Scoping review identifies significant number of knowledge translation theories, models and frameworks with limited use

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ABSTRACT

Objective: To conduct a scoping review of knowledge translation (KT) theories, models and frameworks that have been used to guide dissemination or implementation of evidence-based interventions targeted to prevention and/or management of cancer or other chronic diseases.

Study design and setting: We used a comprehensive multistage search process from 2000-2016, which included traditional bibliographic database searching, searching using names of theories, models and frameworks, and cited reference searching. Two reviewers independently screened the literature and abstracted data.

Results: We found 596 studies reporting on the use of 159 KT theories, models or frameworks. A majority (87%) of the identified theories, models or frameworks were used in five or fewer studies, with 60% used once. The theories, models and frameworks were most commonly used to inform planning/design, implementation and evaluation activities, and least commonly used to inform dissemination and sustainability/scalability activities. Twenty-six were used across the full implementation spectrum (from planning/design to sustainability/scalability) either within or across studies. All were used for at least individual-level behavior change, while 48% were used for organization-level, 33% for community-level and 17% for system-level change.

Conclusion: We found a significant number of KT theories, models and frameworks with a limited evidence base describing their use.

Keywords (max 6): Knowledge synthesis, Knowledge translation, Implementation, Theory, Model, Framework

Running title: Scoping review of knowledge translation theories, models and frameworks

Word count: 200 (Abstract - 200 max), 4725 (Main text – 3000 - 5000), 2 Figures, 2 Tables, 1 Supplementary File

What is new?**Key findings**

- We employed a new, iterative approach called the BeHEMoTh (Behavior of interest; Health context; Exclusions; Models or Theories) framework to inform our search protocol and to build a list of names of knowledge translation (KT) theories, models and frameworks.
- Our scoping review identified 596 studies reporting on the use of 159 KT theories, models or frameworks. A majority of the theories, models and frameworks were used in less than 1% (i.e., five or fewer) of the included studies, with many used once.

What this adds to what was known?

- To our knowledge, this is the first comprehensive review of KT theories, models and frameworks that have been used to guide dissemination or implementation of evidence-based interventions targeted to prevention and/or management of cancer or other types of chronic diseases.

What is the implication and what should change now?

- We found a significant number of KT theories, models and frameworks with a limited evidence base describing their use in practice. Our results suggest that a decision support tool to help end users identify an appropriate theory, model or framework to inform their KT activities would be beneficial.

1. INTRODUCTION

Knowledge translation (KT) theories, models and frameworks are beneficial when implementing and sustaining evidence-based chronic disease and cancer control practices and policies. In particular, they may improve the likelihood of successful implementation and sustainability [1, 2]. Yet studies have shown that researchers fail to use them or may not use them appropriately [3, 4]. Given that theories, models and frameworks serve different purposes, using a taxonomy may help to facilitate their uses in practice and research [5]. For example, Nilsen's 2015 taxonomy [5] describes KT theories as useful for understanding or explaining aspects of implementation (i.e., the mechanism of change). Examples include Rogers's Theory of Diffusion [6], Bandura's Social Cognitive Theory [7], and May's Normalization Process Theory [8]. Nilsen's taxonomy describes KT models as useful for guiding the steps or process of implementation. Graham et al.'s Knowledge-to-Action Framework [9] and Meyers et al.'s Quality Implementation Framework [10] are examples of such models. Finally, KT frameworks are described as useful for understanding or explaining influences on implementation outcomes or for evaluating implementation efforts [5]. Michie et al.'s Theoretical Domains Framework [11], Damschroder et al.'s CFIR (Consolidated Framework for Implementation Research) [12], and Glasgow et al.'s RE-AIM (Reach Effectiveness Adoption Implementation Maintenance) [13] framework are examples that meet this definition.

There are over 100 identified KT theories, models and frameworks to choose from (e.g., Nilsen, 2015 [5]; Tabak et al., 2012 [14]; Straus et al., 2013 [15]). Yet few studies have methodically examined their use in practice or research [16]. A recent citation network analysis of 63 KT theories, models and frameworks found that while some were highly cited, most were rarely cited

in the literature from 1985 to 2012 [17]. A rigorous knowledge synthesis is required to identify which theories, models and frameworks have been used to inform the spectrum of KT activities across the different levels of behavior change and to provide guidance on what theories, models and frameworks might be useful for implementation researchers and practitioners. To fill this gap, and in response to a proposal request from the Canadian Partnership Against Cancer for a rapid review, we conducted a scoping review of theories, models and frameworks used in KT to guide dissemination or implementation of evidence-based interventions targeted to prevention or management of cancer or other chronic diseases.

