokering Frameworks outlined by Oldham and McLean[2] scored highest on the knowledge to action health equity assessment. These are a series of three frameworks for knowledge brokering: a knowledge framework, a transactional framework, and a social change framework. The combination of these three frameworks had important implications for its high ranking in the health equity assessment. It explicitly supports an inclusive conceptualization of knowledge and although there is some emphasis on research evidence, it is not limiting. It prioritizes the engagement of a variety of stakeholders, and it has a strong emphasis on contextual factors. In addition, it discusses how the use of a social change framework in knowledge brokering could help address power differentials and encourage work that supports human rights.

The next highest scoring model in the health equity assessment was the model of Knowledge Translation and Exchange with Northern Aboriginal Communities.[6] This model focuses on knowledge translation specifically for northern indigenous peoples. Using this model would include: establishing partnerships and trust with and among community members; undertaking capacity development activities; and engaging community field workers in all stages of research planning, data collection, analysis, interpretation, and dissemination. Researchers are called to have regular workshops for all members of the research team and make a commitment to return research results to the participants and communities first for verification and validation. There is also a commitment to make research and policy products relevant so that government decision makers might use them to inform policy and practice. The authors propose a true gold standard for integrated research and knowledge translation with vulnerable groups and include a specific sensitivity to the added ethical, cultural and spiritual dimensions of knowledge translation with indigenous peoples. This model scores high on the health equity assessment because it has an explicit focus on equity and justice; it reflects an inclusive conceptualization of knowledge; it promotes meaningful and prolonged community engagement; and it is sensitive to contextual factors. The model scores lower on the problem-solving variable; although it is implicitly an applied approach, the authors do not explicitly describe whether research is chosen (or should be chosen) based on a specific issue or problem, nor do they describe how that priority setting might be approached. The model also does not emphasize work across jurisdictions or sectors, although it would be possible to see how this could be easily integrated.

There are a further group of four models that scored "8" in the health equity assessment. The Translational Research Framework to Address Health Disparities proposed by Fleming et al.[5] is a framework that is specifically focused on addressing health disparities by better aligning and translating research. This framework is made up of two interlinked conceptual models. The first model illustrates how to advance health disparities research through identifying disparities, examining their causes, developing and implementing interventions, and monitoring differential outcomes. The second model outlines knowledge to action and the different components of this in all realms of health research (e.g. the translation of knowledge from "bench" to "bedside" or from "bedside" to "community and public health practice"). The authors emphasize the need to connect biomedical to public health and clinical research, and to use research for real-world applications and community health intervention. The strengths of this model are that it focuses specifically on issues of health disparities, and there is a

logical consideration of addressing problems associated with these disparities. There is also significant emphasis placed on contextual factors and the authors support an inclusive idea of knowledge.

Two other models: A Framework for Research Transfer[3] and The Joint Venture Model of Research Utilization[4] also scored "8" in the health equity review, and for similar reasons. These models touch on most aspects of the six features examined and had a strong emphasis on contextual features. Edgar and colleagues focus upon the interactions that happen in particular contexts, for example, individuals as they engage in organizations that in turn exist in social environments. Leadership, emotional intelligence and work, and socio-political environments are all featured components as well. In their framework, Nieva and colleagues identify that end users need a "change leader", and that intervention tools need to be adapted to local needs and to particular organizational contexts. Developments and adaptations of knowledge to action strategies for particular contexts of health equity could be supported by components of these models. In addition, both of these models have some reference to work across disciplines or sectors.

The final model to receive an "8" in the health equity assessment was the Ecohealth Model as applied to knowledge translation;[7] this is a combination of a health model and a knowledge to action model. The Ecohealth Model (described by Hancock[32] as well as others) links the fields of health and ecology and focuses on the health of humans, the health of other species, and the natural environment. Humans and human health are components of ecosystems. Arrendondo and Orozco[7] take this conceptualization and overlap it with a model of knowledge to action that includes the participation of researchers and other specialists in specific knowledge areas (and of different types of knowledge) with community members and other decision makers. The authors highlight that the pillars of transdisciplinarity, participation, and equity support an overlapped model of Ecohealth and knowledge to action.

DISCUSSION

The purpose of this project was to review existing knowledge to action models and critically examine their utility for promoting or supporting health equity. Forty-eight unique models of knowledge to action used or identified by scholars in the past 15 years were identified. All of the models were then assessed across six characteristics relevant for supporting health equity. While no models scored full marks, the highest scoring models were found to have features relevant to advancing knowledge translation for health equity.