2. METHODS

2.1 Protocol

Our protocol was developed using the scoping review methods by Arksey and O'Malley (2005) [18] and outlined in the Joanna Briggs Institute Reviewers' Manual [19]. We defined KT as “a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge” [20]. As such, we considered KT broadly to include both implementation practice (i.e., implementing research evidence into practice) and implementation science, which we defined as “the systematic study of specified activities designed to put into practice activities or programs of known dimensions” [21]. The P (patient, problem or population) I (intervention) C (comparison, control or comparator) O (outcome) and eligibility criteria were specified a priori with input from our knowledge users (LZ, JK) at the Canadian Partnership Against Cancer (a federally-funded organization that is the steward of the Canadian Strategy for Cancer Control). We used an integrated KT approach to our scoping review, defined as “an approach to doing research that applies the principles of KT to the entire research process [by]

involving knowledge users as equal partners alongside researchers” [22]. Specifically, our knowledge users were engaged at all phases including the protocol construction, literature search, screening, data abstraction, synthesis, and dissemination. We chose to follow the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement [23] for reporting our results, since a reporting tool for scoping reviews does not yet exist.

2.2 Eligibility criteria

All theories, models and frameworks relevant to evidence dissemination or implementation, whether developed in health or other fields (e.g., business, social sciences) were eligible for inclusion. Specifically, we searched for articles reporting on dissemination or implementation of any KT intervention (a) designed to change behavior at the level of the individual, organization, community, or system, and (b) targeted to prevention or management of cancer or other types of chronic disease (including chronic mental illness such as mood disorders including depression and anxiety, schizophrenia, dementia, drug addiction) and related risk factors (such as smoking, exercise, alcohol, diet, hypertension, obesity, tobacco and other risk factor modification), in all relevant healthcare and community settings, and for all ages. We included all study designs, including experimental, quasi-experimental, observational and qualitative. Articles were excluded if they mentioned a KT theory, model or framework (e.g., in the introduction or discussion sections) without reporting on using it to guide dissemination or implementation of a KT intervention. We also excluded articles focused on describing or discussing the development of a KT theory, model or framework. To increase feasibility, we excluded non-English articles, those published before the year 2000, book chapters, dissertations and reviews. Conference abstracts

and study protocols were only considered for inclusion if the study results (preliminary or full) had been published.

2.3 *Information sources and search strategy*

Theory is a difficult subject to search as the language used to describe theories, models and frameworks is inconsistent, which creates a challenge for the searcher. To develop a more systematic approach to searching this subject area, we employed a new, iterative approach called the BeHEMoTh (Behavior of interest; Health context; Exclusions; Models or Theories) framework [24] to inform our search protocol and to build a list of names of KT theories, models and frameworks. This approach was specifically developed to provide a template and process to identify theories, models and frameworks for developing and testing complex interventions for different types of systematic reviews. Before we began the search, the team prepared the question using the BeHEMoTh question formulation.

The first stage of the search protocol included searching bibliographic databases for ‘Behavior of interest’ and ‘Health context’ and then consolidating the leads from this approach using a systematic search process to build a list of names of KT theories, models and frameworks. We operationalized the ‘Behavior of interest’ as any KT intervention designed to change behavior at the level of individual, organization, community, or system. We operationalized the ‘Health context’ as the prevention or management of cancer or other chronic diseases. ‘Exclusions’ were non-theoretical/technical models such as statistical models. Using BeHEMoTh, we operationalized theory in a search string as ‘model* or theor* or concept* or framework*’. We developed the search strategy by combining subject headings and text words for the ‘Behavior of

interest' AND 'Health context' AND the theory search string. We ran the finalized search strategy in MEDLINE, EMBASE, and PsycINFO on July 5, 2016 and included limits for publication language (English only) and publication date (2000 to 2016) to increase feasibility. The MEDLINE version of the search strategy was peer reviewed independently by an information specialist (EC) using the Peer Review of Electronic Search Strategies (PRESS) criteria [25] and modified, as needed. The MEDLINE search strategy was then adapted to the other databases. The final MEDLINE search strategy is found in Appendix A (Supplementary file).

In the second stage of the search protocol, we compiled a list of relevant named theories, models and frameworks identified during the first stage (i.e., extracted during title and abstract screening). We supplemented this list with additional KT theories, models and frameworks identified from existing published knowledge syntheses [5, 14, 15], for a total of 305 names. The full list of KT theories, models and frameworks is found in Appendix B (Supplementary file).

The third stage of the search included a 'named item' search based on identified theories, models and frameworks found in stage two combined with subject headings and text words for 'Health context'. This search was conducted in MEDLINE, EMBASE, and PsycINFO on August 18, 2016 and January 6, 2017, and was limited by publication language (English only) and publication date (2000 to 2016).

The fourth stage of the search protocol was a cited reference search using the Web of Science database. The first 285 citations of screened and potentially relevant articles identified in the previous stages, were entered into Excel. Using the RANDBETWEEN function in Excel, we

created a randomized sample of 15%. Within the cited references, a sub search was used to identify 'Behavior of interest', to limit citing articles to citations featuring the KT concepts. The search was run on January 10, 2017 and was limited to article type (primary studies) and publication date (2000 to 2016).

In addition, we used the Canadian Agency for Drugs and Technologies in Health (CADTH) Grey Matters approach to guide our search of the grey literature [26]. Specifically, we scanned national and international websites that were identified by a KT expert (SES) and an experienced research librarian (JM). The list of websites is found in Appendix C (Supplementary file). Finally, to ensure literature saturation, we searched for additional articles by screening the reference lists of relevant systematic reviews identified during the first three stages of screening. We combined the results from all stages of searching and removed duplicate citations.

2.4 Study selection process

Two reviewers independently screened titles and abstracts (level 1) and full-text articles (level 2) using online systematic review software Synthesi.sr [27]. Prior to screening, all reviewers completed two separate calibration exercises at each level to ensure reliability. Inter-rater agreement was calculated using percent agreement ($>75\%$) across all reviewers. We achieved acceptable agreement after two random samples of 50 articles at level 1, and two sets of 20 articles at level 2. Discrepancies between reviewers were resolved by consensus, or by a third reviewer (LS, SES).

2.5 Data items and abstraction process

Two reviewers independently abstracted data from each article. Prior to data abstraction, all reviewers completed two calibration exercises on a total of 10 articles to ensure team agreement through consensus. Data abstraction items included study characteristics (e.g., year, geographic region, context, funding source), KT theory, model or framework characteristics (e.g., name, reference, description of how it was used and at which stage of KT practice), and KT intervention characteristics (e.g., study design, description of intervention and comparator groups, setting, target, level of behavior change, stage of care, outcomes), as well as the evidence-based clinical intervention. The stages of KT practice were categorized as dissemination, planning/design, implementation, evaluation, and sustainability/scalability based on Graham et al.'s Knowledge-to-Action process model [9]. For example, the planning/design stage included identifying barriers and facilitators to behavior change and assessing organizational readiness to change, and the implementation stage included selecting, tailoring, implementing, and monitoring KT interventions. The KT intervention setting was defined as community (e.g., schools, community organizations), outpatient clinic, hospital, home, government, or long-term care. The KT intervention target was abstracted using the Effective Practice and Organisation of Care (EPOC) taxonomy and categorized as patient/general public interventions, healthcare professional interventions, organizational interventions, financial interventions, and regulatory interventions [28]. For example, KT interventions targeting patients, family members, and/or the general public directly were classified as patients/public. The level of behavior change was abstracted using a broad socio-ecological framework of individual, organizational, community, and system [29]. For example, KT interventions focused on changing knowledge, attitudes, and/or behaviors at the level of the individual were classified as individual level change. The stage of care was abstracted using the care continuum categories of prevention, screening, diagnosis, clinical care/treatment,

prognosis, survivorship, and palliative/end-of-life care. Outcomes were abstracted and then coded using the Cochrane taxonomy of relevant outcomes [30]. To optimize feasibility, we did not contact study authors for clarity on the theories, models or frameworks used, or to obtain information missing from the included study.

2.6 *Methodological quality appraisal*

We did not appraise the quality of the studies included in our scoping review, which is consistent with the Joanna Briggs Institute Reviewers' Manual [19] as well as scoping reviews on clinical topics [31].