In the assessment, we propose six characteristics that could be important markers: 1) an explicit mention of equity, justice or similar concept; 2) the involvement of various stakeholders; 3) an explicit focus on engagement across multiple sectors or disciplines; 4) the use of an inclusive conceptualization of knowledge; 5) the recognition of the importance of contextual factors; and, 6) a proactive or problem-solving focus. Specific populations, topics and solutions are marginalized, ignored, or not acted upon when, for example, only certain knowledge is considered valuable, when we don't have a specific focus on equity or justice, and when we don't work across sectors or consider contextual determinants of health.[27, 28]

Health inequities are often enduring and profound. Commonly, factors that lead to inequity are deeply embedded in systems, processes, and norms of societies and cultures.[24] In addressing the "causes of the causes"[33] of health inequities, multisectoral approaches, focused on recognizing and addressing inequities, have been heralded. For example, transdisciplinary and cross-sector action is one of the key recommendations of the WHO Commission on the Social Determinants of Health and of the NCCDH report on *Integrating Social Determinants of Health and Health Equity into Canadian Public Health Practice*. Of the six health equity supportive characteristics looked for in the knowledge to action models an explicit mention of multisectoral approaches or actions was the factor found to be most often lacking. Among the models scoring high for health equity support, the Ecohealth Model Applied to Translate Knowledge[7] was the only one that strongly demonstrated integration of this component. One other model, among the 48, also showed this level of strength: the Model for Large-Scale Knowledge Translation.[34] While there is likely utility of other models across disciplines or sectors, this has not been explicit, and remains an area of focus that could be developed and examined further.

In order to inform decisions and change situations of inequity, adopting, collecting, synthesizing or valuing various new pieces of knowledge is often required. This can require difficult shifts from norms of practice, current and ingrained behaviour, or systems of engagement, especially if considering work that might span disciplines or sectors. The creation of supportive structures in this process is ideal.[26] Knowledge brokering involves guided actions that can link producers of knowledge, including knowledge about inequities, with possible knowledge users.[35] This is sometimes conceptualized by focusing on guided interactions between researchers and decision makers[29] where these two groups are largely situated in different realms or communities. Knowledge brokers, whether whole organizations or specific individuals or groups, help to facilitate interactions; their goal is to support understanding and relationship building among diverse stakeholders. When a more full understanding of the various goals and professional cultures is established, new partnerships can be forged. This provides an opportunity for decisions to be informed by research knowledge.[29,36] The Knowledge Brokering Frameworks outlined by Oldham and McLean[2] scored highest for supporting health equity among the 48 models identified. Included in this model are a knowledge framework, a transactional framework, and a social change framework. These frameworks explicitly support an inclusive conceptualization of knowledge, recognize the importance of contextual determinants of knowledge to action as well as the engagement of a variety of stakeholders. They have been designed to consider the social contexts and power differentials that can be at the heart of health inequities. Knowledge brokering has been an approach supported by Canadian organizations previously, including the Canadian Health Services and Research Foundation and the Canadian Coalition for Global Health Research. It may be time to revisit this concept and these approaches when considering further actions for knowledge translation, health equity and the social determinants on health. It is not clear exactly how knowledge brokering could best be approached to ensure more effective action to address health inequity in Canada, however, this area represents an avenue for further discussion as well.

Links between vulnerability of specific populations and factors of social and physical environments are clear.[37,38] In addition, to knowledge brokering as an area of focus, there appears to be distinct promise in a conceptualization of knowledge to action that is holistic and interconnected, considering features of context and environment as important health and health equity determinants. Environmental features differentially impact sub-populations, and thus privilege some concerns or issues over others.[39] For this reason, models such as the Ecohealth Model[7] or the model of Knowledge Translation and Exchange with Northern Aboriginal Communities[6] have appeal. They have utility when considering the dynamic social, cultural, and historic features[39] surrounding knowledge to action work. The Jardine and Furgal[6] model, emanating from a community-based partnership for indigenous health research, has a strong emphasis on and recognition of the cultural, social, spiritual and geographic contexts; various types of knowledge and ways of knowing; and the essential nature of stakeholder engagement and leadership. Similarly, it is helpful to look towards research ethics models that have been developed for work with indigenous people[40] to further consider how participatory, culturally sensitive, integrative, or community-based approaches may be useful to inform knowledge to action and health equity pursuits. These models have not yet been used widely outside indigenous communities, and there remains distinct potential for their uptake in different arenas of action to advance health equity.

LIMITATIONS

Our intention was to identify the most prominent and established models, especially those referred to by Canadian scholars over the past 15 years, in order to determine which ones may have utility in supporting health equity efforts. We understand that we may not have identified every possible existing model. We did not search "evidence-based" as a unique keyword (as in evidence-based medicine; evidence-based practice), however, we did include these types of models in our list if they were found in the documents amassed in the search strategy outlined here (Table 1).

The characteristics making up the "heath equity assessment" score used to assess the models were generated from the literature and each given the same weight. The assessment relied on the model descriptions which were often only briefly included in the literature. This may not accurately capture all aspects and nuance of health equity support, and does not always take into account how effectively a model can be applied in practice. The assessment was completed by just one person (primary author). We recognize that there may have been some variation in assessments if done by multiple independent reviewers, especially in interpretations of "minimal" and "significant" relevance for health equity (point values 1 and 2). We also recognize that some models may have been missed.