2.7 *Synthesis*

We summarized the included studies based on study characteristics, KT theory, model or framework characteristics, and KT intervention characteristics as reported in the individual studies. Based on input from our knowledge users at the Canadian Partnership Against Cancer, subgroup analyses were performed to explore the context (cancer, chronic disease, both), stage of care (prevention, screening, diagnosis, treatment, prognosis, survivorship, palliative care), and level of behavior change (individual, organization, community, system).

3. RESULTS

3.1 *Literature search*

We identified 1664 citations from our first search; 1989 citations from our named search; 235 citations from our cited reference search; 977 citations from our grey literature search of 24 websites; and 319 citations from checking the reference lists of 31 systematic reviews. After

removing duplicates, we screened 4598 citations at the title and abstract level and 1899 articles at the full-text level. Overall, we included 596 studies and 47 companion reports in our scoping review (Figure 1). Of the 596 includes, 122 articles were from our grey literature search and all articles were published. The full citation list for the 596 included articles and 47 companion reports is found in Appendix D (Supplementary file).

3.2 Study characteristics

The 596 included studies were most commonly conducted in North America (74%; Table 1). The studies were published from 2000 to 2016, with 69% of studies published in the last 10 years (2007 to 2016), 37% published in the last 5 years (2012 to 2016), and 20% published in the last 3 years (2014 to 2016). Figure 2 shows the publication of studies over time. The funding source was public in 74%, private or a mix of public and private in 7%, no funding in 3%, and not reported in 17% of studies.

The context included cancer in 350 studies (59 %) or other chronic diseases in 295 studies (49%); 49 studies (8%) examined patients with cancer and other types of chronic diseases. The five most common cancer types (including prevention and risk factors) were breast (21%), general/all (cancer) types (13%), colorectal (8%), cervical (7%), and lung (6%). The five most common chronic diseases (including prevention and risk factors) were cardiovascular (11%), diabetes (9%), general/all (chronic disease) types (9%), obesity/overweight (8%), and other/unspecified (8%; Table 1).

The included studies reported using KT theories, models or frameworks to guide KT interventions to disseminate or implement 927 clinical interventions. The most frequent study

design was experimental (50%) followed by observational (19%) and qualitative (18%). The most common intervention settings were community only (35%), outpatient clinic only (23%), and multiple settings (i.e., at least two of: community, outpatient clinic, hospital, home, government, and long-term care; 21%). The majority of the interventions targeted patients/general public (85%), while 31% targeted healthcare professionals, and 23% targeted organizations. Further, 30% of the KT interventions targeted more than one stakeholder group (i.e., at least two of: patients/general public, healthcare professionals, organizations, and financial/regulatory; Table 1).

3.3 KT theory, model and framework characteristics

We identified 159 different KT theories, models and frameworks. Appendix E (Supplementary file) summarizes their key characteristics across the included studies, and organizes them by the stage of KT they were used for; the level of behavior change they targeted; the context (cancer, chronic disease, or both); whether they were used prospectively or retrospectively (i.e., after the study was completed); and the total number of studies in which they were used.

Overall, the three most frequently used theories, models or frameworks were Bandura's Social Cognitive Theory (168 studies), Prochaska and DiClemente's Transtheoretical Model of Behavior Change (141 studies) and Rosenstock's Health Belief Model (67 studies). In contrast, 139 (87%) of the theories, models and frameworks were used in five or fewer studies, with 95 (60%) used once. The majority (91%) of theories, models and frameworks were reported to be used prospectively.

3.4 Stages of KT

Most frequently, the 159 identified theories, models and frameworks were used to inform planning/design (81%), implementation (67%) and evaluation (55%) activities. The theories, models and frameworks were less frequently used to inform dissemination (32%) and sustainability and/or scalability activities (23%).

Twenty-six theories, models or frameworks were used across all four KT stages of planning/design, implementation, evaluation, and sustainability/scalability; we call these ‘full-spectrum theories, models or frameworks’. This category includes theories, models and frameworks that were used to inform the four KT stages either within a single study (as was the case in 32 out of 421 studies that used a full-spectrum theory, model or framework) or across different studies. Table 2 presents the 26 full-spectrum theories, models and frameworks and organizes them by KT intervention target; level of behavior change; context (cancer, chronic disease, or both); and stage of cancer/chronic disease care continuum. Additional details concerning study design, setting and outcomes for the 26 full-spectrum theories, models and frameworks are found in Appendix F (Supplementary file).

Of the 26 full-spectrum theories, models and frameworks, 18 were used prospectively, two were used retrospectively, and six were used both prospectively and retrospectively in different studies. As shown in Table 2, cancer control (with or without other chronic diseases) was the context for 21 of the 26 full spectrum theories, models and frameworks; of these, 18 theories, models or frameworks covered more than one stage of care, of which two covered the full cancer control continuum (Action Research, and Rogers’s Diffusion of Innovations Theory). Overall, the 21 full-spectrum theories, models and frameworks used in cancer control were most often used in studies

on cancer prevention, screening, treatment and survivorship. ‘Other chronic diseases only’ was the context for five of the full-spectrum theories, models and frameworks; of these, one theory, model or framework (Institute for Healthcare Improvement’s Collaborative Model for Achieving Breakthrough Improvement) covered more than one stage of care, and none covered the full chronic disease control continuum. The five full-spectrum theories, models or frameworks used in chronic disease care only were most often used in studies on prevention and treatment. Fifteen of the 26 full-spectrum theories, models and frameworks were also used for dissemination, thus covering the full KT continuum.

3.5 Level of behavior change

All 159 theories, models and frameworks were used for at least individual-level change, while 48% were used for organization-level, 33% for community-level, and 17% for system-level change. Overall, 11% of the identified theories, models and frameworks addressed all four levels of behavior change across the included studies. Of the 26 full-spectrum theories, models and frameworks (used across the planning/design, implementation, evaluation, and sustainability/scalability stages), 24 were used for organization-level change, 19 for community-level change, and 11 for system-level change. Overall, 10 full-spectrum theories, models and frameworks addressed all four levels of behavior change across the included studies (Table 2).

4. DISCUSSION

To our knowledge, this is the first comprehensive review of KT theories, models and frameworks that have been used to guide dissemination or implementation of evidence-based interventions targeted to prevention and/or management of cancer or other types of chronic diseases. We

identified 596 studies (plus 47 companion reports) reporting on the use of 159 KT theories, models or frameworks used to inform 627 KT interventions.

Of the 159 identified KT theories, models and frameworks, only three were used in more than 10% of the included studies: Social Cognitive Theory, Transtheoretical Model of Behavior Change, and Health Belief Model. These theories, models and frameworks have been developed from different fields including education and psychology amongst others. This diversity highlights the challenge for those interested in KT to conduct broad literature searches including other disciplines to inform their work. Moreover, this also underscores the critical need to test the application of these theories, models and frameworks that are developed in other fields in the KT and healthcare contexts. For example, little is known on whether these theories, models and frameworks can predict individual behavior change in healthcare (Table 2). In contrast, 139 (87%) theories, models and frameworks were used in less than 1% of the included studies (i.e., five or fewer studies), with 95 (60%) used once. Our findings highlight the significant number of KT theories, models and frameworks currently available and the limited evidence-base describing their use in practice.

The 159 identified theories, models and frameworks were most commonly used to inform planning/design, implementation, and evaluation activities, and least commonly used to inform dissemination and sustainability and/or scalability activities. Twenty-six were used across the full KT spectrum, from planning/design to sustainability/scalability. While we used the stages of the Knowledge-to-Action cycle in a linear approach to frame this review, this is not how the cycle was intended to be used. It is a cycle and as such it should be used in an iterative fashion.

However, this is an element that could not be explicitly captured from the theories, models and frameworks – namely, how they approach the iterative nature of KT work. Although the Knowledge-to-Action cycle is one of the most commonly-used process models, there are others we could have used to structure our findings.

With most of the 627 KT interventions targeted to individuals (e.g., patients/general public or healthcare professionals), it is not surprising that all of the identified theories, models and frameworks covered at least individual-level behavior change, while only a few covered system-level change. Given the complexity of healthcare system change, this is a limitation of these theories, models and frameworks. Typically in KT work, there are multiple behaviors being changed among multiple actors (patients, clinicians, healthcare managers, policy makers) and across various settings. For KT science to advance and inform KT practice, it is critical to have valid theories, models and frameworks that address system-level change.