CONCLUSION

Forty-eight models of knowledge to action were identified and assessed based on six characteristics of health equity; the highest score being a possible 12. There were no "perfect" models. Six models, all scoring between 8 and 10 of a maximum 12 points, exist as promising examples of knowledge to action models that may have utility for supporting health equity. Each could be strengthened in some way to make them more useful in supporting health equity by considering the six characteristics used in this review. Of particular interest is knowledge brokering as well as the use of holistic and cross-sector models of knowledge to action that consider environmental and contextual determinants. These are specific future avenues identified in this project. As there was no single ideal model found, discussion could also centre on what an ideal health equity knowledge to action model might look like and if thought beneficial, how this could be developed, tested and used effectively. This conversation could be informed by those with knowledge and experience in knowledge brokering, as well as with Ecohealth approaches, and participatory and integrative research, and knowledge translation with Aboriginal people in Canada.

IMPLICATIONS FOR PUBLIC HEALTH

- Existing knowledge translation models can help guide the application of knowledge to inform public health action to improve health equity. The six models analysed in detail exist as promising examples of knowledge to action models that have utility for supporting action on the social determinants of health and improving health equity.
- The most relevant models are those which embody principles and values reflective of equity and social justice.
- These models explicitly identify equity as a goal; value the involvement of various stakeholders; prioritize multisectoral engagement; use of an inclusive conceptualization of knowledge; recognize the importance of contextual factors; and have a proactive or problem-solving approach.
- There is room to develop and test more robust equity supporting models. This conversation will require attention to the criteria proposed in this paper.

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*Citations for each of the 48 specific models are included in Appendix 1 unless they have been specifically referred to in the results and discussion text, and in that case they will be listed here.

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APPENDIX

APPENDIX 1: Reviewed Knowledge to Action Models

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
1	**Diffusion of Innovations Model**	Diffusion is the spread of ideas and innovations throughout systems. When used in the sense of knowledge translation, the application and use of knowledge will differ by type of users and by the user's respective needs and incentives.	**1962** Rogers EM. Diffusion of Innovations. 3rd rev. ed. New York: The Free Press; 1962, 1995, 2003.
2	**Knowledge Translation within a Communication System Paradigm**	Knowledge translation is presented as one of six nested functions, activities or processes within a larger communication system paradigm of knowledge production, management, translation, product development, product dissemination, and product adoption or utilization.	**1978** Beal G, Meehan P. Knowledge production and utilization. Annual Meeting of the Rural Sociological Society; 1978 Sep. San Francisco
3	**Six Knowledge Utilization Models**	The author proposes six knowledge (research) utilisation models or scenarios where research knowledge is used due to different motivations and underpinnings: 1) the knowledge model; 2) the problem-solving model; 3) an interactive model; 4) a political model; 5) an enlightenment model; and 6) a tactical model.	**1979** Weiss C. The many meanings of research utilization. Public Admin Review. 1979: 39; 426–31.
4	**Two-Communities or Two-Cultures Model**	This model conceptualizes the different worlds in which researchers and decision makers work and emphasises principles of intercultural understanding.	**1979** Caplan N. The two-communities theory and knowledge utilization. Am Behav Sci. 1979;22(3):459–70.
5	**Four Levels of Knowledge Utilization**	Four levels of knowledge utilization are explained. At its most basic (level one), knowledge utilization includes dissemination activities such as information clearinghouses. At its most sophisticated (level four), knowledge utilization includes an "integrated system for knowledge translation", which is described as a "master plan" for a knowledge utilization system that is integrated into specific policy. Integration of relevant knowledge translation activities within the context in which the knowledge is to be applied is emphasized as being an important knowledge translation strategy.	**1991** Backer TE. Knowledge utilization, the third wave. Knowledge: Creation, Diffusion, Utilization. 1991;12:225-40.
6	**Knowledge Brokering Frameworks**	These authors propose three frameworks for considering "knowledge brokering": 1) the Knowledge System Framework refers to how knowledge is created, diffused, and used within a country and the role played by various institutions, interactions among institutions, and how the various processes can be strengthened; 2) the Transactional Framework focuses on the interface between organizations that are "creators" of knowledge and organizations that are "users" of knowledge in a particular context; and 3) the Social Change Framework relates to activities that enhance access to knowledge within a society that may directly or indirectly lead to positive social outcomes (e.g. important changes in power relationships, social roles or human rights).	**1997** Oldham G, McLean R. Approaches to Knowledge-Brokering [Internet]. Winnipeg (MB): Institute of Sustainable Development (CA). 1997 May [cited: 2013 Mar]. Available from:http://www.iisd.org/publications/pub.aspx?id=829