Compared to a previously published review by Tabak and colleagues [14] describing 61 theories, models and frameworks, our scoping review included more than double the number of theories, models and frameworks. Despite including the names of all 61 theories, models and frameworks in our search, and similarly focusing on all levels of behavior change, we did not expect all of them to be included in our review, considering our narrower practice versus research focus and the focus on cancer and other types of chronic diseases. A recent citation network analysis of 63 KT theories, models and frameworks found that while some were highly cited (such as the Knowledge-to-Action Framework), most were rarely cited in the literature from 1985 to 2012 [17]. Another citation analysis by Field and colleagues explored use of the Knowledge-to-Action

Framework in the literature from 2006 to 2013 [32]. Out of 146 identified studies, the authors found that 101 studies either cited the model without explanation or used it to guide the project in a 'general, non-specified way', while only 10 studies used the model to inform 'the design, delivery, and evaluation of implementation activities' [32]. Similarly, our scoping review identified a significant number of KT theories, models or frameworks with a limited evidence-base describing their use in practice. As such, the KT field would benefit from better reporting [33], including a more detailed description by study authors of how they used the theory, model or framework, if one was selected. However, with over 150 identified KT theories, models or frameworks to choose from, it can be difficult to know which one(s) would be an appropriate choice – especially when some of the theories, models and frameworks identified in this review included, were informed by, or modified other existing theories, models or frameworks. It would also be useful to conduct a future study to understand how individuals in the field select what theory, model and/or framework to use to inform their work and why ones such as the Knowledge-to-Action cycle are cited more frequently than others.

Given the large number of KT theories, models and frameworks available, our summary tables can be searched for theories, models or frameworks depending on the details of the dissemination or implementation project. For instance, an end user might consider whether they are looking for a theory or a model or a framework to inform their entire organizational activities, their individual projects, or both. Other criteria to consider might include theories, models or frameworks that cover multiple steps in the KT process (e.g., full-spectrum theories, models and frameworks), those that have been used across the cancer/chronic disease control continuum, as well as those that were reported as being used prospectively.

420

421 A decision support tool to help end users identify an appropriate KT theory, model or framework
422 to inform their work would therefore be highly beneficial. While a similar tool does exist for KT
423 researchers [34], the tool is not based on a comprehensive systematic or scoping review approach.
424 Therefore, we intend to use the findings of our scoping review to inform the development of a
425 comprehensive tool to help end users identify an appropriate theory to inform their KT activities.
426 Such a tool has the potential to benefit the healthcare system by helping frontline users develop
427 better interventions and achieve greater success when implementing evidence into practice. It also
428 seems clear that while the KT field is changing rapidly, as evidenced by the ever-increasing
429 number of theories, models and frameworks being published in recent years, there is little
430 evidence that any consolidation of a few theories, models or frameworks is taking place [35].
431 Such efforts could help both guide the field and aid implementation practitioners and researchers
432 in translating the lessons learned from science into more broadly implementing evidence-based
433 interventions in cancer and chronic disease prevention and control.

434

435 There are limitations to our scoping review worth noting. First, there is potential for
436 misclassification of theories, models and frameworks. Different terms (theory versus model
437 versus framework) were used by study authors when describing the theories, models and
438 frameworks both across and within their own studies, which highlights that some were
439 misclassified by study authors. The main purpose for using the BeHEMoTh approach to identify
440 theories, models and frameworks for the search strategy was to account for these differences.
441 Thus, we abstracted and reported the terms as used by the study authors, while additional terms

that were used (e.g., approach) were abstracted as ‘other’. Consistent terminology is important because theories, models and frameworks serve different purposes (e.g., Nilsen’s taxonomy) [5].

Second, we limited our literature search to English language articles and excluded book chapters [36]. As such, it is not clear how many non-English articles may have been excluded. Despite this, we identified almost 600 studies, making it the largest review of KT theories, models and frameworks to our knowledge. Further, we included studies conducted in different continents, suggesting applicability of the findings for other countries. Third, we focused on the prevention and/or management of cancer and other chronic diseases. However, this was inclusive of chronic mental illness as well as risk factors for cancer and chronic disease. Therefore, the scope of our review was quite broad and the findings are applicable to a wide range of health areas including public health. Fourth, we did not assess the limitations to the different theories, models and frameworks, such as whether or not it is appropriate for a certain context or is lacking validity evidence [3]. For instance, Prochaska and DiClemente’s Transtheoretical Model of Behavior Change is an example of a widely-used theory, model or framework that lacks supporting evidence of effectiveness from systematic reviews [37]. The use of an operational definition of a theory, a model and a framework could have affected the number identified and included in our review. As such, we chose to code the theories, models and frameworks based on how the study authors reported using them to inform their work, and not based on the intended use according to the developer or the constructs present in the theory, model or framework. Whether or not the study authors correctly selected and applied the theory, model or framework was beyond the scope of this review and highlights something that could be explored in a future project. Further, we chose to report on the number of times each theory, model and framework was used in