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
7	**Measuring Knowledge Utilization Model**	Knowledge utilization is conceptualized as a process that occurs gradually over an extended period of time. This process consists of information pickup, information processing, and information application. Depending upon the individual and/or organization, this process can take a long or short period of time. There may be several variations within each of these stages or steps.	**1997** Rich RF. Measuring knowledge utilization process and outcomes. Knowledge and Policy. 1997:10(3);3-10.
8	**Ottawa Model of Research Use**	The Ottawa Model of Research Use (OMRU) provides a framework to assess, monitor, and evaluate knowledge translation strategies. It begins with an assessment of the attributes and process of innovation/knowledge, then an assessment of the barriers and supports to knowledge use, and then understanding and evaluating the outcomes. The developers indicate that this model may be particularly relevant in low or middle-income countries if barriers to the application of knowledge exist and little evaluation has been conducted.	**1998** Logan J, Graham I. Toward a comprehensive interdisciplinary model: health care research use. Sci Commun. 1998;20(2):227–46.
9	**Research Utilization Model**	The Research Utilization Model is composed of six steps for change to evidence-based practice. Step 1: is to assess the need for change in practice Step 2: is to link the problem with interventions and outcomes Step 3: is to synthesize the best evidence Step 4: is to design a change in practice Step 5: is to implement and evaluate the change in practice Step 6: is to describe integrating and maintaining that change	**1999** Rosswurm MA, Larrabee JH. A model for change to evidence-based practice. J Nurs Scholarship. 1999;31:317-22.
10	**Locally Based Research Transfer Model**	The starting point for locally-based research transfer is awareness of the needs of both agencies and researchers. The second stage is communication between the groups. The third stage is interaction with integrated knowledge and skills from both parties for mutual benefit. Interaction is the end point in the evolution of an effective research transfer process.	**1999** Anderson M, Cosby J, Swan B, Moore H, Broekhoven M. The use of research in local health service agencies. Soc Sci Med. 1999;49:1007-19.
11	**Framework for Changing Implementation Behaviour**	This is a five-stage framework for the use of research evidence and changing practice. It is based on experiences from a comprehensive program on implementing evidence-based clinical guidelines in primary care. The stages include: 1) development of a concrete proposal for change; 2) analysis of the target setting and group to identify obstacles to change; 3) linking interventions to needs, facilitators, and obstacles to change; 4) development of an implementation plan; and 5) monitoring the progress of the implementation.	**1999** Grol R, Grimshaw J. Evidence-based implementation of evidence-based medicine. Joint Commission Journal of Quality Improvement. 1999;25(10): 503-13.
12	**Technology Transfer Model**	There are three major phases of activity in this model: pre-implementation, implementation, and maintenance and evolution. Pre-implementation involves identifying interventions and preparing for implementation. Implementation entails applying the interventions and conducting evaluations. The final phase is necessary to continue to develop support for the intervention and to assess if any adjustments need to be made. Planning and evaluation are important to the success of effective intervention services.	**2000** Kraft JM, Mezoff JS, Sogolow ED, Neumann MS, Thomas PA. A technology transfer model for effective HIV/AIDS interventions: science and practice. AIDS Educ Prev. 2000;12:7-20.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
13	**CHSRF Model of Knowledge Transfer and Exchange**	The CHSRF Model concentrates on the relationships between decision makers, research funders, researchers, and knowledge purveyors. It emphasizes three things: 1) translating evidence into decision making involves many steps and there is no direct linkage between researchers and decision makers; 2) each step requires good relationships and communication among the four different groups in the health sector; and 3) any "weak links in the chain" have the ability to interrupt the ideal flow of research into decision making. The knowledge exchange self-assessment tool for organizations focuses on acquiring evidence, assessing evidence, adapting the format of the evidence, and applying the evidence in decision making. The CHSRF model of knowledge transfer and exchange model has been subsequently discussed within the User-Context Framework for Knowledge Translation proposed by Jacobson, Butterill and Goering (2003) [#19 in this review].	**2000** Canadian Foundation for Healthcare Improvement. Knowledge exchange self assessment tool. Ottawa: CHSFR (CA). 2000 [cited 2013 Mar]. Available from: http://www.chsrf.ca/publicationsandresources/ResourcesForResearchers/SelfAssessmentTool.aspx
14	**Iowa Model of Evidence-Based Practice**	In this model, the knowledge seeker is triggered by practical experiences. Evidence-based practice relies on knowledge "pull" by clinicians so that evidence is used in practice to solve problems that cannot be solved by existing knowledge.	**2001** Titler MG, Kleiber C, Steelman VJ, Rakel BA, Budreau G, Everett LQ, et al. The Iowa model of evidence-based practice to promote quality care. Critical Care Nursing Clin North Am. 2001;13:497-509.
15	**Framework for Research Dissemination and Utilization**	The framework is depicted in the form of a linear pathway of the innovation adoption process. It begins at knowledge, moves to persuasion, then to a decision, implementation, and confirmation. It shows that the process of the adoption of research evidence in the health-care field is influenced by a variety of characteristics as progression from the knowledge stage to the confirmation stage occurs.	**2002** Dobbins M, Ciliska D, Cockerill R, Barnsley J, DiCenso A. A framework for the dissemination and utilization of research for health-care policy and practice. Online J Knowl Synth Nurs. 2002;9:7.
16	**Model of Research Utilization**	External contexts as well as internal processes influence the transfer of knowledge. It relies on knowledge "pull" from individuals and organizations and assumes that users are more knowledge, rather than rules oriented.	**2001** Stetler CB. Updating the Stetler model of research utilization to facilitate evidence-based practice. Nurs Outlook. 2001;49:272-9.
17	**Five-Point Knowledge Translation Framework**	This framework for knowledge translation articulated the five points of focus, which are the: 1) message; 2) target audience; 3) messenger; 4) actual KT process and support system; and 5) evaluation.	**2003** Lavis J, RobertsonD, Woodside J, McLeod C, Abelson J, Knowledge Transfer Study Group. How can research organizations more effectively trans- fer research knowledge to decision makers? Milbank Quarterly. 2003;81:221–48.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
18	**Pathman-PRECEED Model for Knowledge translation**	Interventions can predispose, enable, and reinforce. Interventions must align with the perspective of the target audience (whether it is the general public, the patient, a policy maker or others). Knowledge translation will differ whether the target audience is in a stage of awareness, agreement, adoption, or adherence.	**2003** Davis, D Evans M, et al. The case for knowledge translation: shortening the journey from evidence to effect. British Medical Journal. 2003;327(7405):33-5.
19	**User-Context Framework for Knowledge Translation**	This model consists of five domains: 1) the user group and the context in which the population operates; 2) the message or related issue that is to be translated; 3) the characteristics of the research (i.e. What research evidence already exists? Or, how familiar is the target audience with topic?); 4) the researcher-user relationship; and 5) the actual knowledge translation strategy used.	**2003** Jacobson N, Butterill D, Goering P. Development of a framework for knowledge translation: understanding user context. J Health Serv Res Policy. 2003;8:94-9.
20	**Knowledge Translation as part of the Research Cycle Model**	The model reflects a belief that knowledge translation should be an iterative, multi-dimensional process that is integral to all parts of the research cycle including: 1) the interactions that take place between knowledge producers and users; 2) the activities associated with conducting the research; 3) the ability to contextualize research findings against the background of other knowledge and socio-cultural norms; 4) the act of catering reports and publishing in plain language; 5) the ability to inform action and decision making; and 6) the ability to influence subsequent rounds of research. This model has been subsequently developed and articulated further as the Knowledge to Action Process Model, 2006 [#30 in this review].	**2004** Canadian Institutes of Health Research. The CIHR knowledge translation strategy 2004–2009: innovation in action. Ottawa (ON): Canadian Institutes of Health Research. 2004.
21	**Conceptual Model for Considering the Determinants of Diffusion, Dissemination, and Implementation**	The model's main components are the innovation, adaptation by individuals, assimilation by the system (including system antecedents for innovation and system readiness for innovation), diffusion and dissemination, implementation and routinization.	**2004** Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. Milbank Quarterly. 2004;82(4):581-629.
22	**ACE Star Model of Knowledge Transformation**	This model consists of five stages, which are: 1) discovery: Generating knowledge; 2) evidence Summary; 3) translation: Transformation of evidence into practice; 4) integration: Implementation of innovations; and 5) evaluation: Evidence-based quality improvement of health care.	**2004** Stevens KR. ACE star model of EBP: knowledge transformation [Internet]. 2004 [cited 2013 Mar]. Available from: http://www.acestar.uthscsa.edu/acestar-model.asp
23	**Promoting Action on Research Implementation in Health Services (PARIHS) Framework**	The PARIHS framework presents successful research implementation as a function of the relationships among evidence, context, and facilitation. The framework considers these elements to have a dynamic and simultaneous relationship. The three elements are each positioned on a high to low continuum and include sub-elements such as local data, the patient experience, culture, leadership, purpose, and skills. This model builds on the previous conceptual framework of Kitson A, Harvey G, McCormack B. Enabling the Implementation of Evidence Based Practice: a Conceptual Framework. Qual Health Care. 1998;7(3):149-158.	**2004** Rycroft-Malone. The PARIHS framework—a framework for guiding the implementation of evidence-based practice. J Nurs Care Qual. 2004;19(4): 297-304.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
24	**Reach, Efficacy or Effectiveness, Adoption, Implementation, Maintenance (RE-AIM)**	The RE-AIM framework is designed to enhance the quality, speed, and public health impact of efforts to translate research into practice in five steps, which are: 1) reach the intended target population; 2) effectiveness or efficacy; 3) adoption by target settings or institutions; 4) implementation and consistency of delivery of intervention; and 5) maintenance of intervention effects in individuals and settings over time.	**2004** Dzewaltowski DA, Glasgow RE, Klesges LM, Estabrooks PA, Brock E. RE-AIM: evidence-based standards and a web resource to improve translation of research into practice. Ann Behav Med. 2004;28:75-80.
25	**Advancing Research and Clinical Practice through Close Collaboration (ARCC) Model of Evidence-Based Practice in Nursing and Healthcare**	The ARCC Model outlines sequential stages of knowledge transfer, which are: 1) assessment of organizational and culture readiness for evidence-based practice (EBP); 2) identification of strengths and major barriers to EBP implementation; 3) development and use of EBP mentors (typically advanced practice nurses or clinicians with in-depth knowledge of EBP); and 4) increased EBP implementation and better outcomes.	**2005** Melnyk BM, Fineout-Overholt E. Evidence-based practice in nursing and healthcare: a guide to best practice. Philadelphia: Lippincott Williams & Wilkins; 2005.