practice to help map the current literature; however, we would strongly caution against using the frequency of use as an indicator of quality. Assessment of the quality of various theories, models and frameworks was out of scope and would require separate search strategies of each of the included theories, models and frameworks to identify evidence of their validity.

Our scoping review found a significant number of KT theories, models and frameworks with a limited evidence-base describing their use in practice. A comprehensive tool to help end users identify an appropriate theory, model or framework to inform their KT activities would be beneficial. Subsequent work will aim to develop and test a decision support tool for end users.

LIST OF ABBREVIATIONS

KT = Knowledge translation

FIGURES

Figure 1. Study flow diagram

Figure 2. Number of studies reporting on use of KT theories/models/frameworks over time

ADDITIONAL FILES

File name: Supplementary file .pdf

Title: Appendices A-F

Description: Supplementary file with appendices A-F

DECLARATIONS

Ethics Approval and Consent to Participate

Not applicable

Consent for Publication

Not applicable

Availability of Data and Material

Not applicable

Competing Interests

Jessie McGowan, Andrea Tricco and Sharon Straus are on the editorial board for the Journal, but were not involved with the peer review process or decision to publish. All other authors declare that they have no competing interests.

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Author Contributions

Study concept and design: Strifler, Tricco, Straus. Developed the search strategy: McGowan. Data acquisition, cleaning, or interpretation: Strifler, Cardoso, Cogo, Nincic, Khan, Scott, Ghassemi, MacDonald, Lai, Treister, Tricco, Straus. Drafted the manuscript: Strifler, Straus. Provided input and revised the manuscript: Strifler, Cardoso, McGowan, Cogo, Nincic, Khan, Scott, Ghassemi, MacDonald, Lai, Treister, Tricco, Straus. Obtained funding: Straus. Supervised the study: Strifler, Straus. All authors read and approved the final manuscript.

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TABLES

Table 1. Study Characteristics

	No. of studies (n=596)	% of studies
Year of publication		
2007 - 2016	412	69
2012 - 2016	220	37
2014 - 2016	121	20
Geographic region		
North America	438	73
Europe	72	12
Australia & New Zealand	40	7
Asia	31	5
Africa	5	1
Intercontinental	4	1
Central & South America	6	1
Context^F		
Cancer^Y	350	59
Breast	125	21
General/all types	79	13
Colorectal	50	8
Cervical	44	7
Lung	33	6
Chronic disease^Y	295	49
Cardiovascular disease	68	11
Diabetes	56	9
General/all types	53	9
Obesity/overweight	50	8
Other/unspecified	45	8
	No. of interventions (n=627)	% of interventions
Intervention target*		
Patients/general public	528	84
Healthcare professionals	206	33
Organization	142	23
Financial/regulatory	34	5
All 4 target categories	6	1
>1 target categories	192	31
Intervention setting*		
Community	228	36
Clinic (outpatients)	149	24
Multiple settings	141	22
Home	69	11

Hospital (inpatients)	26	4
Not reported	19	3
Government	4	1
Long-term care	1	0
Study design*		
Experimental	302	48
Observational	128	20
Qualitative	116	18
Mixed/multi-methods	34	5
Quasi-experimental	29	5
Unclear	18	3
*Multiple health context, interventions, settings and study designs reported per study; †Most common reported; ‡Includes risk factors		