26	**A Framework for Research Transfer**	The framework presents three major stages in moving research findings toward utilization, which are: 1) knowledge creation and distillation; 2) diffusion and dissemination, including developing partnerships with knowledge brokers and connector organizations; and 3) end user adoption, implementation, and institutionalization. The authors describe the development of "intervention packages" as guidelines, information materials, training, and other implementation aids. End users must have a change leader and team. Intervention tools need to be adapted to local needs and fit the organizational context.	**2005** Nieva VF, Murphy R, Ridley N, et al. From science to service: a framework for the transfer of patient safety research into practice. In: Henriksen K, Battles JB, Marks ES, et al., editors. Advances in patient safety: from research to implementation (Volume 2: Concepts and Methodology). Rockville (MD): Agency for Healthcare Research and Quality (US); 2005 Feb. p 441-53.
27	**Framework for Translating Evidence into Action**	The framework is made up of five key policy and program issues. These are: 1) building a case for action; 2) identifying contributing factors and points of intervention; 3) defining the opportunities for action; 4) evaluating potential interventions; and 5) selecting a portfolio of specific policies, programs, and actions.	**2005** Swinburn B, Gill T, Kumanyika S. Obesity prevention: a proposed framework for translating evidence into action. Obes Rev. 2005;6:23-33.
28	**Knowledge to Action Process Model**	The concept that research or knowledge has to be put into action is emphasized. The action cycle consists of identifying the problem, reviewing and selecting knowledge, adapting knowledge to local context, assessing barriers to knowledge use, selecting, tailoring, implementing interventions, monitoring knowledge use, evaluating outcomes, and sustaining knowledge use.	**2006** Graham ID, Logan J, Harrison MB, et al. Lost in knowledge translation: time for a map? J Contin Educ Health. 2006;26(1):13-24.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
29	**Equity-Oriented Knowledge Translation Framework**	The framework builds on the knowledge translation component of the Community Equity-Effectiveness Loop (Tugwell P, de Savigny D, Hawker G, Robinson V. Applying Clinical Epidemiological Methods to Health Equity: the Equity Effectiveness Loop. BMJ .2006; 332:358-61). It is grounded in the concept of health equity and is a cascade of knowledge translation related activities including: the assessment of potential knowledge translation barriers and facilitators; the prioritization of barriers for modification; the choice of knowledge translation interventions to address barriers; the evaluation of knowledge translation; and the facilitation of knowledge management or sharing.	**2006** Tugwell P, Robinson V, Grimshaw J, Santesso N. Systematic reviews and knowledge translation. Bull World Health Organ. 2006;84(8):643-9.
30	**Joint Venture Model of Knowledge Utilization**	This model focuses on the interactions among individuals, organizations, and the social environment. It includes the factors that influence health care knowledge utilization, notably: leadership, emotional intelligence, "the person", "the message", the working environment, the socio-political environment, and the outcomes.	**2006** Edgar L, Herbert R, Lambert S, MacDonald JA, Dubois S, Latimer M. The joint venture model of knowledge utilization: a guide for change in nursing. Nurs Leadership. 2006;19:41-55.
31	**The Knowledge Value Chain**	The knowledge value chain has three levels: tactical (the tactics and tools), operational (the functions and activities), and strategic (the strategies used). The knowledge value chain is based on the management of five dyadic capabilities: mapping and acquisition, creation and destruction, integration and sharing/transfer, replication and protection, and performance and innovation. Knowledge is managed as a resource similar to physical, human and financial resources.	**2006** Landry R, Amara N, Pablos-Mendes A, Shademani, R. The knowledge-value chain: conceptual framework for knowledge translation in health. Bull World Health Organ. 2006; 84:597–602.
32	**Outcomes-Focused Knowledge Translation Intervention Framework**	Outcomes-focused knowledge translation involves four components, these are: 1) patient outcomes measurement and real-time feedback about outcomes achievement; 2) best-practice guidelines, embedded in decision support tools that deliver key messages in response to patient assessment data; 3) clarification of patients' preferences for care; and 4) facilitation by advanced practice nurses and practice leaders.	**2007** Doran DM, Sidani S. Outcomes-focused knowledge translation: a framework for knowledge translation and patient outcomes improvement. Worldviews Evid Based Nurs 2007;4:3-13.
33	**Model of Strategic Change**	This theoretical framework has three overarching dimensions of strategic change: the context, the content, and the process. The "why" of strategic change is relevant to context, the "what" of strategic change is related to content, and the "how" is significant to process. The model also identifies the signs and symptoms of receptivity in the health care system.	**2007** Pettigrew M, Whipp R. Model of strategic change. Implement Sci. 2007;2:3.
34	**The Trinity Evidence-Based Practice Model**	This is a model for evidence-based practice (EBP) that is based on strategic and organizational change theory. The goal is to promote uptake and adoption of new knowledge. Using the metaphor of a growing tree the authors describe many components of leadership (the sun); barriers to EBP such as the lack of autonomy, the lack of confidence (the clouds); education (water); quality research (the roots) and a system of evidence-based practice for organizations (the tree).	**2007** Vratny A, Shriver D. A conceptual model for growing evidence-based practice. Nurs Adm Q. 2007;31:162-70.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
35	Stages of Research Utilization Model	The concept of linking systems by connecting the resource system to the user system is central to this model. The model is described in the following stages: Stage 0: Research Development Stage 1: Dissemination Stage 2: Intent to Adopt Stage 3a: Implementation Stage 3b: Adaptation Stage 4: Institutionalization Stage 5: Diffusion and Replication	**2007** Davis SM, Peterson JC, Helfrich CD, Cunningham-Sabo L. Introduction and conceptual model for utilization of prevention research. Am J Prev Med. 2007;33:S1-5.
36	Replicating Effective Programs Framework	This framework includes four phases, which are: 1) pre-conditions (e.g., identifying need, target population, and suitable intervention); 2) pre-implementation (e.g., intervention packaging and community input); 3) implementation (e.g., package dissemination, training, technical assistance, and evaluation); and 4) maintenance and evolution (e.g., preparing the intervention for sustainability).	**2007** Kilbourne AM, Neumann MS, Pincus HA, Bauer MS, Stall R. Implementing evidence-based interventions in health care: application of the replicating effective programs framework. Implement Sci;2:42.
37	The Sticky Knowledge Framework	The sticky knowledge model identifies the factors influencing knowledge diffusion in the context of primary care. These are: causal ambiguity, unproven knowledge, motivation of source, credibility of source, recipient motivation, recipient absorptive capacity, recipient retentive capacity, barren organisational context, and the arduous relationship between source and recipient. It relates "stickiness" to stages of transferring practice in: 1) initiation Stickiness; 2) implementation Stickiness; 3) ramp-up Stickiness; and 4) integration Stickiness.	**2007** Elwyn G, Taubert M, Kowalczuk J. Sticky knowledge: a possible model for investigating implementation in healthcare contexts. Implement Sci. 2007;2:44.
38	Model for Large-Scale Knowledge Translation	The approach has five key components: A focus on systems (how we organize work) rather than care of individual patients; Engagement of local interdisciplinary teams to assume ownership of the improvement project; creation of centralized support for the technical work; Encouraging local adaptation of the intervention; Creating a collaborative culture within the local unit and larger system. The model is made up of four stages, which are: 1) summarize the evidence; 2) identify local barriers to implementation; 3) measure performance; and 4) ensure all patients receive intervention (engage, educate, execute, evaluate, endure and extend).	**2008** Pronovost PJ, Berenholtz SM, Needham DM. Translating evidence into practice: a model for large scale knowledge translation. BMJ. 2008;337: a1714.
39	Tehran University of Medical Sciences (TUMS) Knowledge Translation Model	This model includes five main domains, which are: 1) knowledge creation; 2) knowledge transfer; 3) research utilization; 4) question transfer; and 5) context of organization. There is a push component from knowledge producers and pull side from knowledge users and this is all couched within a process of exchange.	**2008** Majdzadeh R, Sadighi J, Nejat S, Mahani AS, Gholami J. Knowledge translation for research utilization: design of a knowledge translation model at Tehran University of Medical Sciences. J Contin Educ Health Prof. 2008;28:270-7.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
40	**Collaborative Model for Knowledge Translation Between Research and Practice Settings**	The model is a non-linear cyclical representation of the knowledge translation as a process of data synthesis, data collection, and data analysis. It focuses on the relationship between researchers and practitioners and describes the knowledge translation cycle in six basic "benchmarks." The benchmarks are: 1) research question; 2) share emerging findings in "real time"; 3) refine research question; 4) develop and implement knowledge translation initiatives; 5) "just in time" teaching and action plans; and 6) transformative practice.	**2008** Baumbusch JL, Kirkham SR, Khan KB, McDonald H, Semeniuk P, Tan E, et al. Pursuing common agendas: a collaborative model for knowledge translation between research and practice in clinical settings. Res Nurs Health. 2008;31:130-40.
41	**Interactive Systems Framework for Dissemination and Implementation**	The framework consists of three systems: the Prevention Synthesis and Translation System (to distill information about innovations and prepare them for implementation by end users), the Prevention Support System (supporting the work of those who will put the innovations into practice), and the Prevention Delivery System (the implementation of innovations in the field).	**2008** Wandersman A, Duffy J, Flaspohler P, Noonan R, Lubell K, Stillman L, et al. Bridging the gap between prevention research and practice: the interactive systems framework for dissemination and implementation. Am J Community Psychol. 2008;41:171-81.
43	**Practical, Robust Implementation and Sustainability Model (PRISM)**	PRISM is a comprehensive model that examines different perspectives of the intervention and different characteristics of the recipients of the intervention. The model considers the intervention design; the external environment, the implementation and the sustainability infrastructure; and the recipients influence program adoption, implementation, and maintenance. It draws from the RE-AIM framework in the reach and effectiveness analysis of adoption, implementation, and maintenance.	**2008** Feldstein AC, Glasgow RE. A practical, robust implementation and sustainability model (PRISM) for integrating research findings into practice. Jt Comm J Qual Patient Saf;34:228-43.
43	**Translational Research Framework to Address Health Disparities**	This framework involves two conceptual models. The first illustrates a framework for advancing health disparities research in three sequential phases: 1) detecting disparities; 2) examining their causes and developing interventions; and 3) implementing those interventions and monitoring outcomes specific to health disparities. The second model outlines phase one as the transition from "bench" to "bedside" and phase two as the transition from "bedside" to "community and public health practice". It connects biomedical research to public health research to clinical research and the resulting impacts of real-world applications of research findings and community health intervention.	**2008** Fleming ES, Perkins J, Easa D, Conde JG, Baker RS, Southerland WM, et al. The role of translational research in addressing health disparities: a conceptual framework. Ethn Dis;18(S2):155-60.