Table 2. Full-spectrum KT theories, models and frameworks

Name of KT theory, model or framework	KT intervention target				Behavior change level				Continuum of care							Context	# of studies*
	Professionals	Patients/public	Organizational	Financial/regulatory	Individual	Organization	Community	System	Prevention	Screening	Diagnosis	Treatment	Prognosis	Survivorship	End-of-life care		
Action Research	22	31	21	3	41	21	15	1	14	13	4	22	3	8	5	Both	42
CAN-IMPLEMENT (Canadian Guideline Adaption Study Group)	8	1	7	0	4	4	0	1	0	0	2	4	2	2	0	Cancer	4
Collaborative Model for Achieving Breakthrough Improvement (Institute for Healthcare Improvement)	6	5	4	2	4	4	2	2	1	1	1	3	0	0	2	Chronic Disease	3
Community Connection Model (Liddy et al.)	1	1	1	0	1	1	1	0	0	0	0	1	0	0	0	Chronic Disease	1
Consolidated Framework for Implementation Research (CFIR) (Damschroder)	5	3	4	0	6	4	1	0	3	1	0	5	0	1	0	Both	7
Diffusion of Health Promotion Innovations (Oldenburg et al.)	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	Chronic Disease	1
Diffusion of Innovations (Rogers)	26	20	15	6	37	17	13	7	22	10	1	12	2	2	1	Both	37
Interactive Systems Framework (Wandersman)	5	2	1	0	1	1	0	0	1	1	0	1	0	1	0	Cancer	1
Interorganizational Relations Theory	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	Cancer	1
Knowledge-to-Action (KTA) (Graham et al.)	3	2	2	0	4	2	0	0	0	0	1	4	1	1	0	Both	4
LEAN Transformation Process	2	1	2	0	2	2	0	0	0	0	0	2	0	0	0	Cancer	2
Model for Accelerating Improvement (Associates in Process Improvement)	4	2	3	0	4	3	1	1	0	1	0	3	0	0	0	Both	4
Plan-Do-Study-Act (PDSA) Cycles (Deming)	22	17	21	12	16	12	2	2	4	3	1	14	0	0	1	Both	16
Precaution Adoption Process Model (PAPM) (Weinstein & Sandman)	0	8	0	0	8	0	0	0	5	3	0	0	0	0	0	Both	8
PRECEDE-PROCEED (Green)	6	18	4	0	17	5	4	1	5	9	0	4	0	0	0	Both	17
Quality Implementation Framework (Meyers, Durlak & Wandersman)	1	0	1	1	1	1	0	0	0	0	0	1	0	1	0	Cancer	1
Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) (Glasgow et al.)	13	20	7	3	18	4	3	0	15	4	0	9	1	2	2	Both	23
Self-Regulation Theory	0	12	0	0	14	0	1	0	6	1	0	6	1	1	0	Both	14
Social Cognitive Theory (Bandura)	16	135	9	4	168	19	20	5	79	15	1	57	11	27	0	Both	168

Social Ecology Model for Health Promotion (Stokols)	0	2	0	0	4	1	2	0	3	1	0	0	0	1	0	Both	4
Social Learning Theory (Bandura)	2	23	2	0	23	2	2	1	11	5	0	8	0	2	0	Both	23
Social Marketing Framework	2	10	2	0	10	2	5	0	5	3	0	3	0	0	0	Both	10
Stage Theory of Organizational Change	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0	Cancer	1
Three-World View Model (Peek)	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	Chronic Disease	1
Transtheoretical Model of Behaviour Change (Prochaska & DiClemente)	17	142	10	4	142	11	10	3	88	31	0	22	0	17	0	Both	141
Western Australia Health Network Policy Development and Implementation Cycle	4	3	4	4	1	1	1	1	0	0	0	1	0	0	0	Chronic Disease	1
Note: *References to studies can be found in the supplementary file

Figure 2. Number of studies reporting on use of KT theories/models/frameworks over time

What is new?**Key findings**

- We employed a new, iterative approach called the BeHEMoTh (Behavior of interest; Health context; Exclusions; Models or Theories) framework to inform our search protocol and to build a list of names of knowledge translation (KT) theories, models and frameworks.
- Our scoping review identified 596 studies reporting on the use of 159 KT theories, models or frameworks. A majority of the theories, models and frameworks were used in less than 1% (i.e., five or fewer) of the included studies, with many used once.

What this adds to what was known?

- To our knowledge, this is the first comprehensive review of KT theories, models and frameworks that have been used to guide dissemination or implementation of evidence-based interventions targeted to prevention and/or management of cancer or other types of chronic diseases.

What is the implication and what should change now?

- We found a significant number of KT theories, models and frameworks with a limited evidence base describing their use in practice. Our results suggest that a decision support tool to help end users identify an appropriate theory, model or framework to inform their KT activities would be beneficial.