APPENDIX 1: Reviewed Knowledge to Action Models Listed in Approximate Chronological Order CONT.

	MODEL OR FRAMEWORK	GENERAL DESCRIPTION	CITATION
44	Translational Framework for Public Health Research	This framework is a non-linear pathway. It defines the end point as population health improvement, which relates to changes in health-related behavior or other risk factors (in the shorter term), and wellbeing or quality of life, or 'hard' morbidity or mortality end points (in the longer term). This implies a need for a feedback loop. The feedback loop involves evidence synthesis, knowledge translation, and surveillance. It identifies connections between evidence synthesis to knowledge translation occurring indirectly into the public realm and directly into professional practice.	**2009** Ogilvie D, Craig P, Griffin S, Macintyre S, Wareham NJ. A translational framework for public health research. 2009. BMC Public Health;9:116.
45	Framework for Transferring Knowledge into Action	The framework for transferring knowledge into action identifies five common components of the knowledge transfer process: 1) problem identification and communication; 2) knowledge/research development and selection; 3) analysis of context; 4) knowledge transfer activities or interventions; and 5) knowledge/ research utilization. The study establishes an arrangement of the components into linear processes, cyclical processes, and dynamic multidirectional processes. The framework shows a multidirectional set of interactions occurring simultaneously, in any given order and at multiple times.	**2009** Ward V, House A, Hamer S. Developing a framework for transferring knowledge into action: a thematic analysis of the literature. J Health Serv Res Policy. 2009;14:156-64.
46	A Model for Knowledge Translation and Exchange with Northern Aboriginal Communities	This model for knowledge translation and exchange is grounded in: 1) establishing partnerships and trust with the communities; 2) using trained community field workers/ researchers for all stages of research planning, data collection, analysis, interpretation, and dissemination; 3) holding regular workshops for all members of the research team; 4) making a commitment to return the research results to the participants and communities first, for verification and validation; and 5) translating the research results for government decision makers so that they might be used to inform policy and practice.	**2010** Jardine C, Furgal C. Knowledge translation with northern Aboriginal communities: a case study. Can J Nurs Res;42(1):119-27.
47	A Model for Evidence-Based Practice Implementation	This is a four-phase model of the evidence-based implementation process for public sector services. The model includes exploration, adoption/preparation, implementation, and sustainment. It highlights features of the inner and outer contexts of organizations of public sector service systems and how these impact implementation. This model builds on a series of evidence-based practice studies, some of which present models for EBP in clinical settings, not all of the previous models are represented in this review.	**2011** Aarons GA, Hurlburt M, McCue-Horwitz S. Advancing a conceptual model of evidence-based practice implementation in public service sectors. Adm Policy Ment Health. 2011;38:4–23.
48	Ecohealth Model Applied to Translate Knowledge	The Ecohealth Model emphasizes context and places human health at the centre of environmental factors, economic factors, and community aspirations. Applying this model to knowledge translation involves three participating groups: researchers and other specialists, community members, and decision makers. The model is built on the pillars of transdisciplinary practice, participation and equity.	**2012** Arredondo A, Orozco E. Application of the ecohealth model to translate knowledge into action in the health sciences. Environ Health Perspect. 2012;120(3):104-105.

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